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DESIGN WEST ENGINEERING

UPS BFI GATEWAY PROJECT
7300 PERIMETER ROAD

WSEC COMPLIANCE FORMS
OCTOBER 30, 2019

Project Summary, pg 1 PROJ-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

General Info

*PROJ-SUM form shall be provided as a cover sheet for all compliance form submittals. **Project Title** shall match project plans title block.*

Project Title:	**UPS BFI Gateway Project**
Project Street Address:	7300 Perimeter Road
Project City, County, Zip:	Seattle, WA 98108
Project Owner or Rep:	UPS
Jurisdiction:	King County
Date	10/30/2019
For Building Department Use	

Project Description

Select all that apply to the scope of project.

Select Addition + Existing or Alteration + Existing if the existing building will be combined with the addition or alteration to demonstrate compliance per Section C502.1 or C503.1.

New Construction and Additions

- [x] New Building
- [ ] Building Addition

Existing Building Retrofit

- [ ] Alteration
- [ ] Change of Occupancy
- [ ] Change in Space Conditioning
- [ ] Historic Building

Building Elements Scope - Select all that apply

- [x] All
- [ ] Building Envelope
- [ ] Mechanical Systems
- [ ] Service Hot Water Systems
- [ ] Lighting Systems
- [ ] Electrical Systems

Occupancy Type

- (●) All Commercial
- ( ) Group R - R2, R3, & R4 over 3 stories and all R1
- ( ) Mixed Use

***Mixed Use** - Building is greater than three stories above grade and it has both Commercial and Group R occupancies.*

***Mixed Occupancy** - Building is three stories or less above grade and it has both Commercial and Group R2, R3 or R4 occupancies. Select All Commercial to document compliance for the commercial areas of the building. The residential spaces shall comply with the WSEC Residential Provisions.*

Space Conditioning Categories

Select all that apply to the scope of project

- [x] Fully Conditioned
- [ ] Semi-heated[2]
- [ ] Refrigerated Spaces (Warehouse and/or Walk-in[1])
- [ ] Low Energy Space Category[3]

Eligible Low Energy Spaces

- [ ] Unconditioned
- [ ] Low energy heating/cooling capacity
- [ ] Wireless service equipment shelter
- [ ] Greenhouse[4]
- [ ] Equipment building

Floor Area and Stories

Floors Above Grade	Building Gross Conditioned Floor Area	Project Gross Conditioned Floor Area
2	**52,370**	**63,370**

General Compliance Path

- (●) Compliance Method 1 - General
- ( ) Compliance Method 2 - Total Building

***Compliance Method 1** - Projects shall demonstrate compliance with all applicable mandatory and prescriptive requirements of this code. Refer to C401.2, Item 1 for more information. Compliance forms to include with a Prescriptive submittal: All applicable ENV, LTG, and MECH.*

***Compliance Method 2** - Projects complying via total building performance (TBP) shall include a summary of results from a whole building energy model per Section C407 and shall demonstrate compliance with all applicable mandatory provisions in this Code. Refer to Section C401.2, Item 2 for more information. Compliance forms to include with a TBP submittal: PROJ-SUM, ENV-CHK, LTG-EXT, LTG-CHK, and all MECH forms except MECH-ECONO and MECH-VENT (pending).*

Note 1 - Refrigerated Spaces - They shall comply with the envelope and refrigeration equipment requirements in Section C410. Warehouse coolers and freezers shall also comply with the envelope requirements in C402. C410 takes precedent for overlapping requirements.

Note 2 - Semi-heated Spaces - If heated with equipment other than electric resistance may take an exemption for wall insulation. All other envelope assemblies shall comply with the thermal envelope provisions.

Note 3 - Exemptions For Low Energy Spaces - Low Energy spaces are exempt from all provisions in WSEC Section C402 Building Envelope, however all other applicable provisions in the Code do apply including lighting, mechanical, service water heating, etc.

Note 4 - Eligible Space Conditioning For Low Energy Greenhouses - Greenhouses are defined as spaces that maintain a specialized sunlit environment that is used exclusively for cultivation, protection and maintenance of plants. Cooling with outside air and/or evaporative cooling, and any form of heating equipment, are allowed under the Low Energy Greenhouse category. Greenhouses with cooling equipment that requires a condensing unit are NOT eligible.

DESIGN WEST ENGINEERING

Project Summary, pg 2 PROJ-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

General Info	Project Title: UPS BFI Gateway Project	Date 10/30/2019

C406 Additional Efficiency Package Options Summary

A minimum of two Options are required for new construction, and change in space conditioning or occupancy projects.

Select all Options included in the current project scope. Also select Options complied with under previous projects (shell and core, other tenant spaces in building, etc)

Buildings with multiple tenant spaces may comply with different options (mix & match).

Options are required for all space conditioning categories.

Include discipline specific information for C406 options in ENV-SUM, LTG-SUM and

Refer to SBCC website for official interpretations regarding C406 provisions.

Building level efficiency options:	Current Scope	Previous Projects
C406.8 Enhanced envelope performance	☐	☐
C406.9 Reduced air infiltration	☑	☐
C406.5 On-site renewable energy	☐	☐
Building area level efficiency options		
C406.2 More efficient HVAC equipment	☐	☐
C406.6 Dedicated outside air systems (DOAS)	☑	☐
C406.7 Reduced energy use in service water heating	☐	☐
C406.3 Reduced lighting power	☐	☐
C406.4 Enhanced digital lighting controls	☐	☐

C406 Comments:

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Envelope Summary — ENV-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

Project Info

Applicant Info. *Provide contact information for individual who can respond to inquiries about information provided.*

Project Title:	**UPS BFI Gateway Project**	Date	10/30/2019
Company Name:	**Design West Engineering**	For Building Department Use	
Company Address:	**110 James Street, Suite 106, Edmonds, WA 98020**		
Applicant Name:	**Liesbet Hess**		
Applicant Phone:	**425-458-9700 x256**		
Applicant Email:	**lhess@designwesteng.com**		

Project Description

☑ New Building ☐ Addition ☐ Alteration ☐ No Envelope Scope

Envelope Project Scope

Select all that apply.

☑ All Commercial ☐ Group R - Commercial ☐ Mixed Use - Commercial + Group R

☐ Semi-heated ☐ Refrigerated Cooler ☐ Refrigerated Freezer ☐ Equipment Building

Envelope Description

Provide brief description of the project and relevant supporting documentation.

If project includes multiple Target Insulation Allowance areas, and/or is demonstrating compliance as an Addition + Existing, Alteration + Existing, or Addition + Alteration + Existing project, provide a brief summary of the approach to whole building compliance.

Air Barrier Testing

Air barrier testing is required for all new construction projects. Testing criteria is 0.40 cfm/ft² under test pressure of 0.3 inch w.g.

To comply with C406.9, demonstrate that measured air leakage of building envelope

☑ Air barrier testing per Section C402.5.1.2 included in project scope

☐ Additional Efficiency Package Option - C406.9 Reduced Air Infiltration

☐ Testing not required. Explanation: ______________________

Compliance Documentation Scope and Method

Scope of This Calculation

☑ New Building ☐ Addition ☐ Alteration ☐ No Envelope Scope

Target Insulation Allowance

Sets the title and calculations in the compliance forms. Selection required to enable forms.

◉ Fully Conditioned - Commercial, Group R, Mixed Use

○ Semi-heated ○ Refrigerated Cooler ○ Refrigerated Freezer

If project includes more than one Target Insulation Allowance area, and/or if project includes addition and alteration areas complying independently, for each area complete an ENV-SUM form Rows 16-46 and either an ENV-PRESCRIPTIVE form, or ENV-UA + ENV-SHGC forms if demonstrating compliance via component performance.

Envelope Compliance Path

Selection required to enable forms.

◉ Prescriptive ○ Component Performance

Component Performance Calculation Adjustments

☐ Change of Occupancy (C503.2) / Conditioning (C505) - *10% higher UA allowed*

☐ Additional Efficiency Package Option - C406.8 Enhanced Envelope - *15% lower UA required*

Additions

○ Addition stand alone ○ Addition + Existing

Addition stand alone *- Complete Vertical Fenestration and Skylight Area Calculation. Enter total existing-to-remain wall, roof, vertical fenestration and skylight areas as EXISTING. Enter total addition envelope assembly areas as NEW. If resulting total building WWR exceeds 30% and/or SSR exceeds 5%, refer to C502.2.1 and C502.2.2 for prescriptive compliance alternatives. If complying via component performance, complete ENV-UA per instructions for addition stand alone projects.*

Addition + existing *- Complete ENV-UA per instructions for addtion + existing projects.*

Alterations - Fenestration and Skylight

☐ Replacement windows only, or resulting total building WWR ≤ original WWR

☐ Total building WWR increased by

☐ Replacement skylights only, or resulting total building SRR ≤ original SRR

☐ Total building SRR increased by alteration

WWR and SRR not increased *- Vertical Fenestration and Skylight Area Calculation not required.*

WWR and/or SRR increased *- Complete Vertical Fenestration and Skylight Area Calculation. Enter total existing-to-remain wall, roof, vertical fenestration and skylight areas as EXISTING. Enter total altered envelope assembly areas as NEW. If resulting total building WWR exceeds 30% and/or SSR exceeds 5%, refer to C503.3.2 and C503.3.3 for prescriptive compliance alternatives. If complying via component performance, complete ENV-UA per instructions for alteration + existing projects.*

Project Title:	**UPS BFI Gateway Project**	Date	10/30/2019

Vertical Fenestration and Skylight Area Calculation

Prescriptive Path *- Enter envelope sf values directly into this section of ENV-SUM for vertical fenestration, skylights, net walls and roof. For Additions and Alterations, refer to these sections in ENV-SUM for further instructions.*

Component Performance *- When this Envelope Compliance Path is selected, write-protection of this section is enabled. Enter envelope sf values for all assemblies into the ENV-UA form. Envelope information from ENV-UA will auto-fill into this section of*

	Total Vertical Fenestration Area (rough opening)	NET Exterior Above Grade Wall Area	Total Skylight Area (rough opening)	NET Exterior Roof Area
New	**3,138**	**20,468**	**0**	**0**
Existing	**0**	**0**	**0**	**0**
Total	**3,138**	**20,468**	**0**	**0**
	Vertical Fenestration-to-Wall Ratio (WWR)	**13.3%**	Skylight-to-Roof Ratio (SRR)	

Vertical Fenestration Area Compliance	**VERTICAL FENESTRATION AREA COMPLIES WITH MAXIMUM ALLOWANCE**
Skylight Area Compliance	

Vertical Fenestration Alternates

◯ High performance fenestration U-factors and SHGC per C402.4.1.3

◯ Dedicated outdoor air system per C402.4.1.4 and C403.6

Show locations of qualifying daylight zone (DLZ) areas and ft² on project plans.

For Daylight Zone Area Calculations -
a) Sidelight areas include primary + secondary daylight zone areas.
b) Include overlapping toplight and sidelight daylight zone areas under Toplight.
c) Net floor area definition in Chapter 2.

◯ In buildings ≥ 3 stories, 25% or more of NET floor area is in DLZ per C402.4.1.1

◯ In buildings < 3 stories, 50% or more of CONDITIONED floor area is within DLZ per C402.4.1.1

Daylight Zone Calculations

Not Selected. No Calculations Required	Sidelight Daylight Zone Area	Toplight Daylight Zone Area	Percent Daylight Zone Area

Spaces in Single Story Building Requiring Skylights

In these spaces a minimum of 50% of the floor area shall be within a skylight daylight zone (DLZ). Refer to C402.4.2 for requirements.

SRR = Skylight to roof ratio

List all enclosed spaces that exceed 2,500 ft², have ceiling height greater than 15 ft, and are space types required to comply with this provision. Indicate aperture with "AP" prefix (AP 1.1%)

Space	Space Area (ft²)	DLZ Area (ft²)	SRR or Aperture	Exception

Envelope Exemptions

Low Energy and Semi-heated Spaces

Low energy spaces per C402.1.1 Item 1 are exempt from the thermal envelope provisions. Semi-heated spaces heated by systems other than electric resistance are exempt from wall insulation provision only per C402.1.1.1.

Complete Low Energy and Semi-Heated Spaces table in MECH-SUM to verify eligibility based on installed peak heating and cooling capacity per sf.

Equipment Buildings

Equipment buildings are exempt from the thermal envelope provisions per C402.1.2.

The following shall be met to be eligible: building size ≤ 500 sf, average wall/roof U-factor ≤ U-0.20, electronic equipment load ≥ 7 watts/sf, heating system output capacity ≤ 17,000 btu/h. Cooling system capacity not limited.

	Wall Insulation R-Value	Roof Insulation R-Value	Overall Average U-Factor
Equipment Building Envelope			

Electronic equipment power (watts/sf)	
Heating system output capacity (Btu/hr)	
Cooling capacity (Yes/No)	

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Prescriptive Path, pg. 1 — ENV-PRESCRIPTIVE

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

Project Title:	**UPS BFI Gateway Project**	Date	10/30/2019
Target Insulation Allowance — **Fully Conditioned Space - Commercial, Group R, Mixed Use**		For Building Department Use	
Fenestration Area as % gross above-grade wall area **13.3%**	Max. Target: **30.0%**		
Skylight Area as % gross roof area	Max. Target: **5.0%**		
Vertical Fenestration Alternates:	**None Selected on ENV-SUM**	User Note	

Prescriptive compliance of envelope assemblies may be accomplished by providing insulation R-values per Table C402.1.3 or U-factors / F-factors per Tables C402.1.4 and C402.4. A single project may comply via R-values for some envelope assemblies and U-factors / F-factors for others.

Building Component		Provide plan/detail # of assembly and description	R-Value Method for Prescriptive Compliance: Cavity Ins. R-Value	Continuous Ins. (CI) R-Value[1]	% Area of Metal Penetrations in CI[2]	U-Factor/F-Factor Method for Prescriptive Compliance: Assembly U-Factor	U-Factor Source[3]
Roofs	Deck	A000 Detail 10 & 11		38.0			
Roofs	Mtl Bld[4]						
Roofs	Joist/Rftr						
Roofs	Attic/Oth						
Opaque Walls - Above Grade[15]	Steel	A000 Details 1A , 1B, 3A, 3B and 5	30.0				
Opaque Walls - Above Grade[15]	Mtl Bld.						
Opaque Walls - Above Grade[15]	Wood/Oth[5]						
Opaque Walls - Above Grade[15]	Mass[6]						
Opaque Walls - Above Grade[15]	Transfer[7]						
Group R Walls[15]	Steel						
Group R Walls[15]	Mass						
Below Grade Walls	Comm						
Below Grade Walls	Group R						
Floors	Mass						
Floors	Framed[8]						

DESIGN WEST ENGINEERING

Project Title:	UPS BFI Gateway Project	Date	10/30/2019
Fenestration Area as % gross above-grade wall area	13.3%	Max. Target:	30.0%
Skylight Area as % gross roof area		Max. Target:	5.0%

For Building Department Use

If vertical fenestration or skylight area exceeds maximum allowed per C402.4.1, then the project must comply via Component Performance and provide ENV-UA and ENV-SHGC forms.

Building Component

			R-Value Method for Prescriptive Compliance			U-Factor/F-Factor Method for Prescriptive Compliance	
		Provide plan/detail # of assembly and description	Perim. Ins. R-Value	Full Slab CI R-Value		F-Factor	F-Factor Source[10]
Slab-on-grade[9]	Unheated	A000 Detailss 15 & 16	10.0				
	Heated						
		Provide ID from door schedule and description	Ins. R-Value			Assembly U-Factor	U-Factor Source[11]
Opaque Doors	Swinging	A101, D120 & D121				0.370	
	Other	Rapid Overhead doors, A005				*Quick acting doors close rapidly to improve energy compliance	
			Solar Heat Gain Coefficient (SHGC)			U-Factor for Prescriptive Compliance	
		Provide ID from window schedule and description	Projection Factor (PF) if applicable[12]	Orientation (N or SEW)[13]	Assembly SHGC[14]	Assembly U-Factor	U-Factor Source[14]
Vertical Fenestration	Non-Metal						
	Metal, fixed	A102, 100 through 210		N	0.40	0.38	
		A102, 100 through 210		SEW	0.40	0.38	
	Metal, op.						
	Mtl entry						

derneath a slab-on-grade or exposed floor, this floor shall be thermally broken from the surrounding floor area with the same amount of insulation as re

Skylights	All Types						

Miscellaneous - Refrigerated Spaces

		Provide plan/detail # of assembly and description	Ins. R-Value			Assembly U-Factor	U-Factor Source
Freezer Floor[17]							
		Provide ID from window schedule and description	Cooler / Freezer	Double Pane Glass	Triple Pane Glass	Inert Gas Filled	Heat Reflective Treated Glass
azing[16,17]	In Door						
	In						

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Project Summary, pg 1 — PROJ-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

General Info

*PROJ-SUM form shall be provided as a cover sheet for all compliance form submittals. **Project Title** shall match project plans title block.*

Project Title:	**UPS BFI Gateway Project**	Date	10/30/2019
Project Street Address:	7300 Perimeter Road	For Building Department Use	
Project City, County, Zip:	Seattle, WA 98108		
Project Owner or Rep:	UPS		
Jurisdiction:	King County		

Project Description

Select all that apply to the scope of project.

Select Addition + Existing or Alteration + Existing if the existing building will be combined with the addition or alteration to demonstrate compliance per Section C502.1 or C503.1.

New Construction and Additions

- [x] New Building
- [ ] Building Addition

Existing Building Retrofit

- [ ] Alteration
- [ ] Change of Occupancy
- [ ] Change in Space Conditioning
- [ ] Historic Building

Building Elements Scope - Select all that apply

- [x] All
- [ ] Building Envelope
- [ ] Mechanical Systems
- [ ] Service Hot Water Systems
- [ ] Lighting Systems
- [ ] Electrical Systems

Occupancy Type

- (●) All Commercial
- ( ) Group R - R2, R3, & R4 over 3 stories and all R1
- ( ) Mixed Use

***Mixed Use** - Building is greater than three stories above grade and it has both Commercial and Group R occupancies.*

***Mixed Occupancy** - Building is three stories or less above grade and it has both Commercial and Group R2, R3 or R4 occupancies. Select All Commercial to document compliance for the commercial areas of the building. The residential spaces shall comply with the WSEC Residential Provisions.*

Space Conditioning Categories

Select all that apply to the scope of project

- [x] Fully Conditioned
- [ ] Semi-heated[2]
- [ ] Refrigerated Spaces (Warehouse and/or Walk-in[1])
- [ ] Low Energy Space Category[3]

Eligible Low Energy Spaces

- [ ] Unconditioned
- [ ] Low energy heating/cooling capacity
- [ ] Wireless service equipment shelter
- [ ] Greenhouse[4]
- [ ] Equipment building

Floor Area and Stories

Floors Above Grade	Building Gross Conditioned Floor Area	Project Gross Conditioned Floor Area
1	9,750	63,370

General Compliance Path

- (●) Compliance Method 1 - General
- ( ) Compliance Method 2 - Total Building

***Compliance Method 1** - Projects shall demonstrate compliance with all applicable mandatory and prescriptive requirements of this code. Refer to C401.2, Item 1 for more information. Compliance forms to include with a Prescriptive submittal: All applicable ENV, LTG, and MECH.*

***Compliance Method 2** - Projects complying via total building performance (TBP) shall include a summary of results from a whole building energy model per Section C407 and shall demonstrate compliance with all applicable mandatory provisions in this Code. Refer to Section C401.2, Item 2 for more information. Compliance forms to include with a TBP submittal: PROJ-SUM, ENV-CHK, LTG-EXT, LTG-CHK, and all MECH forms except MECH-ECONO and MECH-VENT (pending).*

Note 1 - Refrigerated Spaces - They shall comply with the envelope and refrigeration equipment requirements in Section C410. Warehouse coolers and freezers shall also comply with the envelope requirements in C402. C410 takes precedent for overlapping requirements.

Note 2 - Semi-heated Spaces - If heated with equipment other than electric resistance may take an exemption for wall insulation. All other envelope assemblies shall comply with the thermal envelope provisions.

Note 3 - Exemptions For Low Energy Spaces - Low Energy spaces are exempt from all provisions in WSEC Section C402 Building Envelope, however all other applicable provisions in the Code do apply including lighting, mechanical, service water heating, etc.

Note 4 - Eligible Space Conditioning For Low Energy Greenhouses - Greenhouses are defined as spaces that maintain a specialized sunlit environment that is used exclusively for cultivation, protection and maintenance of plants. Cooling with outside air and/or evaporative cooling, and any form of heating equipment, are allowed under the Low Energy Greenhouse category. Greenhouses with cooling equipment that requires a condensing unit are NOT eligible.

Project Summary, pg 2 PROJ-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 Revised Oct 2017

General Info	Project Title: UPS BFI Gateway Project	Date 10/30/2019

C406 Additional Efficiency Package Options Summary

A minimum of two Options are required for new construction, and change in space conditioning or occupancy projects.

Select all Options included in the current project scope. Also select Options complied with under previous projects (shell and core, other tenant spaces in building, etc)

Buildings with multiple tenant spaces may comply with different options (mix & match).

Options are required for all space conditioning categories.

Include discipline specific information for C406 options in ENV-SUM, LTG-SUM and

Refer to SBCC website for official interpretations regarding C406 provisions.

Building level efficiency options:	Current Scope	Previous Projects
C406.8 Enhanced envelope performance	☐	☐
C406.9 Reduced air infiltration	☑	☐
C406.5 On-site renewable energy	☐	☐
Building area level efficiency options		
C406.2 More efficient HVAC equipment	☐	☐
C406.6 Dedicated outside air systems (DOAS)	☑	☐
C406.7 Reduced energy use in service water heating	☐	☐
C406.3 Reduced lighting power	☐	☐
C406.4 Enhanced digital lighting controls	☐	☐

C406 Comments:

DESIGN WEST ENGINEERING

Envelope Summary — ENV-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

Project Info

Applicant Info. *Provide contact information for individual who can respond to inquiries about information provided.*

Project Title:	**UPS BFI Gateway Project**
Company Name:	**Design West Engineering**
Company Address:	**110 James Street, Suite 106, Edmonds, WA 98020**
Applicant Name:	**Liesbet Hess**
Applicant Phone:	**425-458-9700 x256**
Applicant Email:	**lhess@designwesteng.com**

Date: 10/30/2019

For Building Department Use

Project Description

☑ New Building ☐ Addition ☐ Alteration ☐ No Envelope Scope

Envelope Project Scope

Select all that apply.

☑ All Commercial ☐ Group R - Commercial ☐ Mixed Use - Commercial + Group R

☐ Semi-heated ☐ Refrigerated Cooler ☐ Refrigerated Freezer ☐ Equipment Building

Envelope Description

Provide brief description of the project and relevant supporting documentation.

If project includes multiple Target Insulation Allowance areas, and/or is demonstrating compliance as an Addition + Existing, Alteration + Existing, or Addition + Alteration + Existing project, provide a brief summary of the approach to whole building compliance.

Air Barrier Testing

Air barrier testing is required for all new construction projects. Testing criteria is 0.40 cfm/ft² under test pressure of 0.3 inch w.g.

To comply with C406.9, demonstrate that measured air leakage of building envelope

☑ Air barrier testing per Section C402.5.1.2 included in project scope

☐ Additional Efficiency Package Option - C406.9 Reduced Air Infiltration

☐ Testing not required. Explanation:

Compliance Documentation Scope and Method

Scope of This Calculation

☑ New Building ☐ Addition ☐ Alteration ☐ No Envelope Scope

Target Insulation Allowance

Sets the title and calculations in the compliance forms. Selection required to enable forms.

◉ Fully Conditioned - Commercial, Group R, Mixed Use

○ Semi-heated ○ Refrigerated Cooler ○ Refrigerated Freezer

If project includes more than one Target Insulation Allowance area, and/or if project includes addition and alteration areas complying independently, for each area complete an ENV-SUM form Rows 16-46 and either an ENV-PRESCRIPTIVE form, or ENV-UA + ENV-SHGC forms if demonstrating compliance via component performance.

Envelope Compliance Path

Selection required to enable forms.

◉ Prescriptive ○ Component Performance

Component Performance Calculation Adjustments

☐ Change of Occupancy (C503.2) / Conditioning (C505) - *10% higher UA allowed*

☐ Additional Efficiency Package Option - C406.8 Enhanced Envelope - *15% lower UA required*

Additions

○ Addition stand alone ○ Addition + Existing

Addition stand alone *- Complete Vertical Fenestration and Skylight Area Calculation. Enter total existing-to-remain wall, roof, vertical fenestration and skylight areas as EXISTING. Enter total addition envelope assembly areas as NEW. If resulting total building WWR exceeds 30% and/or SSR exceeds 5%, refer to C502.2.1 and C502.2.2 for prescriptive compliance alternatives. If complying via component performance, complete ENV-UA per instructions for addition stand alone projects.*

Addition + existing *- Complete ENV-UA per instructions for addtion + existing projects.*

Alterations - Fenestration and Skylight

☐ Replacement windows only, or resulting total building WWR ≤ original WWR ☐ Total building WWR increased by

☐ Replacement skylights only, or resulting total building SRR ≤ original SRR ☐ Total building SRR increased by alteration

WWR and SRR not increased *- Vertical Fenestration and Skylight Area Calculation not required.*

WWR and/or SRR increased *- Complete Vertical Fenestration and Skylight Area Calculation. Enter total existing-to-remain wall, roof, vertical fenestration and skylight areas as EXISTING. Enter total altered envelope assembly areas as NEW. If resulting total building WWR exceeds 30% and/or SSR exceeds 5%, refer to C503.3.2 and C503.3.3 for prescriptive compliance alternatives. If complying via component performance, complete ENV-UA per instructions for alteration + existing projects.*

Envelope Summary, pg. 2 ENV-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 Revised Oct 2017

Project Title:	UPS BFI Gateway Project	Date	10/30/2019

Vertical Fenestration and Skylight Area Calculation

Prescriptive Path *- Enter envelope sf values directly into this section of ENV-SUM for vertical fenestration, skylights, net walls and roof. For Additions and Alterations, refer to these sections in ENV-SUM for further instructions.*

Component Performance *- When this Envelope Compliance Path is selected, write-protection of this section is enabled. Enter envelope sf values for all assemblies into the ENV-UA form. Envelope information from ENV-UA will auto-fill into this section of*

	Total Vertical Fenestration Area (rough opening)	NET Exterior Above Grade Wall Area	Total Skylight Area (rough opening)	NET Exterior Roof Area
New	**537**	**12,800**	**0**	**0**
Existing	**0**	**0**	**0**	**0**
Total	**537**	**12,800**	**0**	**0**
	Vertical Fenestration-to-Wall Ratio (WWR)	**4.0%**	Skylight-to-Roof Ratio (SRR)	

Vertical Fenestration Area Compliance	**VERTICAL FENESTRATION AREA COMPLIES WITH MAXIMUM ALLOWANCE**
Skylight Area Compliance	

Vertical Fenestration Alternates

◯ High performance fenestration U-factors and SHGC per C402.4.1.3

◯ Dedicated outdoor air system per C402.4.1.4 and C403.6

Show locations of qualifying daylight zone (DLZ) areas and ft² on project plans.

For Daylight Zone Area Calculations -
a) Sidelight areas include primary + secondary daylight zone areas.
b) Include overlapping toplight and sidelight daylight zone areas under Toplight.
c) Net floor area definition in Chapter 2.

◯ In buildings ≥ 3 stories, 25% or more of NET floor area is in DLZ per C402.4.1.1

◯ In buildings < 3 stories, 50% or more of CONDITIONED floor area is within DLZ per C402.4.1.1

Daylight Zone Calculations

Not Selected. No Calculations Required	Sidelight Daylight Zone Area	Toplight Daylight Zone Area	Percent Daylight Zone Area

Spaces in Single Story Building Requiring Skylights

In these spaces a minimum of 50% of the floor area shall be within a skylight daylight zone (DLZ). Refer to C402.4.2 for requirements.

SRR = Skylight to roof ratio

List all enclosed spaces that exceed 2,500 ft², have ceiling height greater than 15 ft, and are space types required to comply with this provision. Indicate aperture with "AP" prefix (AP 1.1%)

Space	Space Area (ft²)	DLZ Area (ft²)	SRR or Aperture	Exception

Envelope Exemptions

Low Energy and Semi-heated Spaces

Low energy spaces per C402.1.1 Item 1 are exempt from the thermal envelope provisions. Semi-heated spaces heated by systems other than electric resistance are exempt from wall insulation provision only per C402.1.1.1.

Complete Low Energy and Semi-Heated Spaces table in MECH-SUM to verify eligibility based on installed peak heating and cooling capacity per sf.

Equipment Buildings

Equipment buildings are exempt from the thermal envelope provisions per C402.1.2.

The following shall be met to be eligible: building size ≤ 500 sf, average wall/roof U-factor ≤ U-0.20, electronic equipment load ≥ 7 watts/sf, heating system output capacity ≤ 17,000 btu/h. Cooling system capacity not limited.

	Wall Insulation R-Value	Roof Insulation R-Value	Overall Average U-Factor
Equipment Building Envelope			
		Electronic equipment power (watts/sf)	
		Heating system output capacity (Btu/hr)	
		Cooling capacity (Yes/No)	

DESIGN WEST ENGINEERING

Prescriptive Path, pg. 1 — ENV-PRESCRIPTIVE

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

Project Title: **UPS BFI Gateway Project** — Date 10/30/2019

For Building Department Use

Target Insulation Allowance

Fully Conditioned Space - Commercial, Group R, Mixed Use

Fenestration Area as % gross above-grade wall area **4.0%** Max. Target: **30.0%**

Skylight Area as % gross roof area Max. Target: **5.0%**

Vertical Fenestration Alternates: **None Selected on ENV-SUM** — User Note

Prescriptive compliance of envelope assemblies may be accomplished by providing insulation R-values per Table C402.1.3 or U-factors / F-factors per Tables C402.1.4 and C402.4. A single project may comply via R-values for some envelope assemblies and U-factors / F-factors for others.

Building Component		Provide plan/detail # of assembly and description	Cavity Ins. R-Value (R-Value Method for Prescriptive Compliance)	Continuous Ins. (CI) R-Value[1]	% Area of Metal Penetrations in CI[2]	Assembly U-Factor (U-Factor/F-Factor Method for Prescriptive Compliance)	U-Factor Source[3]
Roofs	Deck	A000 Detail 10 & 11		38.0			
Roofs	Mtl Bld[4]						
Roofs	Joist/Rftr						
Roofs	Attic/Oth						
Opaque Walls - Above Grade[15]	Steel	A000 Details 1A , 1B, 3A, 3B and 5	30.0				
Opaque Walls - Above Grade[15]	Mtl Bld.						
Opaque Walls - Above Grade[15]	Wood/Oth[5]						
Opaque Walls - Above Grade[15]	Mass[6]						
Opaque Walls - Above Grade[15]	Transfer[7]						
Group R Walls[15]	Steel						
Group R Walls[15]	Mass						
Below Grade Walls	Comm						
Below Grade Walls	Group R						
Floors	Mass						
Floors	Framed[8]						

Prescriptive Path, pg. 2 — ENV-PRESCRIPTIVE

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

Project Title:	UPS BFI Gateway Project		Date	10/30/2019
Fenestration Area as % gross above-grade wall area	4.0%	Max. Target: 30.0%	For Building Department Use	
Skylight Area as % gross roof area		Max. Target: 5.0%		

If vertical fenestration or skylight area exceeds maximum allowed per C402.4.1, then the project must comply via Component Performance and provide ENV-UA and ENV-SHGC forms.

Building Component

		Provide plan/detail # of assembly and description	R-Value Method for Prescriptive Compliance: Perim. Ins. R-Value	Full Slab CI R-Value		U-Factor/F-Factor Method for Prescriptive Compliance: F-Factor	F-Factor Source[10]
Slab-on-grade[9]	Unheated	A000 Detailss 15 & 16	10.0				
	Heated						

		Provide ID from door schedule and description	Ins. R-Value			Assembly U-Factor	U-Factor Source[11]
Opaque Doors	Swinging	A401, D400, D401, D402, D403 & D404				0.370	
	Other	Overhead doors, A401, D, E & F	4.8				

		Provide ID from window schedule and description	Solar Heat Gain Coefficient (SHGC): Projection Factor (PF) if applicable[12]	Orientation (N or SEW)[13]	Assembly SHGC[14]	U-Factor for Prescriptive Compliance: Assembly U-Factor	U-Factor Source[14]
Vertical Fenestration	Non-Metal						
	Metal, fixed	A401, 401		N	0.40	0.38	
		A401, 402, 403, 404, 405 & 406		SEW	0.40	0.38	
	Metal, op.						
	Mtl entry						

derneath a slab-on-grade or exposed floor, this floor shall be thermally broken from the surrounding floor area with the same amount of insulation as re

Skylights	All Types						

Miscellaneous - Refrigerated Spaces

	Provide plan/detail # of assembly and description	Ins. R-Value			Assembly U-Factor	U-Factor Source
Freezer Floor[17]						

		Provide ID from window schedule and description	Cooler / Freezer	Double Pane Glass	Triple Pane Glass	Inert Gas Filled	Heat Reflective Treated Glass
Glazing[16,17]	In Door						
	Reach In						

DESIGN WEST ENGINEERING

Project Summary, pg 1 — PROJ-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

General Info

PROJ-SUM form shall be provided as a cover sheet for all compliance form submittals. ***Project Title*** *shall match project plans title block.*

Project Title:	**UPS BFI Gateway Project**	Date	10/30/2019
Project Street Address:	7300 Perimeter Road	For Building Department Use	
Project City, County, Zip:	Seattle, WA 98108		
Project Owner or Rep:	UPS		
Jurisdiction:	King County		

Project Description

Select all that apply to the scope of project.

Select Addition + Existing or Alteration + Existing if the existing building will be combined with the addition or alteration to demonstrate compliance per Section C502.1 or C503.1.

New Construction and Additions

- [x] New Building
- [ ] Building Addition

Existing Building Retrofit

- [ ] Alteration
- [ ] Change of Occupancy
- [ ] Change in Space Conditioning
- [ ] Historic Building

Building Elements Scope - Select all that apply

- [x] All
- [ ] Building Envelope
- [ ] Mechanical Systems
- [ ] Service Hot Water Systems
- [ ] Lighting Systems
- [ ] Electrical Systems

Occupancy Type

- (●) All Commercial
- ( ) Group R - R2, R3, & R4 over 3 stories and all R1
- ( ) Mixed Use

Mixed Use *- Building is greater than three stories above grade and it has both Commercial and Group R occupancies.*

Mixed Occupancy *- Building is three stories or less above grade and it has both Commercial and Group R2, R3 or R4 occupancies. Select All Commercial to document compliance for the commercial areas of the building. The residential spaces shall comply with the WSEC Residential Provisions.*

Space Conditioning Categories

Select all that apply to the scope of project

- [x] Fully Conditioned
- [ ] Semi-heated[2]
- [ ] Refrigerated Spaces (Warehouse and/or Walk-in[1])
- [ ] Low Energy Space Category[3]

Eligible Low Energy Spaces

- [ ] Unconditioned
- [ ] Low energy heating/cooling capacity
- [ ] Wireless service equipment shelter
- [ ] Greenhouse[4]
- [ ] Equipment building

Floor Area and Stories

Floors Above Grade	Building Gross Conditioned Floor Area	Project Gross Conditioned Floor Area
1	1,250	63,370

General Compliance Path

- (●) Compliance Method 1 - General
- ( ) Compliance Method 2 - Total Building

Compliance Method 1 *- Projects shall demonstrate compliance with all applicable mandatory and prescriptive requirements of this code. Refer to C401.2, Item 1 for more information. Compliance forms to include with a Prescriptive submittal: All applicable ENV, LTG, and MECH.*

Compliance Method 2 *- Projects complying via total building performance (TBP) shall include a summary of results from a whole building energy model per Section C407 and shall demonstrate compliance with all applicable mandatory provisions in this Code. Refer to Section C401.2, Item 2 for more information. Compliance forms to include with a TBP submittal: PROJ-SUM, ENV-CHK, LTG-EXT, LTG-CHK, and all MECH forms except MECH-ECONO and MECH-VENT (pending).*

Note 1 - Refrigerated Spaces - They shall comply with the envelope and refrigeration equipment requirements in Section C410. Warehouse coolers and freezers shall also comply with the envelope requirements in C402. C410 takes precedent for overlapping requirements.

Note 2 - Semi-heated Spaces - If heated with equipment other than electric resistance may take an exemption for wall insulation. All other envelope assemblies shall comply with the thermal envelope provisions.

Note 3 - Exemptions For Low Energy Spaces - Low Energy spaces are exempt from all provisions in WSEC Section C402 Building Envelope, however all other applicable provisions in the Code do apply including lighting, mechanical, service water heating, etc.

Note 4 - Eligible Space Conditioning For Low Energy Greenhouses - Greenhouses are defined as spaces that maintain a specialized sunlit environment that is used exclusively for cultivation, protection and maintenance of plants. Cooling with outside air and/or evaporative cooling, and any form of heating equipment, are allowed under the Low Energy Greenhouse category. Greenhouses with cooling equipment that requires a condensing unit are NOT eligible.

DESIGN WEST ENGINEERING

Project Summary, pg 2 PROJ-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 Revised Oct 2017

General Info	Project Title: UPS BFI Gateway Project	Date 10/30/2019

C406 Additional Efficiency Package Options Summary

A minimum of two Options are required for new construction, and change in space conditioning or occupancy projects.

Select all Options included in the current project scope. Also select Options complied with under previous projects (shell and core, other tenant spaces in building, etc)

Buildings with multiple tenant spaces may comply with different options (mix & match).

Options are required for all space conditioning categories.

Include discipline specific information for C406 options in ENV-SUM, LTG-SUM and

Refer to SBCC website for official interpretations regarding C406 provisions.

Building level efficiency options:	Current Scope	Previous Projects
C406.8 Enhanced envelope performance	☐	☐
C406.9 Reduced air infiltration	☑	☐
C406.5 On-site renewable energy	☐	☐
Building area level efficiency options		
C406.2 More efficient HVAC equipment	☐	☐
C406.6 Dedicated outside air systems (DOAS)	☑	☐
C406.7 Reduced energy use in service water heating	☐	☐
C406.3 Reduced lighting power	☐	☐
C406.4 Enhanced digital lighting controls	☐	☐

C406 Comments:

DESIGN WEST ENGINEERING

Envelope Summary ENV-SUM

2015 WSEC Compliance Forms for Commercial Buildings including R2, R3, & R4 over 3 stories and all R1 — Revised Oct 2017

Project Info

Applicant Info. *Provide contact information for individual who can respond to inquiries about information provided.*

Project Title:	**UPS BFI Gateway Project**	Date **10/30/2019**
Company Name:	**Design West Engineering**	For Building Department Use
Company Address:	**110 James Street, Suite 106, Edmonds, WA 98020**	
Applicant Name:	**Liesbet Hess**	
Applicant Phone:	**425-458-9700 x256**	
Applicant Email:	**lhess@designwesteng.com**	

Project Description

☑ New Building ☐ Addition ☐ Alteration ☐ No Envelope Scope

Envelope Project Scope

Select all that apply.

☑ All Commercial ☐ Group R - Commercial ☐ Mixed Use - Commercial + Group R

☐ Semi-heated ☐ Refrigerated Cooler ☐ Refrigerated Freezer ☐ Equipment Building

Envelope Description

Provide brief description of the project and relevant supporting documentation.

If project includes multiple Target Insulation Allowance areas, and/or is demonstrating compliance as an Addition + Existing, Alteration + Existing, or Addition + Alteration + Existing project, provide a brief summary of the approach to whole building compliance.

Air Barrier Testing

Air barrier testing is required for all new construction projects. Testing criteria is 0.40 cfm/ft² under test pressure of 0.3 inch w.g.

To comply with C406.9, demonstrate that measured air leakage of building envelope

☑ Air barrier testing per Section C402.5.1.2 included in project scope

☐ Additional Efficiency Package Option - C406.9 Reduced Air Infiltration

☐ Testing not required. Explanation:

Compliance Documentation Scope and Method

Scope of This Calculation

☑ New Building ☐ Addition ☐ Alteration ☐ No Envelope Scope

Target Insulation Allowance

Sets the title and calculations in the compliance forms. Selection required to enable forms.

◉ Fully Conditioned - Commercial, Group R, Mixed Use

○ Semi-heated ○ Refrigerated Cooler ○ Refrigerated Freezer

If project includes more than one Target Insulation Allowance area, and/or if project includes addition and alteration areas complying independently, for each area complete an ENV-SUM form Rows 16-46 and either an ENV-PRESCRIPTIVE form, or ENV-UA + ENV-SHGC forms if demonstrating compliance via component performance.

Envelope Compliance Path

Selection required to enable forms.

◉ Prescriptive ○ Component Performance

Component Performance Calculation Adjustments

☐ Change of Occupancy (C503.2) / Conditioning (C505) - *10% higher UA allowed*

☐ Additional Efficiency Package Option - C406.8 Enhanced Envelope - *15% lower UA required*

Additions

○ Addition stand alone ○ Addition + Existing

Addition stand alone *- Complete Vertical Fenestration and Skylight Area Calculation. Enter total existing-to-remain wall, roof, vertical fenestration and skylight areas as EXISTING. Enter total addition envelope assembly areas as NEW. If resulting total building WWR exceeds 30% and/or SSR exceeds 5%, refer to C502.2.1 and C502.2.2 for prescriptive compliance alternatives. If complying via component performance, complete ENV-UA per instructions for addition stand alone projects.*

Addition + existing *- Complete ENV-UA per instructions for addtion + existing projects.*

Alterations - Fenestration and Skylight

☐ Replacement windows only, or resulting total building WWR ≤ original WWR ☐ Total building WWR increased by

☐ Replacement skylights only, or resulting total building SRR ≤ original SRR ☐ Total building SRR increased by alteration

WWR and SRR not increased *- Vertical Fenestration and Skylight Area Calculation not required.*

WWR and/or SRR increased *- Complete Vertical Fenestration and Skylight Area Calculation. Enter total existing-to-remain wall, roof, vertical fenestration and skylight areas as EXISTING. Enter total altered envelope assembly areas as NEW. If resulting total building WWR exceeds 30% and/or SSR exceeds 5%, refer to C503.3.2 and C503.3.3 for prescriptive compliance alternatives. If complying via component performance, complete ENV-UA per instructions for alteration + existing projects.*

Project Title: UPS BFI Gateway Project	Date 10/30/2019

Vertical Fenestration and Skylight Area Calculation

Prescriptive Path *- Enter envelope sf values directly into this section of ENV-SUM for vertical fenestration, skylights, net walls and roof. For Additions and Alterations, refer to these sections in ENV-SUM for further instructions.*

Component Performance *- When this Envelope Compliance Path is selected, write-protection of this section is enabled. Enter envelope sf values for all assemblies into the ENV-UA form. Envelope information from ENV-UA will auto-fill into this section of*

	Total Vertical Fenestration Area (rough opening)	NET Exterior Above Grade Wall Area	Total Skylight Area (rough opening)	NET Exterior Roof Area
New	**382**	**2,272**	**0**	**0**
Existing	**0**	**0**	**0**	**0**
Total	**382**	**2,272**	**0**	**0**
	Vertical Fenestration-to-Wall Ratio (WWR)	**14.4%**	Skylight-to-Roof Ratio (SRR)	

Vertical Fenestration Area Compliance	**VERTICAL FENESTRATION AREA COMPLIES WITH MAXIMUM ALLOWANCE**
Skylight Area Compliance	

Vertical Fenestration Alternates

- ◯ High performance fenestration U-factors and SHGC per C402.4.1.3
- ◯ Dedicated outdoor air system per C402.4.1.4 and C403.6
- ◯ In buildings ≥ 3 stories, 25% or more of NET floor area is in DLZ per C402.4.1.1
- ◯ In buildings < 3 stories, 50% or more of CONDITIONED floor area is within DLZ per C402.4.1.1

Show locations of qualifying daylight zone (DLZ) areas and ft² on project plans.

For Daylight Zone Area Calculations -
a) Sidelight areas include primary + secondary daylight zone areas.
b) Include overlapping toplight and sidelight daylight zone areas under Toplight.
c) Net floor area definition in Chapter 2.

Daylight Zone Calculations

Not Selected. No Calculations Required	Sidelight Daylight Zone Area	Toplight Daylight Zone Area	Percent Daylight Zone Area

Spaces in Single Story Building Requiring Skylights

In these spaces a minimum of 50% of the floor area shall be within a skylight daylight zone (DLZ). Refer to C402.4.2 for requirements.

SRR = Skylight to roof ratio

List all enclosed spaces that exceed 2,500 ft², have ceiling height greater than 15 ft, and are space types required to comply with this provision. Indicate aperture with "AP" prefix (AP 1.1%)

Space	Space Area (ft²)	DLZ Area (ft²)	SRR or Aperture	Exception

Envelope Exemptions

Low Energy and Semi-heated Spaces

Low energy spaces per C402.1.1 Item 1 are exempt from the thermal envelope provisions. Semi-heated spaces heated by systems other than electric resistance are exempt from wall insulation provision only per C402.1.1.1.

Complete Low Energy and Semi-Heated Spaces table in MECH-SUM to verify eligibility based on installed peak heating and cooling capacity per sf.

Equipment Buildings

Equipment buildings are exempt from the thermal envelope provisions per C402.1.2.

The following shall be met to be eligible: building size ≤ 500 sf, average wall/roof U-factor ≤ U-0.20, electronic equipment load ≥ 7 watts/sf, heating system output capacity ≤ 17,000 btu/h. Cooling system capacity not limited.

	Wall Insulation R-Value	Roof Insulation R-Value	Overall Average U-Factor
Equipment Building Envelope			
		Electronic equipment power (watts/sf)	
		Heating system output capacity (Btu/hr)	
		Cooling capacity (Yes/No)	

DESIGN WEST ENGINEERING

Prescriptive Path, pg. 1 — ENV-PRESCRIPTIVE

Project Title:	UPS BFI Gateway Project	Date	10/30/2019

Target Insulation Allowance

Fully Conditioned Space - Commercial, Group R, Mixed Use

For Building Department Use

Fenestration Area as % gross above-grade wall area **14.4%** Max. Target: **30.0%**

Skylight Area as % gross roof area Max. Target: **5.0%**

Vertical Fenestration Alternates: **None Selected on ENV-SUM**

User Note

Prescriptive compliance of envelope assemblies may be accomplished by providing insulation R-values per Table C402.1.3 or U-factors / F-factors per Tables C402.1.4 and C402.4. A single project may comply via R-values for some envelope assemblies and U-factors / F-factors for others.

Building Component		Provide plan/detail # of assembly and description	R-Value Method for Prescriptive Compliance: Cavity Ins. R-Value	Continuous Ins. (CI) R-Value[1]	% Area of Metal Penetrations in CI[2]	U-Factor/F-Factor Method for Prescriptive Compliance: Assembly U-Factor	U-Factor Source[3]
Roofs	Deck	A000 Detail 10 & 11		38.0			
Roofs	Mtl Bld[4]						
Roofs	Joist/Rftr						
Roofs	Attic/Oth						
Opaque Walls - Above Grade[15]	Steel	A000 Details 1A , 1B, 3A, 3B and 5	30.0				
Opaque Walls - Above Grade[15]	Mtl Bld.						
Opaque Walls - Above Grade[15]	Wood/Oth[5]						
Opaque Walls - Above Grade[15]	Mass[6]						
Opaque Walls - Above Grade[15]	Transfer[7]						
Group R Walls[15]	Steel						
Group R Walls[15]	Mass						
Below Grade Walls	Comm						
Below Grade Walls	Group R						
Floors	Mass						
Floors	Framed[8]						

DESIGN WEST ENGINEERING

Prescriptive Path, pg. 2 — ENV-PRESCRIPTIVE

Project Title:	**UPS BFI Gateway Project**		Date	10/30/2019
Fenestration Area as % gross above-grade wall area	**14.4%**	Max. Target: **30.0%**	For Building Department Use	
Skylight Area as % gross roof area		Max. Target: **5.0%**		

If vertical fenestration or skylight area exceeds maximum allowed per C402.4.1, then the project must comply via Component Performance and provide ENV-UA and ENV-SHGC forms.

Building Component

	Provide plan/detail # of assembly and description	R-Value Method for Prescriptive Compliance: Perim. Ins. R-Value	Full Slab CI R-Value		U-Factor/F-Factor Method for Prescriptive Compliance: F-Factor	F-Factor Source[10]
Slab-on-grade[9] – Unheated	A000 Details 15 & 16	10.0				
Slab-on-grade[9] – Heated						

	Provide ID from door schedule and description	Ins. R-Value			Assembly U-Factor	U-Factor Source[11]
Opaque Doors – Swinging	A501, D500, D501, D502, D503, D504, D505 & D506				0.370	
Opaque Doors – Other						

	Provide ID from window schedule and description	Solar Heat Gain Coefficient (SHGC): Projection Factor (PF) if applicable[12]	Orientation (N or SEW)[13]	Assembly SHGC[14]	U-Factor for Prescriptive Compliance: Assembly U-Factor	U-Factor Source[14]
Vertical Fenestration – Non-Metal						
Vertical Fenestration – Metal, fixed	A501, 501 & 505		N	0.40	0.38	
	A501, 502, 503, 504		SEW	0.40	0.38	
Vertical Fenestration – Metal, op.						
Vertical Fenestration – Mtl entry						

derneath a slab-on-grade or exposed floor, this floor shall be thermally broken from the surrounding floor area with the same amount of insulation as re

Skylights – All Types						

Miscellaneous - Refrigerated Spaces

	Provide plan/detail # of assembly and description	Ins. R-Value			Assembly U-Factor	U-Factor Source
Freezer Floor[17]						

	Provide ID from window schedule and description	Cooler / Freezer	Double Pane Glass	Triple Pane Glass	Inert Gas Filled	Heat Reflective Treated Glass
Glazing[16,17] – In Door						
Glazing[16,17] – Reach In						

DESIGN WEST ENGINEERING

Mechanical Summary — MECH-SUM

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2 & R3 over 3 stories and all R1 — Revised January 2017

Project Information

Project Title:	UPS BFI Gateway Project	Date 10/30/2019
Applicant Information. Provide contact information for individual who can respond to inquiries about compliance form information provided.		For Building Dept. Use
Company Name:	Design West Engineering	
Company Address:	110 James Street, Suite 106, Edmonds, WA 98020	
Applicant Name:	Liesbet Hess	
Applicant Phone:	425-458-9700 x256	

Project Description

Briefly describe mechanical systems in the text box provided

☐ Total Bldg Performance (TBP)

This path includes all mandatory provisions per C401.2 Option 2. MECH-SUM, MECH-CHK, and C407 Energy Analysis forms required.

☑ New Building ☐ Building Addition ☐ Tenant Improvement ☐ System Retrofit ☐ No System Changes

Design Load Calculations

☑ Load calculation summary ☐ MECH-LOAD-CALC Form

Provide design load calculations for all mechanical systems and equipment serving the building heating, cooling or ventilating needs. If a load calculation summary is provided with the permit documents that includes all applicable compliance information then the MECH-LOAD-CALC form is not required.

Mechanical Schedules

☑ Mechanical Plans ☐ MECH-EQ Forms (TBD)

Indicate location of equipment compliance information. If provided on plans then MECH-EQ forms are not required, however, include on plans all applicable compliance information listed in MECH-EQ tables.

Dedicated Outdoor Air System Requirements and High Efficiency VAV Alternate

☑ DOAS is required per C403.6 effective July 1, 2017 (office, retail, education, library and fire station occupancies)

All occupied, conditioned areas shall be served by a DOAS that delivers required ventilation air in a manner that does not require space conditioning fan operation. Space conditioning fans cycled off when no heating or cooling is required.

- ☐ Ventilation provided via natural ventilation per 2015 IMC in lieu of DOAS (C403.6, Exception 1)
- ☐ Ventilation and space conditioning provided by a HEVAV system per C403.7 in lieu of DOAS (C403.6, Exception 2)

☐ DOAS included in project, although not required (occupancy not office, retail, education, library or fire station)

☐ DOAS related allowances included in project:

- ☐ Prescriptive vertical fenestration maximum area allowance increased to 40% per C402.4.1.4 with 100% of conditioned floor area in building served by DOAS.
- ☐ Exception to air economizer per C403.3 Exception 1, include MECH-ECONO form.

Fan Power

☑ Project includes HVAC air distribution systems that provide heating and/or cooling

If yes, provide a MECH-FANSYS -SUM form.

☐ For one or more systems, the total fan motor nameplate hp of all fans in HVAC system exceeds 5hp.

If yes, provide a seperate MECH-FANSYS form for each HVAC system exceeding the 5 horsepower threshold. Refer to Section C403.2.11 and MECH-FANSYS-DOC for requirements and exceptions.

HVAC Hydronic Systems

☐ Hydronic chilled water ☐ Water-loop heat pump ☑ No hydronic systems

☐ Hydronic heating water ☐ Geothermal

C406 Additional Efficiency Options - Mechanical

☐ C406.2 More efficient HVAC equipment and fan systems

Requires 90% of heating and cooling capacity to be equipment listed in tables C403.2.3(1)-(9) or air-to-water heat pumps and heat recovery chillers. All equipment listed in tables C403.2.3(1)-(7) must be 15% more efficient than minimum requirements. All stand alone supply, return, and exhaust fans over 1hp must have FEQ ≥ 71 and must be selected within 10% of maximum total or static pressure.

☑ C406.6 Dedicated outdoor air system (DOAS)

Requires 90% of conditioned floor area to be served by a DOAS per C403.6 that delivers required ventilation air in a manner that does not require space conditioning fan operation.

☐ C406.7 Reduced energy in service water heating

Requires 90% of floor area be in occupancy types listed in C406.7.1 and that 60% of annual hot water energy use be provided by heat pump, waste heat recovery or solar water-heating systems.

DESIGN WEST ENGINEERING

Mechanical Summary, pg. 2 — MECH-SUM

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2 & R3 over 3 stories and all R1 — Revised January 2017

Service Water Heating Systems

Equipment Type (s)

- [x] Hot water heating tank(s)
- [x] Instantaneous
- [ ] No service water systems
- [ ] Dedicated boiler
- [ ] Heat exchange from space heat boiler or central hot water/steam

Distribution Type (s)

- [x] Circulation System
- [x] On-demand

Commissioning

Commissioning is required for:

- [x] Mechanical systems per C408.2
- [ ] Service water heating systems per C408.4

If required, commissioning shall be performed for all applicable systems regardless of individual equipment capacity.

Exceptions to commissioning requirements:

- [ ] Total output capacity of all mechanical space conditioning systems in the building do not exceed 240,000 Btu/h cooling or 300,000 Btu/h heating. Mechanical systems commissioning not required.
- [x] Capacity of largest service water heating system in building does not exceed 200,000 Btu/h. Service water heating systems commissioning not required.

Low Energy and Semi-Heated Spaces

(Note 6 and 7)

Space Type	Location in Plan(s)	Space(s) Served	Area Served, square feet	Heating Capacity, Btu/h (Note 4)	Cooling Capacity, Btu/h (Note 5)	Peak Space Conditioning Capacity, Btu/h-sf	Compliance Check	Notes

Note 4 - Provide total installed heating output capacity of systems serving Low Energy or Semi-Heated space(s) in btuh.
Note 5 - Provide total installed cooling capacity of system serving Low Energy space(s) in Btu/h. Not allowed for semi-heated spaces. Enter 0 if no cooling.
*Note 6 - Refer to Section C402.1.1 Low Energy Building. Intalled peak space conditioning capacity, heating or cooling, may not exceed 3.4 Btu/h*sf.*
*Note 7 - Refer to Section C402.1.1.1 and Semi-Heated Space definition in Chapter 2. Total heating output capacity may not exceed 8 Btu/h*sf. Only systems without electric resistance heating and no cooling are eligible for the wall insulation exception under semi-heated.*

DESIGN WEST ENGINEERING

Air System Sizing Summary for Level 1- Whole System

Project Name: 18-380 UPS Boing Field Expansion 10/30/2019
Prepared by: Design West Engineering 02:05PM

Air System Information

Air System Name	**Level 1- Whole System**		Number of zones	**1**	
Equipment Class	**UNDEF**		Floor Area	**6875.0**	ft²
Air System Type	**SZCAV**		Location	**Seattle IAP, Washington**	

Sizing Calculation Information

Calculation Months	**Jan to Dec**	Zone CFM Sizing	**Sum of space airflow rates**
Sizing Data	**Calculated**	Space CFM Sizing	**Individual peak space loads**

Central Cooling Coil Sizing Data

Total coil load	**9.9**	Tons	Load occurs at	**Jul 1700**	
Total coil load	**118.4**	MBH	OA DB / WB	**83.2 / 64.4**	°F
Sensible coil load	**116.8**	MBH	Entering DB / WB	**76.9 / 64.9**	°F
Coil CFM at Jul 1700	**6551**	CFM	Leaving DB / WB	**60.1 / 59.0**	°F
Max block CFM	**6551**	CFM	Coil ADP	**58.3**	°F
Sum of peak zone CFM	**6551**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.987**		Resulting RH	**55**	%
CFM/Ton	**664.2**		Design supply temp.	**58.0**	°F
ft²/Ton	**697.0**		Zone T-stat Check	**1 of 1**	OK
BTU/(hr·ft²)	**17.2**		Max zone temperature deviation	**0.0**	°F
Water flow @ 10.0 °F rise	**23.69**	gpm			

Central Heating Coil Sizing Data

Max coil load	**63.9**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**6551**	CFM	BTU/(hr·ft²)	**9.3**	
Max coil CFM	**6551**	CFM	Ent. DB / Lvg DB	**65.0 / 74.2**	°F
Water flow @ 20.0 °F drop	**6.40**	gpm			

Supply Fan Sizing Data

Actual max CFM	**6551**	CFM	Fan motor BHP	**0.00**	BHP
Standard CFM	**6446**	CFM	Fan motor kW	**0.00**	kW
Actual max CFM/ft²	**0.95**	CFM/ft²	Fan static	**0.00**	in wg

Outdoor Ventilation Air Data

Design airflow CFM	**673**	CFM	CFM/person	**17.70**	CFM/person
CFM/ft²	**0.10**	CFM/ft²			

DESIGN WEST ENGINEERING

Zone Sizing Summary for Level 1- Whole System

Project Name: 18-380 UPS Boing Field Expansion — 10/30/2019
Prepared by: Design West Engineering — 02:05PM

Air System Information

Air System Name .... **Level 1- Whole System**
Equipment Class .... **UNDEF**
Air System Type .... **SZCAV**

Number of zones **1**
Floor Area .... **6875.0** ft²
Location .... **Seattle IAP, Washington**

Sizing Calculation Information

Calculation Months .... **Jan to Dec**
Sizing Data .... **Calculated**

Zone CFM Sizing .... **Sum of space airflow rates**
Space CFM Sizing .... **Individual peak space loads**

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/ft²	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 20.0 °F	Zone Htg Unit Coil Load (MBH)	Zone Htg Unit Water gpm @ 20.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	6551	6551	0.95	0.0	0.00	0.0	0.00	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)
Zone 1	116.7	Jun 1700	29.9	6875.0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
110 Break Room	1	16.3	Jun 1700	903	6.3	960.0	0.94
111 IT Storage	1	1.9	Jun 1400	104	0.1	100.0	1.04
112 Server	1	8.9	Jun 1600	495	0.8	380.0	1.30
113 Women's Restroom	1	2.0	Jun 1500	108	0.7	360.0	0.30
114 Men's Restroom	1	2.0	Jun 1500	108	0.7	360.0	0.30
115 Part Time Supervisor	1	29.6	Jun 1700	1637	5.9	1030.0	1.59
116 Conference Room	1	19.0	Jun 1700	1051	2.9	630.0	1.67
117 Hall	1	1.6	Jun 1400	86	0.8	290.0	0.30
118 Janitor	1	1.4	Jul 1700	79	0.5	270.0	0.29
120 Storage	1	0.2	Jan 2300	10	0.0	55.0	0.19
121 Customs	1	2.6	Sep 1600	142	0.2	105.0	1.35
123 Crew Lounge	1	3.5	Jul 1500	195	1.4	210.0	0.93
124 Hall	1	3.2	Jun 1400	179	0.7	630.0	0.28
125 Crew Ready	1	4.6	Jul 1500	254	1.6	230.0	1.10
126 On Road Supervisor	1	1.9	Jul 1500	107	0.8	125.0	0.85
127 OMS ODC	1	2.0	Jul 1500	108	0.9	125.0	0.86
128 Full Time Supervisor	1	10.9	Jul 1500	602	2.2	305.0	1.97
129 Flight Records	1	2.4	Jun 1400	133	0.2	205.0	0.65
130 Scanners	1	2.7	Jul 1500	151	2.0	280.0	0.54
132 Electrical Room	1	1.8	Jul 1500	98	1.2	225.0	0.43

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 85.0 °F / 65.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 23.0 °F / 19.2 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	780 ft²	22527	-	780 ft²	-	-
Wall Transmission	1114 ft²	1374	-	1114 ft²	2087	-
Roof Transmission	6445 ft²	10485	-	6445 ft²	7609	-
Window Transmission	780 ft²	1573	-	780 ft²	10998	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	42 ft²	104	-	42 ft²	730	-
Floor Transmission	6875 ft²	0	-	6875 ft²	0	-
Partitions	1520 ft²	2524	-	1520 ft²	8475	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	6875 W	23457	-	0	0	-
Task Lighting	1650 W	5630	-	0	0	-
Electric Equipment	9200 W	31390	-	0	0	-
People	38	9310	7790	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**108374**	**7790**	**-**	**29899**	**0**
Zone Conditioning	-	106331	7790	-	30440	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	6551 CFM	0	-	6551 CFM	0	-
Ventilation Load	673 CFM	6383	-7112	673 CFM	33488	0
Supply Fan Load	6551 CFM	0	-	6551 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**112714**	**678**	**-**	**63928**	**0**
Central Cooling Coil	-	112714	696	-	0	0
Central Heating Coil	-	0	-	-	63928	-
>> Total Conditioning	**-**	**112714**	**696**	**-**	**63928**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Information

Air System Name	Level 2 - Whole System		Number of zones	1	
Equipment Class	UNDEF		Floor Area	2790.0	ft²
Air System Type	SZCAV		Location	Seattle IAP, Washington	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	9.0	Tons	Load occurs at	Jul 1600	
Total coil load	107.6	MBH	OA DB / WB	84.5 / 64.8	°F
Sensible coil load	106.7	MBH	Entering DB / WB	76.6 / 65.1	°F
Coil CFM at Jul 1600	6330	CFM	Leaving DB / WB	60.7 / 59.6	°F
Max block CFM	6330	CFM	Coil ADP	59.0	°F
Sum of peak zone CFM	6330	CFM	Bypass Factor	0.100	
Sensible heat ratio	0.992		Resulting RH	56	%
CFM/Ton	705.7		Design supply temp.	58.0	°F
ft²/Ton	311.0		Zone T-stat Check	1 of 1	OK
BTU/(hr·ft²)	38.6		Max zone temperature deviation	0.0	°F
Water flow @ 10.0 °F rise	21.54	gpm			

Central Heating Coil Sizing Data

Max coil load	54.6	MBH	Load occurs at	Des Htg	
Coil CFM at Des Htg	6330	CFM	BTU/(hr·ft²)	19.6	
Max coil CFM	6330	CFM	Ent. DB / Lvg DB	67.7 / 75.8	°F
Water flow @ 20.0 °F drop	5.46	gpm			

Supply Fan Sizing Data

Actual max CFM	6330	CFM	Fan motor BHP	0.00	BHP
Standard CFM	6228	CFM	Fan motor kW	0.00	kW
Actual max CFM/ft²	2.27	CFM/ft²	Fan static	0.00	in wg

Outdoor Ventilation Air Data

Design airflow CFM	242	CFM	CFM/person	15.15	CFM/person
CFM/ft²	0.09	CFM/ft²			

Air System Information

Air System Name .... **Level 2 - Whole System**
Equipment Class .... **UNDEF**
Air System Type .... **SZCAV**

Number of zones **1**
Floor Area .... **2790.0** ft²
Location .... **Seattle IAP, Washington**

Sizing Calculation Information

Calculation Months .... **Jan to Dec**
Sizing Data .... **Calculated**

Zone CFM Sizing .... **Sum of space airflow rates**
Space CFM Sizing .... **Individual peak space loads**

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (CFM)	Minimum Supply Airflow (CFM)	Zone CFM/ft²	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 20.0 °F	Zone Htg Unit Coil Load (MBH)	Zone Htg Unit Water gpm @ 20.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	6330	6330	2.27	0.0	0.00	0.0	0.00	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)
Zone 1	107.6	Jul 1600	44.0	2790.0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Peak Sensible Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
150 Center Manager	2	5.3	Jun 1700	293	2.5	200.0	1.46
151 Center Manager	1	4.9	Jun 1700	274	1.6	190.0	1.44
152 Div Manager	1	5.0	Sep 1100	276	1.8	160.0	1.73
153 Hall	1	0.5	Jul 1400	30	0.4	100.0	0.30
154 Flight Control Dispa	1	73.5	Aug 1600	4068	26.7	820.0	4.96
155 Restroom	1	0.8	Jul 1400	45	0.4	105.0	0.43
156 IE Manager	1	5.1	Jun 1700	285	2.1	170.0	1.67
157 Hall	1	2.5	Jul 1400	136	1.8	445.0	0.31
158 Staff/Vistor Manager	1	7.3	Sep 1100	403	2.5	150.0	2.69
159 Ind. Engineers	1	4.1	Jun 1400	227	1.8	250.0	0.91

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 85.0 °F / 65.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 23.0 °F / 19.2 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	1235 ft²	67217	-	1235 ft²	-	-
Wall Transmission	914 ft²	835	-	914 ft²	1712	-
Roof Transmission	2735 ft²	4449	-	2735 ft²	3229	-
Window Transmission	1235 ft²	4881	-	1235 ft²	34130	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	21 ft²	52	-	21 ft²	365	-
Floor Transmission	1955 ft²	657	-	1955 ft²	4594	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	2790 W	9519	-	0	0	-
Task Lighting	750 W	2559	-	0	0	-
Electric Equipment	3000 W	10236	-	0	0	-
People	16	3920	3280	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**104327**	**3280**	**-**	**44031**	**0**
Zone Conditioning	-	102410	3280	-	42617	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	6330 CFM	0	-	6330 CFM	0	-
Ventilation Load	242 CFM	2289	-2472	242 CFM	11959	0
Supply Fan Load	6330 CFM	0	-	6330 CFM	0	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**104699**	**808**	**-**	**54576**	**0**
Central Cooling Coil	-	104699	817	-	0	0
Central Heating Coil	-	0	-	-	54576	-
>> Total Conditioning	**-**	**104699**	**817**	**-**	**54576**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

DESIGN WEST ENGINEERING

UPS BFI GATEWAY EXPANSION

Surface Water Technical Information Report

Permit Submittal

Prepared for:
United Parcel Service
Omaha, Nebraska

Prepared by:

KPG
Interdisciplinary Design

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October 2019

This document has been prepared under the supervision of a registered professional engineer.

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10/31/19

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Figure 4 – Downstream Map
Figure 5 – Targeted Areas Map

APPENDICES

A – TIR Worksheets & King County Blanket Adjustment No.1 for KCIA
B – Design Calculations & Figures
C – Conveyance Analysis
D – KC CSWPP Worksheet Form
E – KCSWDM Operation & Maintenance Checklist
F – Department of Ecology Industrial Stormwater General Permit

1. Project Overview

1.1 Project Description

The United Parcel Services / Boeing Field International (UPS BFI) Gateway Expansion will redevelop the existing UPS facility located on a tenant leasehold at the King County International Airport (KCIA). KCIA is an unincorporated King County area located in Seattle, Washington approximately five miles south of the city center between I-5 and the Duwamish Waterway. The Airport is bordered by Albro Place and South Norfolk Street on the north and south, respectively, and Airport Way South and East Marginal Way South to the east and west, respectively. The project site is located at 7300 Perimeter Road S that UPS (tenant) currently occupies and will continue to operate from during construction. The project location is shown on Figure 1 – Vicinity Map.

The tenant leasehold area consist of the primary leasehold (13.8 acres) and aircraft ramp leasehold (5.5 acres). Both leasehold areas will be redeveloped as a part of this project. 1.2 acres of the main leasehold area will not be redeveloped and will remain as a staging area and/or overflow parking for tenant operations, but may be used for construction staging.

The primary leasehold area contains the "landside operations" which will include a new main sorting facility with supporting buildings for operations and maintenance, a security building, a caster deck, equipment staging areas with rehabilitated pavements, and an improved driveway with turnaround, and employee parking lot. Pavement replacement will occur around the new buildings and equipment staging areas.

The aircraft ramp leasehold area has five aircraft gates referred to as the "airside operations" that consists of existing impervious surfaces located in the airfield that will be rehabilitated for aircraft and heavy equipment which will include reinforced concrete hardstands that are bound by asphalt pavement overlay. The caster deck will extend into the ramp area at each gate to fixed locating equipment. This section of caster deck is referred to as "fingers".

The proposed project is adjacent to KCIA's Large Aircraft Parking (LAP) Project that is currently in design. Coordination between the two projects is ongoing to accommodate the UPS BFI project construction schedule.

1.2 Design Standards and Available KCIA Resources

Surface water management and storm drainage design requirements for redevelopment projects at King County International Airport (KCIA) are subject to the surface water requirements of the *2016 King County Surface Water Design Manual* (KCSWDM) outlined in Section 2 of this report. In addition to the KCSWDM, KCIA and its tenants are subject to a Washington State Department of Ecology Industrial Stormwater General Permit in accordance to the State's National Pollutant Discharge Elimination Permit (NPDES Permit). KCIA staff has provided other technical resources as design guidelines at the airport.

Blanket Adjustments and Clarifications

A King County document dated July 26, 2016 provides four blanket adjustments to the KCSWDM specific to King County International Airport. KCIA experiences repeated surface drainage manual adjustment requests for the same drainage issues proposed by KCIA and their tenants. Therefore, Blanket Adjustment No. 1 addressed the common requests that serve the public interest by reducing the permit times and costs (for redevelopment), while achieving the required environmental protection and compliance with the KCSWDM. A copy of Blanket Adjustment No. 1 is included in Appendix A.

Washington State Department of Ecology, Industrial Stormwater General Permit

The leasehold area is categorized or zoned as an industrial site and is subject to federal regulations outlined in the Washington State Department of Ecology's Industrial Stormwater General Permit (Permit No. WAR000434). KCIA also maintains an Industrial Stormwater General Permit (Permit No. WAR000343). Both permits went into effect on January 2, 2015 and expires on December 31, 2019. Both permits are in the process of being updated and renewed. The permit requires industrial sites to monitor, measure, and reduce stormwater pollution leaving the site. The redeveloped site will maintain the current use of the site and will improve water quality by the addition treatment facilities that do not currently exist on the leasehold.

Available KCIA Resources

As stated in Blanket Adjustment No. 1, KCIA maintains a robust inspection and maintenance program for the entire KCIA storm system, including leaseholds as the performance of the system is critical to maintaining airport operations. KCIA can respond in a timely manner to any issues due to its underlying ownership and maintenance relationship with its leasehold. Throughout the design process, the UPS BFI design team and KCIA has conducted weekly coordination meetings as well as review of project plans. KCIA plans to redevelop the existing Main Terminal under the Large Aircraft Parking (LAP) project. The project is currently in design with coordination between the LAP and UPS BFI design teams. KCIA has provided the following documents for the stormwater design:

1. "Available Drainage Requirements" is an informal document that provided the design team with the general requirements for redevelopment at KCIA as well as the LAP project.

2. "2016 Composite Utility" drawing in CAD (.dwg) format that provides the most current inventory of KCIA's utility infrastructure. The drawing includes the current stormwater facilities within the project site, other recently improved tenant leaseholds and the downstream system that discharges into the Duwamish Waterway.

3. "King County International Airport Stormwater Capacity Study (Phase II)" by AECOM (consultant) dated August 24, 2018 is a report that provides a comprehensive assessment of potential capacity constraints within KCIA's existing stormwater drainage system.

4. "Taxiway Alpha Rehabilitation and Related Work" conformed construction drawings dated May 20, 2011. The drawings provide a basis of design for airfield operations, additional stormwater mapping, and water quality treatment vault design.

5. "Taxiway Alpha Rehabilitation Technical Information Report" by URS (consultant) dated February 24, 2010 is a report submitted and approved for permit that provided a basis of design and template for the development of the project TIR.

1.3 Existing Site

The existing project site consists of the airfield and current tenant operations with the landside of the leasehold area. The site is bound to the west by the taxiway, to the north by the KCIA Main Terminal Building (future LAP Project), to the east by Airport Way South and to the south by South Portland Street. The site is generally flat with a gentle slope from east to west. The site is fully developed and a composite of existing developments that occurred on the site from previous tenants. The current site has four main buildings and consists of 97% impervious surface areas that consist of concrete foundations that still exist from demolished aircraft hangers, and associated concrete, asphalt pavement, and compacted gravel (overgrown with vegetation). Pervious areas exist along the east border of the site, tree wells within the employee parking areas and along the frontage of Perimeter Road South, a private KCIA road that divides the leasehold area. The drainage system consists of catch basins, inlets, trench drains and manholes. Some drainage systems are remnants for existing buildings that have been demolished. Most existing drainage systems will be removed. Surface flows are ultimately conveyed west via pipes and discharge into the Duwamish Waterway through the KCIA pump stations. There is one known oil-water separator on-site. See Table 1 for existing project areas.

KCIA has four major drainage basins. The project area spans KCIA's Storm Drainage Basin #1 and #2. The existing site conditions are described in the following subsections and illustrated on Figure 2.

1.3.1 Storm Drainage Basin #1

Storm Drainage Basin (Basin) #1 has a total area of approximately 280 acres. It is located in the northern portion of the airfield. The basin is generally level and consists of a piped drainage system that conveys surface water by gravity to a pump station, which eventually discharges to the Duwamish River via a 60-inch storm drain known as Outfall #1. The project site located in Basin #1 is 4.47 acres and consists of northern 2 aircraft gates located in the airfield and northern area of the project site.

1.3.2 Storm Drainage Basin #2

Basin #2 has a total area of approximately 200 acres that covers the middle section of the airfield. The basin is generally level and consists of a piped drainage system that conveys surface water by gravity to a pump station, which eventually discharges to the Duwamish River via a 48-inch storm drain known as Outfall #2. The project site located in Basin #2 is 14.83 acres and consists of the southern 3 aircraft gates and the central and southern portions of the project site.

Threshold discharge areas (TDAs) are defined for projects with multiple storm drainage discharge points. A TDA is defined as an onsite area that drains to a single natural discharge location, or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flow path). The TDA is used to determine the applicability of the core and special requirements of the 2016 KCSWDM.

The UPS/BFI Project site is comprised of a two TDAs, referred to as TDA 1 and TDA 2 that correspond to the storm drainage basins described above. The defined TDA onsite boundaries are based on the existing topography, and storm drainage systems that have been mapped for the project and field visits.

Table 1 – Existing Conditions

	TDA 1	TDA 2	Total
Total Area (Main & Ramp Leasehold)	125,014 sf 2.87 ac	645,337 sf 14.81 ac	840,745 sf 19.3 ac
Pervious Surfaces	0	29,163 sf 0.67 ac	29,163 sf 0.67 ac
Impervious Surface Pavement	125,014 sf 2.87 ac	549,679 sf 12.62 ac	744,014 sf 17.08 ac
Impervious Surface Buildings	0	35,304sf 0.81 ac	35,304 sf 0.82 ac
Impervious Surface Compacted Gravel	0	32,264 sf 0.74 ac	32,264 sf 0.74 ac
Total Existing Impervious Surface	125,014 sf 2.87 ac	686,541 sf 15.77 ac	811,555 sf 18.64 ac

1.4 Proposed Project

The proposed project improvements are shown on Figure 3, and are summarized in the following sections. Replaced impervious surfaces are reconstructed pavement that includes the removal of asphalt concrete (AC) or Portland cement concrete (PCC) down to the subgrade and placing new foundations for the proposed pavement. Existing pavement area that will be graded lower, are defined as replaced impervious surfaces. Existing pavement area that will be graded higher will be milled and overlaid with new asphalt pavement and is not defined as replaced impervious surface.

1.4.1 Storm Drainage Basin #1 (TDA 1)

Project work within TDA 1 includes the following:

- Construction of the operation and maintenance building;
- Construction of the caster deck;
- Construction of two aircraft hardstands and fingers;
- Reconstruction of AC pavement and PCC;
- Milling and overlay of AC pavement;
- Construction of utilities and stormwater collection, conveyance and treatment facilities which include one pump station, a coalescing oil-water separator and a water quality wetvault.

1.4.2 Storm Drainage Basin #2 (TDA 2)

Project work within TDA 2 includes the following:

- Construction of the main sorting building and security building;
- Construction of the caster deck;
- Construction of three aircraft hardstands and fingers;
- Construction of the employee parking lot;
- Reconstruction of AC pavement and PCC;
- Milling and overlay of AC pavement;
- Construction of utilities and stormwater collection, conveyance and treatment facilities which include two pump stations, two coalescing oil-water separator and two water quality wetvaults.

1.5 Proposed Site Conditions

The redevelopment project includes reconstructing, adding, and removing existing impervious surfaces for the work described above as well as landscaped areas. Total areas of impervious and pervious surfaces for each TDA are presented in Table 2.

Table 2 – Proposed Conditions

	TDA 1	TDA 2	Total
Total Area (Primary & Ramp Leasehold)	121,682 sf 2.79 ac	719,063 sf 16.51 ac	840,745 sf 19.3 ac
Pervious Surfaces (Landscape)	0	36,432 sf 0.84 ac	36,432 sf 0.84 ac
Impervious Surface Pavement NPGIS	12,560 sf 0.29 ac	77,494 sf 1.78 ac	90,054 sf 2.07 ac
Impervious Surface Pavement PGIS	95,915 sf 2.20 ac	514,427 sf 11.81 ac	610,342 sf 14.01 ac
Impervious Surface Buildings	13,153 sf 0.30 ac	90,710 sf 2.08 ac	103.863 sf 2.38 ac
Total Proposed Impervious Surface	121,682 sf 2.79 ac	682,631 sf 15.67 ac	804,313 sf 18.46 ac

2. Conditions and Requirements Summary

2.1 Applicability of Drainage Requirements

The type of drainage review and the applicability of the Core and Special Requirements of the 2016 KCSWDM is dependent on the size and type of project. Per Figure 1.1.2.A of the KCSWDM, Flow Chart For Determining Type of Drainage Review Required, the project is subject to Full Drainage Review because it will result in greater than 2,000 square feet of new and/or replaced impervious surface, yet is not a single family residence, agricultural, or urban planned development project. Full Drainage Review, requires compliance with Core Requirements #1 - 9 and Special Requirements #1 – 5 of the KCSWDM.

Table 1 below contains project-specific TDA information used to determine the applicability of drainage requirements for the redevelopment project.

Table 3 – Project Area Summary

	TDA 1	TDA 2	Total
Total Project Site Area	121,682 sf 2.79 ac	719,063 sf 16.51 ac	840,745 sf 19.3 ac
Total New Impervious Surface	0	24,005 sf 0.55 ac	24,005 sf 0.55 ac
Total Replaced Impervious Surfaces	66,999 sf 1.54 ac	585,682 sf 13.44 ac	652,681 sf 14.98 ac
New and Replaced NPGIS	24,843 sf 0.57 ac	144,199 sf 3.31 ac	169,042 sf 3.88 ac
New and Replaced PGIS	42,156 sf 0.97 ac	441,483 sf 10.14 ac	483,639 sf 11.10 ac
Existing PGIS Surface Area	53,757 sf 1.26 ac	72,944 sf 1.67 ac	127,627 sf 2.93 ac
Existing "Replaced" Pervious Surface	0	18,059 sf 0.41 ac	18,059 sf 0.41 ac
Existing Impervious Surface Converted to Landscape Area	0	18,373 sf 0.42 ac	18,373 sf 0.42 ac

2.2 Core and Special Requirements

Following is a description of how each of the Core and Special Requirements of the 2016 KCSWDM is being addressed for this project.

2.2.1 Core Requirement 1 – Discharge at the Natural Location

Within the leasehold area, stormwater runoff from the project area will be connected to the existing stormwater conveyance systems within Storm Drainage Basin #1 and #2 and discharge to the Duwamish Waterway through Outfalls #1 and #2. The project will maintain existing drainage patterns by connecting into the KCIA's existing piped drainage system within the KCIA parcel. See Figure 4.

2.2.2 Core Requirement 2 – Offsite Analysis

An analysis of upstream drainage areas and downstream conditions is discussed in Section 3. There is upstream flows that are conveyed through the site which consists of runoff from S Portland Street, Airport Way South and the Main Terminal Parking Area. New conveyance systems have been designed to maintain these pipe flows to the downstream conveyance system. The KCIA drainage system downstream of the project consists of manmade stormwater conveyance systems, which connect to Outfalls #1 and #2. No conveyance system nuisance problems, severe erosion problems, or severe flooding problems are expected to be created or aggravated by the project.

2.2.3 Core Requirement 3 – Flow Control

The project is exempt from flow control per direct discharge criteria, KCSWDM 1.2.3.1. Outfalls #1 and #2 discharge directly to the Duwamish River below River Mile 6 is a major receiving waterbody. The existing conveyance systems connecting the project areas to the outfall locations are completely comprised of manmade elements. No flows from the project will be diverted to or from and existing wetland or stream sufficient to cause an adverse impact. Under King County Blanket Adjustment #1 for KCIA, Item No. 3 the adjustment exempts projects located at the KCIA from the one-quarter mile distance provision of Criteria A for the Direct Discharge Exemption.

In addition, flow control is not required because the downstream conveyance systems and pump stations have adequate capacity per existing KCIA storm system analysis documentation.

2.2.4 Core Requirement 4 – Conveyance System

The project is located in drainage basin with existing stormwater systems; therefore, the project must be in accordance with the conveyance requirements for existing systems with a change in flow characteristics per KCSWDM Section 1.2.4.2 due to the proposed additional impervious areas. Peak flows within Basin #1 and #2 may increase slightly from current conditions as a result of the addition of impervious area and attenuated within the proposed treatment vaults. The increases in peak flows are not expected to be significant or impact the size of the existing conveyance elements downstream.

The new pipe systems that are onsite are required to be designed with sufficient capacity to convey and contain the 25-year peak flow. In addition, overflows resulting from the 100-year runoff event will be analyzed to verify that any such overflows will not create or aggravate a severe flooding problem or severe erosion problem. The project will consists of new catch basins and pipe conveyance to accommodate the proposed improvement that will connect into the existing downstream system. Other conveyance systems will maintain upstream flows through the site. The on-site conveyance system will also consist of flow splitters that are sized to bypass flows that are higher than the calculated water quality treatment flow rate around the three proposed oil-water separators and water quality wetvaults. Stormwater pump stations have also been designed to lift stormwater to the wetvaults. The design and analysis of the conveyance systems are discussed in Section 5.

2.2.5 Core Requirement 5 – Erosion and Sediment Control

Erosion and sediment control measures proposed for this project are described in Section 8 of this report and included in the project plans to be implemented and maintained during the construction phase. The construction contractor will designate an erosion and sediment control supervisor and will be responsible for modifying the plan to accommodate changing site conditions and to ensure site discharges are in accordance with the State of Washington Construction Stormwater General Permit. A Construction Stormwater Pollution Prevention Plan (CSWPPP) will be prepared for this project using the Department of Ecology's template.

2.2.6 Core Requirement 6 – Maintenance and Operations

All drainage facilities will be maintained by the tenant or by KCIA per their agreement and in accordance to existing operation and maintenance procedures for tenant site as well and Industrial Stormwater General Permit. Appendix E contains standard O&M practices for the treatment facilities

2.2.7 Core Requirement 7 – Financial Guarantees and Liability

Financial guarantee and liability requirements are determined in the leasehold agreement between KCIA and UPS. Financial requirements will be met prior to permit issuance. KCIA and UPS will continue to be responsible for the planned improvements, site stabilization, and current maintenance of the existing systems.

2.2.8 Core Requirement 8 – Water Quality Facilities

Water quality treatment is required for the project's new and replaced pollution-generating surfaces, consisting of mostly replaced impervious surfaces as listed in Table 3. Replaced PGIS is a required target surface since the parcel redevelopment project adds more than 5,000 square feet of new and replaced impervious surface and the valuation of the proposed improvements (including interior improvements and excluding required mitigation improvements) will succeed 50% of the assessed value of the existing site improvements. Since the project meets the Direct Discharge Exemption for flow control as discussed in Section 2.2.3, the Basic Water Quality Menu is only required. This is also consistent with recent redevelopment projects at KCIA as well as the KCIA Taxiway Rehabilitation Project. The project proposes three water quality wetvaults and coalescing oil water separators. The design of the wetvaults are discussed in Section 3.2.

Furthermore, the leasehold site will maintain their Washington State Department of Ecology Industrial Stormwater General Permit, that provides water quality benchmarks based on site use that is monitored and reported quarterly.

2.2.9 Core Requirement 9 – Flow Control BMPs

The project is subject to the requirement of Large Lot BMP's per Section 1.2.9.2.2 of the KCSWDM. King County Blanket Adjustment No. 1 for KCIA, Item 2 does not require a reduced footprint or native growth retention. Target surfaces for application of Core Requirement #9 include new impervious surfaces, new pervious surfaces, replaced impervious surfaces, and any existing impervious surfaces added on or after January 8, 2001 not already mitigated with an approved flow control BMP or flow control facility.

An evaluation of the feasibility of onsite flow control BMPs has been included in Section 4.3 of this report. No Flow Control BMPs are proposed due to the infeasibility criteria outlined in Appendix C of the KCSWDM.

2.2.10 Special Requirement 1 – Other Adopted Area-Specific Requirements

The Washington State Department of Ecology's Stormwater Industrial General Permit for the UPS facility provides benchmarks for water quality standards based on potential sources of pollution and storage of materials that are consistent with site use. A State Environmental Police Act (SEPA) and National Environmental Policy Act (NEPA) determination has been submitted.

2.2.11 Special Requirement 2 – Flood Hazard Area Delineation

The project area is not located within a FEMA-mapped floodplain (FEMA Flood Insurance Rate Map FIRM No. 53033C0645F) or not located within the 100-year flood plain.

2.2.12 Special Requirement 3 – Flood Protection Facilities

Special Requirement 3 does not apply to this project because the project is not located within the 100-year flood plan; or will not rely on or modify an existing flood protection facility.

2.2.13 Special Requirement 4 – Source Control

KCIA and its leaseholders are subject to the Washington State Department of Ecology's Industrial Stormwater General Permit. Temporary ESC measures during construction a have been designed to reduce pollutants based on site construction activities from entering the downstream conveyance system. All other sources of contaminants are located inside buildings where spill prevention measures are included particularly in the maintenance building. The aircraft gates will be subject to de-icing fluid. As a result, a diversion system has been designed to direct surface runoff that includes de-icing agents directly to the sanitary sewer system with the operation of inline, automated valve system. The conveyance system will be flushed and reverted back to the storm drainage system.

2.2.14 Special Requirement 5 – Oil Control

Coalescing plate oil-water separators has been designed for oil control in locations susceptible to oil. Outlet traps will also be included in all catch basins within the site that accept surface flows.

3. Upstream and Downstream Analysis

On-site field investigations were conducted throughout the design process. A full downstream analysis was not conducted due to the constraints of entering the secured Federal Aviation Administration, Air Operations Area (AOA) for the downstream assessment. As mentioned earlier in the TIR, KCIA maintains a current inventory and analysis of their existing drainage systems. Other than the “Available Drainage Requirements”, KCIA has not recommended any further improvements within the leasehold areas or to the immediate downstream system. The following are documented information provided by KCIA to fulfill the Upstream and Downstream Analysis.

As stated in the “Taxiway Alpha Rehabilitation” Technical Information Report:

> *An outfall assessment report was completed for the airport (URS, 2009) to evaluate existing drainage and outfall systems for Outfalls #1, #2, #3, and #5. The purpose of the assessment was to identify potential impacts to KCIA during a flood event in the Duwamish River caused by the modified operations of the Howard Hanson Dam during the wet season of 2009/2010. The evaluation concluded that except for Outfall #5, the storm system draining KCIA is adequate and protected from high water in the Duwamish River. Resulting from this evaluation, a new storm drain line to divert runoff from Basin #5 to Basin #2 was designed and constructed in December 2009.*

KCIA performs a thorough inventory and analysis of all drainage systems at the airport site. Conveyance analysis is an ongoing effort to maintain operations within the airport. KCIA’s latest analysis is the “King County International Airport Stormwater Capacity Study (Phase II)” by AECOM (consultant) dated August 24, 2018. The report is the next phase of analysis that provides a comprehensive assessment of potential capacity constraints within KCIA’s existing stormwater drainage system. This report recommends drainage improvements at current leasehold areas that are subject to future redevelopment, such as the UPS BFI project. The report does not provide any recommendation for improvement within the leasehold or in the downstream systems. The report provides recommendations to further analyze the drainage system within the existing parking lot of the Main Terminal Building which will be improved as a part of the KCIA LAP Project. This drainage system appears to enter the UPS BFI project site via a 12” storm drain underneath the existing 7300 Building. The project will maintain the current location and upsize the pipe to 18” diameter pipe to its downstream connection.

4. Flow Control and Water Quality Facility Design; and Flow Control BMPs

The applicability of flow control and water quality treatment requirements for this project are described in Sections 2.2.3, 2.2.8, and 2.2.9. The following sections document the analysis and design of the required facilities.

4.1 Flow Control Facility

A flow control facility is not required; since the project meets the criteria for the Direct Discharge Exemption per KCSWDM Section 1.2.3.1 and King County Blanket Adjustment No. 1, Item No. 3 as discussed in Section 2.2.3.

4.2 Water Quality Treatment Design

As discussed in Section 2.2.8, water quality treatment is required for all new and replaced PGIS. See Figure 5 and Table 4. Wetvaults are proposed from the Basic Water Quality Treatment Menu in Section 6.1.1 has been designed to meet the requirements for the project. The project has three wetvaults to treat runoff from areas described as the north, central, and south portions of the project site. A flow splitter structure with a diversion weir and orifice has been designed to limit water quality treatment flows to the coalescing oil-water separator vaults before discharging into the corresponding wetvault. Bypassed flows will be conveyed downstream of the vaults. The basis of design for the wetvaults was taken from the Taxiway Alpha Rehabilitation Project so that KCIA may ultimately provide the same operation and maintenance guidelines. Water quality treatment flow rates and volumes were calculated based on the target surface area and modeled in WWHM 2012, an approved continuous hydrologic modeling software. The wetvault and flow splitter calculations and drawings are included in Appendix B.

The project site is a large site that requires long pipe conveyance systems to each of the three wetvaults. Three pump stations are located downstream of the flow splitter and lift the water quality flows into the oil-water separator. By lifting the conveyance system, oil treatment may be provided as end of pipe treatment and will reduce the depth and overall footprint of the water quality vaults. The pump system will be proprietary based on the specifications provided in the construction documents as a packaged product which will include a duplex (alternating) pump system, equipped with a high alarm system. In the scenario of a pump failure, flows will bypass the pump station and immediately enter the downstream system via the flow splitting structures.

Table 4 – Wetvault Sizing Summary

	North	Central	South
TDA	TDA 1	TDA 2	TDA 2
Target Surface Area: New & Replaced PGIS	42,156 sf 0.97 ac	280,470 sf 6.45 ac	161,013 sf 3.70 ac
Water Quality Treatment Flow Rate (Offline 15 minute timesteps)	0.089 cfs	0.59 cfs	0.34 cfs
Water Quality Treatment Volume Required	5,200 CF	34,800 CF	19,800 CF
Water Quality Treatment Volume Provided	5,760 CF	38,400 CF	24,000 CF

4.3 Flow Control BMPs

Flow control BMPs (FCBMPs) are required to be installed to the maximum extent feasible on projects within the Urban Growth Area per Section 1.2.9.1 of the 2016 KCSWDM. A FCBMP feasibility analysis has been prepared using the Large Lot BMP Requirement lists outlined in Section 1.2.9.2.2 of the 2016 KCSWDM and the design and infeasibility criteria for each FCBMP provided in KCSWDM Section C2.

Target surfaces for this analysis include new impervious surfaces, new pervious surfaces, and replaced impervious surfaces. For this project, the following surfaces must be evaluated for implementation of FCBMPs:

- New & replaced impervious surfaces for roofs
- New & replaced impervious surfaces for pavements
- New pervious surfaces

4.3.1 Full Dispersion

Full Dispersion is not feasible for this project because KCIA is a fully developed site and does not contain native vegetation for dispersal.

4.3.2 Full Infiltration of Roof Runoff

Infiltration is infeasible since the project site has known soil or ground water contamination. The project site was previously occupied with an airplane hangar (Hangar 5 Building), Standard Oil Co site, and the Boeing EMF Building. The site has undergone remediation. Monitoring wells are located throughout to site to record the known plumes that exist in the soils below the leasehold.

4.3.3 Infiltration BMPs

All target impervious surfaces not mitigated by Full Dispersion are required to be mitigated to the maximum extent feasible using one or more of the following BMPs: Full Infiltration, Limited Infiltration, Bioretention, or Permeable Pavement.

Infiltration BMPs are infeasible due to known contaminated soils underneath the leasehold area that is discussed in Section 4.3.2 of this report.

4.3.4 Basic Dispersion BMPs

Basic Dispersion is required for target impervious surfaces not mitigated by Full Dispersion, Infiltration, or Bioretention BMPs. Basic dispersion is not feasible at KCIA since the area lacks the required vegetated flow path for basic dispersion.

4.3.5 Reduced Impervious Surface Credit and Native Growth Retention Credit

The KCIA is exempt from requiring the reduced impervious surface credit and native growth retention credit per the King County Blanket Adjustment No. 1 for KCIA, Item No. 2.

4.3.6 Soil Quality Preservation

New pervious surfaces are required to comply with soil moisture holding requirements, requiring all pervious areas to have an 8-inch thickness of topsoil with 10% organic content in planting beds and 5% organic content in turf areas, and a pH from 6.8 to 8.0 or matching the pH of the undisturbed soil. Planting beds require a 2-inch mulch layer of organic material as specified in either the project plans or specifications for construction.

4.3.7 Roof Downspouts to Drainage Systems

Roof downspouts are required to have a perforated connection to the existing drainage systems. Infiltration is infeasible due to known contaminated soils underneath the leasehold area that is discussed in Section 3.3.2 of this report.

5. Conveyance System Analysis and Design

Most of the existing stormwater system will be removed and replaced with new conveyance pipe systems. The existing system contains remnants of existing drainage systems through multiple redevelopments of the leasehold site that ultimately discharge west to the Duwamish River via pump stations operated and maintained within the airport site.

Peak flow rates of the 25-year and 100-year storms were calculated in WWHM2012 (15-minute timesteps) for all tributary areas. The pipe systems were then modeled in XPStorm 2019, a hydrology and hydraulic analysis software. Offsite flow data was obtained from the “King County International Airport Stormwater Capacity Study (Phase II).”

New pipe systems have been designed with sufficient capacity to convey and contain the 25-year peak flow for the developed conditions for onsite tributary areas and offsite tributary areas.

Pipe system structures may overtop for runoff events that exceed the 25-year design capacity, provided the overflow from a 100-year runoff event does not create or aggravate a severe flooding problem or severe erosion problem. Based on the analysis, the 100-year runoff event does not overtop the proposed system. See Appendix C,

6. Special Reports and Studies

A Geotechnical Engineering Report, prepared by TerraCon, Inc., dated 12/2/2018 is included separately as a part of the Commercial Building Permit submittal for this project.

7. Other Permits

The Full Drainage Review TIR has been completed for the Commercial Building Permit submittal package. A Pre-Issuance Construction Authorization (PICA) may also be submitted for the project for site preparation and utility relocation. The tenant will also maintain and modify their current Washington State Department of Ecology Industrial Stormwater General Permit. A Department of Ecology Construction Stormwater General Permit is also required for the project that will be submitted by the selected contractor.

8. Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (CSWPPP) consists of two parts: an Erosion and Sediment Control (ESC) plan and a Stormwater Pollution Prevention and Spill (CWPPS) plan. Following is a summary of the CSWPPP elements relevant to this project. A draft CSWPPP has been prepared for this project using the Department of Ecology's template, and is bound separately. See Appendix D for the King County CSWPPP Worksheet Form to be completed by the contractor. The contractor will be able to adopt and modify the provided CSWPPP as needed or create a new document for review and submittal to the Department of Ecology.

8.1 Erosion and Sediment Control Plan Analysis & Design

Temporary erosion and sediment control plans have been prepared for this project and incorporated into the contract plans. Prior to construction, the contractor will be responsible to prepare a temporary erosion and sediment control plan (TESC) for the site. Both the TESC and CSWPPP are expected to include elements discussed in the following sections and required to be in compliance with FAA and foreign object debris (FOD) requirements. FOD requirements in the airfield are very stringent for the purpose of providing safe conditions within the AOA.

The contractor is required to designate an ESC Lead/ Supervisor who has a current Certificate of Training in Construction Site Erosion and Sediment Control from a course approved by the Washington State Department of Ecology. The ESC Lead/Supervisor is responsible for installing, inspecting, and maintaining BMPs included in the ESC Plan, and updating the ESC plan to reflect current field conditions.

The ESC Lead/Supervisor is also responsible for turbidity monitoring of discharges from the project site to comply with the State of Washington NPDES Construction Stormwater General Permit and the ESC Standard in Appendix D of the 2016 *KCSWDM*.

Although ESC plans have been prepared for this project, due to the variability in construction conditions and weather, the planned phasing of the project to provide the leasehold tenant to occupy designated areas, it will be necessary to supplement and modify the BMPs shown on the plans over the course of construction.

8.1.1 Erosion and Sediment Control Measures

The following categories of the ESC measures, as detailed in the King County Erosion and Sediment Control Standards (ESCS) and in compliance with the FOD requirements, will be incorporated into the design and construction of the rehabilitation project:

- Clearing Limits – Clearing limits will be installed at the edges of all critical area buffers and any other areas required to be left uncleared. Clearing limits will be defined by the phasing plans included in in the construction documents. The areas provided allow the tenant to maintain operations. The current operations are within a secured fence, and perimeter fencing will be maintained throughout the project to define the areas of work.

- Cover Measures – Permanent cover measures in the form of placing topsoil, seeding, and mulching will be provided to protect all areas to be converted to grass areas. Temporary cover measure will be needed if any excavated material is stockpiled on site.

- Perimeter Protection – Perimeter protection to filter sediment from sheetwash will be located downslope of all disturbed areas and will be installed prior to upslope grading. Perimeter protection includes the use of vegetated strips as well as constructed measures such as silt fences fiber rolls, sand/gravel barriers, brush or rock filters, triangular silt dikes and other methods. All the proposed disturbed areas will sheet flow and quickly drain into concentrated flows in grassed swales and trenches. Perimeter protection will be provided by the combination of catch basin inserts, triangular silt dikes, and existing grass infields that are downgradient of planned disturbed areas.

- Traffic Area Stabilization – In general, unsurfaced entrances, roads, and parking areas used by construction traffic will be stabilized to minimize erosion and tracking of sediment off site. If required, stabilized construction entrances will be installed as the first step in clearing and grading. Stabilized construction entrances and parking areas are not expected to be required for this project, because the areas of work are accessible by existing paved surfaces. Wheel washes may also be implemented at each egress location for both construction activity and tenant operations.

- Sediment Retention – Surface water collection from distributed areas, within Storm will be routed through proprietary filtration systems as needed. Protection of catch basins will also be installed at inlets that are likely to be impacted by sediment generated by the project. Sediment retention facilities will be installed prior to grading of contributing area.

- Surface Water Collection – Surface water from disturbed areas will be intercepted, conveyed to a proprietary filtration system as needed, and discharged downslope of disturbed areas. Surface water control will also be provided by check dams (triangular silt dikes), as necessary. Silt fence and check dams will be used as necessary to direct surface water to the temporary erosion control facilities.

- Dewatering Control – Runoff generated by dewatering will collected and filtered as necessary.

8.2 Stormwater Pollution Prevention and Spill Plan

The stormwater pollution prevention and spill plan must identify all activities that could contribute pollutants to surface and storm water during construction and apply BMPs applicable to these activities. The contractor will be required to prepare and submit a project-specific spill prevention, control and countermeasures plan in accordance with the requirements of the existing KCIA Spill Plan.

9. Bond Quantities, Facility Summaries, and Declaration of Covenant

Bond Quantities will be submitted with the plans for the Commercial Building Permit review . Water Quality Facility Summary Sheets, for the proposed wetvaults are included in Appendix B and will be added to the existing KCIA O&M manual and utility inventory. A facility schematic and details for the treatment facilities are also included in Appendix B. Upon approval of the TIR or issuance of the Commercial Building Permit, a Declaration of Covenant will be recorded and included in the Final Corrected TIR.

10. Operations and Maintenance Manual

Drainage facilities at KCIA will be privately maintained and coordinated between UPS or KCIA Maintenance staff in accordance with KCSWDM Appendix A: Maintenance Requirements of Flow Control, Conveyance and WQ Facilities. King County Maintenance Requirements will be used as the O&M manual for the wetvault systems and included in Appendix E. The tenant will coordinate with KCIA to update their existing O&M Manual to include the requirements for the proposed facilities if standard protocols do not exist. Additional O&M documentation is required by the selected supplier that will be included in the manual. The tenant is also responsible for operating and maintaining the facilities as required for their Washington State Department of Ecology's Industrial Stormwater General Permit.

11. References

King County International Airport, King County Department of Transportation. King County, Washington. Airport Drainage Requirements. January 2019

Terracon Consultants, Inc., King County Washington. Geotechnical Engineering Report for United Parcel Service Proposed Parcel Distribution Facility. December 20, 2018.

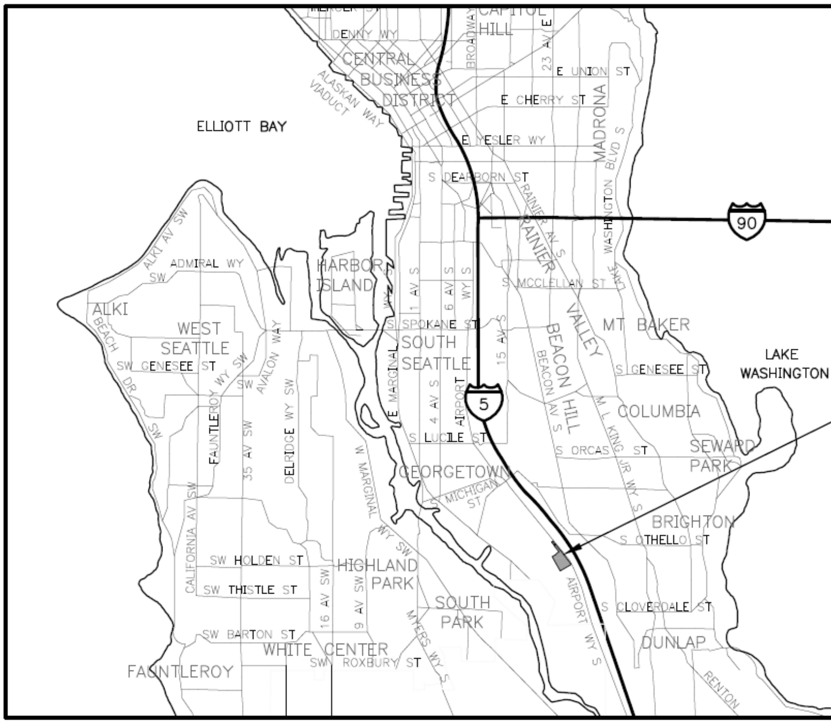
AECOM Seattle, Prepared for King County International Airport. King County, Washington. King County International Airport Stormwater Capacity Study (Phase II). August 24, 2018

King County, Department of Natural Resources. King County, Washington. Surface Water Design Manual (KCSWDM). April 2016

King County, Department of Natural Resources. King County, Washington. Blanket Adjustment No. 1 for King County International Airport Regarding Definition of "Site," Alternative Declaration of Covenant and Grant of Easement, Direct Discharge, and Flow Control BMP Requirements. July 26, 2016

URS, Prepared for King County International Airport. King County, Washington. King County International Airport Taxiway Alpha Rehabilitation. February 24, 2010.

United States Federal Emergency Management Agency, Flood Insurance Rate Map. King County, Washington and Incorporated Areas. Map Number 53033C0645 F. May 16, 1995.



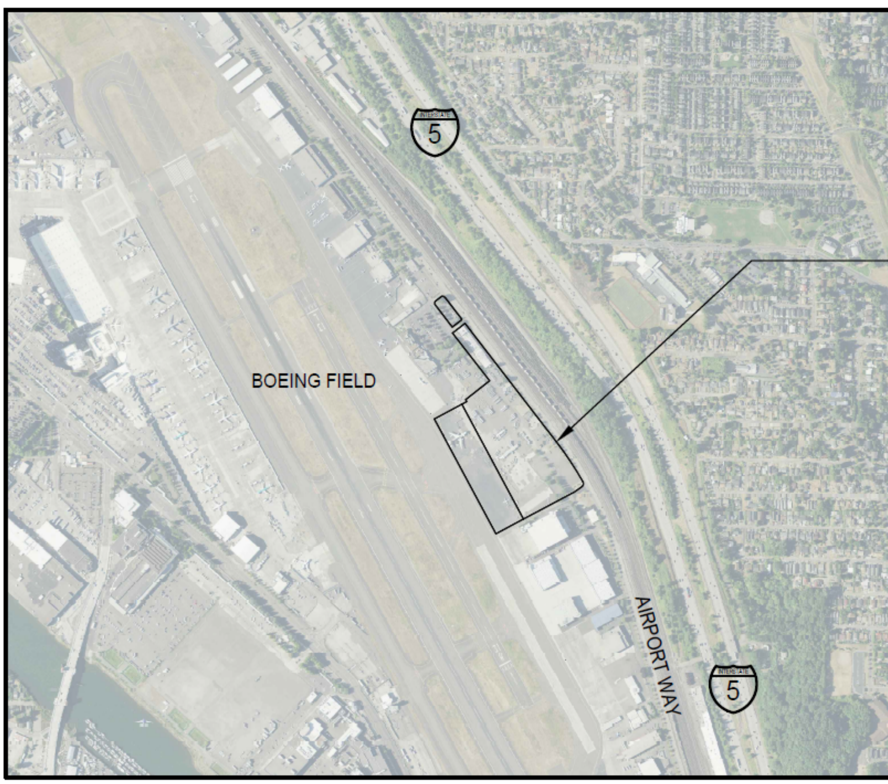


Figure 1 – Vicinity Map

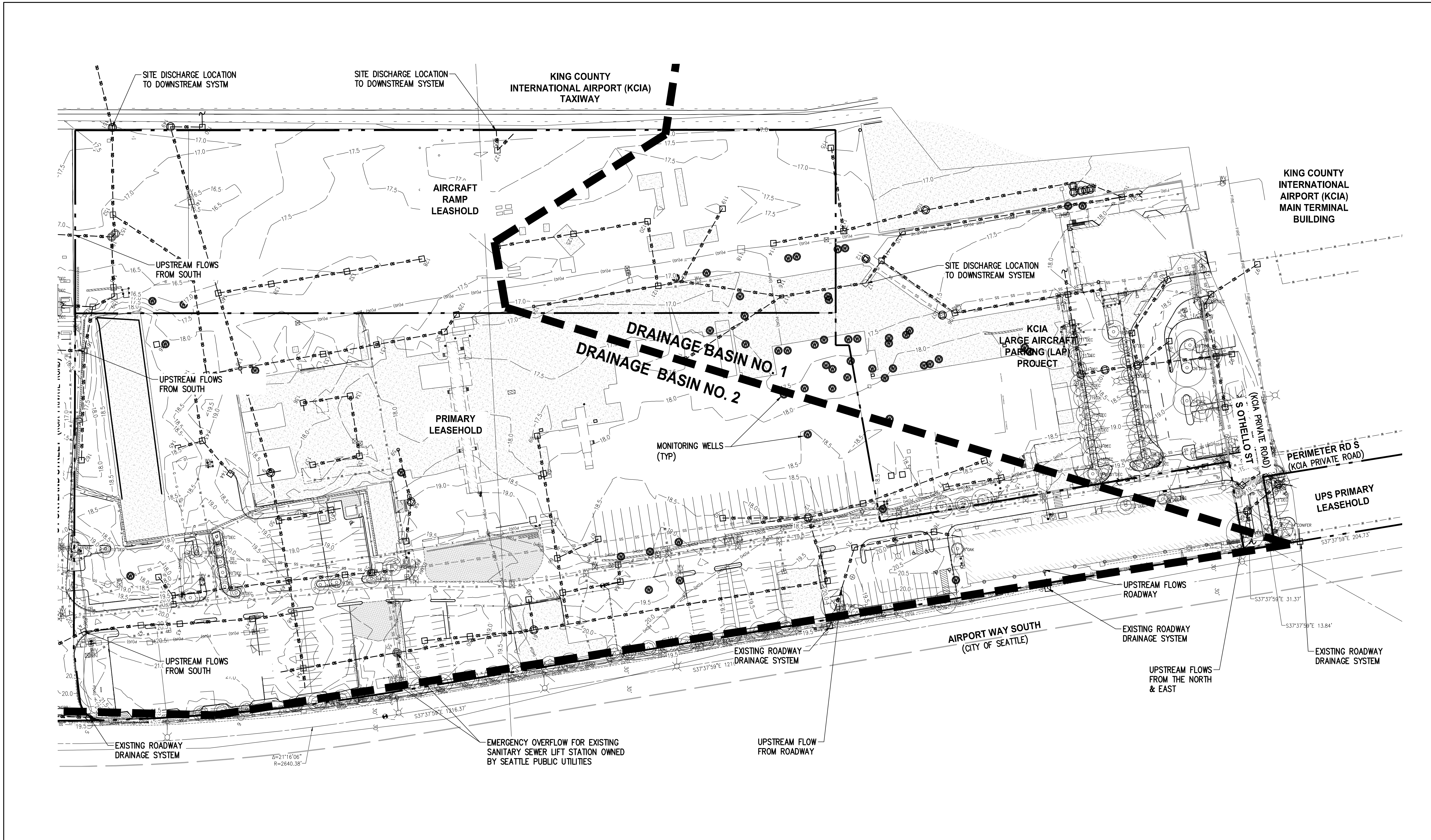


FIGURE 2. EXISTING CONDITIONS

UPS-BFI GATEWAY EXPANSION

KPG
Interdisciplinary Design
SEATTLE
3131 Elliott Ave
Suite 400 WA 98121
(206) 286 1640
Tacoma
Wenatchee
Bellevue
www.kpg.com

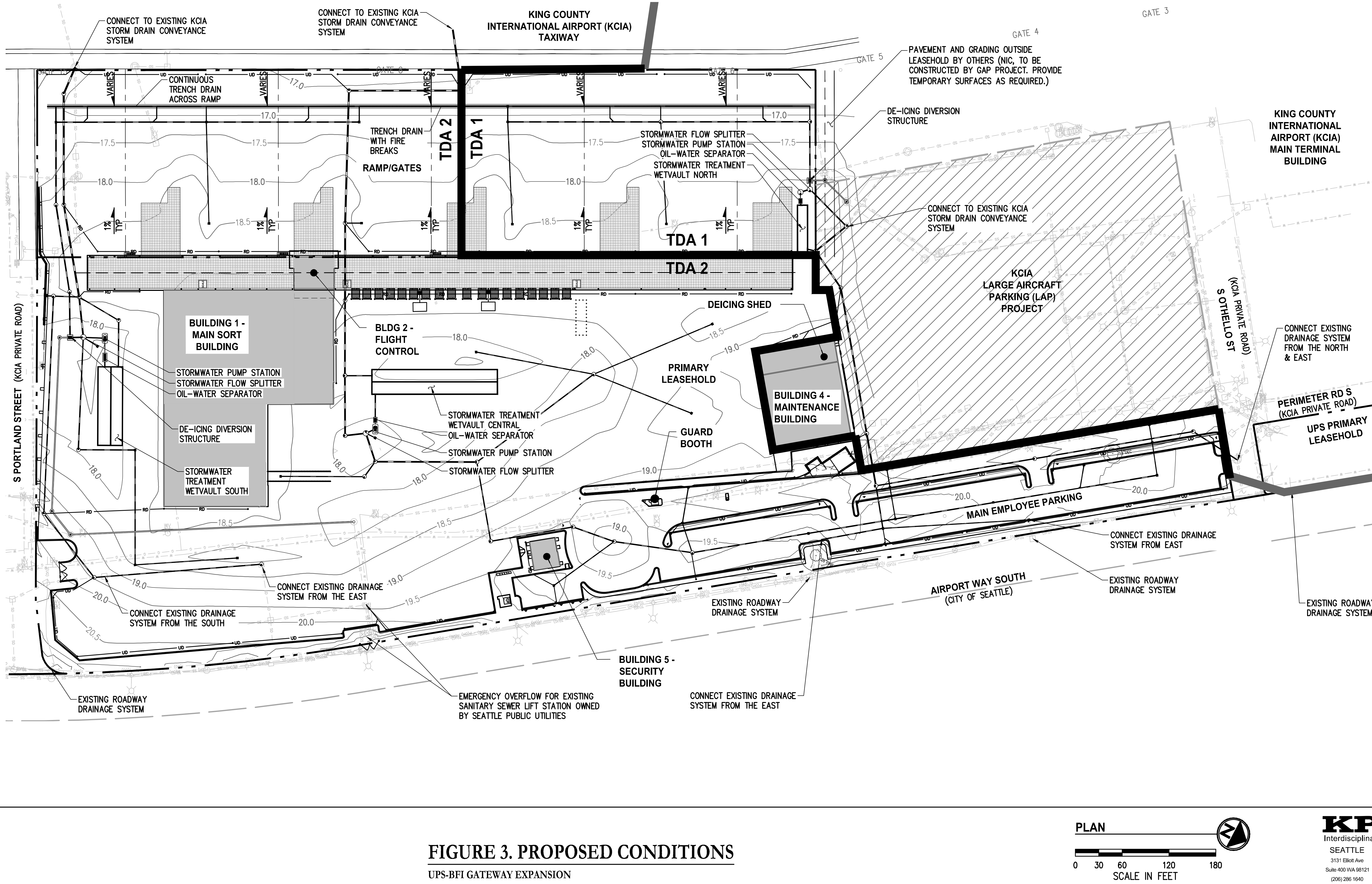


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FIGURE 3. PROPOSED CONDITIONS

UPS-BFI GATEWAY EXPANSION

KPG
Interdisciplinary Design
SEATTLE
3131 Elliott Ave
Suite 400 WA 98121
(206) 286 1640
Tacoma
Wenatchee
Bellevue
www.kpg.com

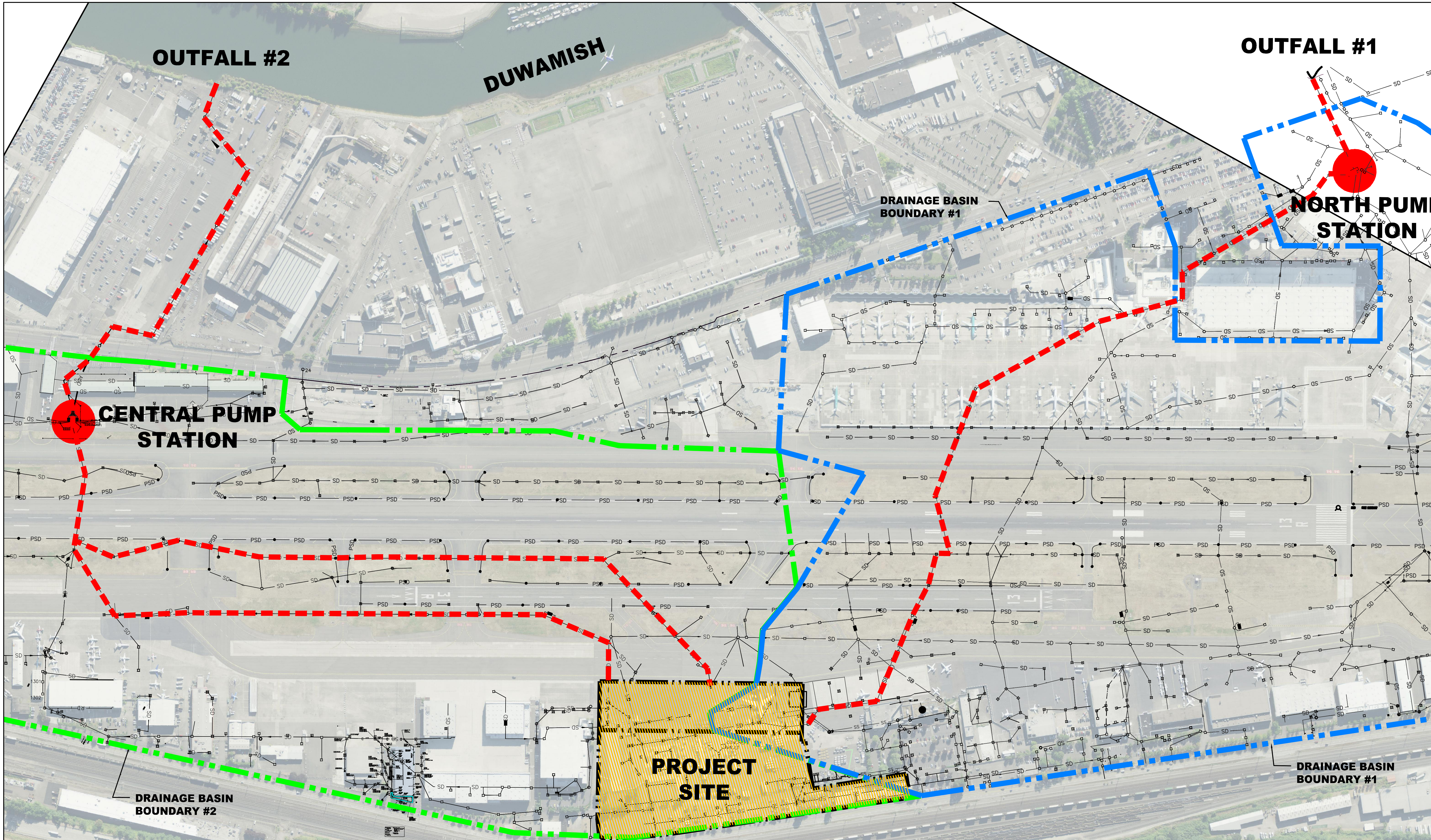


FIGURE 4. DOWNSTREAM MAP

UPS-BFI GATEWAY EXPANSION

KPG
Interdisciplinary Design
SEATTLE
3131 Elliott Ave
Suite 400 WA 98121
(206) 286 1640
Tacoma
Wenatchee
Bellevue
www.kpg.com

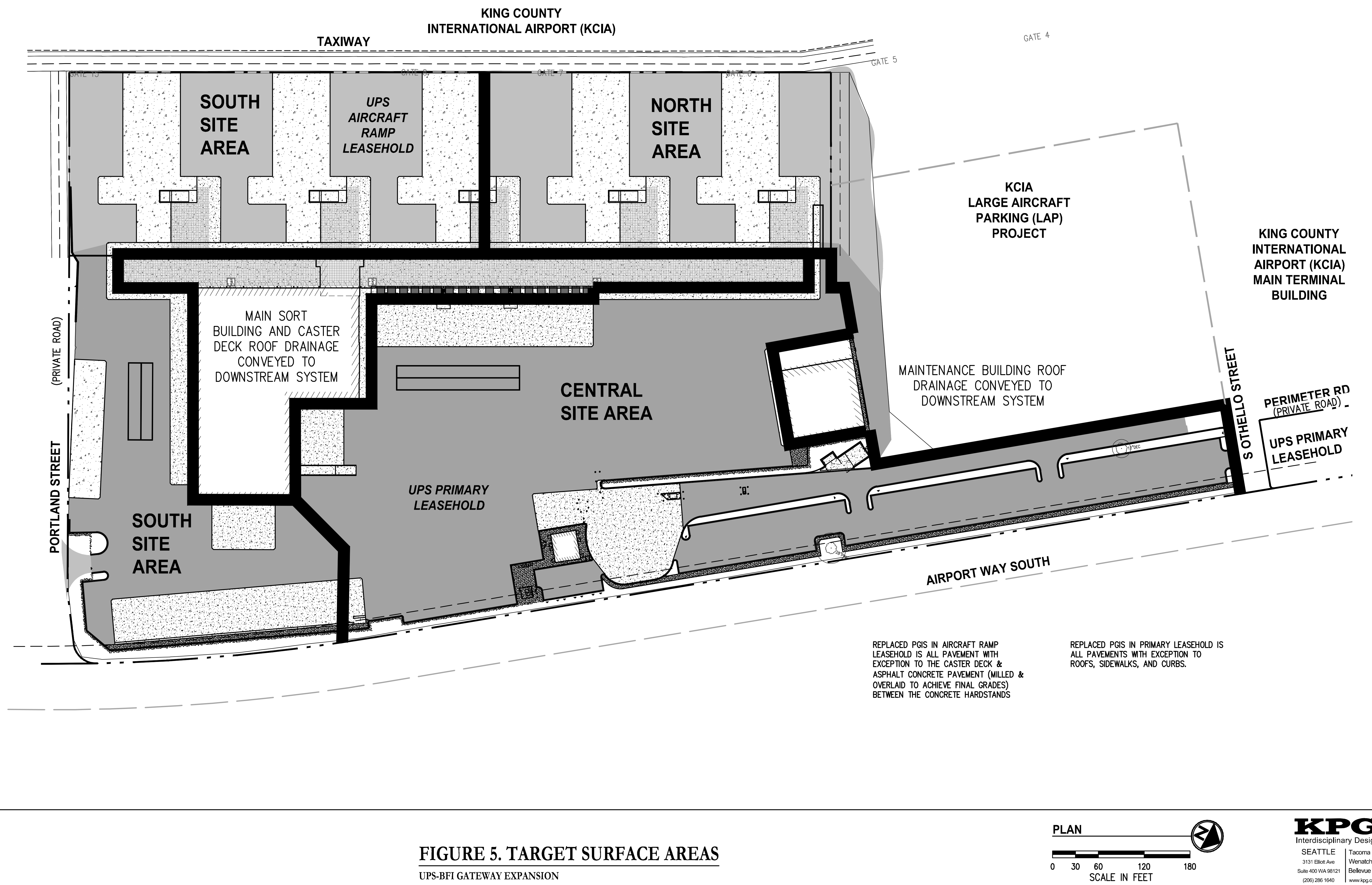


FIGURE 5. TARGET SURFACE AREAS

UPS-BFI GATEWAY EXPANSION

APPENDIX A

TIR Worksheets and King County Blanket Adjustment No. 1 for KCIA

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner: STEVE GINEVAN UNITED PARCEL SERVICES

Phone: (720) 676-9586

Address: UPS PLANT ENGINEERING 19500 E 23RD AVE, AURORA CO 80011

Project Engineer: WM RAY EDRALIN, PE

Company: KPG, PS

Phone: (206) 826-6942

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name: UPS-BFI GATEWAY EXPANSION

DPER Permit #: ____

Location Township: 24

Range: 4

Section: 28

Site Address: 7300 PERIMETER RD S SEATTLE, WA

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Landuse (e.g.,Subdivision / Short Subd. / UPD)
- ☒ Building (e.g.,M/F / Commercial / SFR)
- ☐ Clearing and Grading
- ☐ Right-of-Way Use
- ☐ Other ____

Part 4 OTHER REVIEWS AND PERMITS

- ☐ DFW HPA
- ☐ COE 404
- ☐ DOE Dam Safety
- ☐ FEMA Floodplain
- ☐ COE Wetlands
- ☒ Other ISWGP WAR000434
- ☐ Shoreline Management
- ☐ Structural Rockery/Vault/____
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (check one):
- ☒ Full
- ☐ Targeted
- ☐ Simplified
- ☐ Large Project
- ☐ Directed

Date (include revision dates): ____

Date of Final: ____

Site Improvement Plan (Engr. Plans)

Plan Type (check one):
- ☒ Full
- ☐ Modified
- ☐ Simplified

Date (include revision dates): ____

Date of Final: ____

Part 6 SWDM ADJUSTMENT APPROVALS

Type (circle one): Standard / Experimental / Blanket

Description: (include conditions in TIR Section 2)

KING COUNTY BLANKET ADJUSTMENT NO 1 FOR KCIA (JULY 26, 2016)

Approved Adjustment No. ____ Date of Approval: ____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 7 MONITORING REQUIREMENTS

Monitoring Required: ~~Yes~~ / No

Start Date: ______

Completion Date: ______

Describe: ______

Re: KCSWDM Adjustment No. ______

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : NONE

Special District Overlays: NONE

Drainage Basin: DUWAMISH RIVER BELOW MILE 6

Stormwater Requirements: NONE

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- [x] River/Stream DUWAMISH RIVER
- [ ] Lake ______
- [ ] Wetlands ______
- [ ] Closed Depression ______
- [ ] Floodplain ______
- [ ] Other ______
- [ ] Steep Slope ______
- [ ] Erosion Hazard ______
- [ ] Landslide Hazard ______
- [ ] Coal Mine Hazard ______
- [ ] Seismic Hazard ______
- [ ] Habitat Protection ______
- [x] CONTAMINATED SOILS

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
Qal, Qyal	FLAT	
"ALLUVIAL DEPOSITS"		

- [ ] High Groundwater Table (within 5 feet)
- [ ] Other ______
- [ ] Sole Source Aquifer
- [ ] Seeps/Springs
- [ ] Additional Sheets Attached

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☒ Core 2 – Offsite Analysis	FAA RESTRICTED ACCESS
☐ Sensitive/Critical Areas	
☐ SEPA	
☒ LID Infeasibility	CONTAMINATED SOILS
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description): TDA NO. 1 (KCIA DRAINAGE BASIN NO. 1)

Core Requirements (all 8 apply):

Discharge at Natural Location	Number of Natural Discharge Locations: 1
Offsite Analysis	Level: 1 / 2 / 3 dated: 11/2018
Flow Control (include facility summary sheet)	Level: 1 / 2 / 3 or Exemption Number DIRECT DISCHARGE Flow Control BMPs N/A
Conveyance System	Spill containment located at: OUTLET TRAP AT EACH CB
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	CSWPP/CESCL/ESC Site Supervisor: Contact Phone: After Hours Phone:
Maintenance and Operation	Responsibility (circle one): Private / Public If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: Yes / No
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / Enhanced Basic / Bog or Exemption No. Landscape Management Plan: ~~Yes~~ / ~~No~~

Special Requirements (as applicable):

Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / None Name: N/A
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / None 100-year Base Flood Elevation (or range): Datum:
Flood Protection Facilities	Describe:

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Source Control (commercial / industrial land use)	Describe land use: SORTING FACILITY COURIER SERVICES AT AIRPORT Describe any structural controls: OWS + WETVAULTS
Oil Control	High-use Site: ~~Yes~~ / No Treatment BMP: OWS Maintenance Agreement: ~~Yes~~ / No with whom? KCIA

Other Drainage Structures

Describe:

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION

- ☑ Clearing Limits
- ☑ Cover Measures
- ☑ Perimeter Protection
- ☑ Traffic Area Stabilization
- ☑ Sediment Retention
- ☑ Surface Water Collection
- ☑ Dewatering Control
- ☑ Dust Control
- ☑ Flow Control
- ☐ Protection of Flow Control BMP Facilities (existing and proposed)
- ☑ Maintain BMPs / Manage Project

MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION

- ☑ Stabilize exposed surfaces
- ☑ Remove and restore Temporary ESC Facilities
- ☑ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary
- ☐ Flag limits of SAO and open space preservation areas
- ☐ Other ______

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description	Water Quality	Type/Description
☐ Detention		☐ Vegetated Flowpath	
☐ Infiltration		☑ Wetpool	WETVAULTS
☐ Regional Facility		☐ Filtration	
☐ Shared Facility		☑ Oil Control	COALESCING PLATE
☐ Flow Control BMPs		☑ Spill Control	OUTLET TRAPS
☐ Other		☐ Flow Control BMPs	
		☐ Other	

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☐ Sensitive/Critical Areas	
☐ SEPA	
☐ LID Infeasibility	
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description)	TDA NO. 2 (KCIA DRAINAGE BASIN NO. 2)
Core Requirements (all 8 apply):	
Discharge at Natural Location	Number of Natural Discharge Locations: 2
Offsite Analysis	Level: 1 / 2 / 3 dated: 11/2018
Flow Control (include facility summary sheet)	Level: 1 / 2 / 3 or Exemption Number DIRECT DISCHARGE Flow Control BMPs ________
Conveyance System	Spill containment located at: OUTLET TRAP AT EACH CB
Erosion and Sediment Control / Construction Stormwater Pollution Prevention	CSWPP/CESCL/ESC Site Supervisor: ________ Contact Phone: ________ After Hours Phone: ________
Maintenance and Operation	Responsibility (circle one): Private / Public If Private, Maintenance Log Required: Yes / No
Financial Guarantees and Liability	Provided: Yes / No
Water Quality (include facility summary sheet)	Type (circle one): Basic / Sens. Lake / Enhanced Basic / Bog or Exemption No. ________ Landscape Management Plan: Yes / No
Special Requirements (as applicable):	
Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / None Name: ________
Floodplain/Floodway Delineation	Type (circle one): Major / Minor / Exemption / None 100-year Base Flood Elevation (or range): ________ Datum:
Flood Protection Facilities	Describe:

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 12 TIR SUMMARY SHEET	(provide one TIR Summary Sheet per Threshold Discharge Area)
Source Control (commercial / industrial land use)	Describe land use: COURIER SORTING FACILITY AT KCIA Describe any structural controls: OWS & WETVAULT
Oil Control	High-use Site: Yes / No Treatment BMP: OWS Maintenance Agreement: Yes / No with whom? KCIA
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS	
MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☐ Clearing Limits ☐ Cover Measures ☐ Perimeter Protection ☐ Traffic Area Stabilization ☐ Sediment Retention ☐ Surface Water Collection ☐ Dewatering Control ☐ Dust Control ☐ Flow Control ☐ Protection of Flow Control BMP Facilities (existing and proposed) ☐ Maintain BMPs / Manage Project	☐ Stabilize exposed surfaces ☐ Remove and restore Temporary ESC Facilities ☐ Clean and remove all silt and debris, ensure operation of Permanent Facilities, restore operation of Flow Control BMP Facilities as necessary ☐ Flag limits of SAO and open space preservation areas ☐ Other ______

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description	Water Quality	Type/Description
☐ Detention		☐ Vegetated Flowpath	
☐ Infiltration		☐ Wetpool	
☐ Regional Facility		☐ Filtration	
☐ Shared Facility		☐ Oil Control	
☐ Flow Control BMPs		☐ Spill Control	
☐ Other		☐ Flow Control BMPs	
		☐ Other	

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 15 EASEMENTS/TRACTS	Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement	☐ Cast in Place Vault
☑ Covenant	☐ Retaining Wall
☐ Native Growth Protection Covenant	☐ Rockery > 4' High
☐ Tract	☐ Structural on Steep Slope
☐ Other ______	☒ Other PRECAST VAULT

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER
I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate.
10/31/2019
Signed/Date

King County
Water and Land Resources Division
Department of Natural Resources and Parks
King Street Center
201 South Jackson Street, Suite 600
Seattle, WA 98104-3855
206-477-4800 Fax 206-296-0192
TTY Relay: 711

July 26, 2016

TO: Scott Smith, Principal Engineer, Department of Permitting and Environmental Review (DPER)

FM: Curt W. Crawford, Manager, Stormwater Services Section, Water and Land Resources (WLR) Division, Department of Natural Resources and Parks CWC

RE: Blanket Adjustment #1 for King County International Airport Regarding Definition of "Site," Alternative Declaration of Covenant and Grant of Easement, Direct Discharge, and Flow Control BMP Requirements

Background

King County International Airport (KCIA) experiences repeated surface water drainage manual adjustment requests for the same drainage issues proposed by KCIA and their tenants. A blanket adjustment that addresses these common requests will serve the public interest by reducing permit times and costs, while achieving required environmental protection and compliance with the Surface Water Design Manual (SWDM).

List of Specific Adjustment Items and Discussion

1. Use the 2016 SWDM definition (Chapter 1, Key Terms) of "site" for application of requirements for development proposals vested to earlier versions of the SWDM.

   Findings/Justification

   Earlier versions of the SWDM defined "site" in a manner that treated the entire airport "parcel" as the "site," which resulted in individual leaseholds being required to take actions or having requirements based on areas outside of their leasehold and scope of control. The main airport parcel (282404-9007) constitutes approximately 92 percent of the 600 airport acres and contains approximately 150 tenants and 40+ separate leaseholds. Tenant leaseholds have no control of the remaining parcel and do not own the property that they occupy. The "site" definition has been updated in the 2016 SWDM to address leaseholds (see underlined portion of definition) as follows: "*means a single parcel; or, two or more contiguous parcels that are under common ownership or documented legal control; or a portion of a single parcel under documented legal control separate from the remaining parcel, used as a single parcel for a proposed project for purposes of applying for authority from King County to* *carry out a proposed project. For projects located primarily within dedicated rights-of-way, the length of the project site and the right-of-way boundaries define the site.*"

Conditions of Approval

KCIA projects vested under the 2009 SWDM must use/adopt the revised 2016 SWDM site definition completely and consistently for application of the 2009 manual's requirements.

2. For development/redevelopment projects located at KCIA, eliminate the requirement to implement flow control best management practices (BMPs) to cited minimum levels for individual lots as described in the 2009 and 2016 SWDMs. These minimum levels are specified in 2009 SWDM requirement #3 of Section 5.2.1.1, "Small Lot BMP Requirements," 2009 SWDM requirement #2 of Section 5.2.1.3, "Large Lot High Impervious BMP Requirements," 2016 SWDM requirement #5 of Section 1.2.9.2.1, "Small Lot BMP Requirements," and 2016 SWDM requirement #5 of Section 1.2.9.2.2, "Large Lot BMP Requirements."

Findings/Justification

The 2009 SWDM requires flow control BMPs be applied to a project's targeted surfaces based on the project's size and impervious coverage. These minimum BMP implementation levels were intended to capture "practicable" levels of BMPs, which have been found to be difficult to achieve at KCIA given its unique function and highly impervious footprint.

The 2016 SWDM requires flow control BMPs be applied to an urban located project's targeted surfaces to the "maximum extent feasible" while also requiring the same 2009 SWDM minimum BMP implementation levels be achieved. Where standard infiltrative BMPs are not feasible and cannot achieve the required minimums, the reduced footprint BMP, native growth retention BMP, and/or a fee in lieu of (if the WLR Division has a program for retrofits within the site's basin) may be used for compliance.

The requirement to provide these minimum levels of BMP implementation to be achieved by using either reduced footprint, native growth retention, and/or a fee in lieu of does not apply to road improvement projects in the 2016 SWDM since it is recognized that going beyond the "maximum extent feasible" approach on these projects is neither practicable nor in the public interest. This is because limited right-of-way areas restrain the use of native vegetation and reduced footprint BMPs and it is in the public interest to not displace or reduce the prescribed size of critical transportation infrastructure. This same reasoning applies to projects located at KCIA. This proposal to eliminate the minimum BMP implementation levels for the King County Airport is consistent with the Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMWW), which only requires implementation of the "maximum extent feasible" approach described earlier.

Conditions of Approval

For KCIA projects vested to the 2016 SWDM, all other provisions of Core Requirement 9 (FCBMPs) of the 2016 SWDM not addressed by this adjustment must be met. For projects vested to the 2009 SWDM, all the provisions of Core Requirement 9 of the 2016 SWDM (FCBMP requirements and implementation approach) must be met, except as otherwise allowed by this adjustment.

3. Exempt projects located at the KCIA from the distance provision of criteria (a) of the Direct Discharge Exemption (described in Section 1.2.3 of the 2009 and 2016 SWDMs) that states that "The flow path from the project site discharge point to the edge of the 100-year floodplain of the major receiving water will be no longer than the ¼ mile."

Findings/Justification

Beyond addressing any identified capacity issues for KCIA internal conveyance systems, (which is addressed explicitly by criteria (c) of the Direct Discharge Exemption), requiring flow control facilities for KCIA properties beyond ¼ mile provides no predictable benefit to the downstream major receiving water (Duwamish River).

Ecology's 2014 SMMWW allows the direct discharge exemption from flow control to Duwamish/Green River Downstream of River Mile 6 (South Boeing Access Road) and does not include a ¼-mile distance provision/requirement.

KCIA maintains a robust inspection and maintenance program for the entire KCIA storm system, including leaseholds as the performance of the system is critical to maintaining airport operations. KCIA can respond in a timely matter to any issues due to its underlying ownership and maintenance relationship with its leaseholders.

King County has approved individual SWDM adjustments at the KCIA addressing this issue. In particular, VARD14-0019 (KCIA AARF) is a previously approved SWDM adjustment that allowed a KCIA project to utilize the direct discharge exemption for a project site beyond the ¼ mile specified in Direct Discharge Exemption criteria (a). Key excerpts: "*The flow path from the project site discharge point to the edge of the 100-year floodplain of the Duwamish River is longer than ¼ mile. Therefore, the engineer is submitting a variance to allow direct discharge proposal for a flowpath that is greater than ¼ mile. Their proposed request is based on the following findings:*

- *The project site discharges to the Lower Duwamish River through a manmade (comprised of storm drainage pipes, a pump station, and a tide gate at the outfall to the River) conveyance system.*
- *The downstream system for the project was analyzed by URS Corporation as part of the KCIA Outfalls Assessment in November 2009. The outfall Assessment Report found no downstream conveyance issues related to the discharge system for this project site."*

Conditions of Approval

This adjustment applies to KCIA located projects and addresses only the ¼-mile distance provision of criteria (a) of the Direct Discharge Exemption. All other criteria for Direct Discharge Exemption must be achieved.

4. Allow the following modifications to the standard declaration of covenant and grant of easement for inspection and maintenance of stormwater facilities and FCBMPs that are within KCIA:

Replace standard paragraph #2 with the following text:

"*King County WLR Division personnel with prior arrangement and accompanied by FAA-mandated escort shall have the right to ingress and egress over those portions of the Property necessary to perform inspections of the stormwater facilities and BMPs and conduct other activities specified in this Declaration of Covenant and in accordance with King County Code ("KCC") 9.04.120 or relevant municipal successor's codes as applicable.*"

Replace standard paragraph #3 with the following text:

If King County WLR Division personnel determine that maintenance or repair work is required to be done to any of the stormwater facilities or BMPs, the Director of the WLR Division (Director) or its municipal successor in interest shall give notice of the specific maintenance and/or repair work required pursuant to KCC 9.04.120 or relevant municipal successor's codes as applicable. The Director shall also set a reasonable time in which such work is to be completed by the Owners. If the above required maintenance or repair is not completed within the time set by the Director, the County may perform the required maintenance or repair, and hereby is given access to the Property, subject to the stipulation for prior arrangement and accompaniment by an FAA-mandated escort stated in Paragraph 2 above, for such purposes. Written notice will be sent to the Owners stating the County's intention to perform such work. This work will not commence until at least seven (7) days after such notice is mailed. If, within the sole discretion of the Director, there exists an imminent or present danger, the seven (7) day notice period will be waived and maintenance and/or repair work will begin immediately.

Findings/Justification

Standard declaration of covenant and grant of easement documents for inspection and maintenance of stormwater facilities and FCBMPs are contained in Reference 8-J of the SWDM. In the standard declaration of covenant and grant of easement, "King County" is generically cited as the grantee and inspecting authority. The modified declaration of covenant and grant of easement provides clarity that the King County WLR Division is the inspecting authority as distinguished from onsite KCIA staff (also "King County"). The modified declaration of covenant and grant of easement addresses Federal Aviation Authority (FAA) requirements that visitors (for example, WLR Division inspector) to the "airside" portion of the KCIA be escorted by authorized KCIA staff and formalizes notice requirements to ensure KCIA staff are available. Modified declaration of covenant and grant of easements have previously been recorded at the KCIA that address these issues.

Conditions of Approval

DPER staff will review proposed modified declaration of covenant and grant of easements for KCIA projects to ensure changes are limited to those specified above.

Please note that approval of this adjustment does not relieve applicants from other county, state, or federal requirements, including any requirements imposed through the SEPA process. Individual designs proposing use of this adjustment will be reviewed and approved during plan review to ensure that compliance with the conditions stated herein is achieved. If you have any questions, please call Mark Wilgus, Engineer IV with the Stormwater Services Section, at 206-477-4848.

Approved by the WLR Division and DPER as follows:

Curt W. Crawford
Curt W. Crawford, Manager
Stormwater Services Section
King County WLR Division

Date 7/26/16

Scott Smith
Scott Smith, Principal Engineer
King County DPER

Date 8/10/2016

CC:MW:bgD01

cc: Mark Bergam, Engineer IV, Airport Division, Department of Transportation
Mark Wilgus, Engineer IV, Stormwater Services Section, Water and Land Resources Division, Department of Natural Resources and Parks

APPENDIX B
Facility Design Documents & Worksheets

STORMWATER FACILITY SUMMARY SHEET

(provide one Stormwater Facility Summary Sheet per *Natural Discharge Location*)

DPER Permit No. ____
Date ____
NPDES Permit No. ____

OVERVIEW:

Project Name UPS-BFI GATEWAY EXPANSION

Project Location 7300 PERIMETER RD S, SEATTLE KCIA/BFI

Parcel No. ____
Retired Parcel No. ____

Downstream Drainage Basins:

Major Basin Name DUWAMISH

Immediate Basin Name KCIA DRAINAGE BASIN NO. 1

Project includes Landscape Management Plan? yes ☐ no ☐
(include copy with TIR as Appendix)

Declarations of Covenant	Recording No.
Leachable Metals	
Impervious Surface Limit	
Flow Control BMPs	
Clearing Limit	
Drainage Facility	
Landscape Management Plan	

GENERAL FACILITY INFORMATION:

Detention Type	# of	Infiltration Type	# of	Water Quality Type	# of facilities	Flow Control Performance Std
Ponds		Ponds		Ponds		☐ Basic
Vaults		Tanks		Vaults	1	☐ Conservation
Tanks		Trenches		Tanks		☐ Flood Problem

If no flow control facility, check one:

- ☐ Project qualifies for KCSWDM Exemption (KCSWDM 1.2.3):
  - ☐ Basic Exemption
  - ☐ Impervious Surface Exemption for Transportation Redevelopment projects
  - ☐ Cost Exemption for Parcel Redevelopment projects
  - ☒ Direct Discharge Exemption
  - ☐ Other ____
- ☐ Project qualifies for 0.1 cfs Exception per KCSWDM 1.2.3
- ☒ No flow control required per approved KCSWDM Adjustment No. 1
- ☐ Flow control provided in regional/shared facility per approved approved KCSWDM Adjustment No. ____ Shared Facility Name/Location: ____
- ☐ No flow control required (other, provide justification): ____

TREATMENT SUMMARY FOR TOTAL IMPERVIOUS SURFACES		
(Applies to Commercial parcels only)	Area	% of Total
Total Acreage **(ac)**	0.97 AC	-----
Total Impervious Acreage **(ac)**	2.79 AC	35%
Total impervious surface served by flow control facility(ies) **(sq ft)**	∅	∅
Impervious surface served by flow control facility(ies) designed 1990 or later **(sq ft)**	∅	∅
Impervious surface served by pervious surface absorption **(sq ft)**	∅	∅
Impervious surface served by approved water quality facility(ies) **(sq ft)**	42,300 0.97	100%

PROVIDE FACILITY DETAILS AND FACILITY SKETCH FOR EACH FACILITY ON REVERSE. USE ADDITIONAL SHEETS AS NEEDED FOR ADDITIONAL FACILITIES

STORMWATER FACILITY SUMMARY SHEET

DPER Permit No. ______

(provide one Stormwater Facility Summary Sheet per *Natural Discharge Location*)

Project Name UPS - BFI GATEWAY EXPANSION

Project Location 7300 PERIMETER RD S, SEATTLE KCIA / BFI

Downstream Drainage Basins:

Major Basin Name DUWAMISH

Immediate Basin Name KCIA DRAINAGE BASIN 1

FLOW CONTROL FACILITY: Basin:

Facility Name/Number ______ ☐ New Facility

Facility Location ______ ☐ Existing Facility

UIC? ☐ yes ☒ no **UIC Site ID:**

Live Storage Volume ______ ☐ cu.ft. ☐ ac.ft. Live Storage Depth (ft) ______

Volume Factor of Safety ______

Project Impervious Acres Served ______

% of Total Project Impervious Acres Served ______

No. of Lots Served ______

Control Structure location: ______

Type of Control Structure:

☐ Riser in vault

☐ Riser in Type II CB

☐ Weir in Type II CB

No. of Orifices/Restrictions ______

Size of Orifice/Restriction (in.) (numbered starting with lowest orifice): (inches in decimal format)

No.1 ______

No.2 ______

No.3 ______

No.4 ______

Dam Safety Regulations (WA State Dept of Ecology):

Reservoir Volume above natural grade		☐ cu.ft. ☐ ac.ft.
Depth of Reservoir above natural grade		(ft)

WATER QUALITY FACILITIES

Indicate no. of water quality facilities/BMPs for each type:

______ Flow dispersion

______ Filter strip

______ Biofiltration swale ☐ *regular,* ☐ *wet or* ☐ *continuous inflow*

X Wetvault ☐ *combined w/detention*

______ Wetpond ☐ *basic* ☐ *large* ☐ *combined w/detention*

______ Pre-settling pond

______ Stormwater wetland

______ Sand filter ☐ *basic* ☐ *large* ☐ *regular* ☐ *linear* ☐ *vault*

Sand bed depth (inches) ______

- Is facility lined? ☐ yes ☐ no If so, what marker is used above liner? ______

Design Information

Water Quality design flow (cfs)	0.087
Water Quality treated volume (sandfilter) (cu.ft.)	Ø
Water Quality storage volume (wetpool) (cu.ft.)	5200

☒ **Landscape management plan** ☐ **Farm management plan**

X High flow bypass structure (e.g., flow-splitter catch basin)

X Oil/water separator ☐ *baffle* ☒ *coalescing plate*

______ Storm filter

______ Pre-settling structure (Manufacturer: ______)

______ Catch basin inserts (Manufacturer: ______)

______ Source controls ______

Facility Summary Sheet Sketch: All detention, infiltration and water quality facilities must include a detailed sketch (11"x17" reduced size plan sheets preferred).

STORMWATER FACILITY SUMMARY SHEET

(provide one Stormwater Facility Summary Sheet per *Natural Discharge Location*)

DPER Permit No. ______
Date ______
NPDES Permit No. ______

OVERVIEW:

Project Name UPS BFI GATEWAY EXPANSION

Project Location 7300 PERIMETER RD S, SEATTLE KCIA

Parcel No. ______
Retired Parcel No. ______

Downstream Drainage Basins:

Major Basin Name DUWAMISH

Immediate Basin Name KCIA DRAINAGE BASIN NO. 2

Project includes Landscape Management Plan? yes ☐ no ☐
(include copy with TIR as Appendix)

Declarations of Covenant	Recording No.
Leachable Metals	
Impervious Surface Limit	
Flow Control BMPs	
Clearing Limit	
Drainage Facility	
Landscape Management Plan	

GENERAL FACILITY INFORMATION:

Detention		Infiltration		Water Quality		Flow Control Performance Std
Type	*# of*	*Type*	*# of*	*Type*	*# of facilities*	
Ponds		Ponds		Ponds		☐ Basic
Vaults		Tanks		Vaults	2	☐ Conservation
Tanks		Trenches		Tanks		☐ Flood Problem

If no flow control facility, check one:

- ☒ Project qualifies for KCSWDM Exemption (KCSWDM 1.2.3):
  - ☐ Basic Exemption
  - ☐ Impervious Surface Exemption for Transportation Redevelopment projects
  - ☐ Cost Exemption for Parcel Redevelopment projects
  - ☒ Direct Discharge Exemption
  - ☐ Other ______
- ☐ Project qualifies for 0.1 cfs Exception per KCSWDM 1.2.3
- ☒ No flow control required per approved KCSWDM Adjustment No. 1
- ☐ Flow control provided in regional/shared facility per approved approved KCSWDM Adjustment No. ______ Shared Facility Name/Location: ______
- ☐ No flow control required (other, provide justification): ______

TREATMENT SUMMARY FOR TOTAL IMPERVIOUS SURFACES		
(Applies to Commercial parcels only)	Area	% of Total
Total Acreage **(ac)**	10.14	------
Total Impervious Acreage **(ac)**	15.67	65%
Total impervious surface served by flow control facility(ies) **(sq ft)**	∅	∅
Impervious surface served by flow control facility(ies) designed 1990 or later **(sq ft)**	∅	∅
Impervious surface served by pervious surface absorption **(sq ft)**	∅	∅
Impervious surface served by approved water quality facility(ies) **(sq ft)**	441,700	100%

PROVIDE FACILITY DETAILS AND FACILITY SKETCH FOR EACH FACILITY ON REVERSE. USE ADDITIONAL SHEETS AS NEEDED FOR ADDITIONAL FACILITIES

STORMWATER FACILITY SUMMARY SHEET

DPER Permit No. ________

(provide one Stormwater Facility Summary Sheet per Natural Discharge Location)

Project Name UPS BFI GATEWAY EXPANSION

Project Location 7300 PERIMETER RD S KCIA

Downstream Drainage Basins:
Major Basin Name DUWAMISH
Immediate Basin Name KCIA DRAINAGE BASIN 2

FLOW CONTROL FACILITY: Basin:

Facility Name/Number ________
Facility Location ________
☐ New Facility ☐ Existing Facility
UIC? ☐ yes ☐ no **UIC Site ID:**
Live Storage Volume ________ ☐ cu.ft. ☐ ac.ft.
Live Storage Depth (ft) ________
Volume Factor of Safety ________

Project Impervious Acres Served ________
% of Total Project Impervious Acres Served ________
No. of Lots Served ________

Control Structure location: ________
Type of Control Structure:
☐ Riser in vault
☐ Riser in Type II CB
☐ Weir in Type II CB

No. of Orifices/Restrictions ________
Size of Orifice/Restriction (in.) (numbered starting with lowest orifice): (inches in decimal format)
No.1 ____
No.2 ____
No.3 ____
No.4 ____

Dam Safety Regulations (WA State Dept of Ecology):

Reservoir Volume above natural grade		☐ cu.ft. ☐ ac.ft.
Depth of Reservoir above natural grade		(ft)

WATER QUALITY FACILITIES

Indicate no. of water quality facilities/BMPs for each type:

____ Flow dispersion
____ Filter strip
____ Biofiltration swale ☐ *regular,* ☐ *wet or* ☐ *continuous inflow*
X Wetvault ☐ *combined w/detention*
____ Wetpond ☐ *basic* ☐ *large* ☐ *combined w/detention*
____ Pre-settling pond
____ Stormwater wetland
____ Sand filter ☐ *basic* ☐ *large* ☐ *regular* ☐ *linear* ☐ *vault*
Sand bed depth (inches) ____
● Is facility lined? ☐ yes ☐ no If so, what marker is used above liner? ________

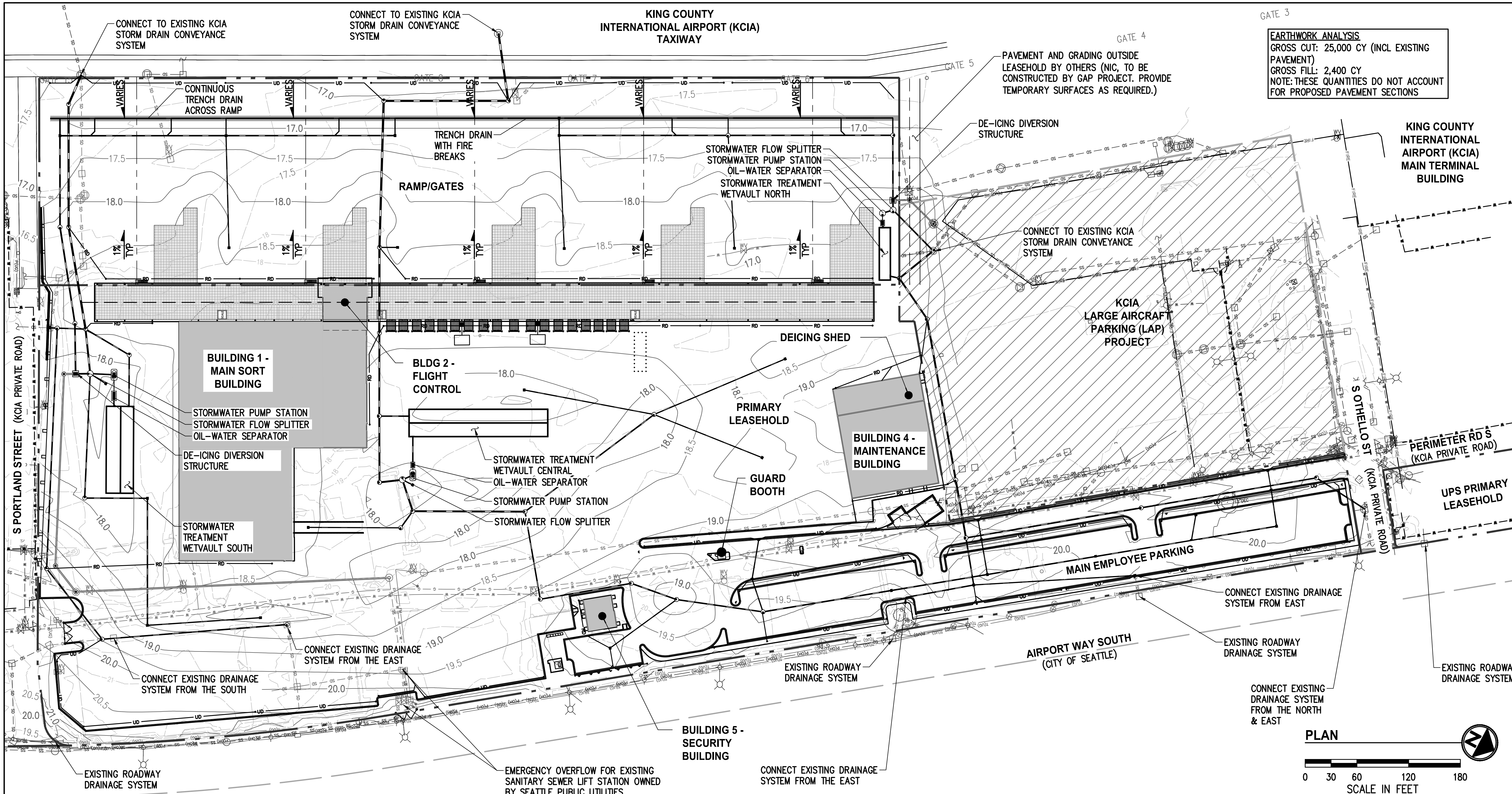
Design Information

Water Quality design flow (cfs)	0.93
Water Quality treated volume (sandfilter) (cu.ft.)	Ø
Water Quality storage volume (wetpool) (cu.ft.)	54,590

☐ **Landscape management plan** ☐ **Farm management plan**

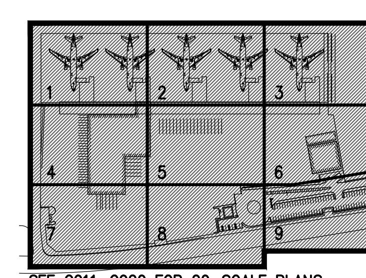
X High flow bypass structure (e.g., flow-splitter catch basin)
X Oil/water separator ☐ *baffle* ☒ *coalescing plate*
____ Storm filter
____ Pre-settling structure (Manufacturer: ________)
____ Catch basin inserts (Manufacturer: ________)
____ Source controls ________

Facility Summary Sheet Sketch: All detention, infiltration and water quality facilities must include a detailed sketch (11"x17" reduced size plan sheets preferred).



GENERAL NOTES

1. EXISTING UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE. ALL UTILITY LOCATIONS (OPERATIONAL AND ABANDONED) SHALL BE LOCATED AND FIELD VERIFIED BY CONTRACTOR PRIOR TO COMMENCING CONSTRUCTION. ANY DAMAGE MUST BE REPAIRED AT THE CONTRACTOR'S EXPENSE.
2. SEE DEMOLITION PLAN SHEET D010 FOR ALL EXISTING UTILITIES TO BE REMOVED AND/OR ABANDONED. CONTRACTOR IS RESPONSIBLE TO MAINTAIN EXISTING STORM DRAIN SYSTEMS OR PROVIDE TEMPORARY BYPASS SYSTEMS DURING ALL SITE WORK THAT WILL INTERFERE WITH MAINTAINING EXISTING STORMWATER FLOWS.
3. THE CONTRACTOR MUST PROVIDE ALL UTILITY REPRESENTATIVES A MINIMUM OF 72 HOURS NOTIFICATION PRIOR TO DEACTIVATING ANY UTILITY. SUCH WORK SHALL NOT BE ACCOMPLISHED WITHOUT PRIOR PERMISSION.
4. ALL PIPES 12" OR LESS, EXCEPT FOR PAVEMENT UNDERDRAINS OR TRENCH DRAINS, WITHIN THE AIRFIELD SHALL BE DUCTILE IRON PIPE CLASS 52.
5. ALL PIPES GREATER THAN 12" WITHIN THE AIRFIELD SHALL BE REINFORCED CONCRETE PIPE CLASS V.
6. ALL PIPES LABELED "SD" SHALL BE PER PROJECT SPECIFICATIONS
7. ALL SOLID WALL PIPES UNDER PAVEMENT WITH LESS THAN TWO FEET OF COVER SHALL BE DUCTILE IRON PIPE CLASS 52.
8. ALL UNDERDRAIN PIPE SHALL BE PER PROJECT SPECIFICATIONS. LOCATIONS IN PLANS ARE SCHEMATIC. LOCATE UNDEDRAIN WITHIN PLANTED AREAS WHERE FEASIBLE.
9. ALL STORM DRAIN STRUCTURES SHALL HAVE A REINFORCED CONCRETE TOP SLAB WITH HEAVY DUTY FRAME AND GRATE. COORDINATE CONCRETE REINFORCEMENT WITH AIRFIELD PAVEMENT DESIGN. SEE DETAIL SHEET C070.
10. ALL VAULT HATCHES SHALL BE HEAVY DUTY FRAME AND SUPPORTED BY A STRUCTURAL, REINFORCED TOP SLAB DESIGNED BY THE MANUFACTURER TO SUPPORT HEAVY LOADS.
11. INSTALL OUTLET TRAP FOR OIL CONTROL ON ALL OUTLET PIPES AT EACH CATCH BASIN (NEW & EXISTING) WITH AN OPEN GRATE. SEE DETAIL SHEET C071.
12. ALL PIPE AND FITTINGS SHALL BE LAID ON PROPERLY PREPARED FOUNDATION PER PROJECT SPECIFICATIONS THIS SHALL INCLUDE LEVELING AND COMPACTING THE TRENCH BOTTOM, THE TOP OF THE FOUNDATION MATERIAL, AND ANY REQUIRED BEDDING TO A UNIFORM GRADE SO THAT THE ENTIRE PIPE IS SUPPORTED BY A UNIFORMLY DENSE UNYIELDING BASE.
13. STORM DRAIN INLETS, CATCH BASINS AND MANHOLES PER KING COUNTY ROADWAY STANDARDS (MOST CURRENT EDITION). SEE SHEET C070 FOR DETAILS.
14. ALL CATCH BASIN GRATES SHALL INCLUDE THE STAMPING "OUTFALL TO STREAM, DUMP NO WASTE POLLUTANTS" AND "PROPERTY OF KING COUNTY".
15. ALL CATCH BASIN REPLACEMENTS SHALL HAVE A MINIMUM OF ONE JOINT OF PIPE REPLACED IN ALL DIRECTIONS THAT ARE CONNECTED TO THE CATCH BASIN, REPLACEMENT JOINTS ARE TO BE FIELD ADJUSTED TO NEW CATCH BASIN. ASSUME ONE LENGTH OF PIPE EQUALS EIGHT (8) FEET.
16. INSTALL FLEXIBLE PIPE JOINTS PRIOR TO ALL STORM DRAIN STRUCTURE CONNECTIONS.
17. STORM DRAIN STRUCTURES ARE LOCATED BY CENTER OF PROJECTED STRUCTURE.
18. ALL CATCH BASIN TO HAVE OPEN, VANED GRATE PER DETAIL SHEET C070 UNLESS OTHERWISE NOTED ON PLANS, PROFILES, OR DETAILS.
19. SEE ARCHITECTURAL PLANS FOR DOWNSPOUT LOCATION. DOWNSPOUT CONNECTION PER DETAIL C073.



SEE C011–C020 FOR 20–SCALE PLANS AND CONSTRUCTION NOTES.

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CIVIL
GRADING & DRAINAGE
SITE PLAN

REVISIONS
NO. | DATE | BY | APPR.

SCALE: ONE INCH AS DRAWN

Approved By
DJ DEAN — OCT 2019
QA/QC MANAGER — DATE
CHARLIE CONWAY
PROJECT MANAGER — DATE
DJ DEAN — MAY 2019
PROJECT ARCHITECT — DATE

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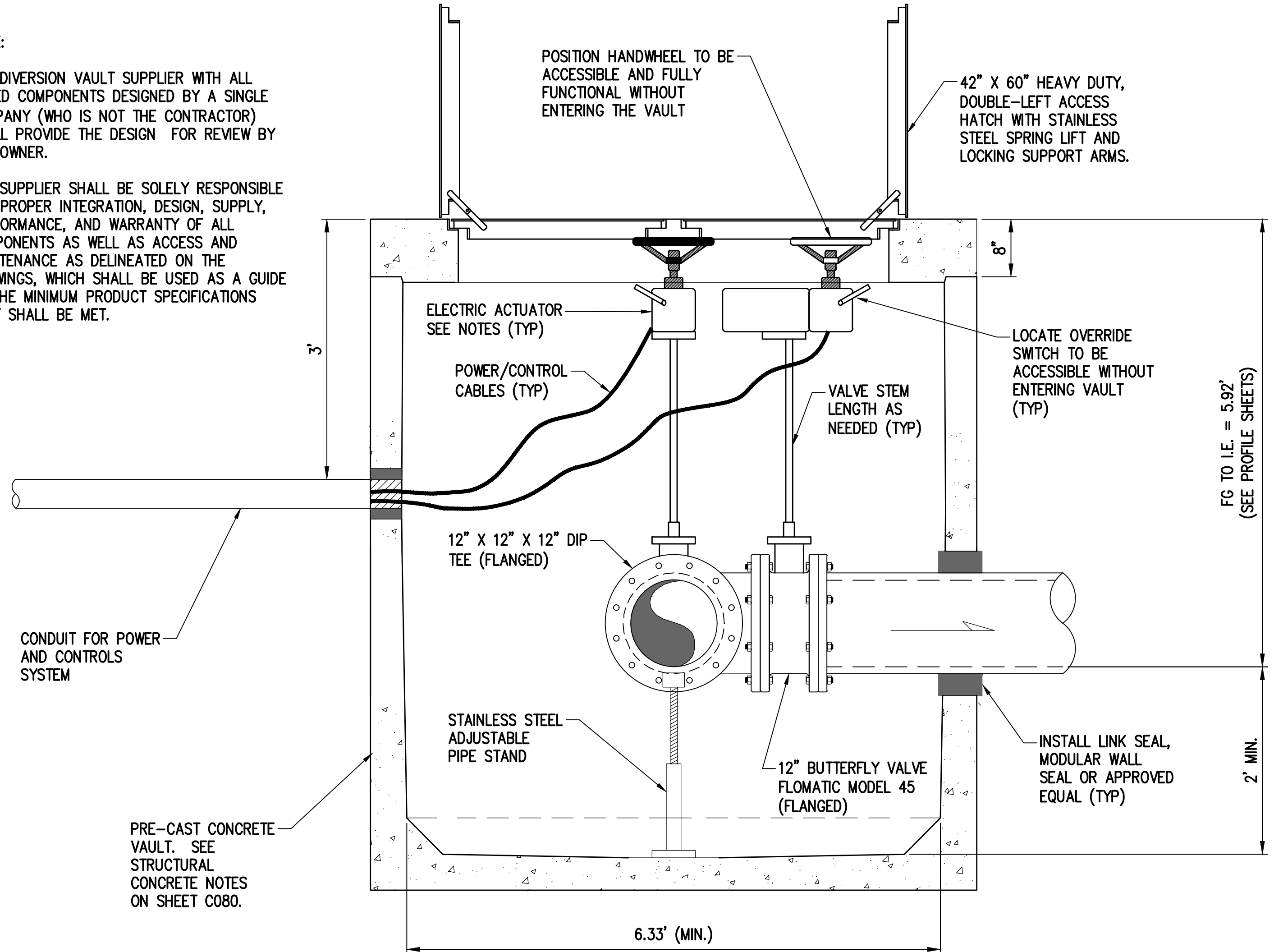
NOTE:

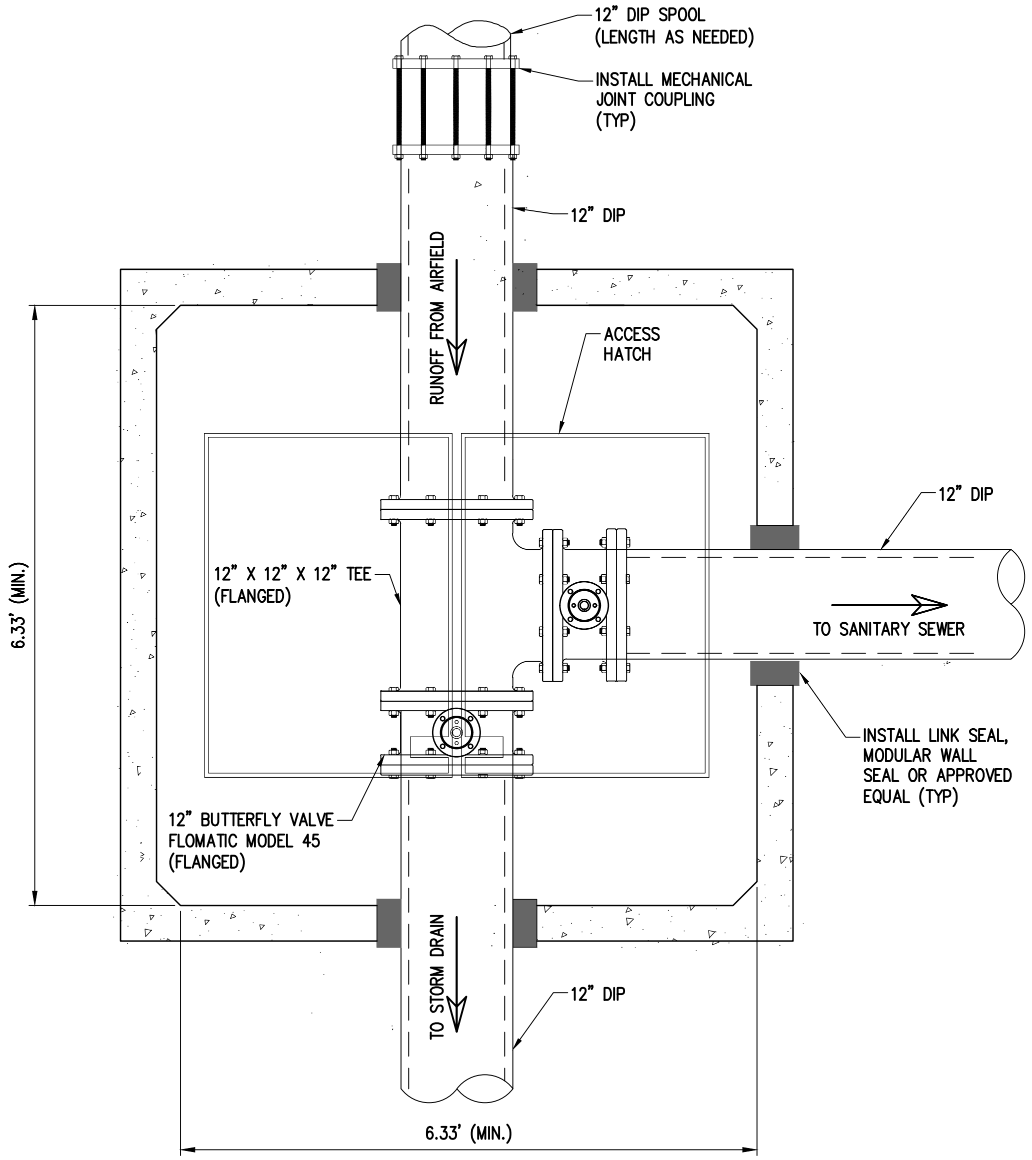
THE DIVERSION VAULT SUPPLIER WITH ALL LISTED COMPONENTS DESIGNED BY A SINGLE COMPANY (WHO IS NOT THE CONTRACTOR) SHALL PROVIDE THE DESIGN FOR REVIEW BY THE OWNER.

THE SUPPLIER SHALL BE SOLELY RESPONSIBLE FOR PROPER INTEGRATION, DESIGN, SUPPLY, PERFORMANCE, AND WARRANTY OF ALL COMPONENTS AS WELL AS ACCESS AND MAINTENANCE AS DELINEATED ON THE DRAWINGS, WHICH SHALL BE USED AS A GUIDE OF THE MINIMUM PRODUCT SPECIFICATIONS THAT SHALL BE MET.



ACTUATOR
FLOWSERVE LIMITORQUE ELECTRIC ACTUATOR OR APPROVED EQUAL FOR BUTTERFLY VALVES. ACTUATOR SHALL BE EXPLOSION PROOF AND WEATHER PROOF WITH MANUAL OVER RIDE.

ELEVATION VIEW
NTS



TOP VIEW
NTS - ACTUATOR NOT SHOWN

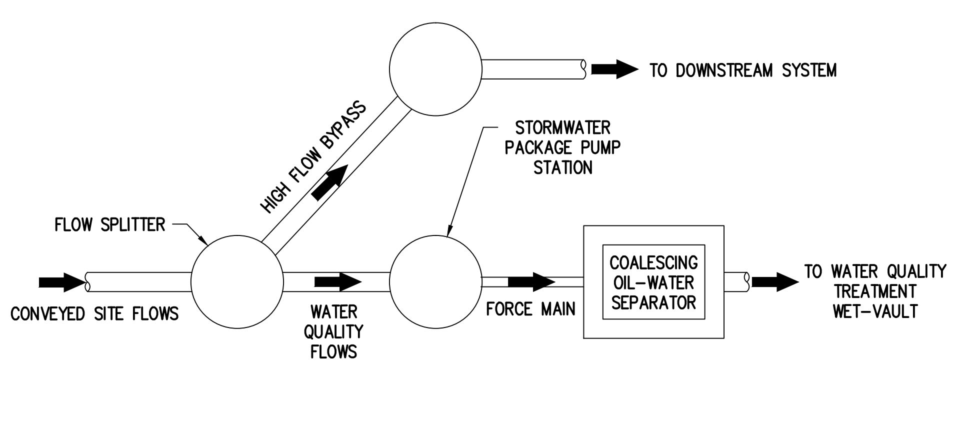
DIVERSION STRUCTURE NORTH DETAIL
NTS

NOTE:
THIS DETAIL IS FOR COORDINATION PURPOSES ONLY. SEE PLANS AND PROFILES FOR ACTUAL LOCATIONS.

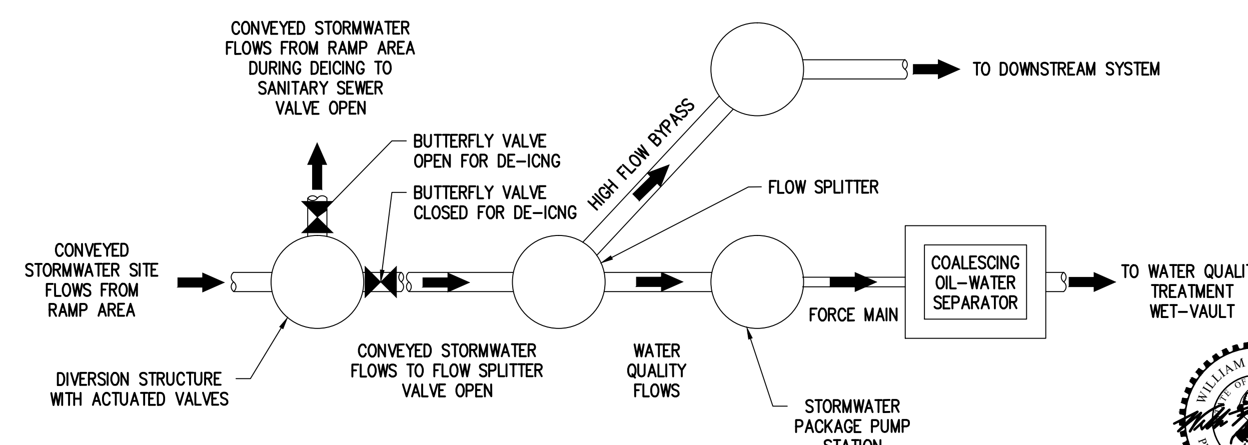
THE CONTRACTOR IS RESPONSIBLE TO FURNISH ALL EQUIPMENT AND TO COORDINATE WITH THE SUPPLIERS TO DESIGN AND SUPPLY THE (1) PACKAGED STORMWATER PUMP STATION AND (2) ACTUATED (ELECTRICAL) VALVES IN EACH DIVERSION STRUCTURE AS SHOWN IN THE PLANS TO BE INSTALLED BY THE CONTRACTOR.

LOCATION OF CONTROL SYSTEMS AND POWER SUPPLY CONNECTION TO BE FIELD LOCATED.

THE DESIGN MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE PRIOR TO INSTALLATION



CONFIGURATION A
CENTRAL



CONFIGURATION B
NORTH & SOUTH

WATER QUALITY TREATMENT SYSTEM SCHEMATIC LAYOUT
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DIVERSION STRUCTURE NORTH

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CHARLIE CONWAY
PROJECT MANAGER DATE
DJ DEAN MAY 2019
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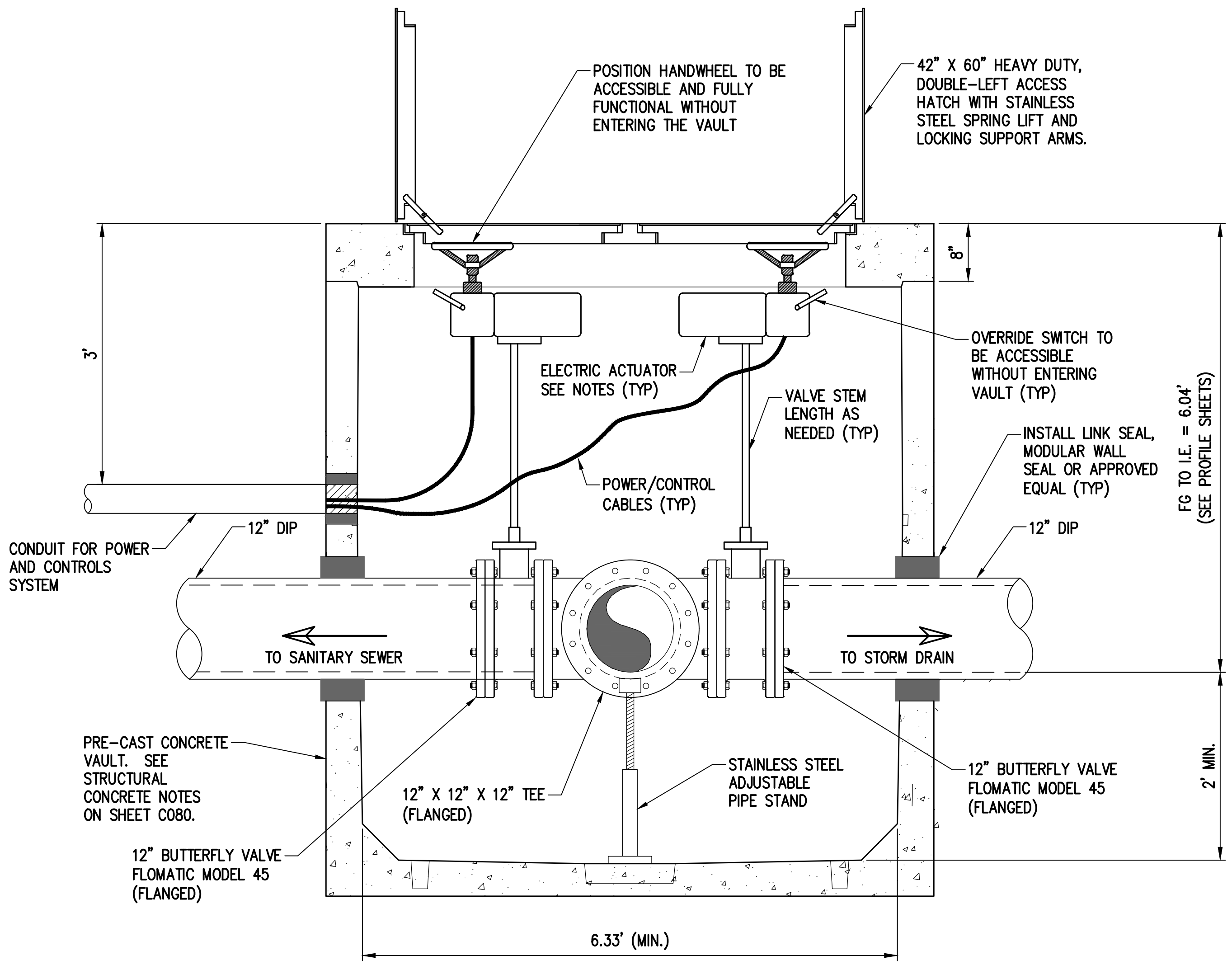
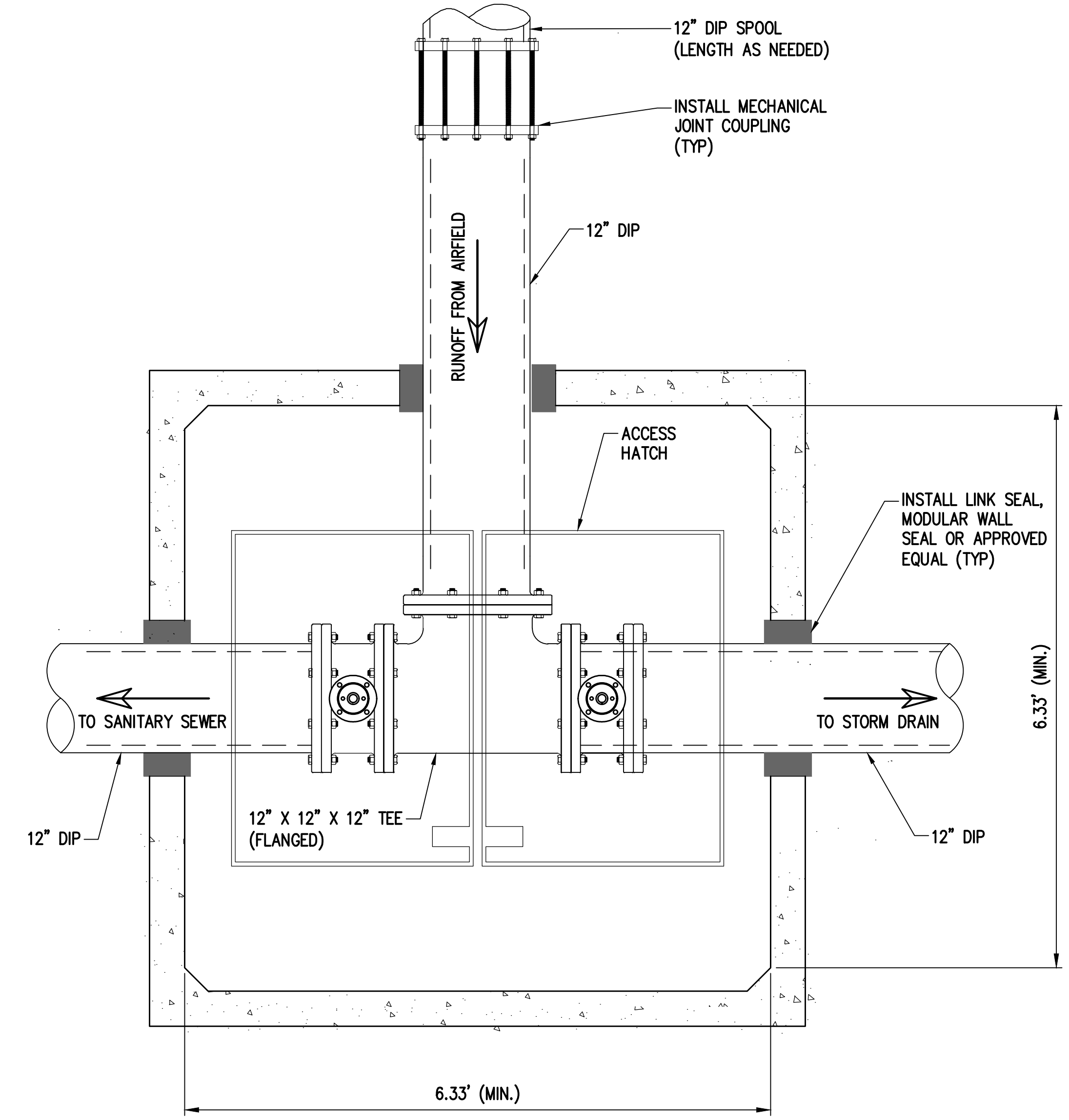


ELEVATION VIEW
NTS – ACTUATOR NOT SHOWN



TOP VIEW
NTS – ACTUATOR NOT SHOWN

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DIVERSION STRUCTURE SOUTH DETAIL
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PROJECT MANAGER DATE
DJ DEAN MAY 2019
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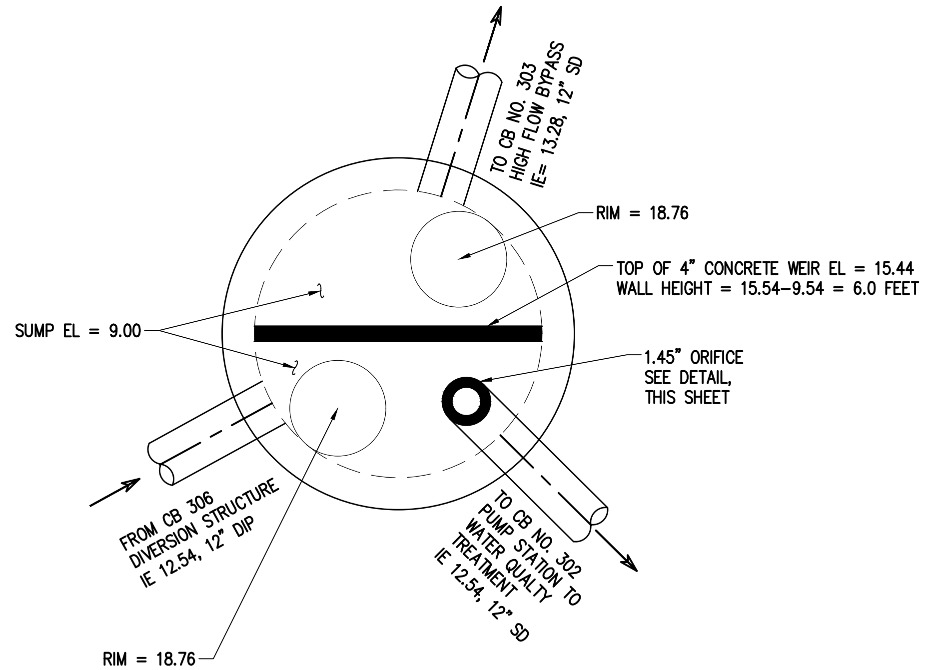
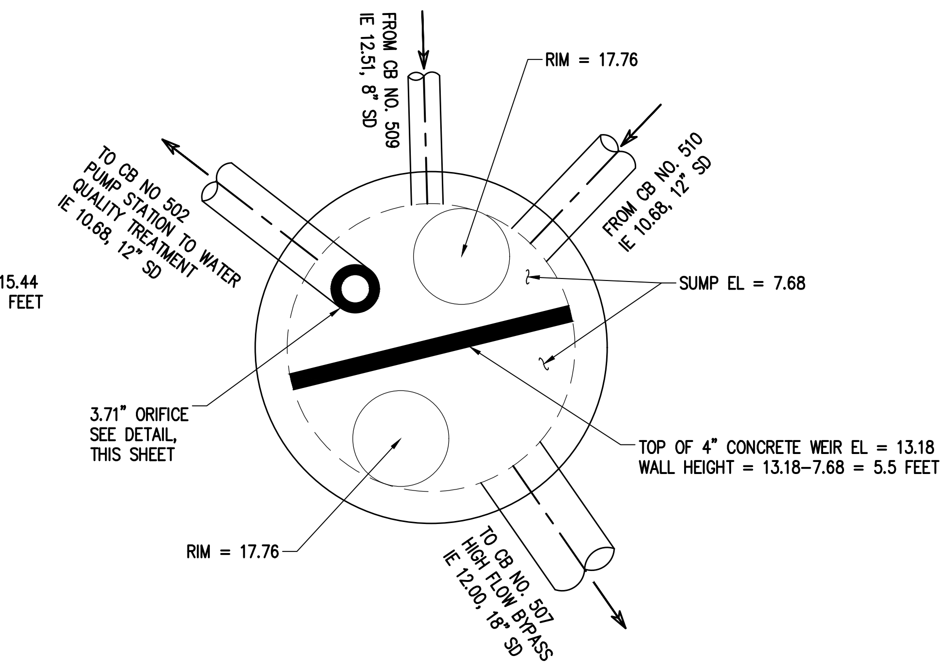


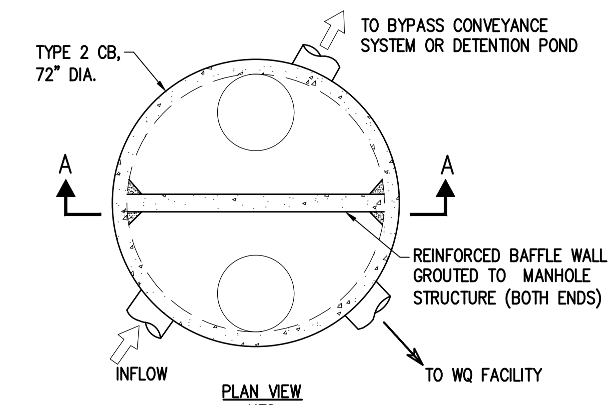
FLOW SPLITTER STRUCTURE NO. 305 (NORTH)

NTS



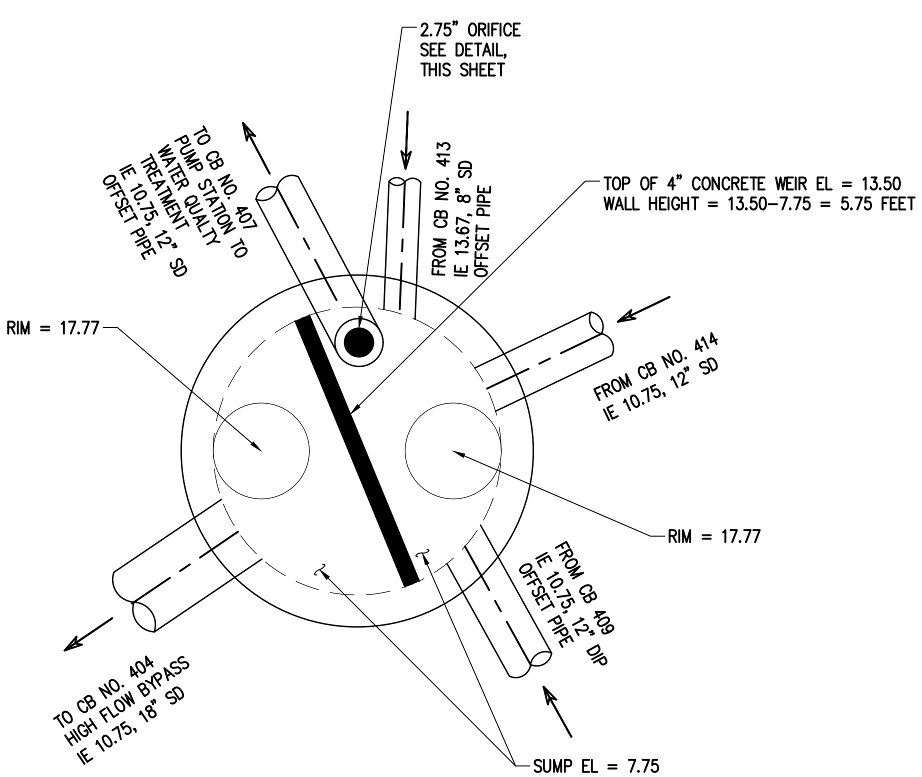
FLOW SPLITTER STRUCTURE NO. 508 (CENTRAL)

NTS



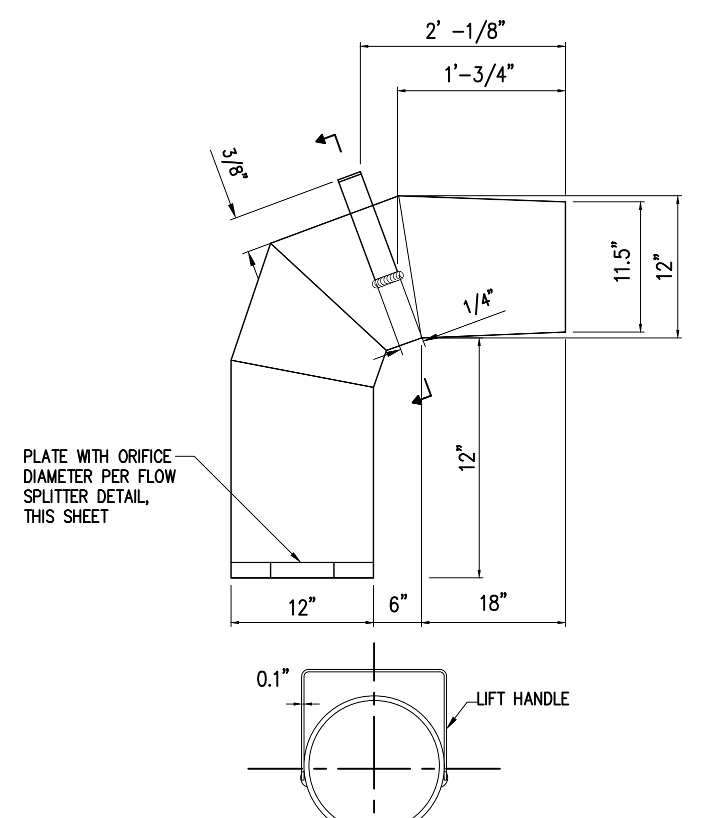
PLAN VIEW

NTS



FLOW SPLITTER STRUCTURE NO. 408 (SOUTH)

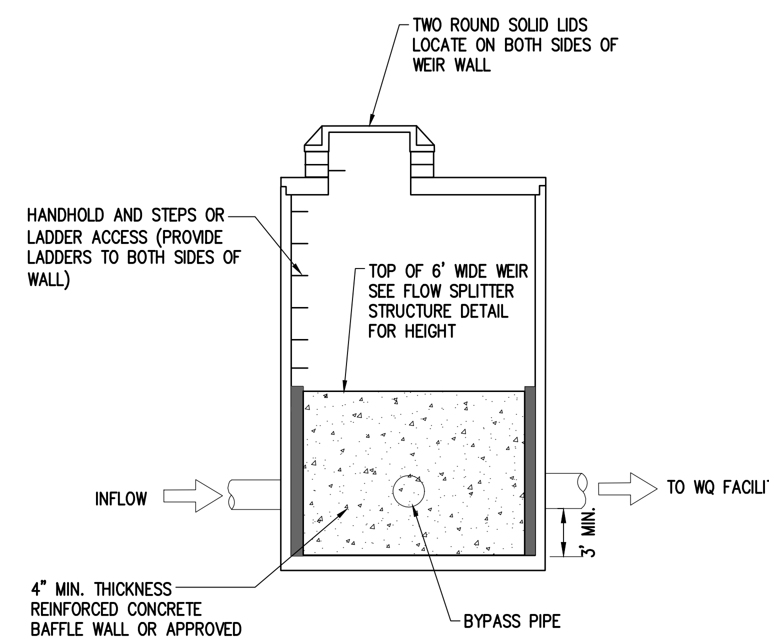
NTS



NOTES:
1. ORIFICE TO BE MADE OF 22 GA SHEET METAL OR 16 GA ALUMINUM
2. ALL JOINTS TO BE SEAMED AND SOLDERED, OR WELDED
3. ALL LONGITUDINAL JOINTS TO BE RIVETED OR WELDED
4. DIAMETER "D" IS NOMINAL DIAMETER OF OUTLET PIPE
5. LIFT HANDLE MUST BE WELDED TO OUTSIDE OF TRAP (1" WIDE X 0.1" THICK)

ORIFICE DETAIL

NTS



SECTION A-A

NTS

TYPICAL FLOW SPLITTER STRUCTURE DETAIL

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CIVIL
STORM DRAINAGE
FLOW SPLITTER DETAILS

REVISIONS				
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CHARLIE CONWAY	
PROJECT MANAGER	DATE
DJ DEAN	MAY 2019
PROJECT ARCHITECT	DATE

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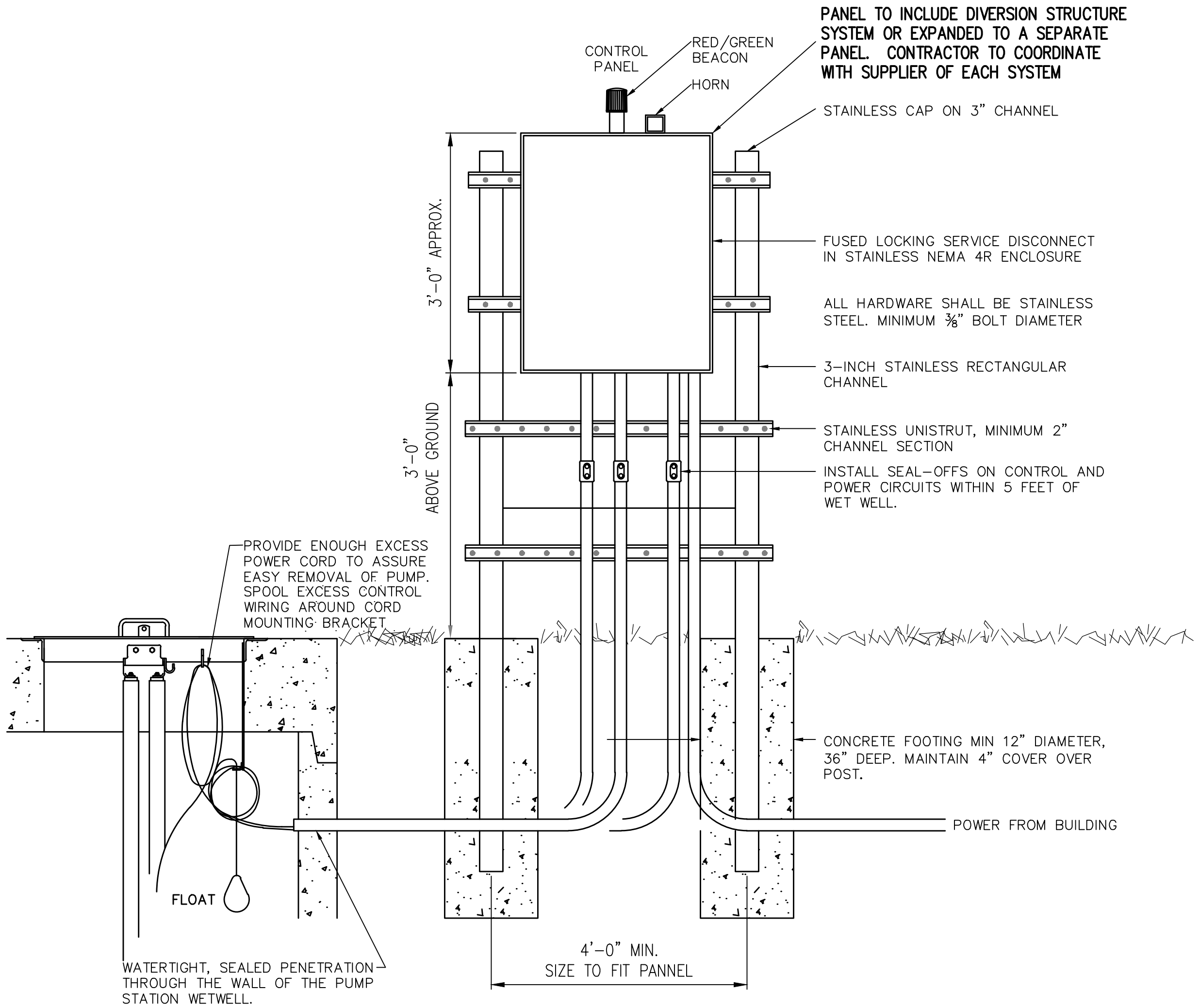


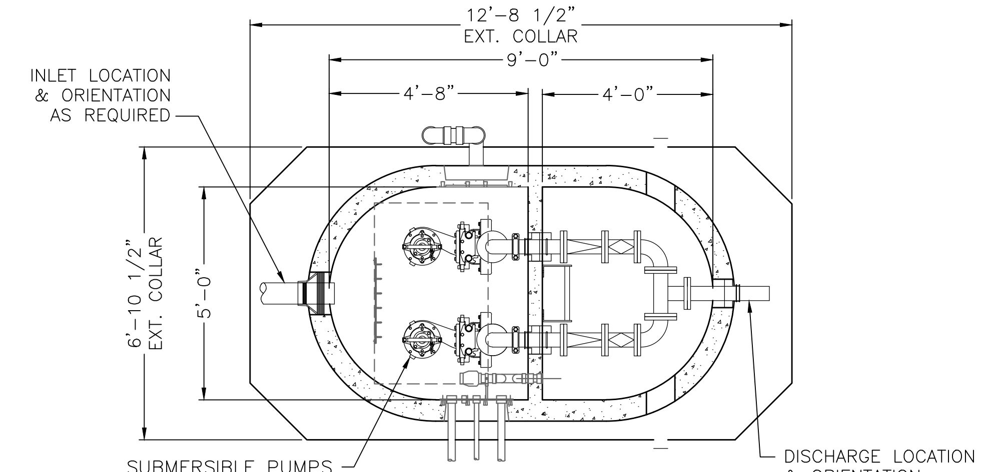
NOTE:

COORDINATE LOCATION OF PANEL FOR BOTH THE PUMP AND DIVERSION STRUCTURE. DETAIL SHOWN PROVIDES INSTALLATION OF PANEL LOCATION WITHIN VEGETATED AREA. MOUNTING DESIGN TO BE REVISED BASED ON LOCATION OR OTHER PANELS BY OTHERS TO BE MOUNTED WITHIN THE VICINITY SELECTED BY THE OWNER. MULTIPLE PANELS MAY BE NEEDED BASED ON CONTROL LAYOUT AND CONFIGURATION FOR THE FOLLOWING CONTROLS:

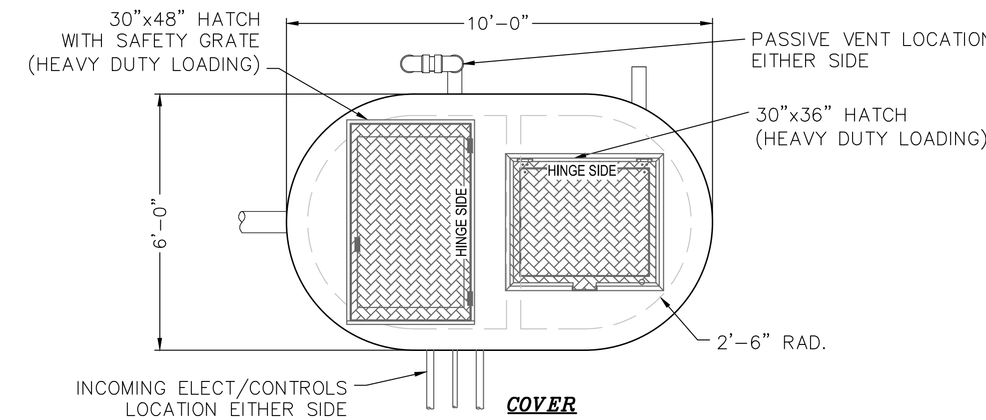
PUMP CONTROL PANEL SHALL PROVIDE THE FOLLOWING FUNCTIONS: (1) HIGH LEVEL ALARM (2) LAG PUMP ON (3) LEAD PUMP ON (4) PUMPS OFF.

DIVERSION STRUCTURE CONTROL PANEL SHALL PROVIDE THE FOLLOWING FUNCTIONS: (1) VALVE ONE OPEN (2) VALVE ONE CLOSED, (3) VALVE TWO OPEN, (4) VALVE FOUR CLOSED.

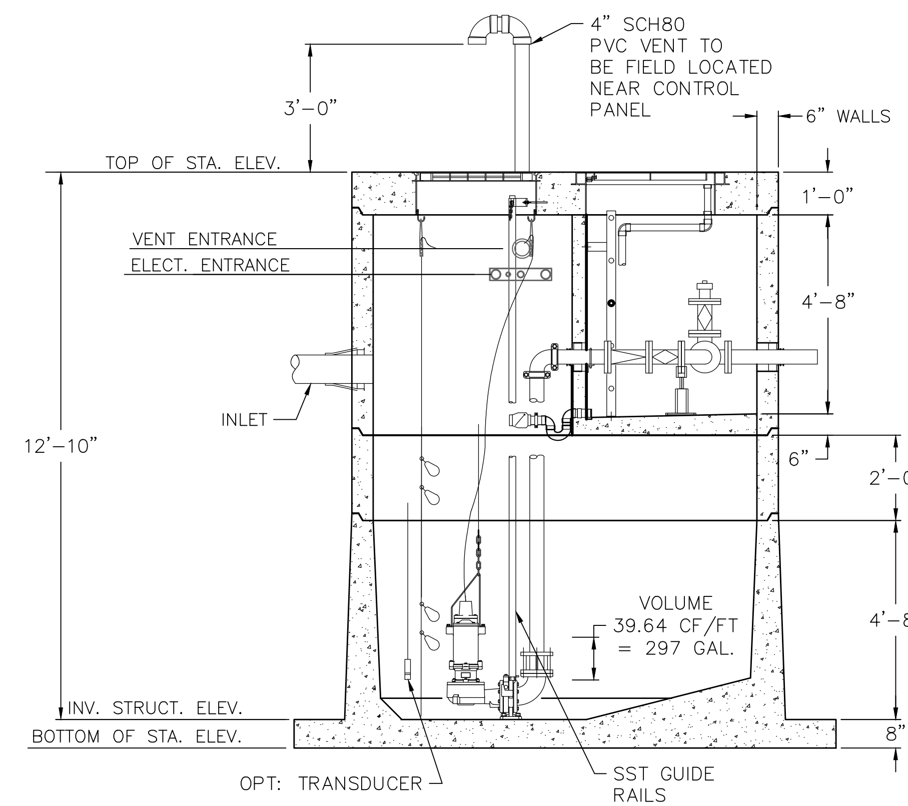
TYPICAL POWER AND CONTROL SYSTEM LAYOUT DETAIL
NTS



VAULT SECTION



COVER



INTERIOR ELEVATION VIEW
RC509 x 12'-10"

PACKAGE PUMP STATION DETAIL
OLDCASTLE PRECAST ONELIFT PUMP STATION MODEL NO. RC509 OR APPROVED EQUAL

NOTE:

1. THE PACKAGE PUMP STATION WITH ALL LISTED COMPONENTS DESIGNED AND SUPPLIED BY A SINGLE COMPANY (WHO IS NOT THE CONTRACTOR) SHALL DESIGN AND SUPPLY ALL CIVIL, MECHANICAL, ELECTRICAL, AND CONTROL STRUCTURES AND EQUIPMENT.
2. THE PACKAGE PUMP STATION SUPPLIER SHALL BE SOLELY RESPONSIBLE FOR PROPER INTEGRATION, DESIGN, SUPPLY, PERFORMANCE, AND WARRANTY OF ALL PACKAGE PUMP STATION COMPONENTS DELINEATED ON THE DRAWINGS, WHICH SHALL BE USED AS A GUIDE OF THE MINIMUM PRODUCT SPECIFICATIONS THAT SHALL BE MET.
3. PUMP STATION SUPPLIER SHALL PROVIDE START UP TEST PER EQUIPMENT MANUFACTURERS REQUIREMENTS, AND PROVIDE ONSITE TRAINING OF OWNER PERSONNEL.
4. EACH PUMP STATION SHALL BE EQUIPPED WITH RAIL SYSTEM AND DISCHARGE ELBOW, SEALING FLANGE WITH RAIL GUIDE, DISCONNECT ELBOW, LIFTING CHAIN, ACCESS FRAME AND DOOR, FLOAT MOUNTING BRACKET, AND GUIDE RAILS.
5. ALL EQUIPMENT SHALL BE EXPLOSION-PROOF AND RATED FOR CLASS 1 DIVISION 1 ENVIRONMENT.
6. CORE DRILL WETWELL PENETRATIONS AFTER VERIFYING PIPE LAYOUT AND DIMENSIONS.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL PERMITS REQUIRED PRIOR TO CONSTRUCTION AND COORDINATE NECESSARY INSPECTIONS.

<u>PUMP STATION NORTH</u>

SUBMERSIBLE DUPLEX PUMP MODEL: FLYGT 1305S-2X.263E.S68 OR APPROVED EQUAL.

FLOW RATE: 103 GPM

HEAD: 14.2 FT

POWER: 460V, 3 HP, 60 Hz

DISCHARGE DIAMETER: 3 INCH

<u>PUMP STATION CENTRAL</u>

SUBMERSIBLE DUPLEX PUMP MODEL: FLYGT NP 3085 MT3, ADAPTIVE 456 OR APPROVED EQUAL.

FLOW RATE: 389 GPM

HEAD: 17.1 FT

POWER: 460V, 3 HP, 60 Hz

DISCHARGE DIAMETER: 3 INCH

<u>PUMP STATION SOUTH</u>

SUBMERSIBLE DUPLEX PUMP MODEL: FLYGT NP 3085 SH3, ADAPTIVE 453 OR APPROVED EQUAL.

FLOW RATE: 164 GPM

HEAD: 10.2 FT

POWER: 460V, 3 HP, 60 Hz

DISCHARGE DIAMETER: 3 INCH

INCLUDE ALL FLOATS NECESSARY TO OPERATE A DUPLEX SUBMERSIBLE PUMP STATION TO OPERATE AT HIGHEST EFFICIENCY. INCLUDE FLOAT FOR HIGH LEVEL WARNING TO INDICATE PUMP SYSTEM MALFUNCTION

<u>SEE PROFILES FOR INLET AND DISCHARGE ELEVATIONS</u>

<u>WETWELL DESIGN:</u>

FOR CONCRETE WETWELL DESIGN, SEE CONCRETE VAULT GENERAL NOTES

HATCH AND TOP SLAB DESIGN FOR HEAVY DUTY LOADING

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STORM DRAINAGE
STORM DRAINAGE
PACKAGE PUMP STATION DETAIL

NO.	DATE	BY	APPR.	REVISIONS

SCALE: ONE INCH AS DRAWN

Approved By

DJ DEAN	OCT 2019
QA/QC MANAGER	DATE
CHARLIE CONWAY	
PROJECT MANAGER	DATE
DJ DEAN	MAY 2019
PROJECT ARCHITECT	DATE

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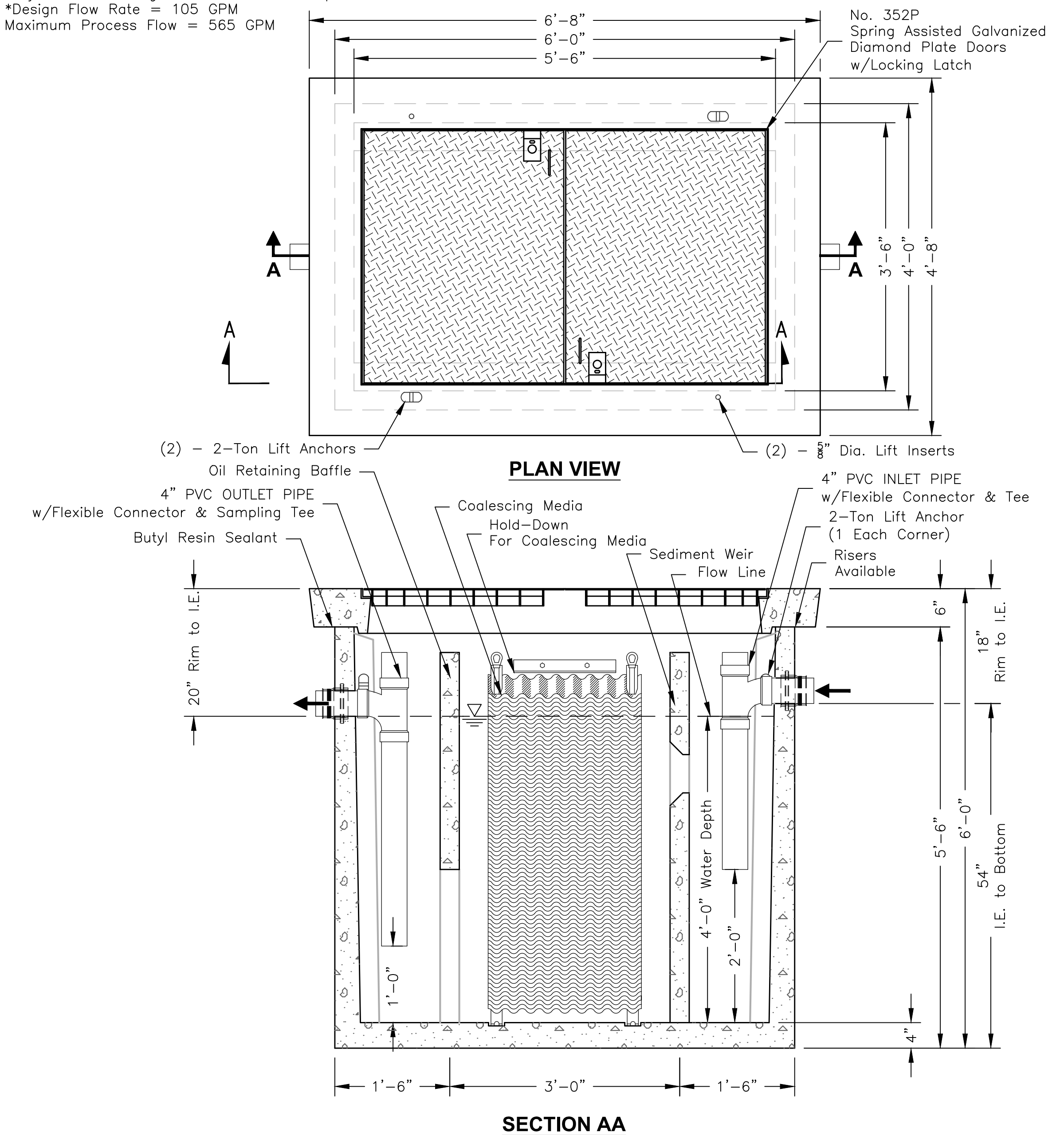
Projected Coalescing Plate Area = 444 Sq.Ft.
*Design Flow Rate = 105 GPM
Maximum Process Flow = 565 GPM



*DESIGN FLOW RATE	EFFLUENT QUALITY	100% COLLECTED SIZE
105 GPM	10 ppm	60 Micron

Basic Design Information: *
Influent Characterics
- Oil Specific Gravity = 0.88
- Operating Temperature = 50°
- Influent Oil Concentration = 100 ppm
- Mean Oil Droplet Size = 130 Microns
- .033 ft/min. Critical Oil Droplet Predicted Rise Rate

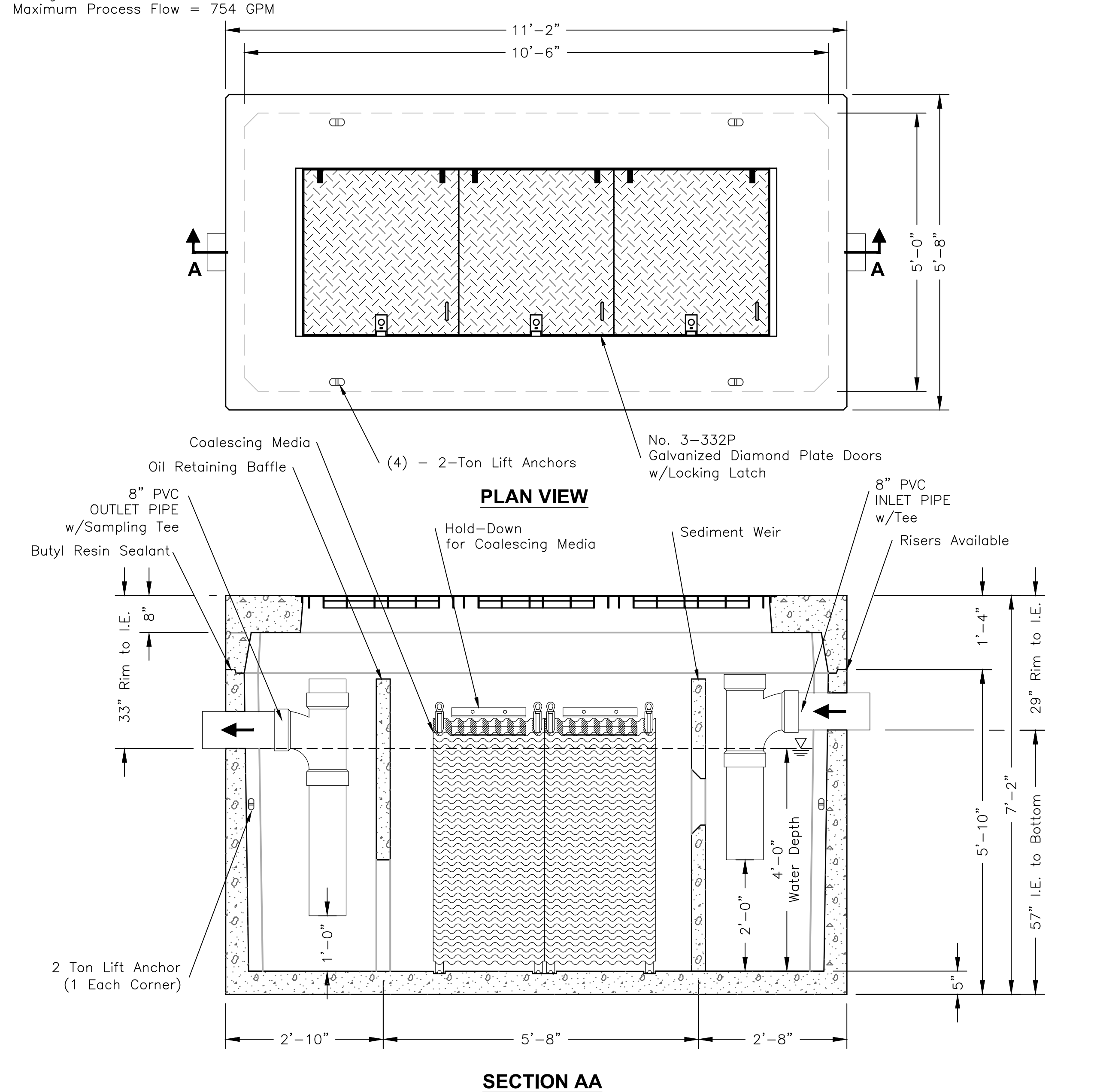
*Basic Design Information per Washington State Department of Ecology; User to Adjust Estimates for Variations in Real Conditions.

Notes:
- Static Water Depth = 4'-0"
- Prior to "Startup" of system, fill with clean water to bottom of outlet pipe. For best results, fill to flow line.
- Follow Regular Inspection, Cleaning, & Maintenance Schedule (See Clean Out & Maintenance).

OIL/WATER COALESCING SEPARATOR NORTH TREATMENT FLOW RATE @ 105 GPM

OLDCASTLE PRECAST, INC. MODEL NO. 660-CPS OR APPROVED EQUAL

Projected Coalescing Plate Area = 1,184 Sq.Ft.
*Design Flow Rate = 280 GPM
Maximum Process Flow = 754 GPM



*DESIGN FLOW RATE	EFFLUENT QUALITY	100% COLLECTED SIZE
280 GPM	10 ppm	60 Micron

Basic Design Information: *
Influent Characterics
- Oil Specific Gravity = 0.88
- Operating Temperature = 50°
- Influent Oil Concentration = 100 ppm
- Mean Oil Droplet Size = 130 Microns
- .033 ft/min. Critical Oil Droplet Predicted Rise Rate

*Basic Design Information per Washington State Department of Ecology; User to Adjust Estimates for Variations in Real Conditions.

Notes:
- Static Water Depth = 4'-0"
- Prior to "Startup" of system, fill with clean water to bottom of outlet pipe. For best results, fill to flow line.
- Follow Regular Inspection, Cleaning, & Maintenance Schedule (See Clean Out & Maintenance).

OIL/WATER COALESCING SEPARATOR SOUTH TREATMENT FLOW RATE @ 280 GPM

OLDCASTLE PRECAST, INC. MODEL NO. 5106-2-CPS OR EQUIVALENT

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CIVIL
STORM DRAINAGE
OIL-WATER SEPARATOR NORTH & SOUTH

REVISIONS

NO.	DATE	BY	APPR.

SCALE: ONE INCH AS DRAWN

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DJ DEAN	OCT 2019
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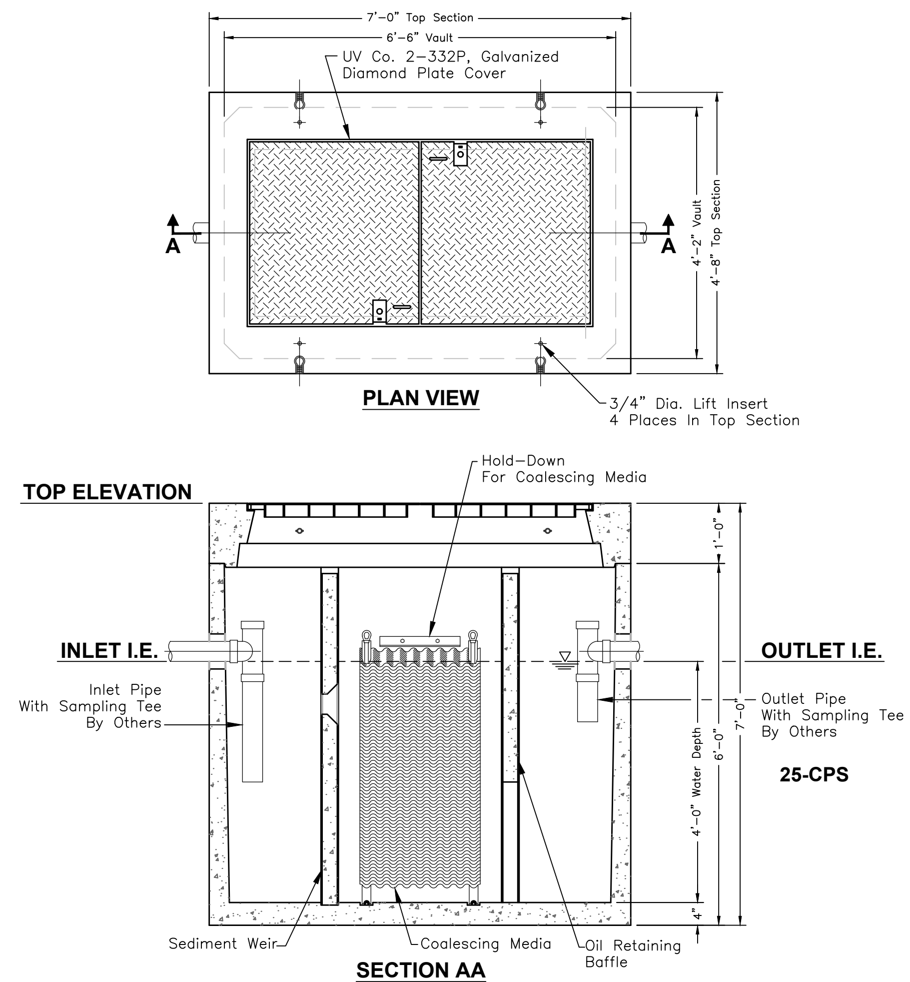
Project Plate Area = 592 Sq/ft

Maximum Process Flow = 555 GPM



STRUCTURAL NOTES:
1. Concrete: 28 Day Compressive Strength f'c= 7000 psi
2. Rebar: ASTM A-615 Grade 60
3. Mesh: ASTM A-185 Grade 65
4. Design: ACI-318-05 Building Code
   ASTM C-890 "Minimum Structural Design Loading For Underground Precast Concrete Water and Wastewater Structures"
5. Loads: HS-20 Truck Wheel w/ 30% Impact Per AASHTO

GENERAL NOTES:
1. All Baffles and Weirs To Be Precast Concrete
2. Static Water Depth = 4'-0"
3. Contractor to:
   Supply and Install All Piping & Sampling Tees
   Grout In All Pipes
   Fill With Clean Water Prior To "Start-Up" Of System
   Verify All BLockout Sizes and Locations

INFORMATION NEEDED:
Top Of Separator Elevation:________
Inlet Pipe Size: ________
Inlet Pipe Elevation: ________
Outlet Pipe Size: ________
Outlet Pipe Elevation: ________

BASIC DESIGN INFORMATION:
INFLUENT CHARACTERISTICS:
Oil Specific Gravity: 0.88
Operating Temperature: 50°
Influent Oil Concentration: 100 ppm
Mean Oil Droplet Size: 130 Microns
0.33 ft/min. Rise Rate
Designed Per Washington State Department Of Ecology

FLOW RATE	EFFLUENT QUALITY	100% COLLECTED SIZE
146 GPM	10 ppm	60 Micron

OIL/WATER COALESCING SEPARATOR CENTRAL TREATMENT FLOW RATE @ 555 GPM

OLDCASTLE PRECAST, INC. MODEL NO. 577-CPS OR APPROVED EQUAL

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REVISIONS			
NO.	DATE	BY	APPR.

SCALE: ONE INCH AS DRAWN

Approved By
DJ DEAN — OCT 2019
QA/QC MANAGER — DATE
CHARLIE CONWAY
PROJECT MANAGER — DATE
DJ DEAN — MAY 2019
PROJECT ARCHITECT — DATE

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FILENAME
DESIGNED BY
DRAWN BY
CHECKED BY

WILLIAM R. EDRALIN, STATE OF WASHINGTON, 45211, REGISTERED PROFESSIONAL ENGINEER

PERMIT SUBMITTAL
11/01/2019

C079

NOTE:

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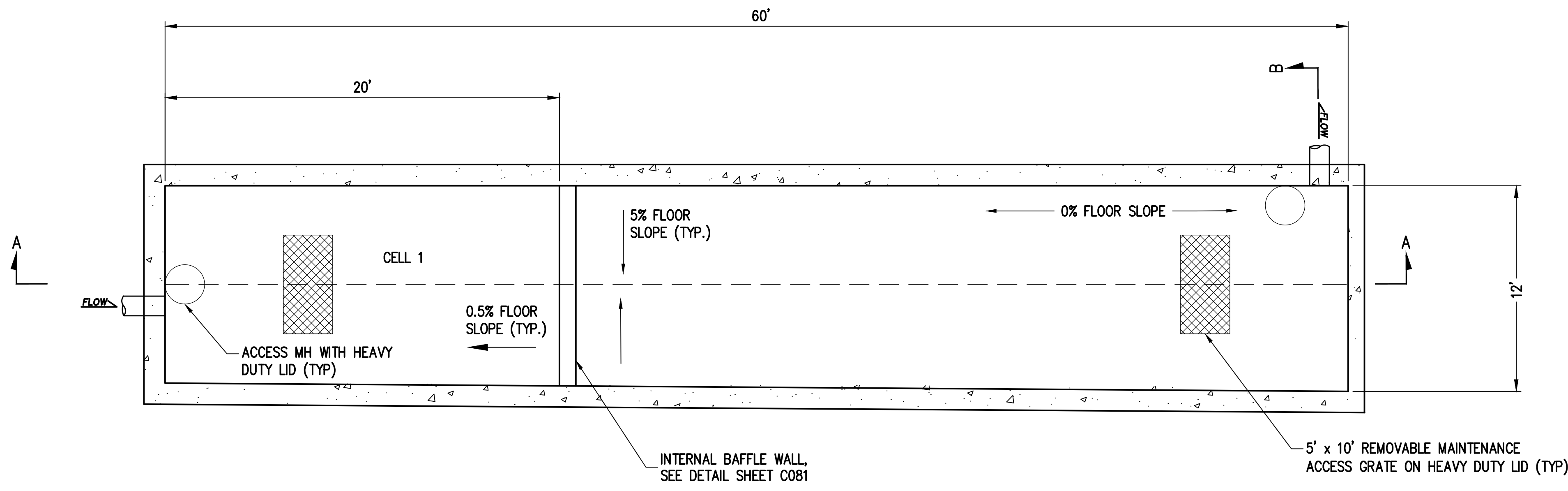
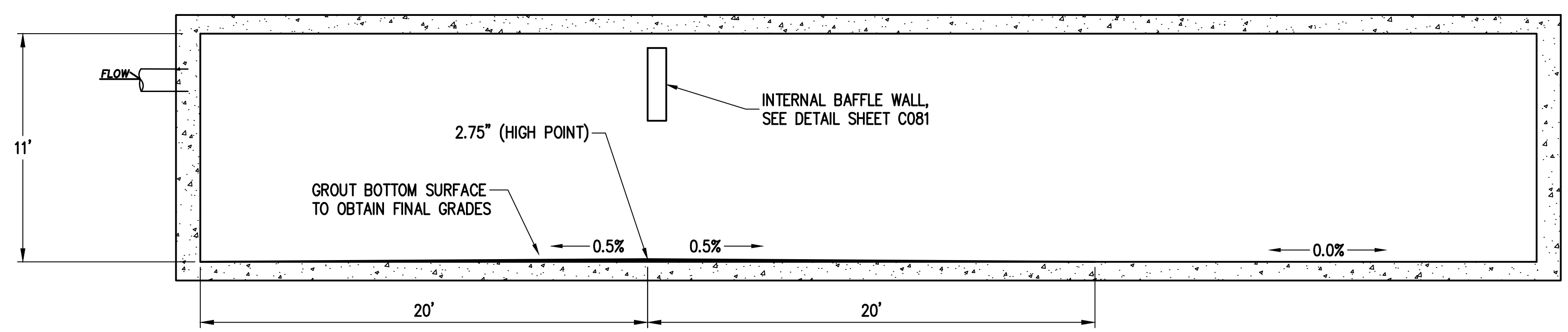
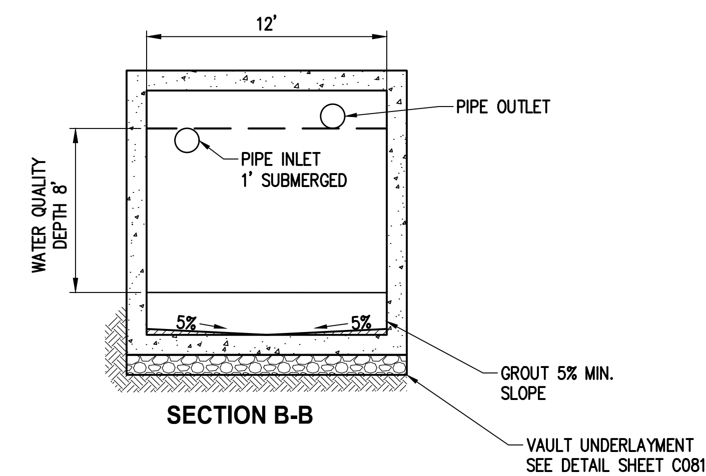


PLAN VIEW



SECTION A-A



SECTION B-B

WATER QUALITY VAULT NORTH DETAIL

NTS

STRUCTURAL NOTES

GENERAL

1. THE STRUCTURAL DRAWINGS REPRESENT THE COMPLETED STRUCTURE AND ARE NOT INTENDED TO INDICATE THE MEANS AND METHOD OF CONSTRUCTION. THE CONTRACTOR SHALL PROVIDE AND BE RESPONSIBLE FOR ALL SHORING, BRACING, SCAFFOLDING, FORMWORK, GUYS, RIGGING AND OTHER TEMPORARY SUPPORTS AS NEEDED TO SAFELY RESIST ALL LOADING IMPOSED UPON THE STRUCTURE BOTH DURING THE REMOVAL OF ANY EXISTING STRUCTURE AND DURING ERECTION AND CONSTRUCTION.
2. ERECTION AND CONSTRUCTION PROCEDURES SHALL CONFORM TO THE REQUIREMENTS OF APPLICABLE ORDINANCES, REGULATIONS AND THE PROVISION OF CODES CITED BELOW.
3. ALL CONSTRUCTION SHALL BE COORDINATED WITH AND SHALL BE SUBJECT TO THE INSPECTION REQUIREMENTS CITED BELOW.
4. THE CONTRACTOR SHALL COORDINATE ALL DIMENSIONS, DETAILS, AND OPENINGS BETWEEN THE STRUCTURAL DRAWINGS AND THAT OF OTHER TRADES PRIOR TO COMMENCING WORK. SHOULD THERE BE ANY CONFLICTS, NOTIFY THE TECHNICAL REPRESENTATIVE FOR CLARIFICATION.
5. EQUIPMENT OR MATERIAL BEING TRANSPORTED TO LOCATION OR TEMPORARILY STORED SHALL NOT EXCEED THE DESIGN LIVE LOAD FOR THE STRUCTURE.
6. THESE GENERAL NOTES ARE TO BE READ IN CONCERT WITH THE SPECIFICATIONS. ANY CONFLICTS BETWEEN THE CONTRACT DRAWINGS AND SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE TECHNICAL REPRESENTATIVE FOR CLARIFICATION.

CODES:

1. 2006 INTERNATIONAL BUILDING CODE.
2. ASCE 7-05 MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES
3. AMERICAN CONCRETE INSTITUTE (ACI) 318-05
4. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, THIRTEENTH EDITION

DESIGN LIVE LOADS:

AIRCRAFT LOADING.............. 100,000 LBS.
TUG LOADING....................... 37,500 LBS.
HS20 LOADING..................... 16,000 LBS.

SEISMIC DESIGN DATA:

MISCELLANEOUS STRUCTURES: I = 1.0
MAPPED SPECTRAL RESPONSE - Ss=150 S1=50
SOIL PROFILE TYPE: F

ALLOWABLE DESIGN STRESSES:

CONCRETE (28 DAY STRENGTH)
ALL CONCRETE UNLESS NOTED OTHERWISE fc'= 4,000 PSI

REINFORCEMENT:

REINFORCEMENT BARS (ASTM A615) Fy = 60,000 PSI

FOUNDATIONS:

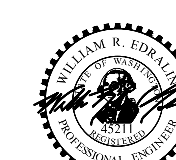
1. SPREAD FOOTING INSTALLATION SHALL BE MONITORED BY THE TECHNICAL REPRESENTATIVE.
2. MIN ALLOWABLE BEARING PRESSURE REQUIRED IS 3,000 PSF, TO BE FIELD VERIFIED.
3. BEAR ALL FOOTINGS ON INORGANIC, UNDISTURBED, DENSE SANDY GRAVEL SOIL OR IN STRUCTURAL FILL AT DEPTHS INDICATED ON DRAWINGS.
4. BEAR FOOTINGS SUBJECT TO FROST A MINIMUM OF 1'-6" BELOW LOWEST ADJACENT GRADE.
5. NO FOOTING SHALL BE PLACED HIGHER THAN 2.0 HORIZONTAL TO 1.0 VERTICAL FROM ANY ADJACENT EXCAVATION.

CONCRETE:

1. DESIGN, MATERIAL AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE FOLLOWING STANDARDS UNLESS OTHERWISE MODIFIED ON THE DRAWINGS OR IN THE SPECIFICATIONS.
   A. 2006 INTERNATIONAL BUILDING CODE.
   B. ACI 318-05 BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE
   C. ACI SP-66 DETAILING MANUAL
   D. ACI 301-08 SPECIFICATIONS FOR STRUCTURAL CONCRETE
   E. CRSI RECOMMENDED PRACTICE FOR PLACING REINFORCING BARS
2. PRIOR TO SHIPPING OF REINFORCING STEEL TO THE FIELD, SHOP DRAWINGS SHALL BE SUPPLIED TO THE TECHNICAL REPRESENTATIVE FOR REVIEW.
3. ALL CONCRETE SHALL CONTAIN A WATER-REDUCING ADMIXTURE, AND/OR A HIGH-RANGE WATER-REDUCING ADMIXTURE, REDUCING THE WATER BY AT LEAST 10 PERCENT FROM THE SAME MIX WITHOUT THE ADMIXTURE.
4. NO WATER FROM THE TRUCK SYSTEM OR ELSEWHERE SHALL BE ADDED AFTER THE INITIAL INTRODUCTION OF MIXING WATER FOR THE BATCH.
5. NOMINAL MAXIMUM SIZE OF AGGREGATE SHALL BE 3/4 INCH. NOMINAL MAXIMUM SIZE OF AGGREGATE IN CONCRETE ON STEEL DECK SHALL BE 3/8 INCH. MAXIMUM SIZE AGGREGATE IN SPREAD FOOTING SHALL BE 1 INCH. AGGREGATE SHALL CONFORM TO ASTM C33.
6. PROVIDE A MINIMUM COVER AS SPECIFIED IN ACI 318-99, BUT NOT LESS THAN THE FOLLOWING:
   A. CONCRETE PLACED DIRECTLY AGAINST GROUND - 3"
   B. CONCRETE EXPOSED TO WEATHER
      #6 OR LARGER - 2"
      #5 OR SMALLER - 1 1/2"
   C. CONCRETE NOT EXPOSED TO WEATHER OR GROUND
      SLABS, WALLS, JOISTS (#11 AND SMALLER) - 3/4"
      BEAMS AND COLUMNS - 1 1/2"
7. REINFORCEMENT INCLUDING WELDED WIRE FABRIC SHALL BE POSITIVELY SUPPORTED IN THE POSITION AS SHOWN ON THE DRAWINGS AND SHALL BE MAINTAINED IN THIS POSITION DURING THE PLACING OF CONCRETE.
8. ALL EXPOSED EDGES OF CONCRETE SHALL HAVE A 3/4 INCH 45 DEGREE CHAMFER.
9. REFER TO MECHANICAL, PIPING AND ELECTRICAL DRAWINGS FOR EMBEDDED ITEMS.
10. FLOOR FINISHES SHALL BE AS SHOWN ON THE DRAWINGS AND/OR DESCRIBED IN THE SPECIFICATIONS.
11. ALL WELDED WIRE FABRIC SHALL BE LAPPED AT LEAST 12 INCHES. ALL REINFORCEMENT BAR LAPS SHALL CONFORM TO ACI LAP REQUIREMENTS. STAGGER SPLICES WHEREVER POSSIBLE.
12. WELDING OF REINFORCING STEEL IS PROHIBITED.
13. ALL REINFORCING BAR BENDS SHALL BE MADE COLD BEND. RADII TO BE PER ACI SPECIFICATION.
14. NO ALUMINUM CONDUITS OR PIPES SHALL BE EMBEDDED IN CONCRETE. THE USE OF ALUMINUM PIPES OR CHUTES TO TRANSPORT CONCRETE SHALL NOT BE PERMITTED.

PRECAST CONCRETE UNITS:

1. FABRICATION AND ERECTION OF PRECAST CONCRETE UNITS SHALL BE IN ACCORDANCE WITH PCI DESIGN HANDBOOK, 7TH EDITION, UNLESS OTHERWISE MODIFIED ON THE STRUCTURAL DRAWINGS OR IN THE SPECIFICATIONS.
2. THE STRUCTURAL DRAWINGS REPRESENT THE COMPLETED STRUCTURE. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING PLACEMENT OF EMBEDDED ITEMS, SHOP AND FIELD WELDING AND THE LOCATION OF ADDITIONAL OPENINGS OR EMBEDDED ITEMS.
3. THE PRECAST CONCRETE MANUFACTURER IS RESPONSIBLE FOR PROVIDING ADDITIONAL REINFORCING AND EMBEDDED ITEMS THAT MAY BE REQUIRED FOR LIFTING, TRANSPORTING AND INSTALLING THE COMPLETED PANEL.
4. ALL EXPOSED EDGES SHALL HAVE A 3/4" 45° CHAMFER.
5. SHOP DRAWINGS SHALL BE SUBMITTED TO THE TECHNICAL REPRESENTATIVE FOR APPROVAL PRIOR TO THE START OF FABRICATION.
6. REINFORCING BARS SHALL BE INSTALLED PER CRSI RECOMMENDED PRACTICE FOR PLACING REINFORCING.
7. REINFORCING SHALL BE DETAILED IN ACCORDANCE WITH ACI SP-66 DETAILING MANUAL.
8. ALL REINFORCING BAR BENDS SHALL BE MADE COLD.
9. WELDING OF REINFORCING BARS IS PROHIBITED.
10. EMBEDDED ITEMS SHALL BE FREE FROM DIRT, RUST AND/OR GREASE. EMBEDDED ITEMS SHALL NOT BE PAINTED.
11. ALL REBAR TO HAVE 90° HOOKS UNLESS DETAILED WITH 180° HOOKS OR 135° HOOKS.



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STORM DRAINAGE
WATER QUALITY VAULT NORTH

REVISIONS

NO.	DATE	BY	APPR.

SCALE: ONE INCH AS DRAWN

Approved By

DJ DEAN	OCT 2019
QA/QC MANAGER	DATE
CHARLIE CONWAY	
PROJECT MANAGER	DATE
DJ DEAN	MAY 2019
PROJECT ARCHITECT	DATE

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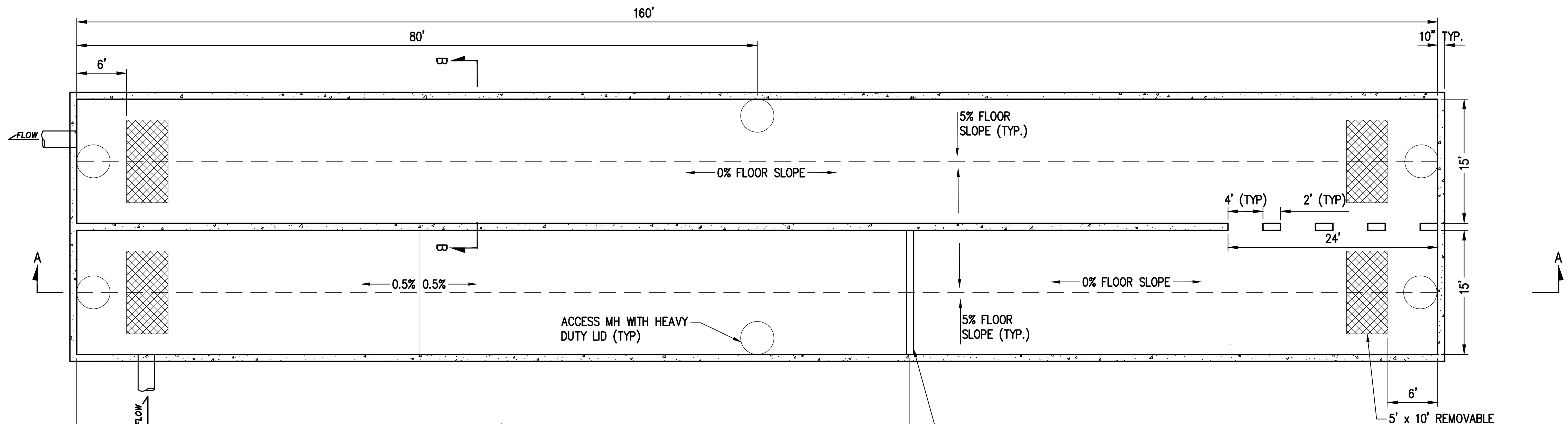
FILENAME

DESIGNED BY

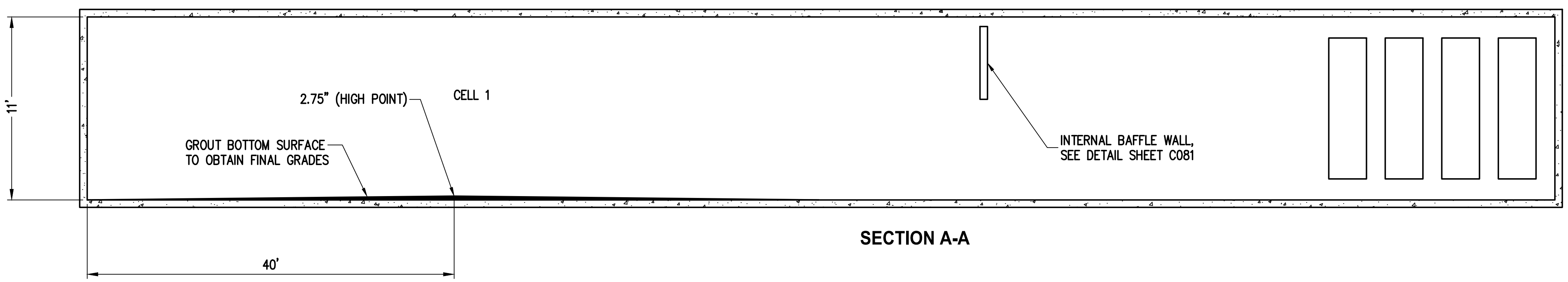
DRAWN BY

CHECKED BY

C080



PLAN VIEW



SECTION A-A

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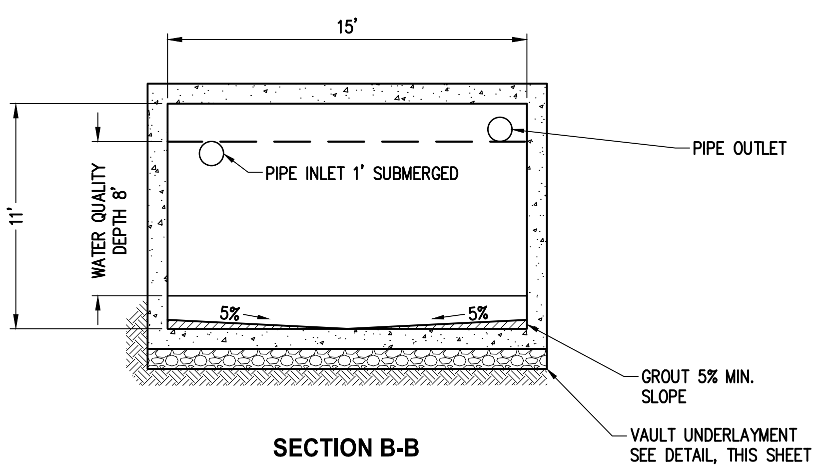
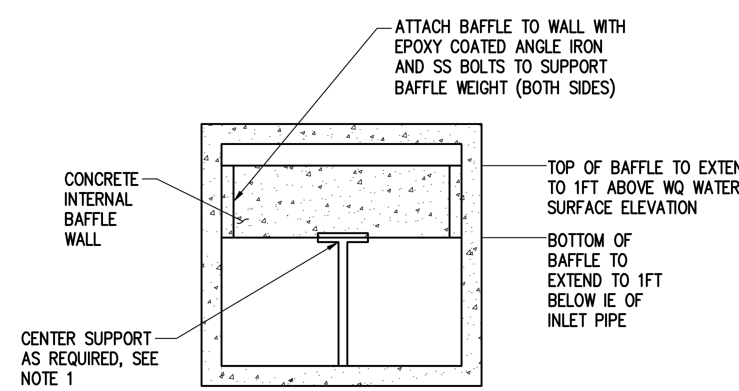


SECTION B-B

WATER QUALITY VAULT CENTRAL DETAIL

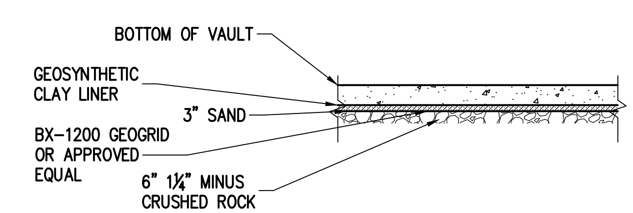
NTS



NOTE:
1. STRUCTURAL DESIGN FOR WETVAULT TO BE COMPLETED BY VENDOR IN ACCORDANCE WITH THE SPECIFICATIONS

INTERNAL BAFFLE WALL

NTS



NOTE:
1. GEOTECHNICAL ENGINEER TO BE ONSITE TO EVALUATE EXISTING SOILS TO DETERMINE IF VAULT UNDERLAYMENT IS NEEDED OR RECOMMEND AN ALTERNATIVE FOUNDATION DESIGN

VAULT UNDERLAYMENT

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CIVIL
STORM DRAINAGE
WATER QUALITY VAULT CENTRAL

REVISIONS

NO.	DATE	BY	APPR.

SCALE: ONE INCH AS DRAWN

Approved By

DJ DEAN OCT 2019
QA/QC MANAGER DATE
CHARLIE CONWAY
PROJECT MANAGER DATE
DJ DEAN MAY 2019
PROJECT ARCHITECT DATE

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FILENAME
DESIGNED BY
DRAWN BY
CHECKED BY

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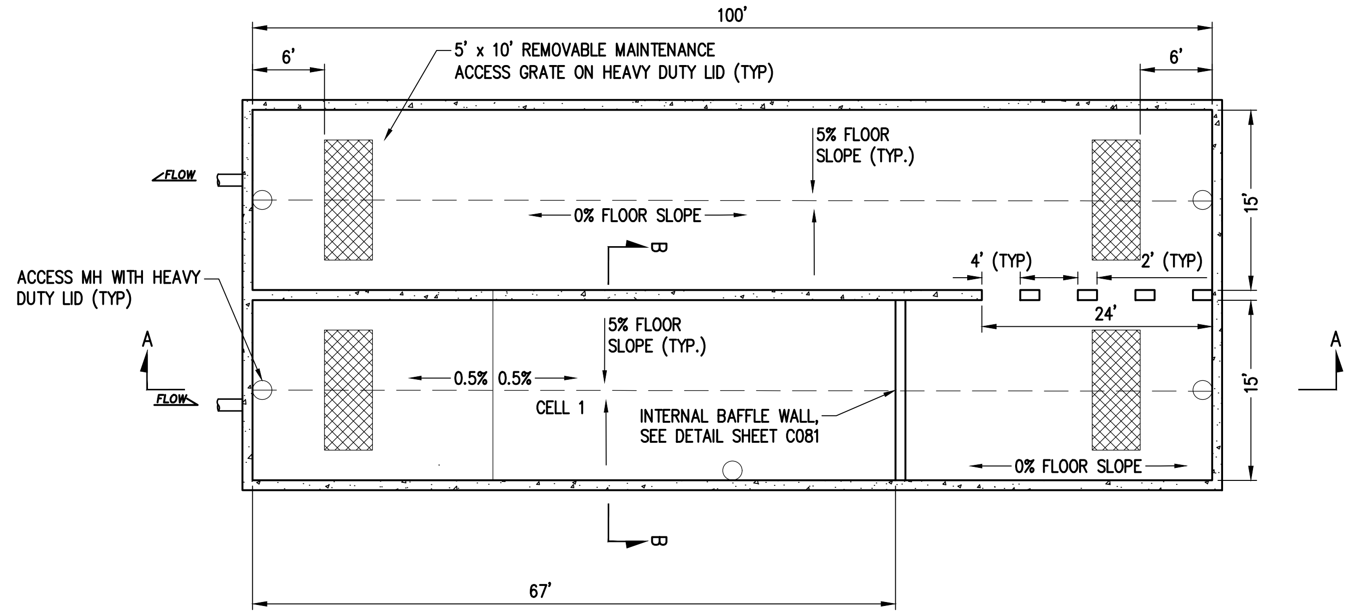

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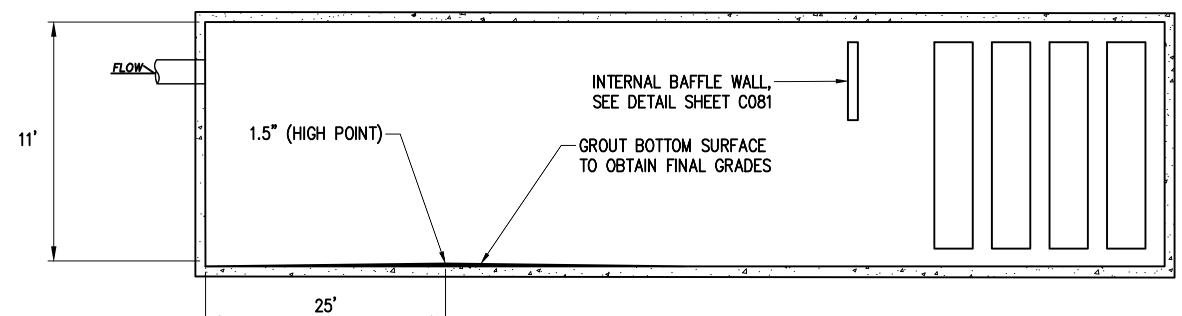

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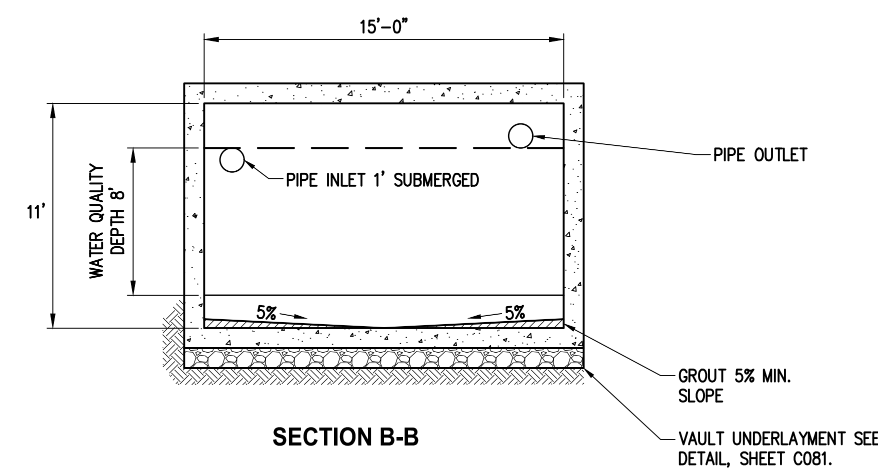

SECTION B-B

WATER QUALITY VAULT SOUTH DETAIL

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WATER QUALITY VAULT SOUTH

NO.	DATE	BY	APPR.	REVISIONS

SCALE: ONE INCH AS DRAWN

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DJ DEAN	OCT 2019
QA/QC MANAGER	DATE
CHARLIE CONWAY	
PROJECT MANAGER	DATE
DJ DEAN	MAY 2019
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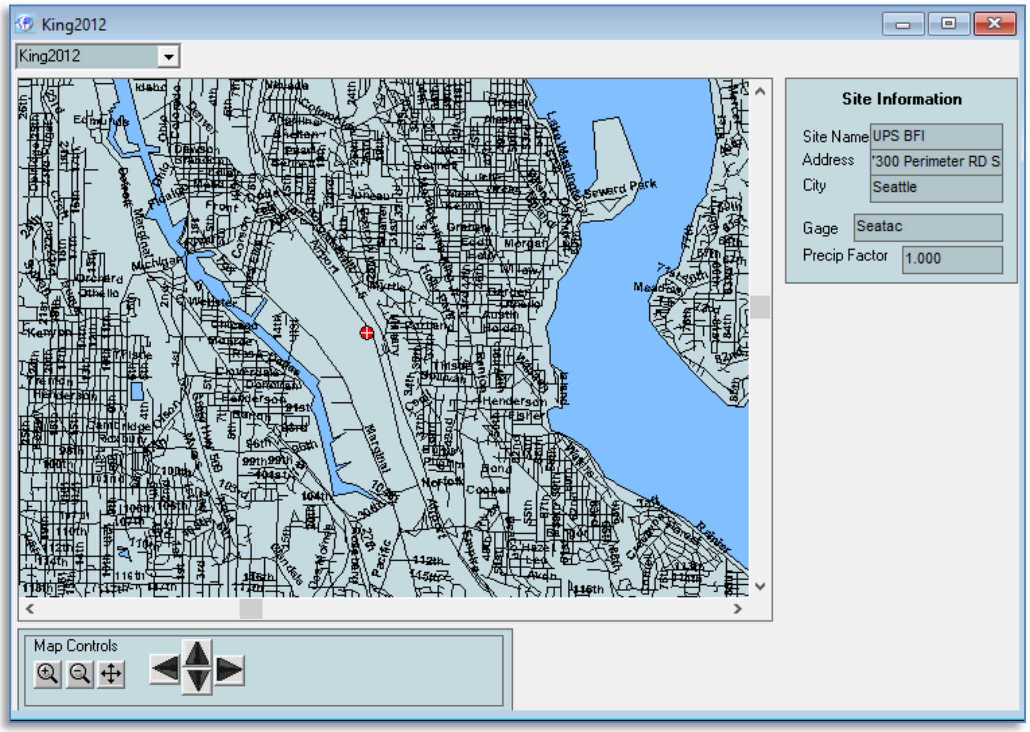
King2012
King2012
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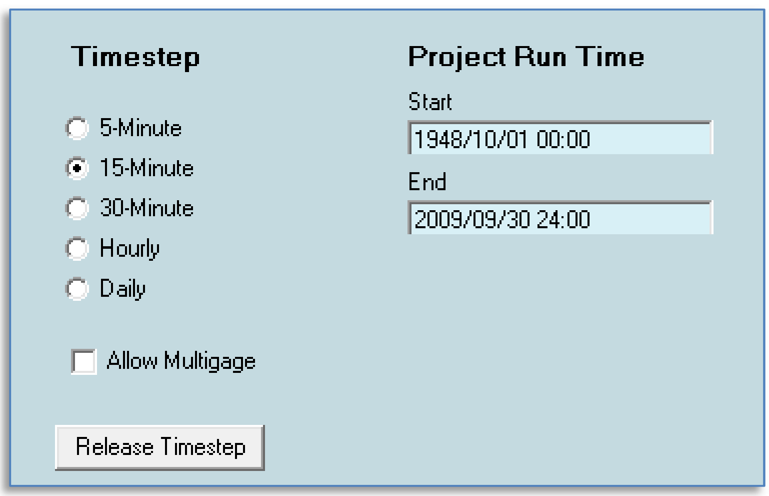
Address '300 Perimeter RD S
City Seattle
Gage Seatac
Precip Factor 1.000
Map Controls


Timestep
5-Minute
15-Minute
30-Minute
Hourly
Daily
Allow Multigage
Release Timestep
Project Run Time
Start
1948/10/01 00:00
End
2009/09/30 24:00

Subbasin Name: North ☐ Designate as Bypass for POC:

	Surface	Interflow	Groundwater
Flows To :			

Area in Basin ☑ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
		☑ ROADS/FLAT	.97

Water Quality

On-Line BMP

24 hour Volume (ac-ft) 0.1193

Standard Flow Rate (cfs) 0.1576

Off-Line BMP

Standard Flow Rate (cfs) 0.0890

Flow Frequency

Flow(cfs)		0801 15m
2 Year	=	0.3698
5 Year	=	0.4671
10 Year	=	0.5332
25 Year	=	0.6190
50 Year	=	0.6846
100 Year	=	0.7519

Subbasin Name: Central ☐ Designate as Bypass for POC:

Flows To :

Surface	Interflow	Groundwater

Area in Basin ☑ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
☑ C, Lawn, Flat	.29	☑ ROADS/FLAT	6.45

Water Quality

On-Line BMP

24 hour Volume (ac-ft) 0.7982

Standard Flow Rate (cfs) 1.0449

Off-Line BMP

Standard Flow Rate (cfs) 0.5903

```
Flow Frequency
Flow(cfs)   0802 15m
2 Year    =    2.4779
5 Year    =    3.1359
10 Year   =    3.5837
25 Year   =    4.1653
50 Year   =    4.6108
100 Year  =    5.0676
```

Subbasin Name: South ☐ Designate as Bypass for POC:

	Surface	Interflow	Groundwater
Flows To :			

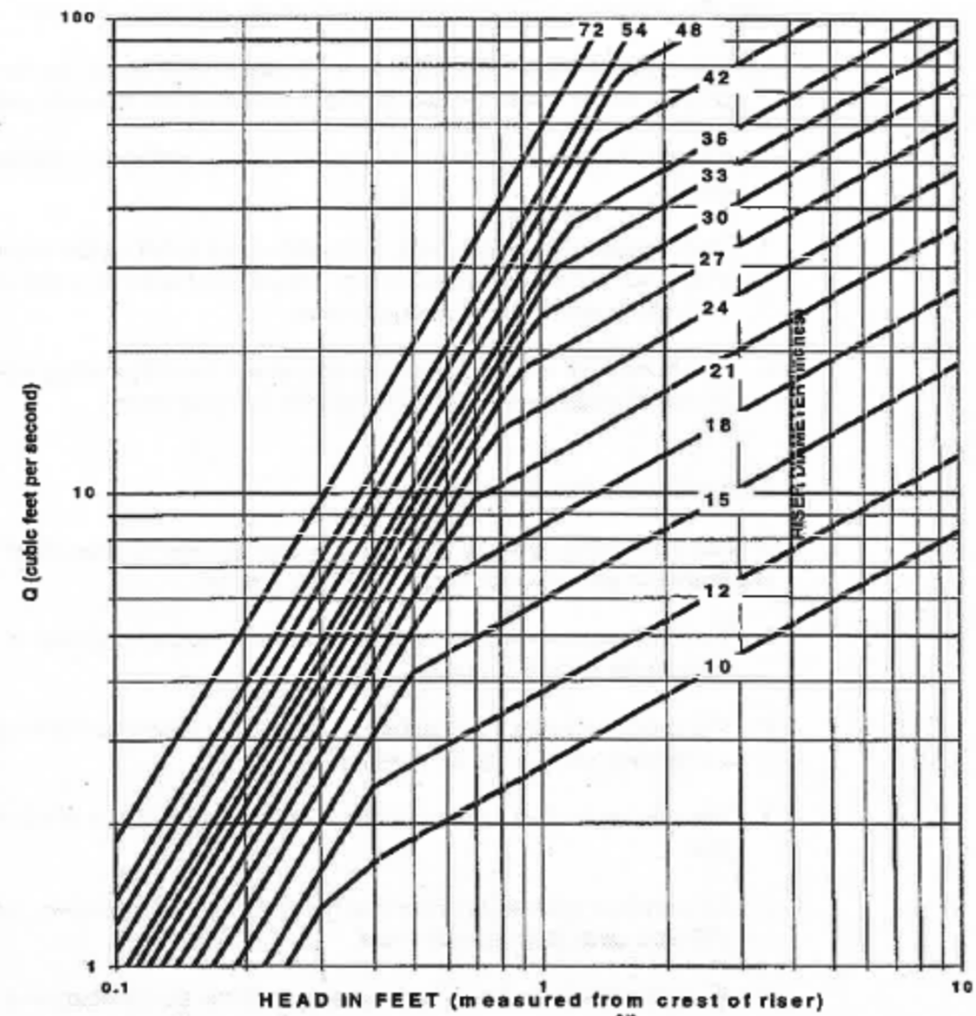
Area in Basin ☑ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
		☑ ROADS/FLAT	3.7

Water Quality

On-Line BMP		Off-Line BMP	
24 hour Volume (ac-ft)	0.4550		
Standard Flow Rate (cfs)	0.6011	Standard Flow Rate (cfs)	0.3396

```
Flow Frequency
Flow(cfs)   0803 15m
2 Year    =     1.4107
5 Year    =     1.7819
10 Year   =     2.0340
25 Year   =     2.3612
50 Year   =     2.6115
100 Year  =     2.8680
```



$Q_{weir} = 9.739\ DH^{3/2}$

$Q_{orifice} = 3.782\ D^2H^{1/2}$

Q in cfs, D and H in feet

Slope change occurs at weir-orifice transition

Figure 3.24 Riser Inflow Curves

Equation No. 1

SOLVE FOR D, ORIFICE DIAMETER

$$D = \left(\frac{4Q_{WQ}}{C\pi(2gh)^{0.5}}\right)^{(1/2)}$$

WHERE,

Q_{WQ} = WATER QUALITY PEAK FLOW

C = ORIFICE LOSS COEFFICIENT, 0.62

h = EFFECTIVE HEAD (TOTAL)

Equation No. 2

SOLVE FOR H, HYDRAULIC HEAD OVER WEIR

$$H = \left(\frac{3Q_{WQ}}{2C_D(2g)^{0.5}L}\right)^{(2/3)}$$

WHERE,

Q_{WQ} = WATER QUALITY PEAK FLOW

C_D = COEFFICIENT OF DISCHARGE, 0.61

L = WEIR LENGTH

Procedure

1. Size orifice (Equation No. 1) based on water quality flow rate and weir height [Range] in structure
2. Check weir height at 100-year peak flow (Equation No. 2) with respect to potential overtopping
3. Check orifice at 100-year flow
4. Select weir height and orifice diameter based on existing system hydraulics and to not exceed 10% increase of flow from 100-year peak flow to water quality system
5. To size overflow riser, see Figure 3.24 Riser Inflow Curves (2005 Stormwater Manual for Western Washinton, Volume III - p. 3-36)
   Calculate riser diameter based on the Q weir equation. Flow rate to WQ at 100-year flow rate is set to a maximum 10% exceedence
   Riser diameter is sized by using the remaining flow rate that is bypassed

Treatment Flow Rate (Qwq)= 0.59 CFS
Weir Length (L) 6.00 FT

Weir Qwq		Orifice Qwq			100-year Flow = 5.07 cfs						
h[1]	WEIR Elev	D	D	A	L	H[2]	Q[3](Orifice)	WSE[4]	Q_{100}/Q_{wq}	FREE BOARD[5]	Notes
FT	FT	FT	IN	SF	FT	FT	CFS	FT	%	FT	
0.50	11.18	0.46	5.55	0.17	6.00	0.41	0.79	11.59	35%	6.17	
0.58	11.26	0.44	5.34	0.16	6.00	0.41	0.77	11.67	30%	6.09	
0.67	11.35	0.43	5.16	0.15	6.00	0.41	0.75	11.75	27%	6.01	
0.75	11.43	0.42	5.01	0.14	6.00	0.41	0.73	11.84	24%	5.92	
0.83	11.51	0.41	4.88	0.13	6.00	0.41	0.72	11.92	22%	5.84	
0.92	11.60	0.40	4.77	0.12	6.00	0.41	0.71	12.00	20%	5.76	
1.00	11.68	0.39	4.66	0.12	6.00	0.41	0.70	12.09	19%	5.67	
1.08	11.76	0.38	4.57	0.11	6.00	0.41	0.69	12.17	17%	5.59	
1.17	11.85	0.37	4.49	0.11	6.00	0.41	0.69	12.25	16%	5.51	
1.25	11.93	0.37	4.41	0.11	6.00	0.41	0.68	12.34	15%	5.42	
1.33	12.01	0.36	4.34	0.10	6.00	0.41	0.67	12.42	14%	5.34	
1.42	12.10	0.36	4.27	0.10	6.00	0.41	0.67	12.50	13%	5.26	
1.50	12.18	0.35	4.21	0.10	6.00	0.41	0.67	12.59	13%	5.17	
1.58	12.26	0.35	4.16	0.09	6.00	0.41	0.66	12.67	12%	5.09	
1.67	12.35	0.34	4.10	0.09	6.00	0.41	0.66	12.75	12%	5.01	
1.75	12.43	0.34	4.05	0.09	6.00	0.41	0.65	12.84	11%	4.92	
1.83	12.51	0.33	4.01	0.09	6.00	0.41	0.65	12.92	11%	4.84	
1.92	12.60	0.33	3.96	0.09	6.00	0.41	0.65	13.00	10%	4.76	
2.00	12.68	0.33	3.92	0.08	6.00	0.41	0.65	13.09	10%	4.67	
2.08	12.76	0.32	3.88	0.08	6.00	0.41	0.64	13.17	9%	4.59	
2.17	12.85	0.32	3.84	0.08	6.00	0.41	0.64	13.25	9%	4.51	
2.25	12.93	0.32	3.81	0.08	6.00	0.41	0.64	13.34	9%	4.42	
2.33	13.01	0.31	3.77	0.08	6.00	0.41	0.64	13.42	8%	4.34	
2.42	13.10	0.31	3.74	0.08	6.00	0.41	0.64	13.50	8%	4.26	
2.50	**13.18**	**0.31**	**3.71**	**0.07**	**6.00**	**0.41**	**0.64**	**13.59**	**8%**	**4.17**	**SELECT***
2.58	13.26	0.31	3.68	0.07	6.00	0.41	0.63	13.67	8%	4.09	
2.67	13.35	0.30	3.65	0.07	6.00	0.41	0.63	13.75	7%	4.01	
2.75	13.43	0.30	3.62	0.07	6.00	0.41	0.63	13.84	7%	3.92	
2.83	13.51	0.30	3.59	0.07	6.00	0.41	0.63	13.92	7%	3.84	
2.92	13.60	0.30	3.57	0.07	6.00	0.41	0.63	14.00	7%	3.76	
3.00	13.68	0.30	3.54	0.07	6.00	0.41	0.63	14.09	7%	3.67	
3.08	13.76	0.29	3.52	0.07	6.00	0.41	0.63	14.17	6%	3.59	
3.17	13.85	0.29	3.50	0.07	6.00	0.41	0.63	14.25	6%	3.51	
3.25	13.93	0.29	3.47	0.07	6.00	0.41	0.63	14.34	6%	3.42	
3.33	14.01	0.29	3.45	0.06	6.00	0.41	0.62	14.42	6%	3.34	
3.42	14.10	0.29	3.43	0.06	6.00	0.41	0.62	14.50	6%	3.26	
3.50	14.18	0.28	3.41	0.06	6.00	0.41	0.62	14.59	6%	3.17	
3.58	14.26	0.28	3.39	0.06	6.00	0.41	0.62	14.67	6%	3.09	
3.67	14.35	0.28	3.37	0.06	6.00	0.41	0.62	14.75	5%	3.01	

1. h, effective head at water quality flow rate 0.59 cfs = height of weir wall with respect to invert out El 10.68 to water quality
2. H, Hydraulic Head over Weir, water surface elevation (WSE) above weir at 100-year flow
3. Q (Orifice), Flow through orifice at 100-year peak flow with effective head equal to h + H.
4. WSE, water surface elevation with respect to weir elevation
5. Free Board, to RIM EL 17.76 from WSE at 100 year peak flow

Treatment Flow Rate (Qwq)= 0.34 CFS
Weir Length (L) 6.00 FT

Weir Qwq		Orifice Qwq				100-year Flow = 2.88 cfs						
h[1]	WEIR Elev	D	D	A		L	H^2	Q[3](Orifice)	WSE[4]	Q_{100}/Q_{wq}	FREE BOARD[5]	Notes
FT	FT	FT	IN	SF		FT	FT	CFS	FT	%	FT	
0.50	11.25	0.35	4.21	0.10		6.00	0.28	0.42	11.53	25%	6.24	
0.58	11.33	0.34	4.05	0.09		6.00	0.28	0.41	11.61	22%	6.16	
0.67	11.42	0.33	3.92	0.08		6.00	0.28	0.40	11.70	19%	6.07	
0.75	11.50	0.32	3.80	0.08		6.00	0.28	0.40	11.78	17%	5.99	
0.83	11.58	0.31	3.70	0.07		6.00	0.28	0.39	11.86	16%	5.91	
0.92	11.67	0.30	3.62	0.07		6.00	0.28	0.39	11.95	14%	5.82	
1.00	11.75	0.29	3.54	0.07		6.00	0.28	0.38	12.03	13%	5.74	
1.08	11.83	0.29	3.47	0.07		6.00	0.28	0.38	12.11	12%	5.66	
1.17	11.92	0.28	3.41	0.06		6.00	0.28	0.38	12.20	11%	5.57	
1.25	12.00	0.28	3.35	0.06		6.00	0.28	0.38	12.28	11%	5.49	
1.33	12.08	0.27	3.29	0.06		6.00	0.28	0.37	12.36	10%	5.41	
1.42	12.17	0.27	3.24	0.06		6.00	0.28	0.37	12.45	9%	5.32	
1.50	12.25	0.27	3.20	0.06		6.00	0.28	0.37	12.53	9%	5.24	
1.58	12.33	0.26	3.16	0.05		6.00	0.28	0.37	12.61	8%	5.16	
1.67	12.42	0.26	3.12	0.05		6.00	0.28	0.37	12.70	8%	5.07	
1.75	12.50	0.26	3.08	0.05		6.00	0.28	0.37	12.78	8%	4.99	
1.83	12.58	0.25	3.04	0.05		6.00	0.28	0.36	12.86	7%	4.91	
1.92	12.67	0.25	3.01	0.05		6.00	0.28	0.36	12.95	7%	4.82	
2.00	12.75	0.25	2.98	0.05		6.00	0.28	0.36	13.03	7%	4.74	
2.08	12.83	0.25	2.95	0.05		6.00	0.28	0.36	13.11	6%	4.66	
2.17	12.92	0.24	2.92	0.05		6.00	0.28	0.36	13.20	6%	4.57	
2.25	13.00	0.24	2.89	0.05		6.00	0.28	0.36	13.28	6%	4.49	
2.33	13.08	0.24	2.86	0.04		6.00	0.28	0.36	13.36	6%	4.41	
2.42	13.17	0.24	2.84	0.04		6.00	0.28	0.36	13.45	6%	4.32	
2.50	13.25	0.23	2.81	0.04		6.00	0.28	0.36	13.53	5%	4.24	
2.58	13.33	0.23	2.79	0.04		6.00	0.28	0.36	13.61	5%	4.16	
2.67	13.42	0.23	2.77	0.04		6.00	0.28	0.36	13.70	5%	4.07	
2.75	**13.50**	**0.23**	**2.75**	**0.04**		**6.00**	**0.28**	**0.36**	**13.78**	**5%**	**3.99**	**SELECT***
2.83	13.58	0.23	2.73	0.04		6.00	0.28	0.36	13.86	5%	3.91	
2.92	13.67	0.23	2.71	0.04		6.00	0.28	0.36	13.95	5%	3.82	
3.00	13.75	0.22	2.69	0.04		6.00	0.28	0.36	14.03	5%	3.74	
3.08	13.83	0.22	2.67	0.04		6.00	0.28	0.36	14.11	4%	3.66	
3.17	13.92	0.22	2.65	0.04		6.00	0.28	0.35	14.20	4%	3.57	
3.25	14.00	0.22	2.64	0.04		6.00	0.28	0.35	14.28	4%	3.49	
3.33	14.08	0.22	2.62	0.04		6.00	0.28	0.35	14.36	4%	3.41	
3.42	14.17	0.22	2.60	0.04		6.00	0.28	0.35	14.45	4%	3.32	
3.50	14.25	0.22	2.59	0.04		6.00	0.28	0.35	14.53	4%	3.24	
3.58	14.33	0.21	2.57	0.04		6.00	0.28	0.35	14.61	4%	3.16	
3.67	14.42	0.21	2.56	0.04		6.00	0.28	0.35	14.70	4%	3.07	

1. h, effective head at water quality flow rate 0.34 cfs = height of weir wall with respect to invert out El 10.75 to water qualit
2. H, Hydraulic Head over Weir, water surface elevation (WSE) above weir at 100-year flow
3. Q (Orifice), Flow through orifice at 100-year peak flow with effective head equal to h + H
4. WSE, water surface elevation with respect to weir elevatior
5. Free Board, to RIM EL 17.77 from WSE at 100 year peak flow

Treatment Flow Rate (Qwq)= 0.09 CFS
Weir Length (L) 6.00 FT

Weir Qwq		Orifice Qwq				100-year Flow = 0.75 cfs						Notes
h[1]	WEIR Elev	D	D	A		L	H[2]	Q[3](Orifice)	WSE[4]	Q_{100}/Q_{wq}	FREE BOARD[5]	
FT	FT	FT	IN	SF		FT	FT	CFS	FT	%	FT	
0.50	13.44	0.18	2.17	0.03		6.00	0.11	0.100	13.55	11%	5.21	
0.58	13.52	0.17	2.08	0.02		6.00	0.11	0.098	13.64	9%	5.12	
0.67	13.61	0.17	2.02	0.02		6.00	0.11	0.097	13.72	8%	5.04	
0.75	13.69	0.16	1.96	0.02		6.00	0.11	0.097	13.80	7%	4.96	
0.83	13.77	0.16	1.91	0.02		6.00	0.11	0.096	13.89	7%	4.87	
0.92	13.86	0.16	1.86	0.02		6.00	0.11	0.095	13.97	6%	4.79	
1.00	13.94	0.15	1.82	0.02		6.00	0.11	0.095	14.05	6%	4.71	
1.08	14.02	0.15	1.79	0.02		6.00	0.11	0.095	14.14	5%	4.62	
1.17	14.11	0.15	1.75	0.02		6.00	0.11	0.094	14.22	5%	4.54	
1.25	14.19	0.14	1.72	0.02		6.00	0.11	0.094	14.30	4%	4.46	
1.33	14.27	0.14	1.69	0.02		6.00	0.11	0.094	14.39	4%	4.37	
1.42	14.36	0.14	1.67	0.02		6.00	0.11	0.094	14.47	4%	4.29	
1.50	14.44	0.14	1.65	0.01		6.00	0.11	0.093	14.55	4%	4.21	
1.58	14.52	0.14	1.62	0.01		6.00	0.11	0.093	14.64	4%	4.12	
1.67	14.61	0.13	1.60	0.01		6.00	0.11	0.093	14.72	3%	4.04	
1.75	14.69	0.13	1.58	0.01		6.00	0.11	0.093	14.80	3%	3.96	
1.83	14.77	0.13	1.57	0.01		6.00	0.11	0.093	14.89	3%	3.87	
1.92	14.86	0.13	1.55	0.01		6.00	0.11	0.093	14.97	3%	3.79	
2.00	14.94	0.13	1.53	0.01		6.00	0.11	0.093	15.05	3%	3.71	
2.08	15.02	0.13	1.52	0.01		6.00	0.11	0.092	15.14	3%	3.62	
2.17	15.11	0.13	1.50	0.01		6.00	0.11	0.092	15.22	3%	3.54	
2.25	15.19	0.12	1.49	0.01		6.00	0.11	0.092	15.30	2%	3.46	
2.33	15.27	0.12	1.47	0.01		6.00	0.11	0.092	15.39	2%	3.37	
2.42	15.36	0.12	1.46	0.01		6.00	0.11	0.092	15.47	2%	3.29	
2.50	**15.44**	**0.12**	**1.45**	**0.01**		**6.00**	**0.11**	**0.092**	**15.55**	**2%**	**3.21**	**SELECT**
2.58	15.52	0.12	1.44	0.01		6.00	0.11	0.092	15.64	2%	3.12	
2.67	15.61	0.12	1.43	0.01		6.00	0.11	0.092	15.72	2%	3.04	
2.75	15.69	0.12	1.41	0.01		6.00	0.11	0.092	15.80	2%	2.96	
2.83	15.77	0.12	1.40	0.01		6.00	0.11	0.092	15.89	2%	2.87	
2.92	15.86	0.12	1.39	0.01		6.00	0.11	0.092	15.97	2%	2.79	
3.00	15.94	0.12	1.38	0.01		6.00	0.11	0.092	16.05	2%	2.71	
3.08	16.02	0.11	1.37	0.01		6.00	0.11	0.092	16.14	2%	2.62	
3.17	16.11	0.11	1.37	0.01		6.00	0.11	0.092	16.22	2%	2.54	
3.25	16.19	0.11	1.36	0.01		6.00	0.11	0.092	16.30	2%	2.46	
3.33	16.27	0.11	1.35	0.01		6.00	0.11	0.092	16.39	2%	2.37	
3.42	16.36	0.11	1.34	0.01		6.00	0.11	0.091	16.47	2%	2.29	
3.50	16.44	0.11	1.33	0.01		6.00	0.11	0.091	16.55	2%	2.21	
3.58	16.52	0.11	1.32	0.01		6.00	0.11	0.091	16.64	2%	2.12	
3.67	16.61	0.11	1.32	0.01		6.00	0.11	0.091	16.72	2%	2.04	

1. h, effective head at water quality flow rate 0.09cfs = height of weir wall with respect to invert out El 12.94 to water quality
2. H, Hydraulic Head over Weir, water surface elevation (WSE) above weir at 100-year flow
3. Q (Orifice), Flow through orifice at 100-year peak flow with effective head equal to h + H.
4. WSE, water surface elevation with respect to weir elevation
5. Free Board, to RIM EL 18.76 from WSE at 100 year peak flow

APPENDIX C

Conveyance Calculations

NODE	AREA	10-YR PEAK FLOW CFS	25-YR PEAK FLOW CFS	100-YR PEAK FLOW CFS
10	7.02	3.86	4.48	5.44
103	0.32	0.1759	0.2042	0.248
113	1.13	0.6212	0.7211	0.8759
209	1.44	0.7916	0.9189	1.1162
214	1.76	0.9675	1.1231	1.3642
308	1.09	0.5992	0.6956	0.8449
404	0.45	0.2474	0.2872	0.3488
408	0.72	0.3958	0.4595	0.5581
414	0.73	0.4013	0.4659	0.5658
505	0.58	0.3188	0.3701	0.4496
506	0.29	0.1594	0.1851	0.2248
507	0.39	0.1979	0.2297	0.279
511	0.95	0.5223	0.6062	0.7364
512	0.68	0.3738	0.4339	0.5271
513	1.02	0.5607	0.6509	0.7906
515	0.69	0.3793	0.4403	0.5348
605	0.33	0.1814	0.2106	0.2558
613	0.73	0.4013	0.4659	0.5658
614	0.4	0.2199	0.2553	0.3101
712	0.41	0.2254	0.2616	0.3178
717	1.03	0.5662	0.6573	0.7984
814	0.36	0.1979	0.2297	0.279
815	0.11	0.0605	0.0702	0.0853
915	0.4	0.2199	0.2553	0.3101
917	0.4	0.2199	0.2553	0.3101
919	0.16	0.088	0.1021	0.124
921	0.2	0.1099	0.1276	0.155
020	0.41	0.2254	0.2616	0.3178
022	0.17	0.0935	0.1085	0.1318

Flows are applied to nodes as a constant calculated
in WWHM2012, 15-minute timesteps

Name	Storm	Upstream Node Name	Downstream Node Name	Shape	Diameter ft	Length ft	Conduit Slope	Roughness	Max Flow cfs	Max Velocity ft/s
Link230	25-Year	102	101	Circular	1.50	37.05	0.50	0.012	4.57	2.54
Link229	25-Year	103	102	Circular	1.50	142.32	0.50	0.012	4.57	2.54
Link239	25-Year	111	410	Circular	1.00	112.92	0.50	0.012	1.95	2.46
Link238	25-Year	112	111	Circular	1.00	105.98	0.50	0.012	1.95	2.46
Link232	25-Year	113	112	Circular	1.00	192.66	0.50	0.012	1.95	2.47
Link210	25-Year	202	201	Circular	1.50	78.85	0.50	0.012	5.05	2.82
Link209	25-Year	203	202	Circular	1.50	144.56	0.46	0.012	5.05	2.83
Link208	25-Year	204	203	Circular	1.50	169.94	0.50	0.012	5.05	2.83
Link220	25-Year	209	308	Circular	1.00	196.00	0.50	0.012	0.92	2.92
Link231	25-Year	214	113	Circular	1.00	196.00	0.50	0.012	1.23	2.52
Link194	25-Year	304	303	Circular	1.50	50.53	0.25	0.012	4.48	4.08
Link223	25-Year	305	303	Circular	1.00	66.52	0.50	0.012	1.61	2.99
Link222	25-Year	307	305	Circular	1.00	86.60	0.50	0.012	1.61	1.99
Link221	25-Year	308	307	Circular	1.00	191.00	0.50	0.012	1.61	3.01
Link228	25-Year	404	103	Circular	1.50	119.89	0.50	0.012	4.37	2.43
Link237	25-Year	408	404	Circular	1.50	51.95	1.97	0.012	3.54	1.98
Link236	25-Year	409	408	Circular	1.00	16.90	6.04	0.012	1.95	2.45
Link235	25-Year	410	409	Circular	1.00	58.60	0.50	0.012	1.95	2.46
Link227	25-Year	411	404	Circular	1.00	32.87	0.50	0.012	0.54	0.67
Link243	25-Year	414	408	Circular	1.00	144.43	2.33	0.012	1.12	1.69
Link242	25-Year	415	414	Circular	1.00	72.79	0.75	0.012	0.66	2.54
Link207	25-Year	505	204	Circular	1.50	99.25	0.50	0.012	5.05	2.84
Link206	25-Year	506	505	Circular	1.50	96.47	0.50	0.012	6.72	3.99
Link205	25-Year	507	506	Circular	1.50	76.88	0.50	0.012	4.49	2.53
Link204	25-Year	508	507	Circular	1.50	26.77	0.50	0.012	4.26	2.40
Link203	25-Year	510	508	Circular	1.00	38.34	0.50	0.012	4.26	5.32
Link202	25-Year	511	510	Circular	1.50	130.29	0.50	0.012	3.82	2.14
Link216	25-Year	512	511	Circular	1.00	187.33	0.50	0.012	1.81	2.49
Link215	25-Year	513	512	Circular	0.67	153.29	0.50	0.012	0.65	2.36
Link214	25-Year	515	510	Circular	1.00	23.79	1.12	0.012	0.44	3.34
Link193	25-Year	605	304	Circular	1.50	57.35	0.20	0.012	4.48	3.71
Link192	25-Year	606	605	Circular	1.50	189.65	0.20	0.012	4.48	3.39
Link218	25-Year	613	512	Circular	0.67	135.03	1.29	0.012	0.47	2.86
Link217	25-Year	614	512	Circular	0.67	165.20	0.96	0.012	0.26	2.06
Link226	25-Year	712	411	Circular	1.00	279.24	0.50	0.012	0.44	0.56
Link225	25-Year	713	712	Circular	1.00	104.21	0.50	0.012	0.44	0.56
Link224	25-Year	714	713	Circular	1.00	215.01	0.50	0.012	0.44	0.56
Link241	25-Year	716	415	Circular	1.00	147.39	0.50	0.012	0.66	2.85
Link240	25-Year	717	716	Circular	1.00	131.39	0.50	0.012	0.66	2.90
Link201	25-Year	812	511	Circular	1.00	103.11	0.50	0.012	1.41	1.77
Link200	25-Year	813	812	Circular	1.00	107.18	0.50	0.012	1.41	1.77
Link199	25-Year	814	813	Circular	1.00	55.79	0.50	0.012	1.41	1.78
Link244	25-Year	815	814	Circular	0.67	95.55	1.79	0.012	0.07	2.40
Link191	25-Year	907	606	Circular	1.50	68.08	0.20	0.012	4.48	3.33
Link198	25-Year	915	814	Circular	1.00	101.17	0.50	0.012	1.11	1.84
Link197	25-Year	917	915	Circular	1.00	263.91	0.50	0.012	0.73	2.17
Link211	25-Year	919	917	Circular	0.67	64.14	2.58	0.012	0.10	1.97
Link213	25-Year	921	915	Circular	0.67	84.01	0.50	0.012	0.13	1.86
Link188	25-Year	O10	OO9	Circular	1.50	66.82	0.20	0.012	4.48	3.27
Link196	25-Year	O20	917	Circular	1.00	340.03	0.50	0.012	0.37	2.13
Link195	25-Year	O22	O20	Circular	0.67	65.56	0.50	0.012	0.11	1.95
Link190	25-Year	OO8	907	Circular	1.50	206.23	0.20	0.012	4.48	3.28
Link189	25-Year	OO9	OO8	Circular	1.50	206.23	0.20	0.012	4.48	3.27

Name	Storm	Ponding Type	Invert Elevation	Ground Elevation at Spill Crest	Max Water Surface Elevation	Freeboard ft
101	25-Year	None	8.23	17.03	14.36	2.67
102	25-Year	None	8.41	17.07	14.68	2.39
103	25-Year	None	9.13	18.28	14.58	3.70
111	25-Year	None	12.62	18.21	15.23	2.98
112	25-Year	None	13.15	17.37	15.49	1.88
113	25-Year	None	14.11	17.17	15.98	1.19
201	25-Year	None	8.60	15.92	13.25	2.67
202	25-Year	None	8.99	16.92	13.40	3.52
203	25-Year	None	9.66	16.95	13.68	3.27
204	25-Year	None	10.51	18.70	14.01	4.69
209	25-Year	None	14.92	17.17	15.32	1.85
214	25-Year	None	15.09	17.17	16.17	1.00
303	25-Year	None	12.95	18.23	13.76	4.47
304	25-Year	None	13.08	18.83	13.98	4.85
305	25-Year	None	12.54	18.76	13.92	4.84
307	25-Year	None	12.98	17.17	14.06	3.11
308	25-Year	None	13.94	17.17	14.56	2.61
404	25-Year	None	9.73	18.52	14.71	3.81
408	25-Year	None	10.75	17.77	14.76	3.01
409	25-Year	None	11.77	17.81	14.80	3.01
410	25-Year	None	12.06	18.53	14.94	3.59
411	25-Year	None	10.39	18.30	14.71	3.59
414	25-Year	None	14.12	17.94	14.86	3.08
415	25-Year	None	14.67	18.18	14.99	3.19
505	25-Year	None	11.01	18.74	14.20	4.54
506	25-Year	None	11.49	18.14	14.36	3.78
507	25-Year	None	11.87	17.91	14.48	3.43
508	25-Year	None	10.68	17.76	14.52	3.24
510	25-Year	None	10.86	18.06	14.97	3.09
511	25-Year	None	11.52	17.54	15.11	2.43
512	25-Year	None	13.65	17.52	15.52	2.00
513	25-Year	None	14.42	17.68	15.88	1.80
515	25-Year	None	14.67	18.20	14.94	3.26
605	25-Year	None	13.20	18.50	14.17	4.33
606	25-Year	None	13.57	18.96	14.63	4.33
613	25-Year	None	15.39	18.12	15.78	2.34
614	25-Year	None	15.24	18.25	15.62	2.63
712	25-Year	None	11.79	19.88	14.91	4.97
713	25-Year	None	12.31	19.48	14.95	4.53
714	25-Year	None	13.39	18.09	14.88	3.21
716	25-Year	None	15.41	18.52	15.75	2.77
717	25-Year	None	16.10	17.84	16.43	1.41
812	25-Year	None	12.04	19.22	15.25	3.98

813	25-Year	None	12.58	19.43	15.38	4.05
814	25-Year	None	12.86	18.80	15.46	3.34
815	25-Year	None	16.71	19.30	16.80	2.50
907	25-Year	None	13.71	19.24	14.78	4.46
915	25-Year	None	13.37	19.20	15.54	3.66
917	25-Year	None	14.68	19.35	15.63	3.72
919	25-Year	None	16.34	18.79	16.44	2.35
921	25-Year	None	16.10	19.08	16.27	2.81
O10	25-Year	None	14.67	20.21	15.76	4.45
O20	25-Year	None	16.38	19.50	16.63	2.87
O22	25-Year	None	17.01	18.51	17.14	1.37
OO8	25-Year	None	14.12	19.68	15.21	4.47
OO9	25-Year	None	14.54	19.19	15.63	3.56

Name	Storm	Upstream Node Name	Downstream Node Name	Shape	Diameter ft	Length ft	Conduit Slope	Roughness	Max Flow cfs	Max Velocity ft/s
Link230	100-Year	102	101	Circular	1.50	37.05	0.50	0.012	5.42	3.01
Link229	100-Year	103	102	Circular	1.50	142.32	0.50	0.012	5.42	3.01
Link239	100-Year	111	410	Circular	1.00	112.92	0.50	0.012	2.24	2.81
Link238	100-Year	112	111	Circular	1.00	105.98	0.50	0.012	2.24	2.82
Link232	100-Year	113	112	Circular	1.00	192.66	0.50	0.012	2.24	2.82
Link210	100-Year	202	201	Circular	1.50	78.85	0.50	0.012	6.13	3.43
Link209	100-Year	203	202	Circular	1.50	144.56	0.46	0.012	6.13	3.43
Link208	100-Year	204	203	Circular	1.50	169.94	0.50	0.012	6.13	3.43
Link220	100-Year	209	308	Circular	1.00	196.00	0.50	0.012	1.17	3.03
Link231	100-Year	214	113	Circular	1.00	196.00	0.50	0.012	1.36	2.48
Link194	100-Year	304	303	Circular	1.50	50.53	0.25	0.012	5.70	4.45
Link223	100-Year	305	303	Circular	1.00	66.52	0.50	0.012	2.02	3.09
Link222	100-Year	307	305	Circular	1.00	86.60	0.50	0.012	2.02	2.56
Link221	100-Year	308	307	Circular	1.00	191.00	0.50	0.012	2.02	3.00
Link228	100-Year	404	103	Circular	1.50	119.89	0.50	0.012	5.17	2.88
Link237	100-Year	408	404	Circular	1.50	51.95	1.97	0.012	4.16	2.32
Link236	100-Year	409	408	Circular	1.00	16.90	6.04	0.012	2.24	2.81
Link235	100-Year	410	409	Circular	1.00	58.60	0.50	0.012	2.24	2.81
Link227	100-Year	411	404	Circular	1.00	32.87	0.50	0.012	0.66	0.82
Link243	100-Year	414	408	Circular	1.00	144.43	2.33	0.012	1.36	1.71
Link242	100-Year	415	414	Circular	1.00	72.79	0.75	0.012	0.80	2.56
Link207	100-Year	505	204	Circular	1.50	99.25	0.50	0.012	6.13	3.44
Link206	100-Year	506	505	Circular	1.50	96.47	0.50	0.012	5.68	3.19
Link205	100-Year	507	506	Circular	1.50	76.88	0.50	0.012	5.46	3.07
Link204	100-Year	508	507	Circular	1.50	26.77	0.50	0.012	5.18	2.91
Link203	100-Year	510	508	Circular	1.00	38.34	0.50	0.012	5.18	6.43
Link202	100-Year	511	510	Circular	1.50	130.29	0.50	0.012	4.64	2.59
Link216	100-Year	512	511	Circular	1.00	187.33	0.50	0.012	2.19	2.76
Link215	100-Year	513	512	Circular	0.67	153.29	0.50	0.012	0.79	2.37
Link214	100-Year	515	510	Circular	1.00	23.79	1.12	0.012	0.54	3.35
Link193	100-Year	605	304	Circular	1.50	57.35	0.20	0.012	5.70	4.04
Link192	100-Year	606	605	Circular	1.50	189.65	0.20	0.012	5.44	3.55
Link218	100-Year	613	512	Circular	0.67	135.03	1.29	0.012	0.57	2.87
Link217	100-Year	614	512	Circular	0.67	165.20	0.96	0.012	0.31	2.07
Link226	100-Year	712	411	Circular	1.00	279.24	0.50	0.012	0.54	0.67
Link225	100-Year	713	712	Circular	1.00	104.21	0.50	0.012	0.53	0.67
Link224	100-Year	714	713	Circular	1.00	215.01	0.50	0.012	0.54	0.68
Link241	100-Year	716	415	Circular	1.00	147.39	0.50	0.012	0.80	2.89
Link240	100-Year	717	716	Circular	1.00	131.39	0.50	0.012	0.80	3.07
Link201	100-Year	812	511	Circular	1.00	103.11	0.50	0.012	1.71	2.14
Link200	100-Year	813	812	Circular	1.00	107.18	0.50	0.012	1.71	2.14
Link199	100-Year	814	813	Circular	1.00	55.79	0.50	0.012	1.71	2.15
Link244	100-Year	815	814	Circular	0.67	95.55	1.79	0.012	0.09	2.42
Link191	100-Year	907	606	Circular	1.50	68.08	0.20	0.012	5.44	3.47
Link198	100-Year	915	814	Circular	1.00	101.17	0.50	0.012	1.35	1.84
Link197	100-Year	917	915	Circular	1.00	263.91	0.50	0.012	0.88	2.18
Link211	100-Year	919	917	Circular	0.67	64.14	2.58	0.012	0.12	1.98
Link213	100-Year	921	915	Circular	0.67	84.01	0.50	0.012	0.16	1.93
Link188	100-Year	O10	OO9	Circular	1.50	66.82	0.20	0.012	5.44	3.36
Link196	100-Year	O20	917	Circular	1.00	340.03	0.50	0.012	0.45	2.13
Link195	100-Year	O22	O20	Circular	0.67	65.56	0.50	0.012	0.13	2.06
Link190	100-Year	OO8	907	Circular	1.50	206.23	0.20	0.012	5.44	3.39
Link189	100-Year	OO9	OO8	Circular	1.50	206.23	0.20	0.012	5.44	3.36

Name	Storm	Ponding Type	Invert Elevation	Ground Elevation at Spill Crest	Max Water Surface Elevation	Freeboard ft
101	100-year	None	8.23	17.03	14.36	2.67
102	100-year	None	8.41	17.07	16.80	0.27
103	100-year	None	9.13	18.28	14.75	3.53
111	100-year	None	12.62	18.21	15.67	2.54
112	100-year	None	13.15	17.37	16.02	1.35
113	100-year	None	14.11	17.17	16.66	0.51
201	100-year	None	8.60	15.92	13.25	2.67
202	100-year	None	8.99	16.92	13.47	3.45
203	100-year	None	9.66	16.95	13.88	3.07
204	100-year	None	10.51	18.70	14.37	4.33
209	100-year	None	14.92	17.17	15.39	1.78
214	100-year	None	15.09	17.17	16.90	0.27
303	100-year	None	12.95	18.23	13.87	4.36
304	100-year	None	13.08	18.83	14.11	4.72
305	100-year	None	12.54	18.76	14.04	4.72
307	100-year	None	12.98	17.17	14.27	2.90
308	100-year	None	13.94	17.17	14.76	2.41
404	100-year	None	9.73	18.52	14.99	3.53
408	100-year	None	10.75	17.77	15.06	2.71
409	100-year	None	11.77	17.81	15.11	2.70
410	100-year	None	12.06	18.53	15.30	3.23
411	100-year	None	10.39	18.30	15.00	3.30
414	100-year	None	14.12	17.94	15.23	2.71
415	100-year	None	14.67	18.18	15.24	2.94
505	100-year	None	11.01	18.74	14.65	4.09
506	100-year	None	11.49	18.14	14.89	3.26
507	100-year	None	11.87	17.91	15.06	2.85
508	100-year	None	10.68	17.76	15.11	2.65
510	100-year	None	10.86	18.06	15.77	2.29
511	100-year	None	11.52	17.54	15.99	1.55
512	100-year	None	13.65	17.52	16.58	0.95
513	100-year	None	14.42	17.68	17.10	0.58
515	100-year	None	14.67	18.20	15.78	2.42
605	100-year	None	13.20	18.50	14.32	4.18
606	100-year	None	13.57	18.96	14.80	4.16
613	100-year	None	15.39	18.12	16.82	1.30
614	100-year	None	15.24	18.25	16.66	1.59
712	100-year	None	11.79	19.88	15.05	4.83
713	100-year	None	12.31	19.48	15.07	4.41
714	100-year	None	13.39	18.09	15.11	2.98
716	100-year	None	15.41	18.52	15.78	2.74
717	100-year	None	16.10	17.84	16.47	1.37
812	100-year	None	12.04	19.22	16.18	3.04

813	100-year	None	12.58	19.43	16.38	3.05
814	100-year	None	12.86	18.80	16.49	2.31
815	100-year	None	16.71	19.30	16.82	2.49
907	100-year	None	13.71	19.24	14.96	4.28
915	100-year	None	13.37	19.20	16.61	2.59
917	100-year	None	14.68	19.35	16.75	2.60
919	100-year	None	16.34	18.79	16.75	2.04
921	100-year	None	16.10	19.08	16.62	2.46
O10	100-year	None	14.67	20.21	15.98	4.23
O20	100-year	None	16.38	19.50	16.86	2.64
O22	100-year	None	17.01	18.51	17.15	1.36
OO8	100-year	None	14.12	19.68	15.41	4.27
OO9	100-year	None	14.54	19.19	15.84	3.35

APPENDIX D

KC CSWPP Worksheet Form

KING COUNTY, WASHINGTON
SURFACE WATER DESIGN MANUAL

REFERENCE 8-E

CSWPP WORKSHEET FORMS

ESC MAINTENANCE REPORT

Performed By: ____________________________
Date: ____________________________
Project Name: ____________________________
DPER Permit #: ____________________________

Clearing Limits
- Damage OK ____ Problem
- Visible OK ____ Problem
- Intrusions OK ____ Problem
- Other OK ____ Problem

Mulch
- Rills/Gullies OK ____ Problem
- Thickness OK ____ Problem
- Other OK ____ Problem

Nets/Blankets
- Rills/Gullies OK ____ Problem
- Ground Contact OK ____ Problem
- Other OK ____ Problem

Plastic
- Tears/Gaps OK ____ Problem
- Other OK ____ Problem

Seeding
- Percent Cover OK ____ Problem
- Rills/Gullies OK ____ Problem
- Mulch OK ____ Problem
- Other OK ____ Problem

Sodding
- Grass Health OK ____ Problem
- Rills/Gullies OK ____ Problem
- Other OK ____ Problem

Perimeter Protection including Silt Fence
- Damage OK ____ Problem
- Sediment Build-up OK ____ Problem
- Concentrated Flow OK ____ Problem
- Other OK ____ Problem

Flow Control BMP protection
- Damage OK ____ Problem
- Sedimentation OK ____ Problem
- Concentrated Flow OK ____ Problem
- Rills/Gullies OK ____ Problem
- Intrusions OK ____ Problem
- Other OK ____ Problem

Brush Barrier
- Damage OK ____ Problem
- Sediment Build-up OK ____ Problem
- Concentrated Flow OK ____ Problem
- Other OK ____ Problem

Vegetated Strip
- Damage OK ____ Problem
- Sediment Build-up OK ____ Problem
- Concentrated Flow OK ____ Problem
- Other OK ____ Problem

Construction Entrance
- Dimensions OK ____ Problem
- Sediment Tracking OK ____ Problem
- Vehicle Avoidance OK ____ Problem
- Other OK ____ Problem

Wheel Wash

Dimensions	OK	Problem
Sed build up or tracking	OK…….	Problem
Other	OK	Problem

Construction Road

Stable Driving Surf.	OK ____	Problem
Vehicle Avoidance	OK ____	Problem
Other	OK ____	Problem

Sediment Trap/Pond

Sed. Accumulation	OK ____	Problem
Overtopping	OK ____	Problem
Inlet/Outlet Erosion	OK ____	Problem
Other	OK ____	Problem

Catch Basin/Inlet Protection

Sed. Accumulation	OK ____	Problem
Damage	OK ____	Problem
Clogged Filter	OK ____	Problem
Other	OK ____	Problem

Interceptor Dike/Swale

Damage	OK ____	Problem
Sed. Accumulation	OK ____	Problem
Overtopping	OK ____	Problem
Other	OK ____	Problem

Pipe Slope Drain

Damage	OK ____	Problem
Inlet/Outlet	OK ____	Problem
Secure Fittings	OK ____	Problem
Other	OK ____	Problem

Ditches

Damage	OK ____	Problem
Sed. Accumulation	OK ____	Problem
Overtopping	OK ____	Problem
Other	OK ____	Problem

Outlet Protection

Scour	OK ____	Problem
Other	OK ____	Problem

Level Spreader

Damage	OK ____	Problem
Concentrated Flow	OK ____	Problem
Rills/Gullies	OK ____	Problem
Sed. Accumulation	OK ____	Problem
Other	OK ____	Problem

Dewatering Controls

Sediment	OK..	Problem

Dust Control

Palliative applied	OK	Problem

Miscellaneous

Wet Season Stockpile	OK ____	Problem
Other	OK ____	Problem

Comments:

Actions Taken:

Problems Unresolved:

BMP Implementation	Completed by:____ Title:____ Date:____

Develop a plan for implementing each BMP. Describe the steps necessary to implement the BMP (i.e., any construction or design), the schedule for completing those steps (list dates), and the person(s) responsible for implementation.

BMPs	Description of Action(s) Required for Implementation	Scheduled Milestone and Completion Date(s)	Person Responsible for Action
Good Housekeeping	1.		
	2.		
	3		
Preventive Maintenance	1.		
	2.		
	3.		
	4.		
Spill Prevention and Emergency Cleanup	1.		
	2.		
	3.		
Inspections	1.		
	2.		
	3.		

BMPs	Description of Action(s) Required for Implementation	Schedule Milestone and Completion Date(s)	Person Responsible for Action
Source Control BMPs	1.		
	2.		
	3		
	4.		
	5.		
	6.		
	7.		
	8.		
Treatment BMPs	1.		
	2.		
	3.		
	4.		
Emerging technologies	1.		
	2.		
Flow Control BMPs	3.		
	4.		

Pollution Prevention Team	**Completed by:** ____________ **Title:** ____________ **Date:** ____________

Responsible Official:____________ Title:____________

Team Leader:____________ Office Phone:____________

Cell Phone #:____________

Pager #:____________

Responsibilities:

____

____

____

(1)____________ Title:____________

Office Phone:____________

Pager #:____________

Cell Phone:____________

Responsibilities:

____

____

____

(2)____________ Title:____________

Office Phone:____________

Pager #:____________

Cell Phone #:____________

Responsibilities:

____

____

____

<table>
<tr><td colspan="2">Employee Training</td><td colspan="2">Completed by:________________
Title:________________
Date:________________</td></tr>
<tr><td colspan="4">Describe the annual training of employees on the SWPPP, addressing spill response, good housekeeping, and material management practices.</td></tr>
<tr><td>Training Topics

1.) LINE WORKERS</td><td>Brief Description of Training Program/Materials (e.g., film, newsletter course)</td><td>Schedule for Training (list dates)</td><td>Attendees</td></tr>
<tr><td>Spill Prevention and Response</td><td></td><td></td><td></td></tr>
<tr><td>Good Housekeeping</td><td></td><td></td><td></td></tr>
<tr><td>Material Management Practices</td><td></td><td></td><td></td></tr>
<tr><td>2.) P2 TEAM:</td><td></td><td></td><td></td></tr>
<tr><td>SWPPP Implementation</td><td></td><td></td><td></td></tr>
<tr><td>Monitoring Procedures</td><td></td><td></td><td></td></tr>
</table>

List of Significant Spills and Leaks	Completed by:________________ Title:________________ Date:________________

List all spills and leaks of toxic or hazardous pollutants that were significant but are not limited to, release of oil or hazardous substances in excess of reportable quantities. Although not required, we suggest you list spills and leaks of non-hazardous materials.

Date (month/day/year)	Location (as indicated on site map)	Description				Response Procedure		Preventive Measure Taken
		Type of Material	Quantity	Source, If Known	Reason for Spill/Leak	Amount of Material Recovered	Material No longer exposed to Stormwater (Yes/No)	

Potential Pollutant Source Identification	**Completed by:**__________ **Title:**__________ **Date:**__________	
List all potential stormwater pollutants from materials handled, treated, or stored on-site.		
Potential Stormwater Pollutant	**Stormwater Pollutant Source**	**Likelihood of pollutant being present in your stormwater discharge. If yes, explain**

Material Inventory	Completed by:________ Title:________ Date:________

List materials handled, treated, stored, or disposed of at the project site that may potentially be exposed to precipitation or runoff.

Material	Purpose/Location	Quantity (Units)				Likelihood of contact with stormwater If Yes, describe reason		Past Spill or Leak	
		Used	Produced	Stored				Yes	No
		(indicate per/wk. or yr.)							

APPENDIX E
KCSWDM Operation & Maintenance Checklist

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the structure opening or is blocking capacity of the structure by more than 10%.	No Trash or debris blocking or potentially blocking entrance to structure.
		Trash or debris in the structure that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the structure.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Sediment	Sediment exceeds 60% of the depth from the bottom of the structure to the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section or is within 6 inches of the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section.	Sump of structure contains no sediment.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering structure through cracks, or maintenance person judges that structure is unsound.	Structure is sealed and structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering structure through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Structure has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Ladder rungs missing or unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
FROP-T Section	Damage	T section is not securely attached to structure wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	T section securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight or show signs of deteriorated grout.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes—other than designed holes—in the structure.	Structure has no holes other than designed holes.

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Cleanout Gate	Damaged or missing	Cleanout gate is missing.	Replace cleanout gate.
		Cleanout gate is not watertight.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
Orifice Plate	Damaged or missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
	Deformed or damaged lip	Lip of overflow pipe is bent or deformed.	Overflow pipe does not allow overflow at an elevation lower than design
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Metal Grates (If Applicable)	Unsafe grate opening	Grate with opening wider than $^7/_8$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $^7/_8$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate. **Any open structure requires urgent maintenance**.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 6 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

NO. 17 – WETVAULT

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris accumulated on facility site.	Trash and debris removed from facility site.
Treatment Area	Trash and debris	Any trash and debris accumulated in vault (includes floatables and non-floatables).	No trash or debris in vault.
	Sediment accumulation	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.	No sediment in vault.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Vault Structure	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch, any evidence of soil entering the structure through cracks, vault does not retain water or qualified inspection personnel determines that the vault is not structurally sound.	Vault is sealed and structurally sound.
	Baffles damaged	Baffles corroding, cracking, warping and/or showing signs of failure or baffle cannot be removed.	Repair or replace baffles or walls to specifications.
	Ventilation	Ventilation area blocked or plugged.	No reduction of ventilation area exists.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Gravity Drain	Inoperable valve	Valve will not open and close.	Valve opens and closes normally.
	Valve won't seal	Valve does not seal completely.	Valve completely seals closed.
Access Manhole	Access cover/lid damaged or difficult to open	Access cover/lid cannot be easily opened by one person. Corrosion/deformation of cover/lid.	Access cover/lid can be opened by one person.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to remove	One maintenance person cannot remove cover/lid after applying 80 lbs of lift.	Cover/lid can be removed and reinstalled by one maintenance person.
	Access doors/plate has gaps, doesn't cover completely	Large access doors not flat and/or access opening not completely covered.	Doors close flat; covers access opening completely.
	Lifting Rings missing, rusted	Lifting rings not capable of lifting weight of door or plate.	Lifting rings sufficient to lift or remove door or plate.
	Ladder rungs unsafe	Missing rungs, misalignment, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.

NO. 23 – COALESCING PLATE OIL/WATER SEPARATOR

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Any trash or debris which impairs the function of the facility.	Trash and debris removed from facility.
	Contaminants and pollution	Floating oil in excess of 1 inch in first chamber, any oil in other chambers or other contaminants of any type in any chamber.	No contaminants present other than a surface oil film.
Vault Treatment Area	Sediment accumulation in the forebay	Sediment accumulation of 6 inches or greater in the forebay.	No sediment in the forebay.
	Discharge water not clear	Inspection of discharge water shows obvious signs of poor water quality - effluent discharge from vault shows thick visible sheen.	Repair function of plates so effluent is clear.
	Trash or debris accumulation	Trash and debris accumulation in vault (floatables and non-floatables).	Trash and debris removed from vault.
	Oil accumulation	Oil accumulation that exceeds 1 inch at the water surface in the in the coalescing plate chamber.	No visible oil depth on water and coalescing plates clear of oil.
Coalescing Plates	Damaged	Plate media broken, deformed, cracked and/or showing signs of failure.	Replace that portion of media pack or entire plate pack depending on severity of failure.
	Sediment accumulation	Any sediment accumulation which interferes with the operation of the coalescing plates.	No sediment accumulation interfering with the coalescing plates.
Vault Structure	Damage to Wall, Frame, Bottom, and/or Top Slab	Cracks wider than ½-inch and any evidence of soil particles entering the structure through the cracks, or maintenance inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications.
	Baffles damaged	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Repair or replace baffles to specifications.
Ventilation Pipes	Plugged	Any obstruction to the ventilation pipes.	Ventilation pipes are clear.
Shutoff Valve	Damaged or inoperable	Shutoff valve cannot be opened or closed.	Shutoff valve operates normally.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.
Access Manhole	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open manhole requires immediate maintenance.**	Manhole access covered.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to remove	One maintenance person cannot remove cover/lid after applying 80 lbs of lift.	Cover/lid can be removed and reinstalled by one maintenance person.
	Ladder rungs unsafe	Missing rungs, misalignment, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.

NO. 23 – COALESCING PLATE OIL/WATER SEPARATOR

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Large access doors/plate	Damaged or difficult to open	Large access doors or plates cannot be opened/removed using normal equipment.	Replace or repair access door so it can opened as designed.
	Gaps, doesn't cover completely	Large access doors not flat and/or access opening not completely covered.	Doors close flat and cover access opening completely.
	Lifting Rings missing, rusted	Lifting rings not capable of lifting weight of door or plate.	Lifting rings sufficient to lift or remove door or plate.

NO. 24 – CATCH BASIN INSERT

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Media Insert	Visible Oil	Visible oil sheen passing through media	Media inset replaced.
	Insert does not fit catch basin properly	Flow gets into catch basin without going through media.	All flow goes through media.
	Filter media plugged	Filter media plugged.	Flow through filter media is normal.
	Oil absorbent media saturated	Media oil saturated.	Oil absorbent media replaced.
	Water saturated	Catch basin insert is saturated with water, which no longer has the capacity to absorb.	Insert replaced.
	Service life exceeded	Regular interval replacement due to typical average life of media insert product, typically one month.	Media replaced at manufacturer's recommended interval.
	Seasonal maintenance	When storms occur and during the wet season.	Remove, clean and replace or install new insert after major storms, monthly during the wet season or at manufacturer's recommended interval.

APPENDIX F

Department of Ecology Industrial Stormwater General Permit

Request for Coverage

Industrial Stormwater General Permit

NOI Version: 1

Application Type: ☐ New ☑ Renewal **Permit Number:** WAR000434 Application Id: 23852

I. Contact Information

Permittee

Honorific: **First Name:** Judi **Last Name:** Johnson-Younce

Organization Name: United Parcel Service Inc. **Title:** NW District Director of Engineering & Maintenance

Mailing Address: 4455 7th Ave S

City: Seattle **State:** WA **Zip Code:** 98108-1731

Email: jyounce@ups.com

Primary Phone: 971-258-4576 **Secondary Phone:**

UBI Number: 578037680

Site Contact

Honorific: **First Name:** Kaytee **Last Name:** Villafranca

Organization Name: United Parcel Service Inc. **Title:** District Environmental Coordinator

Mailing Address: 4455 7th Ave S

City: Seattle **State:** WA **Zip Code:** 98108-1731

Email: kvillafranca@ups.com

Primary Phone: 206-621-6286 **Secondary Phone:** 206-604-8845

UBI Number: 578037680

II. Facility Information

Facility Name: United Parcel Service Boeing Field

Street Address: 7300 Perimeter Rd S

City: SEATTLE **County:** King **Zip Code:** 98108-3816

Latitude: 47.536407 **Longitude:**

Size of Site: 10 acres Date facility began or will begin operation:

List all North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) codes to cover all industrial activities performed at your facility.

NAICS/SIC	Code	Description	Is Primary
SIC	4215	COURIER SERVICES, EXCEPT BY AIR	No
SIC	4513	AIR COURIER SERVICES	Yes
NAICS	492110	Couriers and Express Delivery Services	No
NAICS	481112	Scheduled Freight Air Transportation	Yes

☐ Is this facility a Hazardous Waste Treatment, Storage, and Disposal (TSD) facility regulated under Chapter 17-303 WAC?

For Airport Facilities:

☐ At your airport, do you as a single permittee, or a combination of permitted facilities, use more than 100,000 gallons of glycol-based deicing chemicals and/or 100 tons or more of urea on an average annual basis?

☐ Does your airport have 1,000 or more annual jet departures ("non-propeller aircraft")?

☐ Does the facility discharge wastewater associated with airfield pavement deicing with stormwater?

☐ Do you use urea-containing deicers?

☐ Does your airport meet the definition of a new source ("new airports")?

☐ Does (will) the airport have 10,000 or more annual departures?

☐ Is the airport located in a cold climate zone?

Please enter the URL that your Stormwater Pollution Prevention Plan (SWPPP) is located at: (optional)

Please attach a site map following the requirements of S3.B.1 of the 2020 ISGP.

III. Other Permits/Registration

None

IV. Discharge/Receiving Water

Conveyance System

If you discharge to a municipal stormwater system or other stormwater conveyance system (e.g. Kent stormwater drainage system, roadside ditch), identify the system by name or if unnamed, by other identifier (e.g., 145th street ditch)

King County International Airport drainage system

Location of Discharge into Receiving Water (Outfall)

Outfall Number	Outfall Description	Surface Waterbody Name	Outfall Type	Latitude	Longitude
1	OUTFALL 1	Puget Sound	Surface Water Body	47.5368156433105	-122.31876373291

Location of Discharge Location (Sampling/Monitoring Point)

Monitoring Point Code	Monitoring Point Name	Monitoring Point Type	Outfall Number	Active	Latitude / Longitude
BM1	Benchmark Monitoring 1	Stormwater	1	Yes	47.535006 -122.302021

V. State Environmental Policy Act (SEPA)

This Notice of Intent (NOI) is incomplete and cannot be approved until the applicable SEPA requirements under Chapter 197-11 WAC are met.

SEPA and Public Notice sections apply only to facilities that began operations after January 1, 2020. If the facility began operations before this date, these sections do not need to be filled out.

VI. Public Notice

Public Notice applies to facilities that began operations on or after January 1, 2020.

You must publish a public notice at least **once** a week for **two** consecutive weeks with **seven days** between publications, in at least a **single** newspaper of general circulation in the county in which the facility is located. Ecology cannot grant permit coverage sooner than the end of the 30-day public comment period, which begins on the date of the **second** public notice.

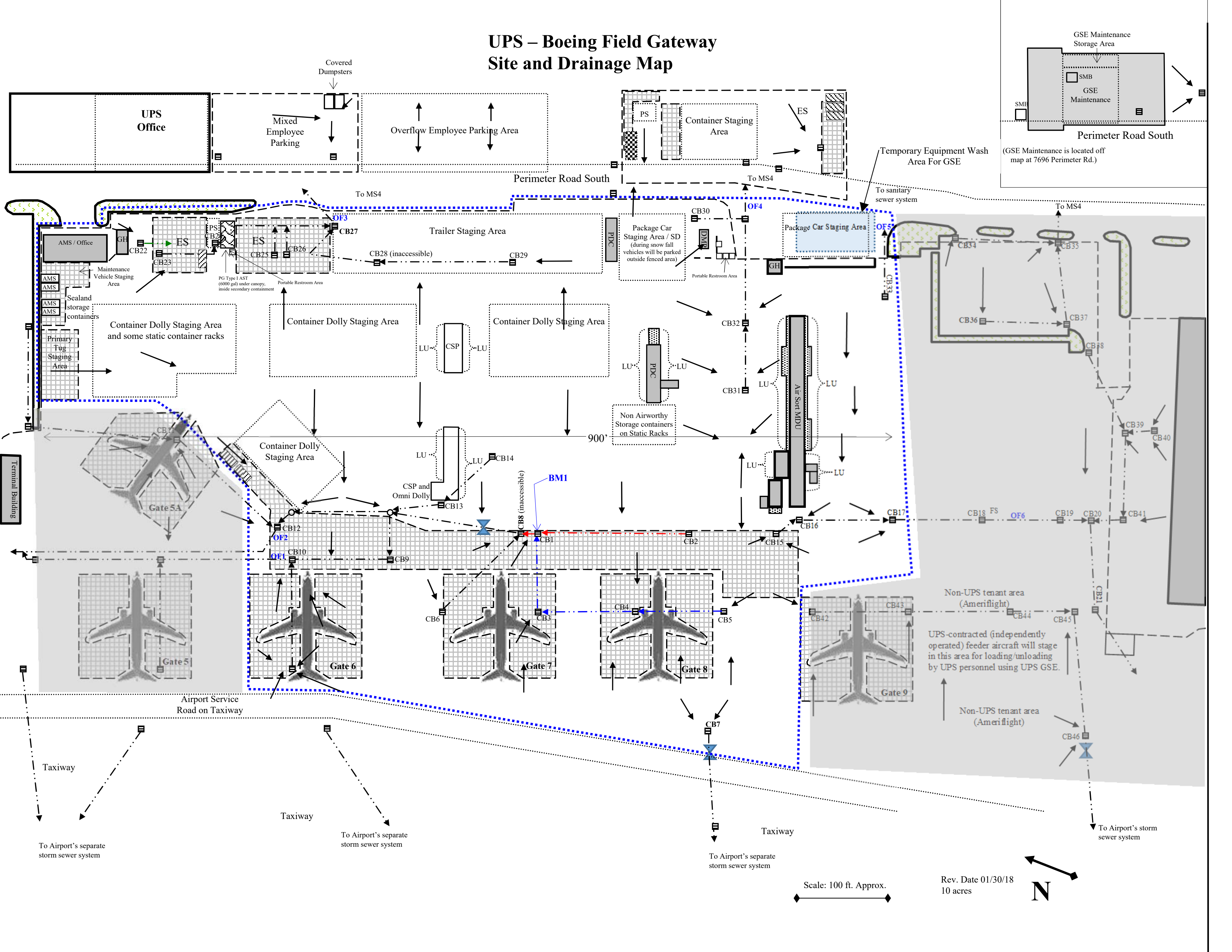
Newspaper Name	First Public Notice Date	Second Public Notice Date

VII. Certification of Permittees

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

	6/28/2019
Permittee Signature	Date

UPS – Boeing Field Gateway
Site and Drainage Map



UPS – Boeing Field Gateway
Site and Drainage Map Legend

Acronym List:
AMS: Aircraft Maintenance Storage
AST: Aboveground Storage Tank
CSP: Container Sort Platform
DMP: Damaged Materials Program area
ES: General/miscellaneous Equipment Staging area
GH: Guardhouse
GSE: Ground Support Equipment
LU: External Loading/Unloading area (mobile equipment fueling can also occur in these areas)
MDU: Mobile Docking Unit
MS4: Municipal Separate Storm Sewer System
PDC: Portable Distribution Center
PG: Propylene Glycol anti-icing/deicing fluid
PS: Pallet Storage area (significant storage)
SD: Snow Dump area
SMB: Covered Scrap Metal Bin

Discharge Point Identifiers:
OFx: Outfall – Discharge associated with a distinctive point and the numerical designator

Monitoring Point Identifiers:
BM1: Location where representative stormwater samples will be collected for benchmark monitoring and the numerical designator. This location will also be used to collect representative samples for industry specific benchmark monitoring, if applicable. This location was determined to be the representative monitoring point using the methodology outlined in the Facility SWPPP.

Stormwater Control Structure Identifiers:
CBx: Catch Basin with numerical designator

Conditionally Authorized Non-Stormwater Discharges Present at Facility:
HVAC: Condensate from roof top HVACs discharges to roof drain system
FS: Fire Suppression system test discharge (potable water)
CRW: Clean Rinse Water drag-out area (rinse water that drips of the outer surfaces of the equipment as it leaves a wash area)

Map Notes:
1. The underground storm sewer system piping is owned and operated by the Airport.
2. GSE are maintained inside the building (7696 Perimeter Road South) with the exception of CSPs and Omni Dollies, which can't be easily moved. This equipment will be maintained in-place using the proper precautions for spill prevention and cleanup.
3. Aircraft Deicing: Performed only in Gates 6, 7 and 8. Deicing may not be performed at Gates 4, 5 or 9. Deicing can be performed at Gate 6 once the Airport has been notified and the storm sewer system piping from this area switched to the municipal sanitary sewer. Deicing can only be performed in Gates 7 and 8 after the three valves shown on the map are shut creating a containment system in this area. Once the aircraft has left Gate 7 or 8 after deicing, a contractor is called to rinse the ramp area into the containment system then evacuate and rinse the underground piping system. Once this procedure has been completed, the valves are opened again.
4. No GSE is washed inside the GSE Maintenance Building (7696 Perimeter Road South). GSE are washed outside in a temporary wash area established in the southeast corner of the airfield property operated by UPS, adjacent to the Package Car Staging Area and south airfield gate onto the property (refer to the **Site and Drainage Map** for the exact location). The pavement sweeping contractor, Linescape, washes equipment for GSE Maintenance upon request. Linescape places plastic sheeting, tarps, and temporary curbing upon the airfield pavement for the temporary wash area. A vactor pumps all washwater needed for washing activities as well as collects all used washwater to haul away for proper disposal. All washwater is contained and collected for off-site disposal; none is discharged or disposed by way of an Airfield property catch basin.
5. All Facility surfaces are paved unless otherwise indicated.
6. Metal surfaces may potentially be a source of pollutants. Metal surfaces are exposed to stormwater at numerous locations throughout the Facility that can be inferred from this site map. Significant metal sources may include, but not be limited to: building roofs and walls (MDU, PDC), building gutters and downspouts, chain-link fences, container racks and most GSE (e.g., K Loaders, container sort platforms (CSPs), belt loaders, etc.). Most of the metal surfaces are painted, with the exception of the chain link fencing and the MDU and PDC awning.
7. CB28: Removed CB28 from map on 01/5/11. When equipment was moved from the area where CB28 was shown on previous map versions, no catch basin was found in this area.

Hangar doors (equipment entrance/exit)
Concrete curbing
Fence line (chain link)
Jersey barriers (concrete or plastic)
Awning (metal)
Grass/vegetated area
GSE general use/storage area: approximate GSE maintenance (e.g., unscheduled maintenance, emergency repair, fluid top-offs), storage prior to maintenance and fueling areas. Loading/unloading may occur in some of these areas.
Approximate UPS industrial activity area boundary
PG Type IV totes (250-gal tote; 6-8 on-site; covered and inside secondary containment)
PG Type I AST (6000-gal capacity) under fabric canopy, inside secondary containment
Deicing truck summer storage area (3 trucks)
Deicing truck winter storage area (3 trucks)

Stormwater flow direction
Underground separate storm sewer pipe – unknown material
Underground separate storm sewer pipe - metal
Underground separate storm sewer pipe - concrete
Underground separate storm sewer pipe – unknown pipe discharge location
Storm sewer drain inlets
Storm sewer shut-off valve
Sanitary sewer drain inlets
Underground sanitary sewer pipe - unknown material type
Temporary Equipment Wash Area (for GSE)

Monitoring Program Information:

Monitoring Program	Applicability to Facility and Parameters if Applicable	Monitoring Points
Benchmark Monitoring	Turbidity, Zinc, Copper, Oil Sheen, pH	BM1
Applicable Industry Specific Benchmark Monitoring	**ISGP Condition S5.B Table 3, Transportation Industry:** Petroleum Hydrocarbons (Diesel Fraction)	BM1
Not Applicable Industry Specific Benchmark Monitoring	**ISGP Condition S5.B Table 3, Air Transportation Industry:** Total Ammonia (as N); BOD_5; COD; Nitrate/Nitrite, as N; Petroleum Hydrocarbons (Diesel Fraction) **ISGP Condition S5.B Table 5, Effluent Limit Applicable to Airports Subject to 40 CFR Part 449:** Total Ammonia (as N)	BM1
Impaired Waters	Total Suspended Solids (TSS)	BM1

Table Notes:
1) **Benchmark Monitoring:** A single representative discharge point has been chosen for benchmark monitoring using the methodology outlined in the Facility SWPPP. Samples for benchmark monitoring will only be collected at the location marked BM1. The benchmark monitoring results at BM1 represent the discharge quality at all other discharge points at the Facility. Benchmark monitoring can be ceased on a parameter-by-parameter basis when a consistent attainment waiver has been achieved for a specific parameter.
2) **Applicable Industry Specific Benchmark Monitoring:** The additional benchmark parameters listed in Permit Condition S5.B Table 3 (Petroleum Hydrocarbons [Diesel Fraction]) for Transportation facilities (40xx – 44xx, except 4221-25) are applicable to this Facility.
3) **Not Applicable Industry Specific Benchmark Monitoring:** The additional benchmark parameters listed in Permit Condition S5.B Table 3 (Ammonia, BOD_5, COD, Nitrate/Nitrite as N, and Petroleum Hydrocarbons [Diesel Fraction]) for Air Transportation facilities (45xx) and Permit Condition S5.B Table 5 (Total Ammonia [as N]) for the Effluent Limit Applicable to Airports Subject to 40 CFR Part 449 do not apply to this Facility. The rationale is that all of the permitted facilities combined at the Airport do not use more than the threshold of 100,000 gallons of glycol-based deicing chemicals and/or 100 tons of urea on an average annual basis.
4) This Facility ultimately discharges to a 303(d)-listed water (Duwamish Waterway) and is required to sample for TSS on a quarterly basis.
5) If a monitoring point is not located at the discharge point (e.g., discharge point is inaccessible, unsafe conditions, flow commingles with MS4 flow), the closest viable upstream location was chosen.
6) Monitoring is performed quarterly. Refer to the SWPPP and SWPPP Form 4 for additional monitoring information.

Rev. Date: 01/30/18

Geotechnical Engineering Report

United Parcel Service
Proposed Parcel Distribution Facility
7575 Perimeter Road South
Seattle, Washington

December 20, 2018
Terracon Project No. 81185115

Prepared for:

United Parcel Service
Omaha, Nebraska

Prepared by:

Terracon Consultants, Inc.
Mountlake Terrace, Washington

December 20, 2018

United Parcel Service
2535 Edward Babe Gomez Avenue
Omaha, Nebraska 68107

Attn: Mr. Jim Reaves
P: (402) 319-4155
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Re: Geotechnical Engineering Report
Proposed Parcel Distribution Facility
7575 Perimeter Road South
Seattle, Washington
Terracon Project No. 81185115

Dear Mr. Reaves:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in accordance with the Master Services Agreement (MSA) between United Parcel Service, Inc. (UPS) and Terracon, dated December 17, 2014, and under Work Order No. 001 for this site and project, dated July 30, 2018. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, vehicle and parcel handling equipment pavements, and aircraft apron hard-stands for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Chad McMullen, P.E.
Geotechnical Project Engineer

Dennis R. Stettler, P.E.
Senior Engineering Consultant

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EXECUTIVE SUMMARY

A geotechnical exploration program has been performed for the proposed Parcel Distribution Facility located at 7575 Perimeter Road South in Seattle, Washington. This site is within the King County International Airport along Taxiway "A" and east of Runway 13L-31R. Terracon's geotechnical scope of services included the advancement of fifteen (15) exploratory borings to approximate depths of between 16½ and 51½ feet below existing site grades, including through existing asphalt and concrete pavements. Based on our current understanding of the proposed development and the results of our subsurface investigation the site appears suitable for the proposed development. The following geotechnical considerations were identified:

- Liquefiable soils were encountered below the water table at all boring locations, including borings advanced to greater depth; a non-liquefiable bearing layer was not encountered within the maximum explored depth, including maximum depths of 51½ feet at three boring locations. Measures to mitigate risk of damage associated with excessive total and differential settlements as a result of liquefaction should be anticipated.

- Based on ASCE 7 table 20.3-1, the seismic site classification for this site is F. However, for the purpose of building design, the ground motions determined according to Site Class D may be used provided that the fundamental period of the structure is less than 0.5 seconds.

- The proposed parcel sorting and distribution structure may be supported on conventional spread footings if used in conjunction with a ground improvement system to mitigate settlement of liquefaction-susceptible alluvial soils. These soils include primarily very loose to loose saturated sands.

- Tie-down ground anchors may be necessary to resist uplift loads, particularly where seismic or wind effects must be resisted; these anchors would need to be installed into the improved ground mass, or else to an as-yet unidentified bearing layer. Anchors may also be necessary to resist toppling of fixed parcel handling equipment during an earthquake event.

- Assuming proper site preparation and the implementation of any necessary subgrade mitigation measures, total and differential building settlement should be within anticipated client/owner specifications.

- Floor slabs and aircraft apron pavement should be supported upon improved ground, or else other slab and pavement support measures should be undertaken.

- Utility connections should be flexible to allow for expected post-liquefaction displacements expected at the site and neighboring property

Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED PARCEL DISTRIBUTION CENTER
7575 PERIMETER ROAD SOUTH
SEATTLE, WASHINGTON

Terracon Project No. 81185115

December 20, 2018

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed Parcel Distribution Facility located at 7575 Perimeter Road South in Seattle, Washington. This site is within the King County International Airport along Taxiway “A” and east of Runway 13L-31R. Our geotechnical engineering scope of services for this project included the advancement of fifteen (15) soil test borings to depths ranging between approximately 16½ and 51½ feet below existing site grades (bgs). The purpose of these services is to provide information and geotechnical engineering recommendations pertaining to:

- subsurface soil conditions
- earthwork and grading
- fill selection and placement
- floor slab and pavement design
- ground improvement
- groundwater conditions
- foundation design
- buried utilities
- construction considerations
- seismic considerations

2.0 PROJECT INFORMATION

2.1. Project Description

The project consists of a parcel receiving and sorting facility that includes:

- Parcel loading/unloading from cargo aircraft along a “Main” ramp
- Cargo cart, tractor, and related parcel handling equipment staging areas, travelways, and a cart scale house
- A cargo cart receiving bay and a parcel sorting floor within a distribution building with a footprint of about 420 feet x 110 feet, plus a mezzanine floor with office space
- Semi-truck loading/receiving bays
- Parcel van loading/receiving bays
- Parking and staging areas for semi-trailers and parcel vans
- Two employee parking areas with a combined total of 195 small vehicle parking stalls.

These project elements are described in greater detail in the following table:

ITEM	DESCRIPTION
Site layout	Refer to the Site Location Map and Boring Location Diagram (Exhibits A-1 and A-2 in Appendix A)
Structures	A sorting building with a 48,325 square-foot ground floor, plus additional square footage on a mezzanine level above the equipment and parcel-sorting floor.
Aircraft Cargo and Parking Areas	Aircraft Aprons: ■ "Ramp" Area will have five aircraft stalls, each of which can accommodate a range of cargo aircraft, including 757-200, 767-300, A-300, and MD-11. ■ Heavy aircraft stalls will include hardstand zones for prolonged static loads from the aircraft landing gear, plus wheel loads from cargo loaders, cargo carts, tractors, and related equipment.
Building construction, (Assumed)	Details not provided, but understood to be steel frame structure with metal cladding, supported on isolated spread footings and strip footings. The mezzanine office floor would presumably be suspended between structure framing, above the sorting floor
Building Floor (Assumed)	■ Concrete slab-on-grade ■ Assumed to be at or within 12 inches above existing site grades. ■ Uniform slab load assumed to be 150 psf ■ Cargo cart bay will support cargo tractor and cart wheel loads
Semi-Trailer and Parcel Van Staging	Located primarily to the east and northeast of the parcel sorting building; presumed to consist of asphalt paving
Yearly Aircraft Arrivals (provided by UPS)	Each of five hardstands on the Main Ramp would experience 730 arrivals/departures per year (2 per day), which could include aircraft as large and heavy as the MD-11
Truck and Parcel Van Traffic (provided by UPS)	Design equivalent axle loads (EAL's): Truck and Parcel Van Areas -- 1.04 million over 30 years Employee Parking -- 797 over 30 years

2.1. Site Location and Description

ITEM	DESCRIPTION
Location	7575 Perimeter Road South, Seattle, Washington
Existing Improvements and Uses	Current improvements consist of a patchwork of asphalt and concrete pavement of various thicknesses. The site is currently used for aircraft loading/unloading operations and for staging and storage of cargo handling equipment. Equipment storage sheds are also located on-site.

Existing topography	Generally flat and level.

3.0 SUBSURFACE CONDITIONS

3.1 . Site Geology

The project site is situated within the extent of the Duwamish River floodplain. The USGS publication *Geologic Map of Seattle – A Progress Report* (2005) was used to reference mapped geologic conditions at the project site. The site location is mapped as units Q_{al} and Q_{yal} described as Holocene-age "alluvial" and "young alluvial" deposits (respectively) consisting of silt, sand, gravel, and cobbles, and locally containing accumulations of peat. These deposits are typically very loose to loose. Although usually not mapped, man-made fill and near-surface graded soils are typically present in previously built environments. The subsurface conditions encountered in the boring explorations were generally consistent with these designated map units, and are overlain by fill, debris, and other evidence of previous grading activities.

The history of the development of the area at and surrounding Boeing Field is also consistent with the findings of this geotechnical investigation. Prior to development, the Duwamish River valley consisted of the river flood plain and tidally influenced marshes. Meander channels of the former path of the Duwamish River and associated side channels are known to exist throughout the Boeing Field area. Over many years between about 1890 and 1930, the area was filled primarily with sediments originating from sluicing from the surrounding hillsides as a part of early Seattle regrading activities and later by dredging and straightening of the Duwamish River in its present channel location. Development of the airport and improvements and expansion over the years has resulted in a long history of fill placement at different times and with a variety of soil types.

3.2 . Typical Subsurface Profile

Presented below is a simplified, generalized soil profile that was generated using the information obtained during the subsurface investigation:

Description	Approximate Depth to Bottom of Stratum Below Existing Ground Surface (typ.)	Material Encountered	Consistency/Density (typ.)
Stratum 1	2 to 7 feet(1)	Asphalt and Portland cement concrete pavements over existing Fill – fine to medium sand with silt to silty, with variable amounts of debris: bricks, concrete rubble, other waste.	Loose to Medium Dense
Stratum 2	Undetermined(2) but greater than 50 feet	Alluvial deposits – generally fine to medium sand, variable amount of silt, though typically between 3% to 8% silt. At greater depth, includes lenses (up to several feet thick) of silt and sandy silt	Very Loose to Loose

1. At Boring B-10, loose gravel with an abundance of bricks and clay pipe debris was encountered to a depth of 18 feet
2. Each exploration was terminated within the described stratum. Extent of deposit is unknown.

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs included in Appendix A of this report.

Laboratory tests were conducted on select soil samples to obtain index properties for analysis purposes. Moisture content, grain size analysis, Atterberg limits, moisture/density determinations, and California Bearing Ratio tests were performed as part of this study. Test results are presented in Appendix B.

3.3 . Groundwater

Groundwater levels were observed and recorded while drilling but do not necessarily reflect steady state conditions at the borehole location. Groundwater was encountered at a depth of between 8 and 11 feet at each of the exploration locations.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. In addition, perched water can develop over low permeability soil strata. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. Fluctuations in groundwater levels can be measured by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time.

3.4 . Environmental Considerations

The scope of Terracon's geotechnical services did not include the identification or evaluation of environmental contaminants in the soil or groundwater beneath the site. The long use of the site and surrounding sites as aviation support facilities means that petroleum products and solvents have been used and in some cases have spilled, leaked, or been discharged into the soil and groundwater beneath the area. Previous environmental investigations have been conducted on nearby sites and have disclosed soil and groundwater contamination.

The potential presence of environmental contaminants in soil and groundwater at the UPS facility needs to be considered in developing the construction specifications for the project. The potential presence of environmental contaminants in the soil and groundwater could dictate specific construction protocols related to worker health and safety, as well as protocols related to excavation and appropriate disposal of soil or groundwater containing contaminants. Terracon is available to evaluate and address these issues but such services are not included in our present scope.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 . Geotechnical Considerations

Existing fill soils were present at each exploration location conducted as part of our study and are anticipated to exist, to some extent, over the entire footprint of the proposed development. Due to the uncertainty associated with undocumented fills, there is an inherent risk for the owner that compressible fill or unsuitable material may exist within or buried by the fill and will go undetected. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill. However, ground improvement techniques, as recommended subsequently in this report, can reduce the potential detrimental effects of poor performance of existing fill.

The native alluvial soils underlying the existing fill consist primarily of saturated, loose to very loose sand with fines to a trace of fines. Where present, silty lenses within the alluvial soils are non-plastic. Western Washington is considered to be an active seismic zone with earthquakes potentially arising from a variety of sources including shallow earthquakes, deep crustal earthquakes, and interplate subduction zone earthquakes. In addition, the site is in close proximity to the Seattle Fault Zone. As such, the site is subject to significant ground shaking during an earthquake and the site subsurface is expected to be highly susceptible to liquefaction during a design-level earthquake, and also susceptible during earthquakes of lesser intensity. Structures and pavements founded above such liquefiable soils can be expected to undergo extreme and structurally unacceptable settlements during and up to several days or weeks following a large earthquake.

Boeing Field was hard hit by the Nisqually Earthquake that occurred on February 28, 2001. Although the earthquake epicenter was about 58 km southwest of Seattle, the earthquake had a moment magnitude of 6.8 and resulted in significant liquefaction at Boeing Field. Numerous sand boils developed at the ground surface and cracks were noted in airport runways and taxiways. Ground settlement of up to 9 inches was reported at Boeing Field and runway pavement cracking up to 1000 feet long with a horizontal crack offset of ½ to 1 inch was observed. The runway and taxiways were closed or only open to limited operations for several weeks as around-the-clock-repairs were made to the runway and taxiways.

Without any ground improvement, settlements on the order of 12 to 21 inches are estimated to occur as a result of liquefaction-induced settlement resulting from a major earthquake. Footings atop such unimproved soils would experience similar settlements; deep foundations extending through these soils would experience strength loss during shaking followed by accumulation of significant downdrag loads and pile settlement.

A non-liquefiable bearing layer was not encountered during our explorations and – based upon our previous observations in the area and existing geologic information – not likely to be present within a reasonable depth for the purpose of deep foundation design. Based on the geotechnical engineering analyses, subsurface exploration and laboratory test program conducted as part of this study, we recommend that the proposed parcel sorting structure and other occupiable structures be supported on conventional spread footings following soil densification by means of aggregate pier ground improvement techniques. Such subgrade soil improvement is achieved by constructing compacted aggregate columns within the existing subsurface soils to both increase the density of the surrounding native soils and to act as a groundwater relief pathway in order to reduce the buildup of groundwater pressure during earthquake shaking; the build-up of groundwater pressure is a primary contributor in the occurrence of liquefaction.

Liquefaction would also negatively affect pavements, including those in aircraft traffic and in truck traffic areas. Ground improvement in these areas could be employed to reduce pavement settlement and damages due to liquefaction, allowing a more rapid resumption in operations following an earthquake. However, it should be noted that areas of Boeing Field outside of these UPS tenant improvements may be substantially impacted following an earthquake, and airfield operations may be suspended pending emergency repair of impacted areas.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are discussed in detail in the following sections. References to ASTM and

WSDOT specifications refer to the current version of the American Society of Testing and Materials and the 2018 Washington State Department of Transportation *Standards and Specifications for Road, Bridge, and Municipal Construction*, publication number M 41-10, respectively. References to FAA specifications refer to the current version of the Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5320-6F.

4.2. Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations, slabs and pavements are contingent upon adherence to the prescribed measures outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during construction efforts.

4.2.1 Site Preparation

We anticipate construction will be initiated by demolishing existing improvements including primarily the full-depth removal of all existing pavements, foundations, and building slabs within the project area. Removal of these existing structures is necessary to allow facilitate ground improvement and to provide for uniform subgrade preparation in advance of foundation, floor slab, and pavement support. Removal depth of these existing features varies considerably across the site, as indicated in our explorations.

Due to the site’s historical filling activities, unsuitable subgrade soils such as overly wet, compressible, or organic-rich soils may be exposed during demolition of the existing site improvements. Unsuitable soils may also be encountered in landscape islands and other undeveloped areas. Wood, concrete, and clay brick or clay pipe construction debris may be present in localized areas. Where encountered, these soils should be removed from the site. A Terracon representative should be on-site to document the presence of these unsuitable soils and to provide timely recommendations for overexcavation and backfilling.

After stripping, proofrolling should be performed with heavy rubber tire construction equipment such as fully loaded tandem-axle dump truck. A geotechnical engineer or his representative should observe proofrolling to aid in locating unstable subgrade materials. Proofrolling should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade and to reduce the amount of undercutting / remedial work required. Unstable materials located should be stabilized as recommended by the engineer based on conditions observed during construction. Undercut and replacement and densification in place are typical remediation methods. Where ground improvement will be used, a second iteration of subgrade preparation and confirmation via proof-rolling will likely be necessary.

4.2.2 Material Types

We expect that the majority of fill – where fill is used on the project – will be used for support of airfield and truck/vehicle pavements, or the support of the slab-on-grade floor of the parcel distribution building. Fill will also be necessary for trench backfill during the construction of buried utilities, and for backfill of over-excavated areas encountered during site preparation. Due to the high fines content of some of the near-surface soils, and the variable make-up of fill owing to the site history, we do not expect that soils generated during site grading will be acceptable for re-use in the support of site pavements or slabs-on-grade; their suitability for backfilling of utilities is expected to be limited. Instead, pavements and slabs should be supported by imported granular fill. Outside of areas where FAA pavements specifications are applicable, we recommend that pavements and concrete slabs-on-grade be supported by Crushed Surfacing; utility trenches can be backfilled with Select Borrow or Gravel Borrow. These materials are described below:

Fill Type	Recommended Materials[1, 2]	Acceptable Location for Placement
Crushed Surfacing	9-03.9(3) *Crushed Surfacing Top Course*[1] 9-03.9(3) *Crushed Surfacing Base Course*[1]	Beneath and adjacent to pavements outside of aircraft travelways, and slab subgrades
	9-03.12(1)A *Gravel Backfill for Foundations Class A*[1]	Foundation backfill
Borrow Fill	Section 9-03.14(1) *Gravel Borrow*[1] Section 9-03.14(2) *Select Borrow*[1]	Trench backfill outside of aircraft travelways

1. WSDOT Standard Specifications
2. Crushed Surfacing and Borrow Fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the fines content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small deviations in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. Optimum moisture content is the moisture at which the maximum dry density for the material is achieved in the laboratory following ASTM procedures.

4.2.3 Compaction Requirements

Crushed Surfacing and Borrow Fill should meet the following compaction requirements.

Item	Crushed Surfacing	Borrow Fill[2]
Maximum Lift Thickness	*8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used* *4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used*	*Same as Crushed Surfacing*
Minimum Compaction Requirements [1]	*95% of max. below pavements and floor slabs*	*92% of maximum dry density, except 95% when within 2 feet of pavement of slab subgrade.*
Water Content Range [1]	*Typically within 2% of optimum*	*As required to achieve min. compaction requirements*

1. Maximum density and optimum water content as determined by the modified Proctor test (ASTM D 1557).
2. Refer to the following section for use of Borrow Fill as utility trench backfill.

Structural fill materials should be placed in horizontal lifts not exceeding about 8 inches in loose thickness. We recommend that each lift then be thoroughly compacted with a mechanical compactor to a uniform density of at least 95 percent, based on the modified Proctor test (ASTM D 1557). Where light compaction equipment is used, as is typical within a few feet of retaining walls and in utility trenches, the lift thickness may need to be reduced to achieve the desired degree of compaction. Soils removed which will be used as structural fill should be protected by plastic sheeting to aid in preventing an increase in moisture content due to rain and other factors. Moisture contents at the time of compaction should be within ±2 percent of the optimum moisture content.

4.2.4 Utility Trench Backfilling

All trenches should be wide enough to allow for compaction around the haunches of the pipe, or material such as pea gravel (provided this is allowed by the pipe manufacturer) should be used below the spring line of the pipes to eliminate the need for mechanical compaction in this portion of the trenches. If water is encountered in the excavations, it should be removed prior to fill placement.

Placement and compaction of recommended materials for utility trench backfill should be in accordance with the recommendations presented above. In our opinion, the initial lift thickness should not exceed one foot unless recommended by the manufacturer to protect utilities from damage by compacting equipment. Light, hand-operated compaction equipment in conjunction with thinner fill lift thicknesses may be utilized on backfill placed above utilities if damage resulting from heavier compaction equipment is of concern.

Flexible connections for utilities that pass through building foundations are recommended to reduce potential stress associated with differential settlement that may occur between the building foundation and the improvements located outside of the building footprint.

4.2.5 Grading and Drainage

Adequate positive drainage should be provided during construction and maintained throughout the life of the development to prevent an increase in moisture content of the foundation, pavement and backfill materials. Surface water drainage should be controlled during and after construction.

Gutters and downspouts that drain water a minimum of 10 feet beyond the footprint of the proposed structures are recommended. This can be accomplished through the use of splash-blocks, downspout extensions, and flexible pipes that are designed to attach to the end of the downspout. Flexible pipe should only be used if it is daylighted in such a manner that it gravity-drains collected water. Splash-blocks should also be considered below hose bibs and water spigots.

4.2.6 Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. If practical, construction traffic over the completed subgrade should be limited to prevent unnecessary disturbances. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction under the observation of Terracon.

Surface water should not be allowed to pond on the site and soak into the soil during construction. Construction staging should provide drainage of surface water and precipitation away from the building and pavement areas. Any water that collects over or adjacent to construction areas should be promptly removed, along with any softened or disturbed soils. Surface water control in the form of sloping surfaces, drainage ditches and trenches, and sump pits and pumps will be important to avoid ponding and associated delays due to precipitation and seepage.

Groundwater was encountered in all explorations at depths ranging from about 8 to 11 feet; however, groundwater may be encountered at shallower depths during the wetter part of the year.

Deeper excavations, where necessary, should anticipate the potential for encountering groundwater. Where groundwater is encountered during construction operations, some form of temporary or permanent dewatering is likely to be necessary. Conventional dewatering methods, such as pumping from sump excavations, may be adequate for temporary removal for perched groundwater in isolated pockets; however well points would likely be required for significant groundwater flow, or where excavations penetrate groundwater in the loose cohesionless sands encountered below the layer of exiting fill.

As mentioned previously in this report, the soil and groundwater beneath the site could potentially be contaminated and could require special procedures and protocols for handling, disposal, and worker health and safety.

All excavations should be sloped or braced as required by OSHA regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current Occupational Health and Safety Administration (OSHA) Excavation and Trench Safety Standards.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied or inferred.

4.2.7 Wet Weather Earthwork

The near-surface soils have a typically moderate to high fines content based on our visual observations and lab testing and are considered moisture sensitive. The soils will exhibit moderate erosion potential and may be transported by running water. Silt fences and other best-management practices will be necessary to control erosion and sediment transport during construction. When subjected to additional moisture plus construction traffic, the native subgrade can be expected to deteriorate rapidly and require corrective action prior to pavement or floor slab construction. To reduce the potential for deterioration of the subgrade during wet weather. We recommend the following “best practices”:

- Perform earthwork in small sections
- Limit construction traffic over unprotected soil
- Slope excavations and subgrade surface to promote drainage and prevent ponding

- Sealing exposed surfaces with a smooth-drum roller or rubber-tire roller at end of each work shift.
- Limit the size and type of construction equipment
- Provide gravel "working mats" over areas of prepared subgrade
- Remove wet surficial soil prior to placement of fill each day
- Provide upgradient perimeter ditches or low earthen berms to direct runoff away from prepared subgrade areas and into sump areas.

If inclement weather or in situ soil moisture content prevents the use of on-site material as structural fill, we recommend importing granular fill containing less than 5 percent by weight passing the U.S. No. 200 sieve, based on the fraction passing the U.S. No. 4 sieve.

Stockpiled soils should be protected with polyethylene sheeting anchored to withstand local wind conditions and preservation of the soil's moisture content.

4.3. Foundations

In our opinion, the proposed building and other structures can be supported by a conventional spread footing foundation system bearing on sufficiently densified subgrade soils using an approved ground improvement method. The purpose of the ground improvement would be to create a "raft" of densified, non-liquefied sand upon which footings could support the parcel distribution building and related structures without incurring excessive settlements during and following an earthquake. Where isolated footings will be used, we recommend that grade beams be used to structurally tie those footings to the rest of the building foundation system.

The use of deep foundations – such as drilled shafts or driven steel pipe piles -- would require additional subsurface exploration to determine the depth of a suitable bearing layer. Based upon our understanding of the site geology and our experience with nearby projects, a suitable bearing layer is unlikely to be present within a depth interval that would be cost-effective for the use of deep foundations.

The following subsections include a discussion of the recommended ground improvement method and the foundation design parameters that may be applied for the system described.

4.3.1 Ground Improvement - Aggregate Piers

Ground improvement utilizing aggregate piers is a method that offers a practical and effective method to densify loose saturated sand, which is necessary to reduce their susceptibility to liquefaction during and following a large earthquake. Aggregate piers are columns of crushed stone that, when configured in groups, can provide a significant increase in the overall density of and stiffness of the surrounding soil mass. Furthermore, the close spacing of these columns of crushed stone also allows for the ready dissipation of groundwater pressure build-up during an earthquake; it is the build-up of groundwater pressure within sands that is a principal culprit leading to liquefaction. The installation method can vary depending on the nature of the soils to be improved, but a typical procedure consists of advancing a downhole vibrating mandrel from the working pad surface to the planned toe elevation of the pier and compacting successive lifts of crushed stone until the desired top of pier elevation is reached. The top of pier is commonly constructed to just above the finished subgrade elevation or to the existing surface of the working pad and can later be excavated to the base of footing elevation during final grading efforts.

It should be noted that the goal of ground improvement would not be to eliminate liquefaction at all depths, nor everywhere on-site. Rather, the design goal would be to create a block or “raft” of non-liquefied sand which is capable of resisting foundation and floor slab loads without excessive settlements, and for that raft to be sufficiently competent to remain intact above underlying layers of liquefied soils. Based on the conditions encountered at our exploration locations, the required toe depth of the aggregate piers would be on the order of 30 to 35 feet below current site grades. Relative spacing of the aggregate piers is typically specified by a specialty contractor that accounts for the anticipated building loads in order to determine the level of improvement deemed necessary to sustain the required loads; however, a center-to-center spacing on the order of 8 to 10 feet appears to be appropriate for this site. Aggregate piers beneath spread footing foundations are generally arranged in tighter configurations than beneath areas to receive slab-on-grade floors, or pavements. As a rule of thumb we recommend that aggregate piers extend approximately 1 pier-spacing beyond all building limits for adequate support of the structures.

The surficial condition of the existing fill on-site varies considerably and may require pre-drilling in order to construct aggregate piers at some locations.

4.3.2 Spread Footing Design Recommendations

The following design summary table applies to conventional spread footings supported by an improved subgrade using the recommended aggregate piers described above. The design bearing pressures and differential settlement estimates are preliminary and should be reviewed by the ground improvement contractor. If the ground improvement contractor recommends a system that warrants greater design pressures Terracon should be retained for additional review.

FOR SPREAD FOOTINGS BEARING ON AGGREGATE PIER IMPROVED SUBGRADE		
Description	**Column**	**Wall**
Net allowable bearing pressure [1]	3,000 psf	3,000 psf
Minimum dimensions	24 inches	18 inches
Minimum embedment below finished grade for frost protection [2]	18 inches	18 inches
Approximate total static settlement [3]	<1 inch	<1 inch

Estimated differential settlement [3]	<½ inch between columns	<½ inch over 40 feet
Post-liquefaction differential settlement [4]	<2 inches	<2 inches
Allowable coefficient of sliding friction	0.35	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable fill or soft soils, if encountered, will be undercut and replaced with engineered fill.
2. And to reduce the effects of seasonal moisture variations in the subgrade soils. For perimeter footing and footings beneath unheated areas.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.
4. Post-liquefaction differential settlement is measured over a distance 40 feet. For life-safety reasons, structural design of the building implies that building collapse is prevented; however, significant repairs may be necessary to resume full operation within the building following a large earthquake.

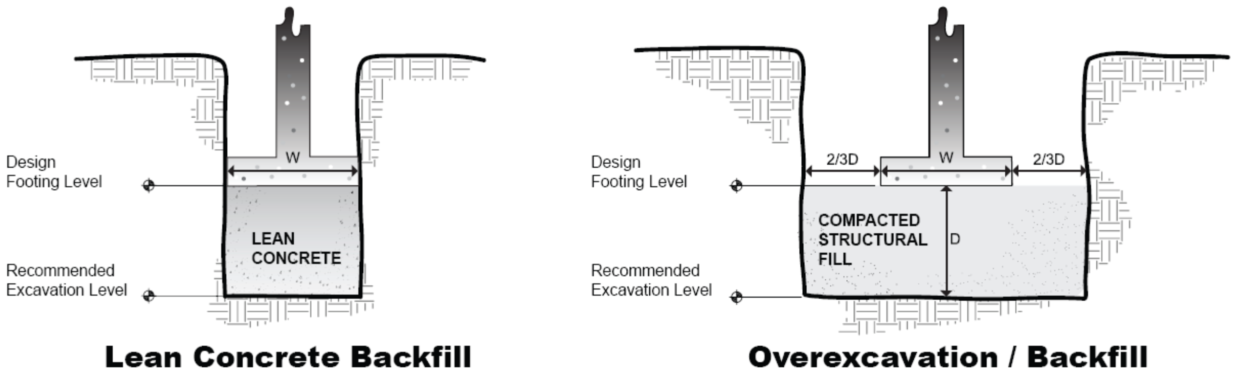
The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations. Interior footings should bear a minimum of 12 inches below finished grade. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

Footings, foundations, and masonry walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ from those presented in this report, supplemental recommendations will be required.

4.3.3 Construction Considerations

If footing subgrades are unsuitable, i.e. contain organics, soft or disturbed, the subgrade soils should be removed and replaced with structural fill in accordance with the recommendations herein. Overexcavation for structural fill placement should extend laterally beyond all edges of the footing as shown in the figure below. Structural fill can be substituted by lean-mix concrete without the need to overexcavate beyond the extents of the footing.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

Areas of loose or disturbed soils may be encountered at foundation bearing depth after excavation is completed for footings. When such conditions exist beneath planned footing areas, the surficial subgrade soils should be compacted prior to placement of the foundation system. If sufficient compaction cannot be achieved in-place, the loose soils should be removed and replaced with engineered fill. For placement of engineered fill below footings, the excavation should be widened laterally, at least eight inches for each foot of fill placed below footing base elevations.

4.4. Seismic Considerations

DESCRIPTION	VALUE
2015 International Building Code (IBC) Site Classification[1]	F[2]
Site Latitude	47.53411° N
Site Longitude	122.30054° W
S_s Spectral Acceleration for a Short Period for Site Class D[3]	1.506g
S_1 Spectral Acceleration for a 1-Second Period for Site Class D[3]	0.575g
F_a Site Coefficient for a Short Period[3]	1.000
F_v Site Coefficient for a 1-Second Period[3]	1.5

NOTES:

1. The 2015 International Building Code (IBC) indicates that the seismic site classification is based on the average soil and bedrock properties in the top 100 feet. The current scope does not include a 100-foot soil profile determination. This seismic site class definition considers that soils encountered at depth in our borings continue below the termination depth. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.
2. Site Class F applies to any profile having (1) soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays and collapsible weakly cemented soils, (2) at least 10 feet of peats and/or highly organic clays, (3) at least 25 feet of very high plasticity clays or (4) at least 120 feet of soft to medium stiff clays. The USGS Seismic Design Maps tool used for analysis does not accommodate Site Class F as

DESCRIPTION	VALUE

site-specific ground motion procedures are generally required. Site Class D was used to generate spectral accelerations S_s and S_1.

3. Section 20.3.1 of ASCE 7-10 allows site coefficients F_a and F_y to be determined assuming that liquefaction does not occur for structures with fundamental periods of vibration less than 0.5 second. Based on the results of the exploration program, Site Class D may be used to determine the values of F_a and F_y. The fundamental period of vibration for the structure should be verified by the structural engineer.

4.4.1 Liquefaction

The native soils encountered during the subsurface investigation consisted of generally very loose to medium dense, predominantly fine to medium sand with low silt content and – to a lesser extent – fine to medium sand with silt. At some exploration locations, these sand layers were interrupted by layers of very soft to soft, non-plastic silt with variable amount of fine sand. Where saturated (i.e. below typical depths of 8 to 11 feet), these soils should all be considered to have a moderate to high risk for liquefaction during and after ground shaking due to an earthquake.

Boring B-13 was chosen as a representative soil boring for determination of susceptibility to liquefaction, and to develop an estimate of post-liquefaction settlement. The groundwater table was placed at a depth of 9½ feet below existing grades for the purpose of the analysis. The results of our analysis indicate that free-field settlements could be on the order of **12** to **21** inches. This amount of settlement typically cannot be accommodated by typical structural design or by construction methods. Due to the flat and level site topography and the great distance to the nearest “free-face” slope (3,300 feet to the east bank of the Duwamish Waterway), we do not expect that significant lateral spreading would occur at the site. However, even when footings are constructed atop a raft of improved soil, good design and construction practice recommends that isolated elements of the building foundation be structurally tied together to reduce the occurrence of incidental lateral movements and separation during and following earthquake shaking.

4.4.2 Surface Rupture

The subject site is located within the Seattle Fault Zone, and can be expected to experience intense ground shaking during movements within that fault zone. However, deep sediments conceal the fault location within the general project vicinity, and the likelihood of a ground surface rupture due to fault movement at depth can be considered low at the subject site.

4.5. Floor Slabs

In our opinion, the site is suitable for conventional, Portland cement concrete slabs-on-grade, which may be used for interior floors and for aprons around the exterior of the building, and elsewhere. Design recommendations for slabs-on-grade bearing on an improved subgrade utilizing aggregate pier ground improvement are presented below.

Design parameters for floor slabs assume the requirements of our Earthwork section have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Item	Description
Floor Slab Support [1]	Minimum 6 inches of 9-03.9(3) *Crushed Surfacing Base Course* [3] Compacted to at least 95% of maximum dry density (ASTM D 1557)
Estimated Modulus of Subgrade Reaction [2]	250 pounds per square inch per inch (psi/in) for point loads

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in the Earthwork section, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. WSDOT Standard Specification

The use of a vapor retarder is recommended beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

4.5.1 Floor Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may become unsuitable for placement of base rock and concrete and corrective action may be required.

We recommend the area underlying the floor slab be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and placement of base rock. Proofrolling should be completed under the observation of the Geotechnical Engineer. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base rock and concrete.

4.6. Airfield Pavement Analysis and Design

4.6.1 General Aircraft Pavement Design Considerations

Pavement design for the air field pavements for this project were conducted in accordance with the procedures outlined in the FAA Advisory Circular (AC) 150/5320-6F. Current FAA practice for design of pavements is based on use of the FAA computer program FAARFIELD, which includes an elastic layer analyses coupled with a finite element analyses for rigid pavements. For pavements supporting aircraft in excess of 100,000 pounds (which is the case for this project), the FAA requires that the PCC pavements be constructed on a stabilized base consisting of either P-304 Cement Treated Base, P-306 Econocrete or P-401/403 Plant-Mixed Bituminous Materials (asphalt concrete). An aggregate subbase (P-209) may be used in combination with any of the stabilized base materials.

UPS requested ten-year and twenty-year designs including consideration for overlay needed to increase the 10-year design to 20 years. The FAA minimum standard design life is 20 years. As you requested, we have included pavement options for traditional asphalt pavements, full-depth asphalt pavements and PCC pavements. PCC overlay alternatives for the air field pavements include recommendations for unbonded PCC overlays.

Based on the figure provided in Work Order No. 001, we understand there is one air field pavement area designated the Airplane Hardstand and Air Field Areas. Details of the pavement design parameters used are presented in the following sections.

4.6.2 Airplane Design Loading

The following table summarizes our understanding of the aircraft information and loading for the Airplane Hardstand and Air Field pavement areas on the project:

Pavement Area	Design Aircraft	Gross Weight (lbs)	Annual Departures	Percent Annual Growth
Airplane Hardstand and Air Field Areas	MD11ER A300-600 std B757-200	633,000 380,518 256,000	243 243 243	2.50% 2.50% 2.50%

The design aircraft loading and annual departures are based on information provided to Terracon by UPS for the design. The traffic arrivals and departures should be confirmed prior to implementing the design thickness recommendations included in this report.

4.6.3 Design Subgrade Support

The design subgrade modulus is based on the CBR testing completed on composite samples of representative subgrade soils. Based on the results of the CBR testing we have selected the following subgrade support parameters for the design of the project.

Design Parameter	Value
CBR	16
Resilient Modulus	24,000 psi
Effective Modulus of Subgrade Reaction, k	250 pci

The PCASE software developed by the U.S. Army Corps of Engineers was used to assess the frost penetration depth expected in the Seattle region based on climate data obtained from the “Seattle Jackson” weather station. The frost penetration is expected to be 10 inches below the top of pavement. The silty sand (SM) subgrade soil was classified as FG-3 frost group. The pavement design alternatives represent designs based on limited frost penetration and subgrade strength reductions.

The FAA AC 150/5320-6F provides subgrade compaction requirements for different values of compaction and airplane gear type. For purposes of this design, the CBR and resultant k-value were selected based on a minimum compaction requirement of 95% of the maximum density as specified in FAA specification P-152. We have assumed the subgrade was previously compacted to FAA standard specifications, however prior to pavement replacement or placement of new fill, the subgrade or exposed base should be proof-rolled and areas of soft or yielding subgrade should be recompacted to 95 percent of ASTM D 1557.

4.6.4 Pavement Thickness Design Recommendations - Airfields

Using the aircraft loading and the subgrade support characteristics as outlined above, alternative pavement sections for each area of the project were developed on the basis of the procedures outlined in Chapter 3 of the FAA Advisory Circular 150/5320-6F.

In summary, the recommended design alternatives for flexible and rigid pavements, summarized for each area, are as follows:

UPS Boeing Field Facility Expansion Flexible Pavement Design and Recommended Thicknesses (Inches) [1, 2]

Pavement Area	Design Life	Pavement Alternative	P-401 HMA Surface	P-403 HMA Base	P-209 Cr Ag	Total
Airplane Hardstand and Air Field Areas	20	A	4	5	9	18
		B	4	9	--	13

[1] Prior to placement of new fill, the subgrade should be proof-rolled and areas of soft or yielding subgrade should be recompacted to 95 percent of ASTM D 1557

[2] Each alternative should be evaluated in part based on material availability, construction conditions and economic factors

UPS Boeing Field Facility Expansion Rigid Pavement Design Recommended Thicknesses (Inches) [1, 2]

Pavement Area	Design Life	Pavement Alternative	P-501 PCC Surface Course	P-403 HMA Base	P-209 Aggregate Base Course	Total Thick. (inches)
Airplane Hardstand and Air Field Areas	20	C1	16½	5	6	27½

[1] Prior to placement of new fill, the subgrade should be proof-rolled and areas of soft or yielding subgrade should be recompacted to 95 percent of ASTM D 1557

[2] Each alternative should be evaluated in part based on material availability, construction conditions and economic factors

The recommended minimum joint spacing is 17.5 feet on center. Joint design details for the project are discussed in Section 4.6.6 below.

4.6.5 Alternative Pavements Designs -- Airfields

We have also developed alternative pavement designs as outlined in the following tables.

UPS Boeing Field Facility Expansion Flexible Pavement Design Alternative Thicknesses (Inches) [1, 2]

Pavement Area	Design Life	Pavement Alternative	P-401 HMA Surface	P-403 HMA Base	P-209 Cr Ag	Total
Airplane Hardstand and Air	10 + 10	A2	4	5	8	17
		A2 OL[3]	2	--	--	--
		B2	4	8½	--	12½

UPS Boeing Field Facility Expansion Flexible Pavement Design Alternative Thicknesses (Inches) [1, 2]						
Pavement Area	**Design Life**	**Pavement Alternative**	**P-401 HMA Surface**	**P-403 HMA Base**	**P-209 Cr Ag**	**Total**
Field Areas		B2 OL[3]	2	--	--	--

[1] Prior to placement of new fill, the subgrade should be proof-rolled and areas of soft or yielding subgrade should be recompacted to 95 percent of ASTM D 1557
[2] Each alternative should be evaluated in part based on material availability, construction conditions and economic factors
[3] The overlay (OL) rehabilitations are to be implemented at 10 years after the initial construction and are designed to provide an additional 10 years of service life

UPS Boeing Field Facility Expansion Rigid Pavement Design Alternative Thicknesses (Inches) [1, 2]							
Pavement Area	**Design Life**	**Pavement Alternative**	**P-501 PCC Unbonded Overlay**	**P-501 PCC Surface Course**	**P-403 HMA Base**	**P-209 Aggregate Base Course**	**Total Pavement Thickness (inches)**
Airplane Hardstand and Air Field Areas	10 + 10	C2	--	16	5	6	27
		C2 OL[3]	5	--	--	--	5

[1] Prior to placement of new fill, the subgrade should be proof-rolled and areas of soft or yielding subgrade should be recompacted to 95 percent of ASTM D 1557
[2] Each alternative should be evaluated in part based on material availability, construction conditions and economic factors
[3] The overlay rehabilitations are to be implemented at 10 years after the initial construction and are designed to provide an additional 10 years of service life

4.6.6 Joint Design

Joints in the PCC pavements should be designed based on the criteria outlined in Section 3.14 of FAA AC 150/5230-6F. Based on the recommended design thickness of the PCC pavements as outlined in this report, the maximum joint spacing for the PCC pavements outlined above should be 17.5 feet based on Table 3-9 of FAA AC 150/5230-6F for pavement thicknesses between 13.5 and 16 inches.

Construction joints should meet the requirements for Type E joints according to Section 3.14 of AC 150/5230-6F. Based on the requirements of Table 3-8 of FAA AC 150/5230-6F for pavement thickness in the range of 12.5 to 16 inches, 1-1/4 inch diameter dowels, 20 inches in length and placed 15 inches on center along the location of the joint should be specified. We recommend that the dowels be placed and epoxy grouted in drill holes in any existing slabs and that the painted and oiled end of the dowel bar be placed in the new PCC pavement. These same joint details should be specified for any other construction joints used in the new PCC pavements.

Based on the requirements of Table 3-7 of FAA AC 150/5230-6F, Type C Doweled Contraction Joints and Type D Dummy contraction joints should be used as appropriate in the design of the new pavements on the project. Joint Details in Section 3.14 should be specified for construction and contraction joints.

4.6.7 Pavement Materials and Construction Considerations

The use of FAA construction specifications are recommended for all airfield work on the project. Based on the recommendations for the alternative pavement thicknesses outlined in this report, and pending the final determination of actual designs, the specifications, at a minimum, should include those listed in the following table. The table also includes our comments on those items that should be specified in each section based on the results of the pavement design.

FAA Specification	Specification Title	Comments/ Recommendations
P-101	Surface Preparation	This specification should include a provision for removal of existing base course and some of the subgrade soils where pavement will be removed to accommodate the new design section thickness.
P-152	Excavation & Embankment	All excavation should be considered as unclassified. Compaction for subgrade should be specified to a minimum of 95% of the maximum dry density determined in accordance with ASTM D1557. We have assumed the existing subgrade has been prepared in accordance with FAA standards.
P-154	Subbase Course	Compaction should be specified to a minimum of 100% of the maximum dry density determined in accordance with ASTM D1557.
P-209	Crushed Aggregate Base Course	Compaction should be specified to a minimum of 100% of the maximum dry density determined in accordance with ASTM D1557.
P-401	Plant Mixed Bituminous Pavements	The use of Performance Grade PG 64H-28 asphalt binder should be specified. A ¾" maximum aggregate mix design for aircraft gross weights exceeding 60,000 pounds should be specified.
P-403	Plant Mixed Bituminous Pavements	The use of Performance Grade PG 64S-28 asphalt binder should be specified as required by WSDOT. A ¾" maximum aggregate mix design for aircraft

FAA Specification	Specification Title	Comments/ Recommendations
		gross weights exceeding 60,000 pounds should be specified.
P-501	Portland Cement Concrete Pavement	The use of ASTM Type II cement should be specified for the concrete pavement. A minimum 28-day flexural strength of 650 psi should be specified for the concrete pavement.

We are available to assist in the review and development of the final specifications for the project once the final design section alternatives are determined.

4.7. "Ground-Side" Pavement Analysis and Design

The following sections address pavement considerations for conventional vehicle traffic around the parcel distribution facility, including the following traffic areas:

1. The Truck Portion of the Package Sorting Facility Parking Lot
2. The Employee Parking Portion of the Package Sorting Facility

4.7.1 Traffic Design Loading

Equivalent Single Axle Loading (ESALs) for the Truck and Employee Portions of the package sorting facility were developed based on the frequency and type of loading provided by UPS. UPS also provided the truck factors used in calculating the ESAL values for each vehicle type expected to use the parking lot. A summary of the design ESALs is provided in the following table.

Pavement Area	Design Vehicle	Truck Factor	Total Design Life Passes	Total Design Life ESALs
Truck Portion of the Package Sorting Parking Lot	Loaded 45' Feeder Loaded Double 28' Feeder Loaded Single 28' Feeder Loaded Package Cars	1.828 2.145 1.116 0.175	56,465 56,465 28,233 56,465	265,724
Employee Portion of the Package Sorting Parking Lot	Employee Personal Vehicles	0.00036	722,800	260

4.7.2 Design Subgrade Support

The design subgrade modulus is based on the CBR testing completed on composite samples of representative subgrade soils. Based on the results of the CBR testing we have selected the following subgrade support parameters for the design of the project.

Design Parameter	Value
CBR	16
Resilient Modulus	24,000 psi
Effective Modulus of Subgrade Reaction, k	250 pci

The PCASE software developed by the U.S. Army Corps of Engineers was used to assess the frost penetration depth expected in the Seattle region based on climate data obtained from the "Seattle Jackson" weather station. The frost penetration is expected to be 10 inches below the top of pavement. The pavement designs alternatives represent designs based on limited frost penetration and subgrade strength reductions.

4.7.3 Pavement Thickness Design

Design of pavements that are not on the airfield were based on the guidelines outlined by the Washington State Department of Transportation (WSDOT) Pavement Policy, dated September 2018, as well as procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993).

Based upon AASHTO criteria, the project site is located within Climatic Region II of the United States. The region is characterized as being wet, with freeze-thaw cycling. The spring thaw condition typically results in saturated or near-saturated subgrade soil moisture conditions. The AASHTO criteria suggest these moisture conditions are prevalent for approximately 4 percent of the annual moisture variation cycle.

Local drainage characteristics of proposed pavements areas are considered fair. The crushed aggregate base provides a limited amount of pavement drainage. These characteristics, coupled with the approximate duration of saturated subgrade conditions, result in a design drainage coefficient of 1.0 when applying the AASHTO criteria for design.

Pavement Thickness Design Parameters		
Input Parameter	**Flexible (asphalt)**	**Rigid (concrete)**
Reliability	85%	85%
Serviceability Loss	1.5	1.5
Standard Deviation	0.45	0.35
Asphalt Layer Coefficient	0.44	N/A
Crushed Surface Aggregate Base Coefficient	0.13	N/A
Aggregate Base Modulus (Mr)	30,000 psi	30,000 psi
Concrete Elastic Modulus(Ec)	N/A	4,000,000 psi
Concrete Modulus of Rupture (S'c)	N/A	650 psi

Pavement Thickness Design Parameters		
Input Parameter	**Flexible (asphalt)**	**Rigid (concrete)**
Load Transfer Coefficient (J)	N/A	Dowelled – 3.2 Not Dowelled – 4.1

As a minimum, we suggest the following pavement sections be considered:

UPS Package Sorting Facility Parking Lot Flexible Pavement Design Alternatives and Recommended Thicknesses (Inches) [1, 2]						
Pavement Area	**Design Life**	**Pavement Alternative**	**HMA Surface[3]**	**HMA Base[3]**	**Crushed Surfacing Base Course (CSBC)[3]**	**Total**
Employee Portion	20	A3	4	--	6	10
		B3	2	3	--	5
	10[4]	A4	4	--	6	10
		B4	2	3	--	5
Truck Portion	20	A5	4	--	6	10
		B5	2	3	--	5
	10[4]	A6	4	--	6	10
		B6	2	3	--	5

[1] Subgrade compaction for non-air field areas must extend to a minimum depth of 10 inches below finished subgrade elevation

[2] Each alternative should be evaluated in part based on material availability, construction conditions and economic factors

[3] The HMA surface course should be ½ inch Nominal Maximum Aggregate Size (NMAS), PG 58H-22. The HMA Base Course should be ¾ inch NMAS, PG 58H-22. The HMA should conform to Section 5-04 of the WSDOT Standard Specifications, 2018. The CSBC should conform to Section 9-03 of the WSDOT Standard Specifications, 2018.

[4] No overlay alternative was presented because a minimum practical section was used with no difference between the 10-year and 20-year design life alternatives

Pavement thickness designs for new PCC pavements based on the traffic loads presented above and the results of our testing and analysis are included below. The pavements in the Truck Portion were designed with dowelled joints whereas the pavements in the Employee Portion were designed without dowelled joints.

UPS Package Sorting Facility Parking Lot Rigid Pavement Design Alternatives and Recommended Thicknesses (Inches) [1, 2]						
Pavement Area	**Design Life**	**Pavement Alternative**	**PCC Bonded Overlay[3]**	**PCC[3]**	**Crushed Surface Aggregate Base[3]**	**Total Pavement Thickness (inches)**
	20	C3	--	5	6	11

UPS Package Sorting Facility Parking Lot Rigid Pavement Design Alternatives and Recommended Thicknesses (Inches) [1, 2]						
Pavement Area	**Design Life**	**Pavement Alternative**	**PCC Bonded Overlay[3]**	**PCC[3]**	**Crushed Surface Aggregate Base[3]**	**Total Pavement Thickness (inches)**
Employee Portion	10	C4	--	5	6	11
Truck Portion	20	C5	--	6½	6	12½
	10	C6	--	6	6	12
		C6 OL[4]	3	--	--	3

[1] Subgrade compaction for non-air field areas must extend to a minimum depth of 10 inches below finished subgrade elevation

[2] Each alternative should be evaluated in part based on material availability, construction conditions and economic factors

[3] The PCC should conform to Section 5-05 of the WSDOT Standard Specifications, 2018. The CSBC should conform to Section 9-03 of the WSDOT Standard Specifications, 2018. The PCC should have a minimum 14-day flexural strength of 650 psi.

[4] The overlay rehabilitations are to be implemented at 10 years after the initial construction and are designed to provide an additional 10 years of service life. No overlay alternative was presented for the Employee Parking portion of the pavement because that area utilized a minimum practical section with no difference between the 10-year and 20-year design life.

4.7.4 Recommendations for Design and Construction

Terracon considered the weather conditions and traffic to determine the appropriate asphalt binder for this project. This was accomplished using the LTPPBind Version 3.1 Beta, dated September 15, 2015 software provided by the Federal Highway Administration (FHWA). This software utilizes historical temperature data from the 5 weather stations nearest the project and considers traffic speed and traffic loading to establish a recommended Performance Graded (PG) binder grade of asphalt concrete. Terracon then compared the software output to the binders that were indicated to be locally available to determine the recommended binder selection for the project.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. A maintenance program including surface sealing, joint cleaning and sealing, and timely repair of cracks and deteriorated areas will increase the pavement's service life. As an option, thicker sections could be constructed to decrease future maintenance.

Concrete for rigid pavements should have a minimum 28-day compressive strength of 4,000 psi and be placed with a maximum slump of 4 inches. Although not required for structural support, a minimum 6-inch thick base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade pumping through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Rigid PCC pavements will perform better than AC in areas where short-radii turning and braking are expected (i.e., entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330-2R and ACI 325. PCC pavements should be provided with mechanically reinforced joints (doweled or keyed) in accordance with ACI 330-2R.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications, so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

EXHIBIT A-1 --SITE LOCATION

UPS – Boeing Field Parcel Distribution Facility ■ Seattle, Washington
December 20, 2018 ■ Terracon Project No. 81185115

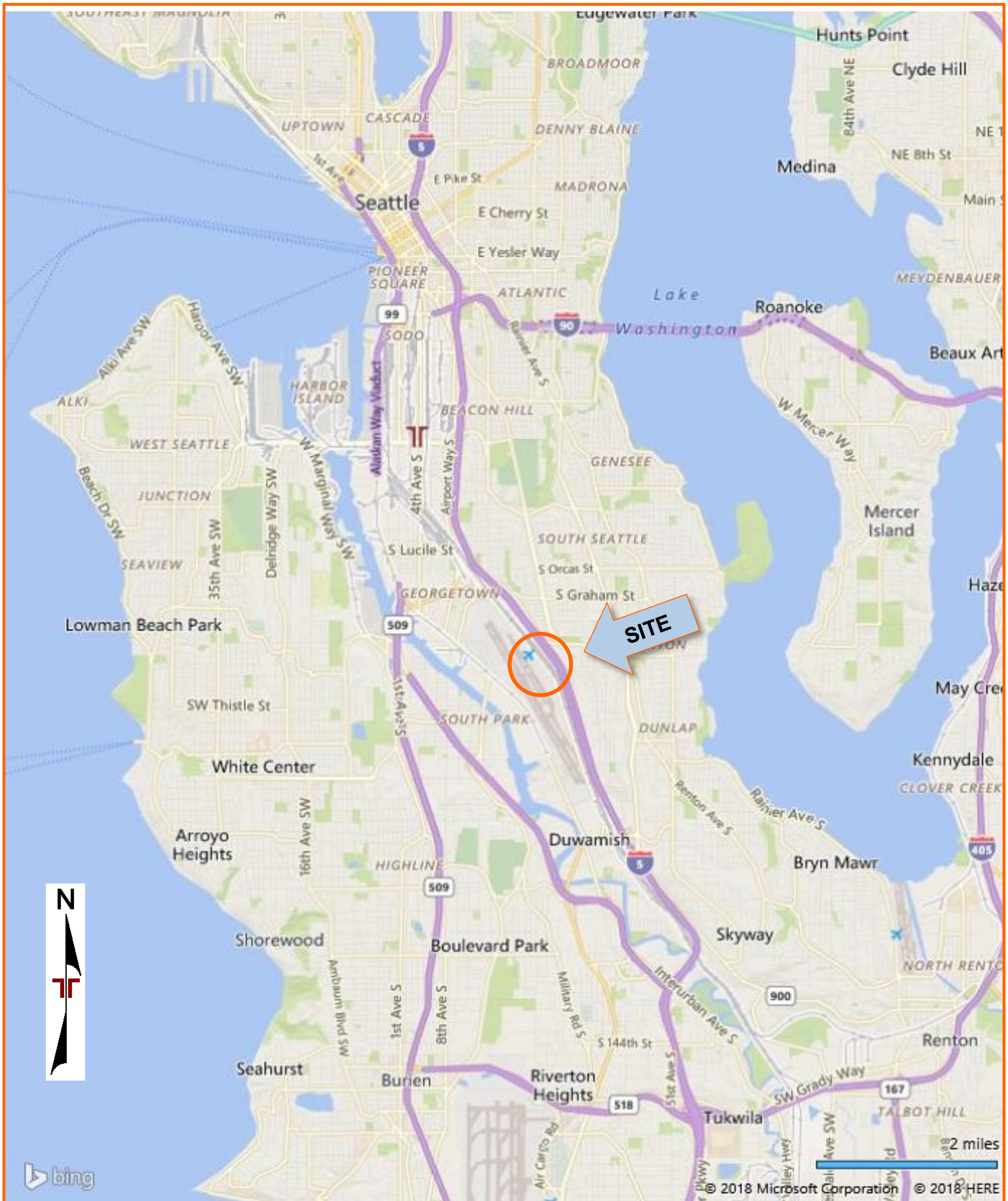


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT A-2 -- EXPLORATION PLAN

UPS – Boeing Field Parcel Distribution Facility ■ Seattle, Washington

December 20, 2018 ■ Terracon Project No. 81185115

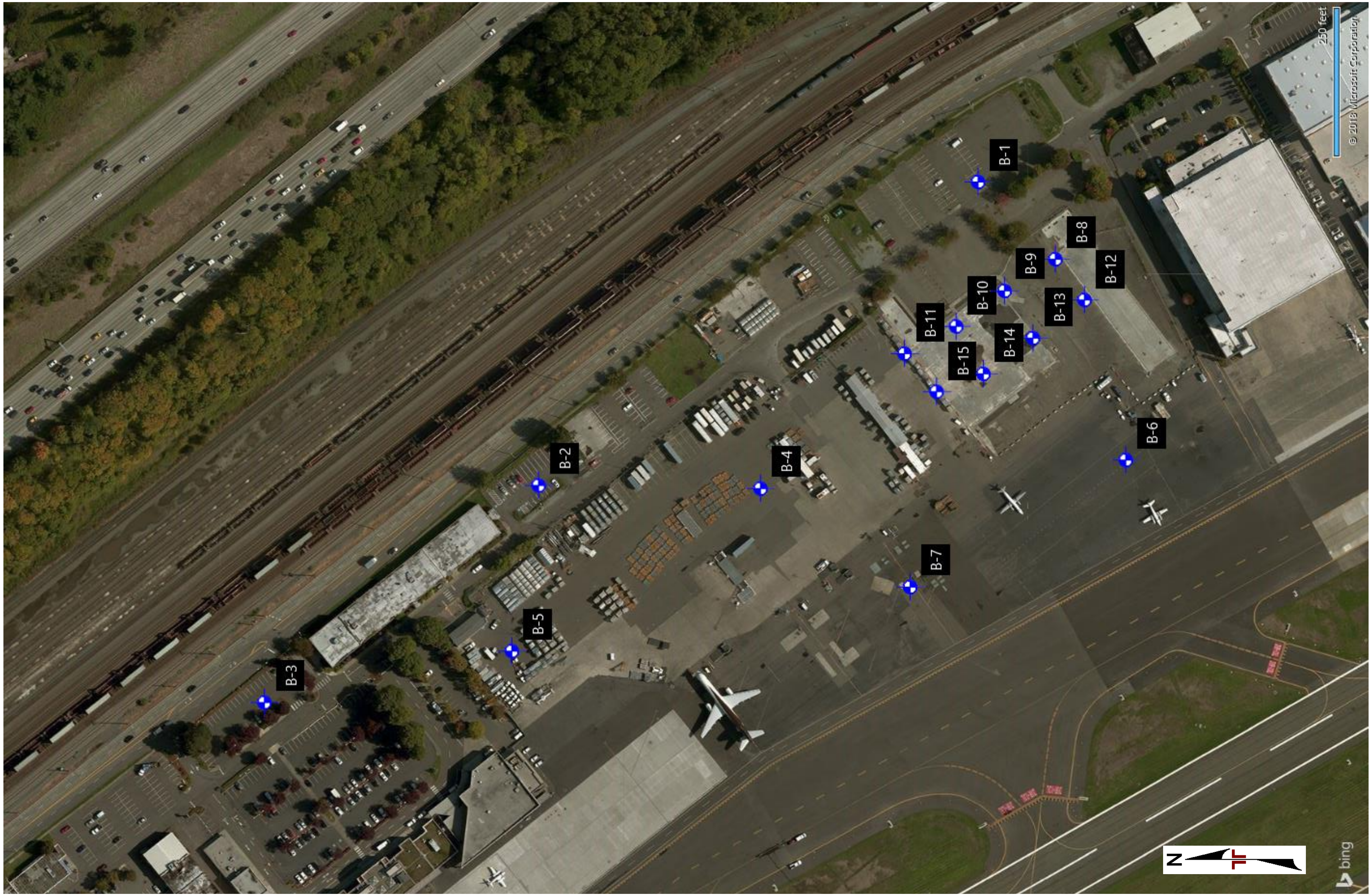


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT A-3 -- FIELD EXPLORATION DESCRIPTION

Field Exploration

We advanced exploration borings B-1 through B-15 to the following depths at the locations shown on Exhibit A-1. Borings were advanced between September 5 and September 7, 2018.

Boring Name	Boring Depth	Primary Engineering Purpose
B-1 through B-7	16½ feet	Pavement Design
B-9, B-10, B-12, B-14, B-15	21½ feet	Building Foundation
B-8, B-11, B-13	51½ feet	Building Foundation

Boring Layout: UPS provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet). If a more precise boring layout is desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted, drill rig using the mud-rotary drilling technique. Mud-rotary drilling was selected due to expected relatively shallow groundwater conditions and loose sands through the depths of exploration. Four samples were obtained in the upper 10 feet of each boring and at depth intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, and in accordance with Washington Department of Ecology regulations for borehole abandonment, all borings were backfilled with bentonite chips after their completion. Pavements were patched with a black-dyed quickset concrete patch.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

BORING LOG NO. B-1

PROJECT: UPS Boeing Field Parcel Distribution Facility

**CLIENT: United Parcel Service
Omaha, NE**

**SITE: 7575 Perimeter Road S.
Seattle, WA**

LOCATION See Exhibit A-2

Latitude: 47.5341° Longitude: -122.2992°

DEPTH	Description
0.3	**ASPHALT CONCRETE**, Asphalt thickness 0.25 feet
1.0	**FILL - POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, fine to coarse grained, angular, brown, moist, medium dense, Crushed base rock
2.5	**FILL - SAND WITH SILT AND GRAVEL (SP-SM)**, fine to medium grained, brown, moist, medium dense
3.0	**FILL - SILT WITH SAND (ML)**, fine grained, dark brown, moist, medium dense, with charcoal
5.0	**SANDY SILT (ML)**, fine grained, light reddish brown, moist, soft to medium stiff
7.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, reddish brown, moist, loose, with interbedded fine sand with silt
16.5	**POORLY GRADED SAND (SP)**, fine to medium grained, reddish brown to dark reddish brown, moist to wet, medium dense, to medium sand with trace silt

Boring Terminated at 16.5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5–2.0		X	1.2	6-8-10 N=18	S-1			
2.5–4.0		X	1.3	2-2-2 N=4	S-2	31		
5.0–6.5		X	1.1	3-4-4 N=8	S-3			
7.5–9.0		X	1.2	3-6-8 N=14	S-4			
10.0–11.5	▽	X	1.3	9-6-7 N=13	S-5			
15.0–16.5		X	1.3	5-6-9 N=15	S-6			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-05-2018	Boring Completed: 09-05-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-4

BORING LOG NO. B-2

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5361° Longitude: -122.3012°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**ASPHALT CONCRETE**, Asphalt thickness 0.2 feet									
2.0	**FILL - SILTY SAND (SM)**, fine to medium grained, dark gray to black, moist, medium dense, with gravel and abundant charcoal and trace brick			X	1.4	5-6-7 N=13	S-1	19		21
4.0	**SILT WITH SAND (ML)**, fine grained, reddish brown, moist, stiff			X	1.2	5-6-7 N=13	S-2			
4.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, light brown, moist, medium dense	5								
16.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, medium grained, dark gray, moist to wet, loose to medium dense, with some interbedded fine to medium sand			X	1.2	3-3-5 N=8	S-3	6		
				X	1.2	3-4-4 N=8	S-4			
		10	▽	X	1.3	3-5-6 N=11	S-5			
		15		X	1.5	3-6-12 N=18	S-6			

Boring Terminated at 16.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-05-2018	Boring Completed: 09-05-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-5

BORING LOG NO. B-3

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5374° Longitude: -122.3027°

DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, Asphalt thickness 0.3 feet									
0.8	**FILL - POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, fine grained, reddish brown, moist, loose			X	1.2	2-4-3 N=7	S-1	25		
2.0	**FILL - SILT WITH SAND (ML)**, fine grained, reddish brown, moist, medium stiff									
3.5	**SILT WITH SAND (ML)**, fine grained, light brown, moist, medium stiff, loose, with interbedded silty fine sand and fine sand with silt			X	1.3	3-2-3 N=5	S-2			
7.0	**POORLY GRADED SAND (SP)**, fine to medium grained, gray to dark gray, moist, loose, with interbedded fine sand with silt	5		X	1.4	2-4-3 N=7	S-3			
	POORLY GRADED SAND (SP), medium grained, dark gray, moist to wet, loose to medium dense			X	1.2	1-2-2 N=4	S-4	11		
		10	▽	X	1.2	2-2-3 N=5	S-5	26		4
16.5		15		X	1.3	4-6-7 N=13	S-6			

Boring Terminated at 16.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-05-2018	Boring Completed: 09-05-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-6

BORING LOG NO. B-4

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5351° Longitude: -122.3013°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, Asphalt thickness 0.25 foot									
4.5	**FILL - POORLY GRADED SAND (SP)**, medium grained, dark gray, moist, loose to medium dense, with trace gravel and concrete debris			X	1.3	6-10-6 N=16	S-1			
				X	1.2	4-4-4 N=8	S-2	8		
9.0	**FILL - POORLY GRADED SAND (SP)**, fine to medium grained, dark gray, moist, loose to medium dense, with trace gravel	5		X	1.2	3-3-3 N=6	S-3			
			▽	X	1	5-6-9 N=15	S-4	13		
11.0	**POORLY GRADED SAND (SP)**, fine to medium grained, dark gray, moist, very loose to loose, with trace silt	10		X	1	2-2-2 N=4	S-5			
13.0	**SILT WITH SAND (ML)**, fine grained, dark gray, wet, soft, with trace silt									
16.5	**POORLY GRADED SAND (SP)**, medium grained, dark gray, wet, very loose	15		X	1.3	1-2-1 N=3	S-6	27		

Boring Terminated at 16.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-05-2018	Boring Completed: 09-05-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-7

BORING LOG NO. B-5

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5363° Longitude: -122.3024°

GRAPHIC LOG / DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**ASPHALT CONCRETE**, Asphalt thickness 0.8 feet									
4.5	**FILL - POORLY GRADED SAND (SP)**, fine to medium grained, dark gray, moist, loose to medium dense, with trace silt			X	1.3	5-7-6 N=13	S-1	5		
				X	1.2	1-1-5 N=6	S-2			
14.0	**POORLY GRADED SAND (SP)**, medium grained, dark gray, moist to wet, very loose to loose, with interbedded fine to medium sand	5		X	1.3	1-4-4 N=8	S-3	4		
			▽	X	1.3	3-4-3 N=7	S-4			
		10		X	1.1	3-2-1 N=3	S-5	28		4
16.5	**SILTY SAND (SC-SM)**, fine grained, dark gray, wet, very loose, with interbedded fine sandy silt with trace wood	15		X	1.2	0-1-2 N=3	S-6			
	Boring Terminated at 16.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-05-2018	Boring Completed: 09-05-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-8

BORING LOG NO. B-6

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5334° Longitude: -122.3011°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.6	**ASPHALT CONCRETE**, Asphalt thickness 0.55 feet									
1.1	**CONCRETE**, Concrete thickness 0.6 feet									
2.5	**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, dark brown to dark gray, moist, medium dense			X	0.9	5-6-8 N=14	S-1	7		
13.0	**POORLY GRADED SAND (SP)**, fine to medium grained, dark brown to dark gray, moist to wet, loose, with trace silt			X	1.1	3-4-5 N=9	S-2			
		5		X	1.1	3-3-7 N=10	S-3			
				X	1.4	3-3-4 N=7	S-4	22		
			▽							
		10		X	1.1	2-2-2 N=4	S-5			
16.5	**SAND WITH SILT (SP-SM)**, fine grained, dark gray, wet, loose, with trace wood and fine organics									
		15		X	1.5	2-3-3 N=6	S-6			

Boring Terminated at 16.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 81185115 UPS BOEING FIELD.GPJ TERRACON_DATATEMPLATE.GDT 12/20/18

BORING LOG NO. B-7

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5344° Longitude: -122.3019°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.8	**ASPHALT CONCRETE**, Asphalt thickness 1.75 feet									
5.5	**FILL - SAND WITH SILT (SP-SM)**, fine to medium grained, light gray, moist, medium dense			X	1.1	7-9-10 N=19	S-1	4		7
7.0	**SILT (ML)**, light brown, moist, medium stiff, grading to fine sandy silt, thinly laminated	5		X	1.3	2-2-3 N=5	S-2			
9.0	**SILTY SAND (SM)**, fine grained, gray, wet, very loose		▽	X	1.2	2-1-2 N=3	S-3	30		
13.0	**SAND WITH SILT (SP-SM)**, fine to medium grained, dark gray, wet, loose	10		X	1.2	1-3-4 N=7	S-4			
16.5	**POORLY GRADED SAND (SP)**, medium grained, dark gray, wet, loose	15		X	1.2	2-2-3 N=5	S-5			
	Boring Terminated at 16.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-10

BORING LOG NO. B-8

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5338° Longitude: -122.2997°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**ASPHALT CONCRETE**, Asphalt thickness 0.2 feet									
	POORLY GRADED SAND WITH SILT (SP-SM), light reddish brown, moist to wet, very loose to loose, with interbedded silty fine sand, thinly laminated			X	1.3	6-4-4 N=8	S-1			
5.0				X	1.1	2-3-4 N=7	S-2			
	POORLY GRADED SAND (SP), fine grained, dark brown, wet, medium dense	5		X	1	4-6-6 N=12	S-3			
7.0										
	POORLY GRADED SAND (SP), fine to medium grained, dark gray, wet, medium dense, with trace silt and fine gravel, and interbedded medium to coarse sand		▽	X	1.2	4-6-8 N=14	S-4			
		10		X	1	4-5-7 N=12	S-5	23		4
18.5		15		X	1.5	7-8-9 N=17	S-6			
	SILT (ML), dark gray, wet, soft, with interbedded fine sand	20		X	0.9	2-1-2 N=3	S-7	36		
23.0										
	POORLY GRADED SAND (SP), fine grained, dark gray, wet, loose, with interbedded silty with fine sand, with wood	25								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-11

BORING LOG NO. B-8

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5338° Longitude: -122.2997°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	POORLY GRADED SAND (SP), fine grained, dark gray, wet, loose, with interbedded silty with fine sand, with wood *(continued)*			X	1	1-3-3 N=6	S-8			
28.0	**SILT (ML)**, gray, wet, soft, with shell fragments and fine laminations	30		X	1.5	1-0-0 N=0	S-9	25	NP	
35.5	**SANDY SILT (ML)**, fine grained, gray, wet, soft, with gravel and shell fragments	35		X	1.4	5-6-7 N=13	S-10			
		40		X	1.5	0-0-2 N=2	S-11	22		36
43.0	**SILT WITH SAND (ML)**, fine to medium grained, light brown, wet, medium dense, with fine gravel	45		X	0.5	10-14-10 N=24	S-12			
		50								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-11

BORING LOG NO. B-8

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 47.5338° Longitude: -122.2997° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILT WITH SAND (ML), fine to medium grained, light brown, wet, medium dense, with fine gravel *(continued)* 51.5			X	0.5	6-4-6 N=10	S-13			
	Boring Terminated at 51.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: Mud-Rotary Abandonment Method: Boring backfilled with bentonite Surface capped with concrete	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any). See Appendix C for explanation of symbols and abbreviations.	Notes:

WATER LEVEL OBSERVATIONS	Terracon 21905 64th Ave W, Ste 100 Mountlake Terrace, WA	Boring Started: 09-07-2018	Boring Completed: 09-07-2018
▽ *While drilling*		Drill Rig: Veh. #92	Driller: Holocene
		Project No.: 81185115	Exhibit: A-11

BORING LOG NO. B-9

PROJECT: UPS Boeing Field Parcel Distribution Facility

**CLIENT: United Parcel Service
Omaha, NE**

**SITE: 7575 Perimeter Road S.
Seattle, WA**

LOCATION See Exhibit A-2

Latitude: 47.534° Longitude: -122.2999°

DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.4	**ASPHALT CONCRETE**, Asphalt thickness 0.4 feet									
0.8	**FILL - AGGREGATE BASE COURSE**, angular, gray, moist, loose, 5/8 inch minus crushed rock				1.1	4-4-3 N=7	S-1			
2.0	**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, gray brown, moist, loose, with trace gravel and wood debris				1	3-4-5 N=9	S-2			
4.0	**SILTY SAND (SM)**, fine to medium grained, gray brown, moist, loose, with trace gravel and charcoal									
9.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, dark gray, moist, loose, with interbedded medium sand and medium sand with silt	5			1.2	4-5-5 N=10	S-3	6		
					1.4	3-4-4 N=8	S-4			
21.5	**SILTY SAND (SM)**, fine to medium grained, dark gray, wet, loose to medium dense, with interbedded silty fine to medium sand	10	▽		1	2-2-6 N=8	S-5A			
							S-5B			
		15			1	1-4-5 N=9	S-6	24		14
		20			1.5	2-3-9 N=12	S-7			

Boring Terminated at 21.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-12

BORING LOG NO. B-10

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5342° Longitude: -122.3002°

DEPTH	Description	DEPTH (Ft.)
0.7	Concrete thickness 0.65 feet	
4.0	**FILL - POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM)**, angular, brown, moist, loose, primarily coal, coal slag and clay pipe debris	
18.0	**FILL - GRAVEL WITH DEBRIS**, angular, yellow, moist, very loose to loose, majority bricks and clay pipe debris, loose and irregularly laying	5, 10, 15
21.5	**POORLY GRADED SAND (SP)**, fine to medium grained, dark gray, wet, medium dense, with interbedded fine sand with silt and trace wood	20
	Boring Terminated at 21.5 Feet	

WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	X	1.3	3-3-4 N=7	S-1			
	X	1	2-2-4 N=6	S-2			
	X	0.5	4-3-3 N=6	S-3			
▽	X	0.5	2-1-2 N=3	S-4			
	X	0.7	1-5-1 N=6	S-5			
	X	0.5	2-1-2 N=3	S-6			
	X	1.5	3-3-7 N=10	S-7			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-13

BORING LOG NO. B-11

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5345° Longitude: -122.3003°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	**ASPHALT CONCRETE**, Asphalt thickness 0.2 feet									
0.7	**AGGREGATE BASE COURSE**, 5/8 inch minus crushed base rock			X	1	12-13-12 N=25	S-1			
7.0	**FILL - POORLY GRADED SAND WITH GRAVEL (SP)**, coarse to medium grained, brown, moist to wet, loose to medium dense, with trace silt			X	0.7	4-5-6 N=11	S-2			
		5		X	0	3-3-4 N=7	S-3			
9.0	**POORLY GRADED SAND (SP)**, fine to medium grained, dark brown, moist, loose		▽	X	0.8	5-5-4 N=9	S-4			
18.0	**POORLY GRADED SAND (SP)**, medium grained, dark gray, wet, loose	10		X	0.6	3-2-2 N=4	S-5			
		15		X	1	3-4-4 N=8	S-6			
23.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, dark gray, wet, medium dense	20		X	1	3-7-9 N=16	S-7	26		8
	SILT WITH SAND (ML), fine grained, dark gray, wet, very soft to soft, with occasional interbedded fine and fine to medium sand	25								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-14

BORING LOG NO. B-11

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5345° Longitude: -122.3003°

DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILT WITH SAND (ML), fine grained, dark gray, wet, very soft to soft, with occasional interbedded fine and fine to medium sand *(continued)*			X	0.9	2-2-9 N=11	S-8			
	30		X	1.5	2-1-1 N=2	S-9	38		83
	35		X	1.5	1-1-2 N=3	S-10	36		
	40		X	1.5	0-0-0 N=0	S-11	26		
43.0 **SILT WITH SAND (ML)**, fine to medium grained, dark gray, wet, stiff, with gravel and interbedded silty fine sand									
	45		X	0	6-7-8 N=15	S-12			
	50								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
While drilling

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-14

BORING LOG NO. B-11

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 47.5345° Longitude: -122.3003° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILT WITH SAND (ML), fine to medium grained, dark gray, wet, stiff, with gravel and interbedded silty fine sand *(continued)* 51.5				1.1	6-6-8 N=14	S-13	18		31
	Boring Terminated at 51.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
While drilling

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-14

BORING LOG NO. B-12

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5336° Longitude: -122.3°

DEPTH	Description
0.5	**ASPHALT CONCRETE**, Asphalt thickness 0.45 feet
1.0	**FILL - SANDY GRAVEL WITH SILT (GP-GM)**, brown and dark gray, moist, loose to medium dense, with silt to trace silt
4.0	**FILL - POORLY GRADED SAND (SP)**, fine to medium grained, brown, moist, loose to medium dense, with trace silt
13.0	**POORLY GRADED SAND (SP)**, fine to medium grained, brown, moist to wet, very loose to loose, with trace silt
16.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, dark gray, wet, loose
21.5	**SILT WITH SAND (ML)**, fine to medium grained, dark gray, wet, soft to medium stiff, with interbedded fine to medium sand with trace silt and shell fragments

Boring Terminated at 21.5 Feet

RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	8-6-5 N=11	S-1			
0.9	10-3-4 N=7	S-2			
1.3	2-3-0 N=3	S-3			
11.3	2-2-2 N=4	S-4			
1.1	1-2-2 N=4	S-5			
1.2	1-1-4 N=5	S-6			
1.3	1-1-2 N=3	S-7	36		

Depth (Ft.): 5, 10, 15, 20

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-15

BORING LOG NO. B-13

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service, Omaha, NE

SITE: 7575 Perimeter Road S., Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5339° Longitude: -122.3002°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.4	**ASPHALT CONCRETE**, Asphalt thickness 0.4 feet									
1.3	**FILL - POORLY GRADED SAND WITH SILT (SP-SM)**, medium to coarse grained, dark brown, moist, loose, primarly coal debris with trace fine gravel			X	1.5	4-3-4 N=7	S-1			
4.5	**FILL - POORLY GRADED SAND (SP)**, medium grained, gray and reddish gray, moist, loose to medium dense, with trace coarse sand and silt			X	1	4-4-6 N=10	S-2			
	POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained, reddish gray to brown gray, moist to wet, medium dense, with interbedded fine sand and medium to coarse sand with trace silt	5		X	0.7	3-4-7 N=11	S-3			
				X	0.9	3-4-8 N=12	S-4	15		6
		10	▽	X	0.75	3-4-6 N=10	S-5			
13.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, dark gray, wet, loose, with some shell fragments									
		15		X	0.7	2-3-3 N=6	S-6			
		20		X	1.1	3-3-4 N=7	S-7			
		25								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-16

BORING LOG NO. B-13

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5339° Longitude: -122.3002°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
25.5	**SILT (ML)**, dark gray, wet, soft to medium stiff, with some wood			X	1	2-2-2 N=4	S-8	39		
28.0	**POORLY GRADED SAND (SP)**, fine to medium grained, dark gray, wet, loose, with trace silt	30		X	1	2-3-4 N=7	S-9	28		3
32.0	**SILT (ML)**, gray, wet, very soft to stiff, with interbedded fine to medium sand and thin laminations	35		X	1.5	1-1-1 N=2	S-10	40		
		40		X	1.3	3-2-4 N=6	S-11			
		45		X	1.5	0-0-0 N=0	S-12	27	NP	
		50								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-16

BORING LOG NO. B-13

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service Omaha, NE

SITE: 7575 Perimeter Road S. Seattle, WA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 47.5339° Longitude: -122.3002° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILT (ML), gray, wet, very soft to stiff, with interbedded fine to medium sand and thin laminations *(continued)* 51.5				1.2	5-6-5 N=11	S-13			
	Boring Terminated at 51.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-07-2018	Boring Completed: 09-07-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-16

BORING LOG NO. B-14

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5341° Longitude: -122.3005°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, Asphalt thickness 0.3 feet									
3.5	**FILL - POORLY GRADED SAND (SP)**, fine to medium grained, brownish gray, moist, medium dense, with trace silt and gravel			X	0.9	8-9-7 N=16	S-1			
				X	1.4	5-8-8 N=16	S-2			
19.0	**POORLY GRADED SAND (SP)**, fine to medium grained, dark brownish gray, moist to wet, loose, with trace silt	5		X	1.3	3-5-5 N=10	S-3			
				X	1	3-2-3 N=5	S-4			
		10	▽	X	1	2-2-2 N=4	S-5			
		15		X	1.5	1-2-2 N=4	S-6			
21.5	**POORLY GRADED SAND (SP)**, fine to medium grained, dark brownish gray, wet, dense, with trace silt	20		X	1.5	6-12-19 N=31	S-7			

Boring Terminated at 21.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-17

BORING LOG NO. B-15

PROJECT: UPS Boeing Field Parcel Distribution Facility

CLIENT: United Parcel Service
Omaha, NE

SITE: 7575 Perimeter Road S.
Seattle, WA

LOCATION See Exhibit A-2

Latitude: 47.5343° Longitude: -122.3006°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (Ft.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.6	**CONCRETE**, Concrete thickness 0.6 feet									
2.0	**FILL - POORLY GRADED GRAVEL WITH SILT (GP-GM)**, light brown, moist, medium dense			X	0.4	7-12-12 N=24	S-1			
9.5	**POORLY GRADED SAND (SP)**, fine to medium grained, dark gray, moist, loose, with trace gravel			X	1.2	4-4-5 N=9	S-2			
		5		X	1.4	2-4-4 N=8	S-3	5		
			▽	X	1.3	3-4-3 N=7	S-4			
18.0	**POORLY GRADED SAND (SP)**, fine grained, dark brown gray, wet, loose, with trace silt	10		X	1.2	2-3-3 N=6	S-5			
		15		X	1.5	2-2-2 N=4	S-6			
21.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, dark gray, wet, loose, with wood	20		X	1.5	1-2-3 N=5	S-7	32		8

Boring Terminated at 21.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud-Rotary

Abandonment Method:
Boring backfilled with bentonite
Surface capped with concrete

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
▽ *While drilling*

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

Boring Started: 09-06-2018	Boring Completed: 09-06-2018
Drill Rig: Veh. #92	Driller: Holocene
Project No.: 81185115	Exhibit: A-18

APPENDIX B

LABORATORY TESTING

EXHIBIT B-1 -- LABORATORY TESTING

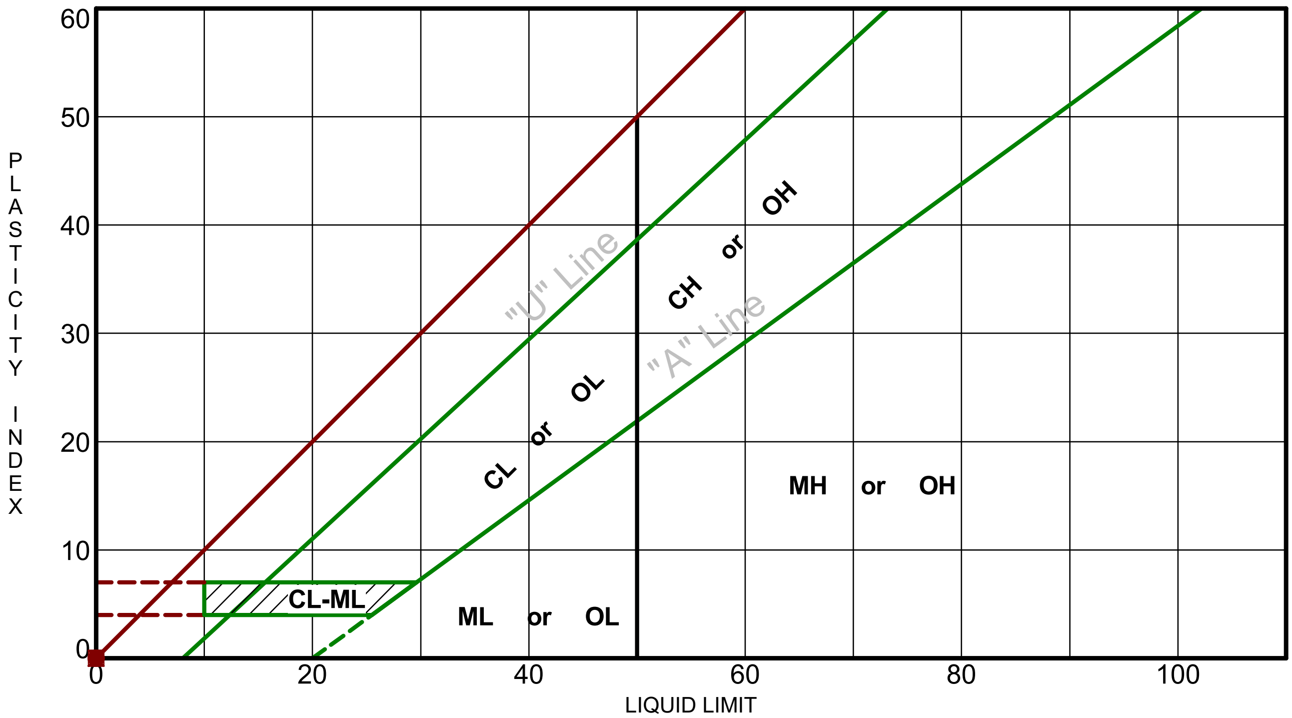
The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- Moisture-Density Relationships (modified Proctor) – ASTM D-1557
- California Bearing Ratio (CBR) – ASTM D-1883

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	**B-8**	**30 - 31.5**	**NP**	**NP**	**NP**		**ML**	**SILT with sand**
☒	**B-13**	**45 - 46.5**	**NP**	**NP**	**NP**		**ML**	**SILT with sand**

PROJECT: UPS Boeing Field Parcel Distribution Facility

SITE: 7575 Perimeter Road S. Seattle, WA

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

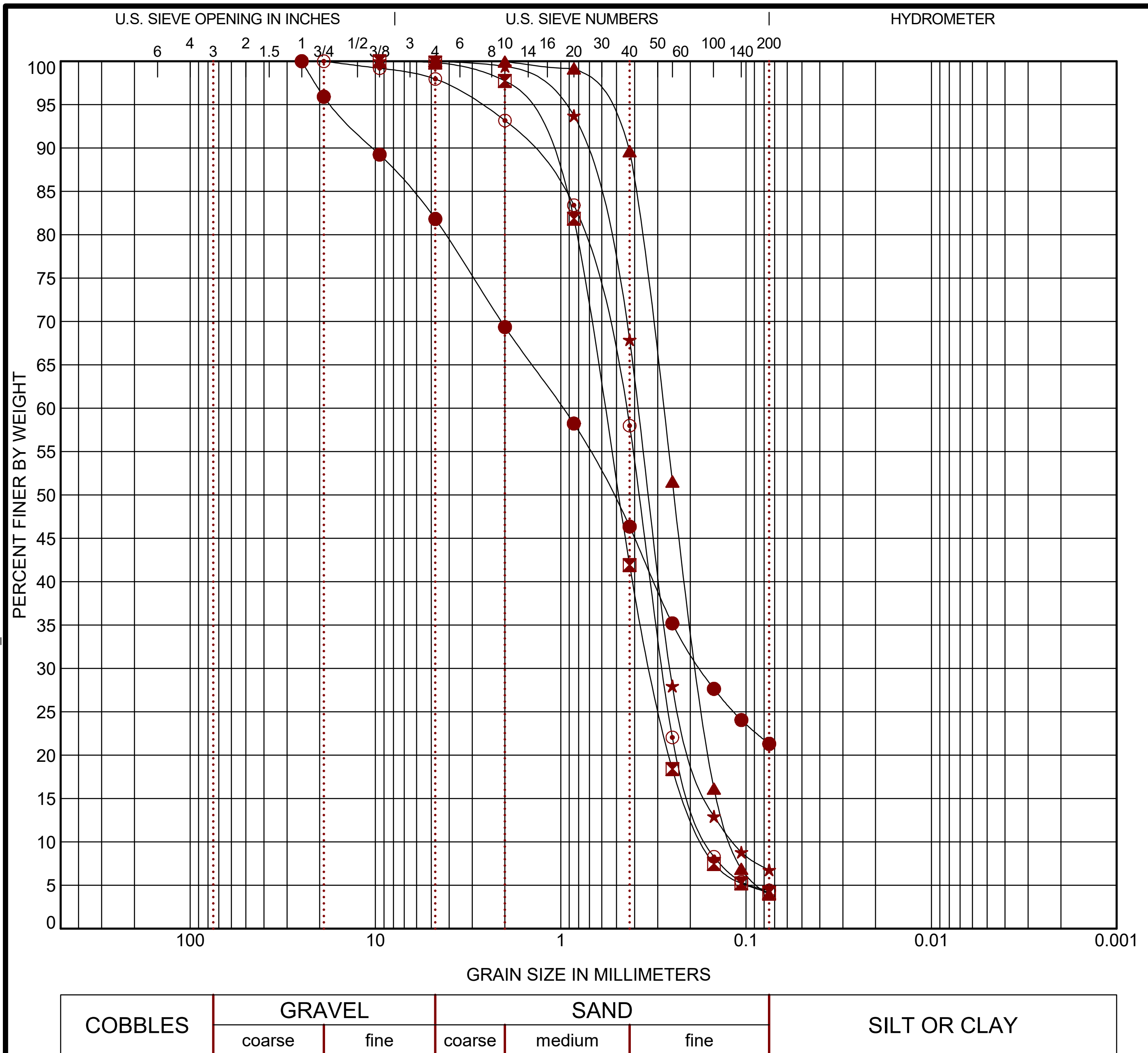
PROJECT NUMBER: 81185115

CLIENT: United Parcel Service Omaha, NE

EXHIBIT: B-2

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● B-2	0.5 - 2	Gravelly silty SAND SM	19					
⊠ B-3	10 - 11.5	Fine to medium SAND, trace silt (SP)	26				1.08	3.46
▲ B-5	10 - 11.5	Fine to medium SAND, trace silt (SP)	28				1.00	2.37
★ B-7	2.5 - 4	Fine to medium SAND with silt SP-SM	4				1.47	3.27
⊙ B-8	10 - 11.5	Fine to medium SAND, trace silt (SP)	23				1.11	2.82

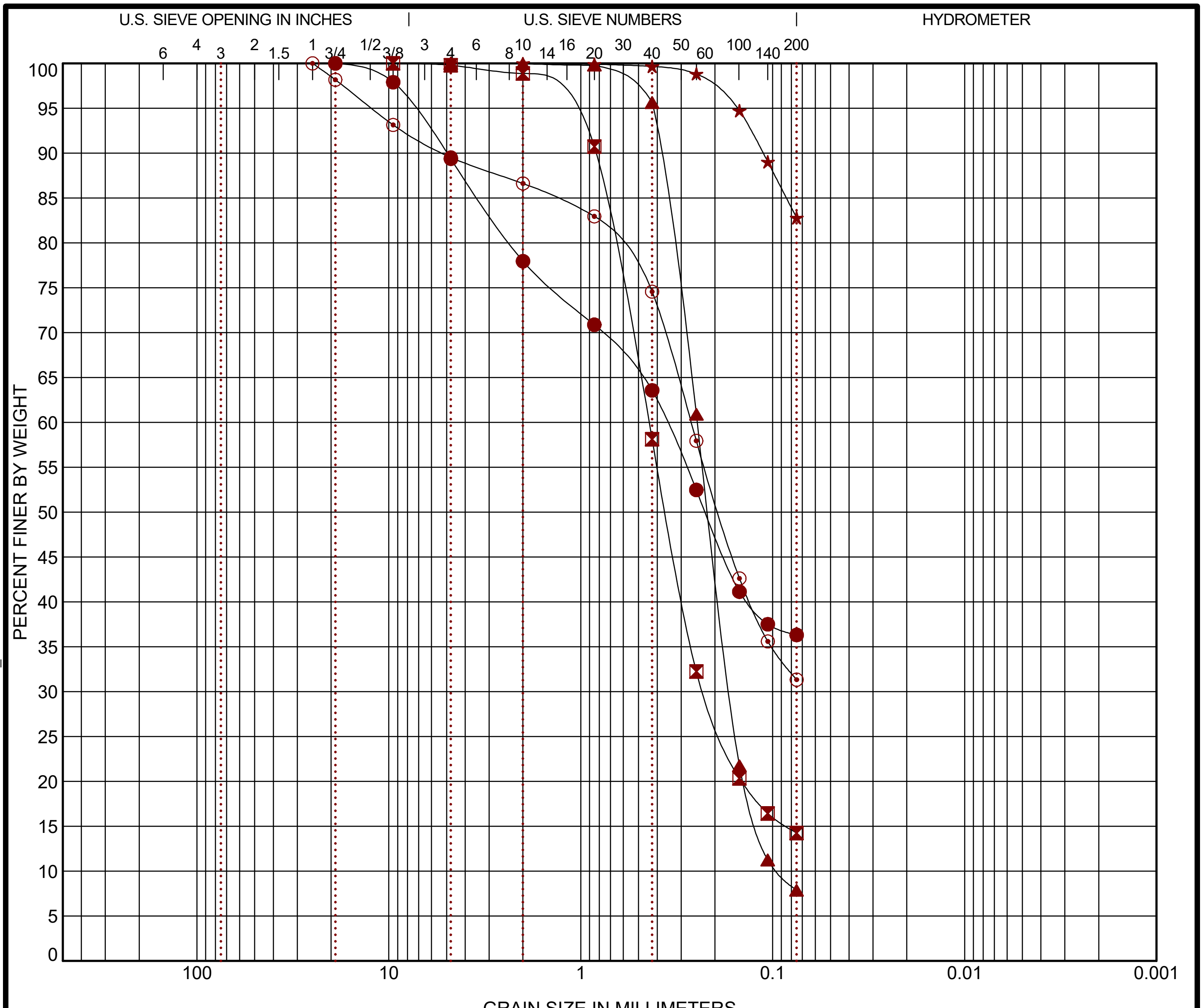
Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-2	0.5 - 2	25	0.974	0.175		18.2	60.5		21.3	
⊠ B-3	10 - 11.5	9.5	0.582	0.325	0.168	0.1	95.7		4.2	
▲ B-5	10 - 11.5	4.75	0.281	0.182	0.119	0.0	96.1		3.9	
★ B-7	2.5 - 4	9.5	0.383	0.257	0.117	0.0	93.2		6.8	
⊙ B-8	10 - 11.5	19	0.449	0.281	0.159	2.0	93.6		4.4	

PROJECT: UPS Boeing Field Parcel Distribution Facility	Terracon 21905 64th Ave W, Ste 100 Mountlake Terrace, WA	PROJECT NUMBER: 81185115
SITE: 7575 Perimeter Road S. Seattle, WA		CLIENT: United Parcel Service Omaha, NE
		EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 81185115 UPS BOEING FIELD.GPJ TERRACON_DATATEMPLATE.GDT 12/17/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-8	40 - 41.5	Silty SAND with gravel SM	22					
⊠	B-9	15 - 16.5	Silty, fine to medium SAND SM	24					
▲	B-11	20 - 21.5	Fine SAND with silt SP-SM	26				1.20	2.65
★	B-11	30 - 31.5	Sandy SILT ML	38					
⊙	B-11	50 - 51.5	Silty SAND with gravel SM	18					

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-8	40 - 41.5	19	0.358			10.6	53.1		36.3	
⊠	B-9	15 - 16.5	9.5	0.442	0.227		0.2	85.5		14.3	
▲	B-11	20 - 21.5	4.75	0.247	0.166	0.093	0.0	92.1		7.9	
★	B-11	30 - 31.5	4.75				0.0	17.2		82.8	
⊙	B-11	50 - 51.5	25	0.267			10.5	58.2		31.3	

PROJECT: UPS Boeing Field Parcel Distribution Facility

SITE: 7575 Perimeter Road S. Seattle, WA

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

PROJECT NUMBER: 81185115

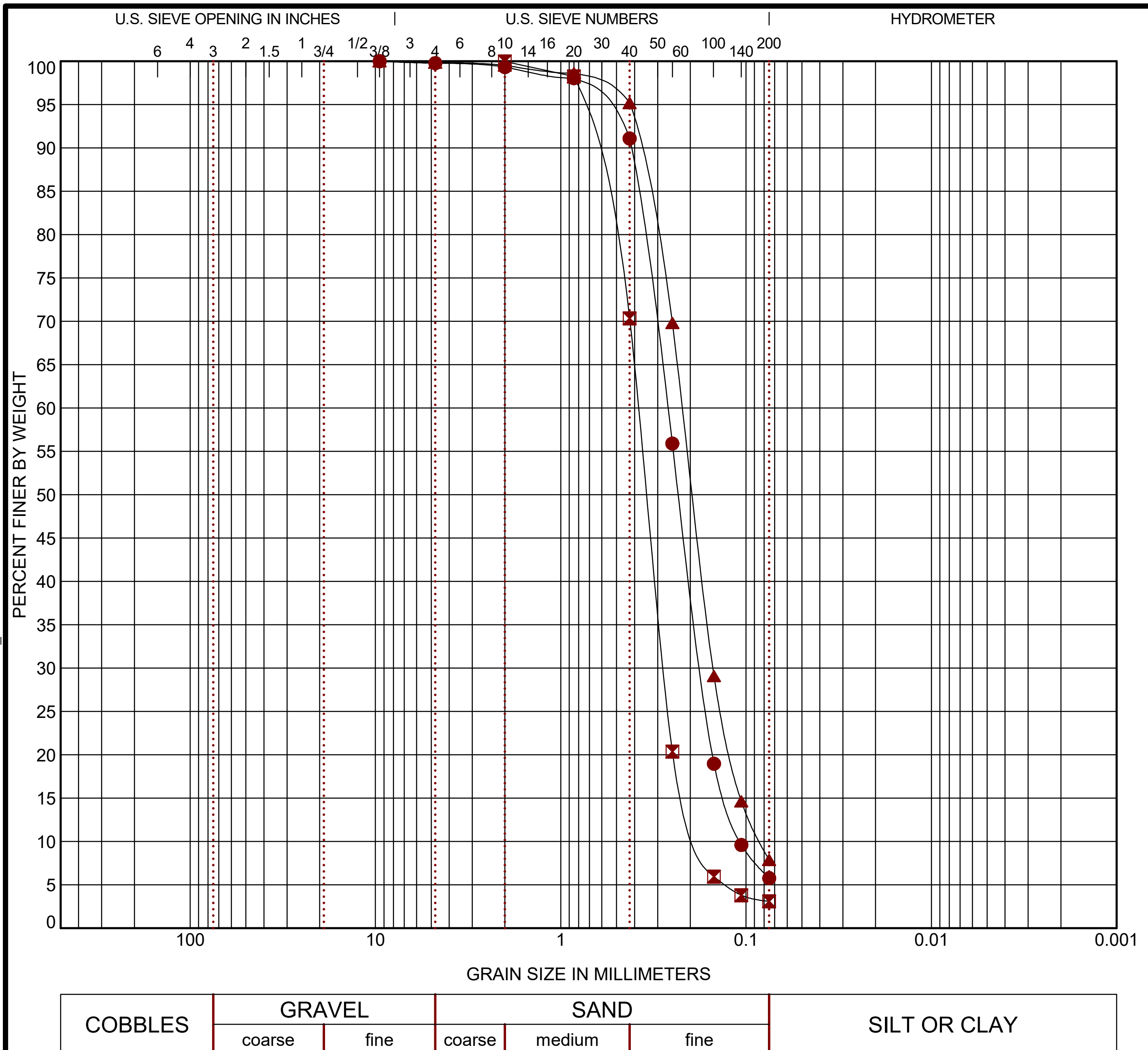
CLIENT: United Parcel Service Omaha, NE

EXHIBIT: B-4

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 81185115 UPS BOEING FIELD.GPJ TERRACON_DATATEMPLATE.GDT 12/17/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● B-13	7.5 - 9	SAND with silt SP-SM	15				1.06	2.47
⊠ B-13	30 - 31.5	Fine to medium SAND, trace silt (SP)	28				1.17	2.21
▲ B-15	20 - 21.5	Fine SAND with silt SP-SM	32				1.23	2.64

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-13	7.5 - 9	9.5	0.266	0.174	0.108	0.2	94.0		5.8	
⊠ B-13	30 - 31.5	2	0.381	0.277	0.172		96.9		3.1	
▲ B-15	20 - 21.5	9.5	0.221	0.151	0.084	0.1	92.0		7.9	

PROJECT: UPS Boeing Field Parcel Distribution Facility

SITE: 7575 Perimeter Road S. Seattle, WA

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

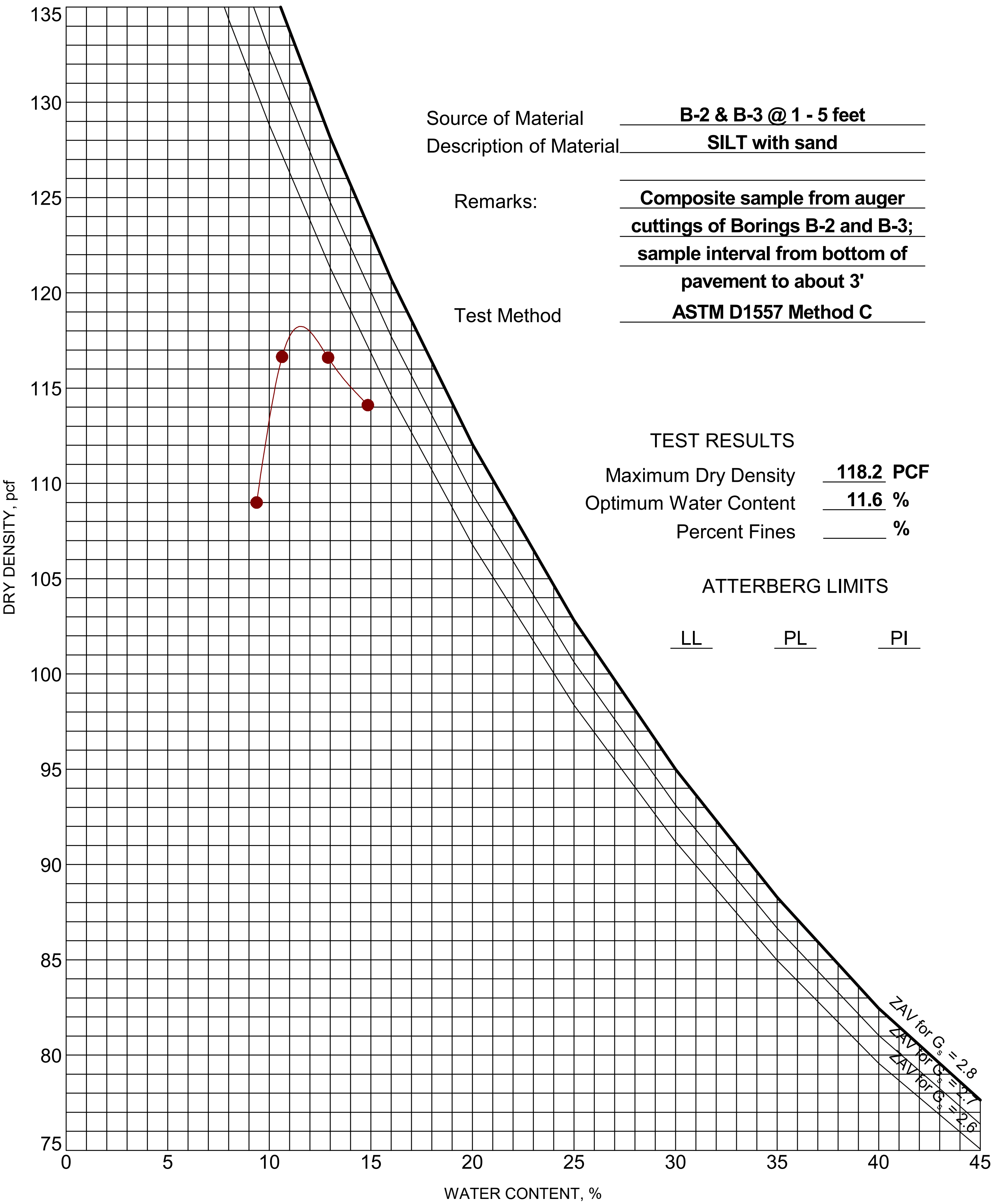
PROJECT NUMBER: 81185115

CLIENT: United Parcel Service Omaha, NE

EXHIBIT: B-5

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**B-2 & B-3 @ 1 - 5 feet**
Description of Material	**SILT with sand**
Remarks:	**Composite sample from auger cuttings of Borings B-2 and B-3; sample interval from bottom of pavement to about 3'**
Test Method	**ASTM D1557 Method C**

TEST RESULTS

Maximum Dry Density	**118.2**	**PCF**
Optimum Water Content	**11.6**	**%**
Percent Fines		**%**

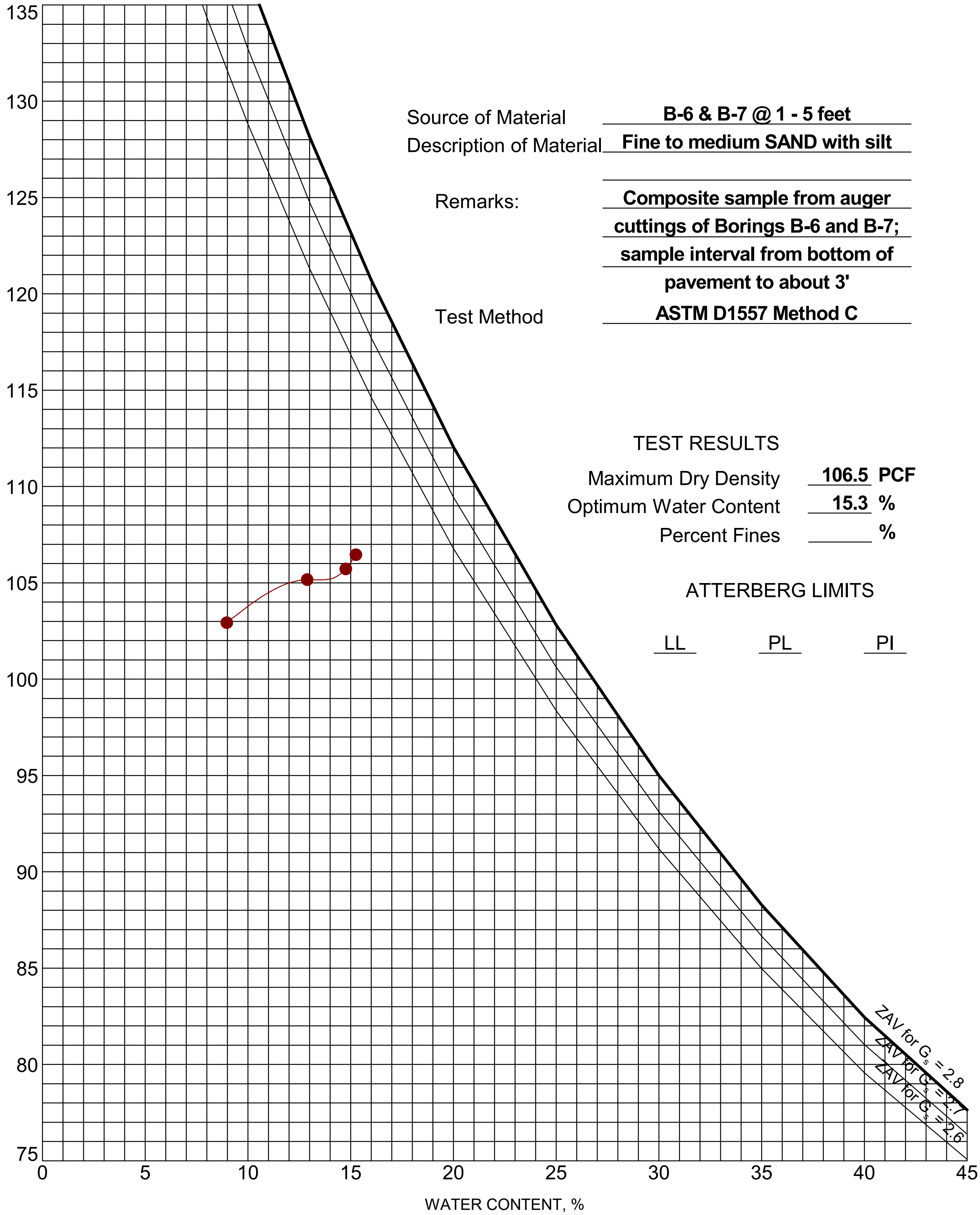
ATTERBERG LIMITS

LL	PL	PI

PROJECT: UPS Boeing Field Parcel Distribution Facility	Terracon 21905 64th Ave W, Ste 100 Mountlake Terrace, WA	PROJECT NUMBER: 81185115
SITE: 7575 Perimeter Road S. Seattle, WA		CLIENT: United Parcel Service Omaha, NE
		EXHIBIT: B-6

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**B-6 & B-7 @ 1 - 5 feet**
Description of Material	**Fine to medium SAND with silt**
Remarks:	**Composite sample from auger cuttings of Borings B-6 and B-7; sample interval from bottom of pavement to about 3'**
Test Method	**ASTM D1557 Method C**

TEST RESULTS

Maximum Dry Density	**106.5**	**PCF**
Optimum Water Content	**15.3**	**%**
Percent Fines		**%**

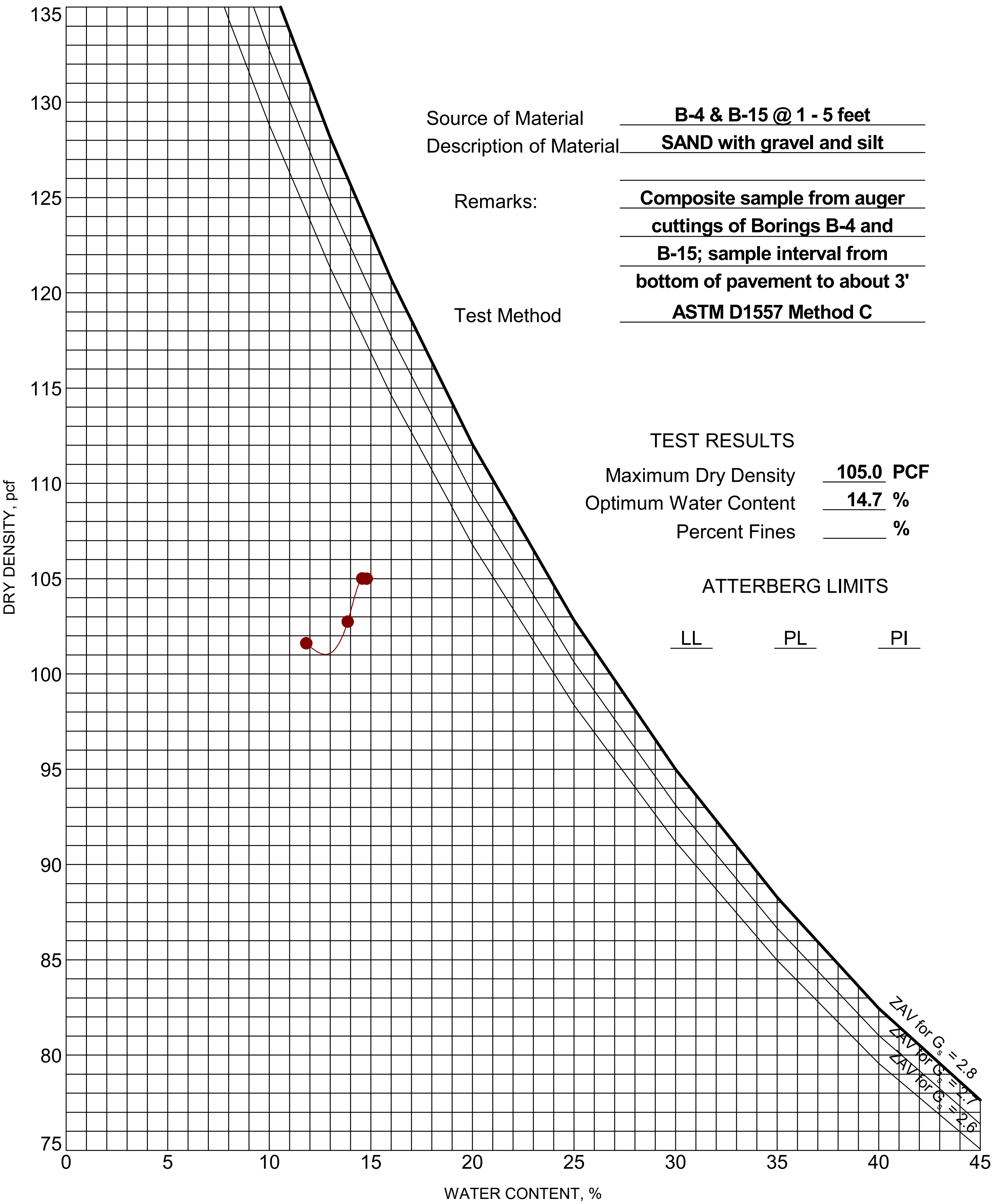
ATTERBERG LIMITS

LL	PL	PI

PROJECT: UPS Boeing Field Parcel Distribution Facility	Terracon	PROJECT NUMBER: 81185115
SITE: 7575 Perimeter Road S. Seattle, WA	21905 64th Ave W, Ste 100 Mountlake Terrace, WA	CLIENT: United Parcel Service Omaha, NE
		EXHIBIT: B-7

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B-4 & B-15 @ 1 - 5 feet**

Description of Material: **SAND with gravel and silt**

Remarks: **Composite sample from auger cuttings of Borings B-4 and B-15; sample interval from bottom of pavement to about 3'**

Test Method: **ASTM D1557 Method C**

TEST RESULTS

Maximum Dry Density **105.0 PCF**

Optimum Water Content **14.7 %**

Percent Fines %

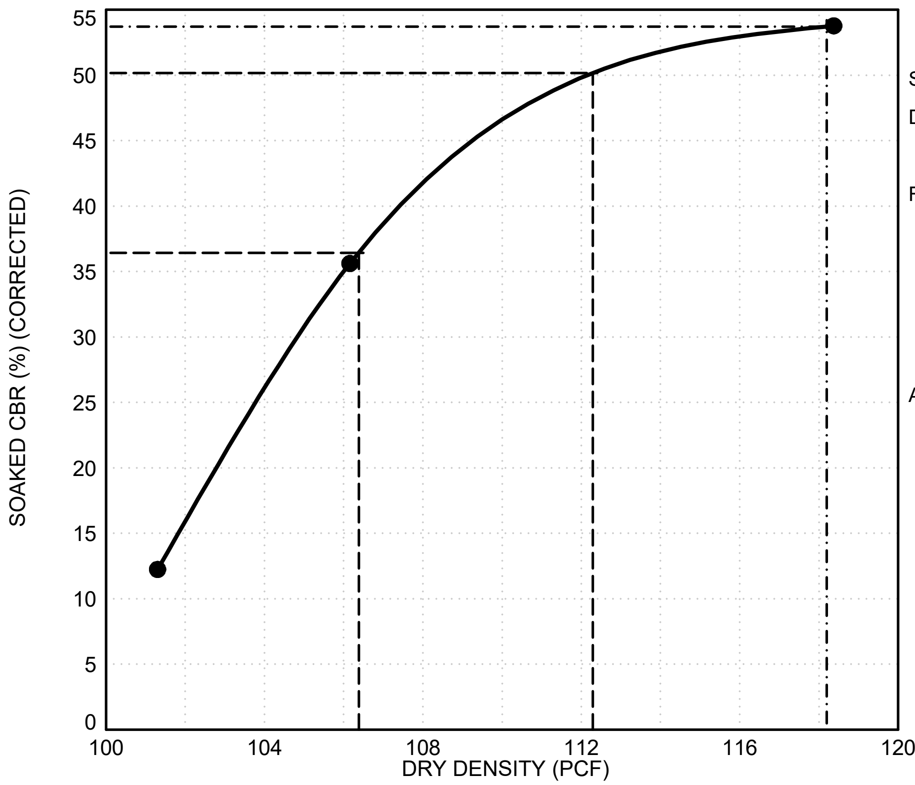
ATTERBERG LIMITS

LL	PL	PI

PROJECT: UPS Boeing Field Parcel Distribution Facility	Terracon 21905 64th Ave W, Ste 100 Mountlake Terrace, WA	PROJECT NUMBER: 81185115
SITE: 7575 Perimeter Road S. Seattle, WA		CLIENT: United Parcel Service Omaha, NE
		EXHIBIT: B-8

CALIFORNIA BEARING RATIO

ASTM D1883-07[2]



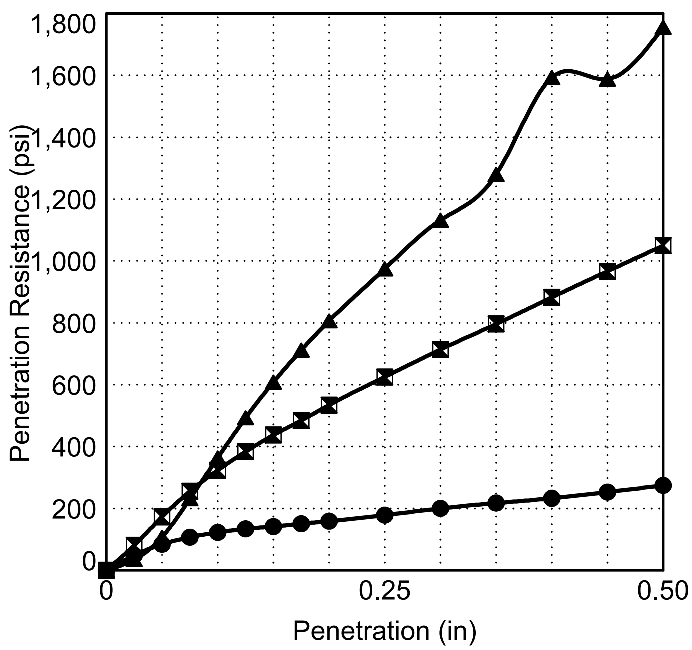
Source of Material **B-2 & B-3 1.0**

Description of Material **SILT with sand**

Remarks: **Composite sample from auger cuttings of Borings B-2 and B-3; sample interval from bottom of pavement to about 3'**

Percent Fines %

Atterberg Limits LL PL PI



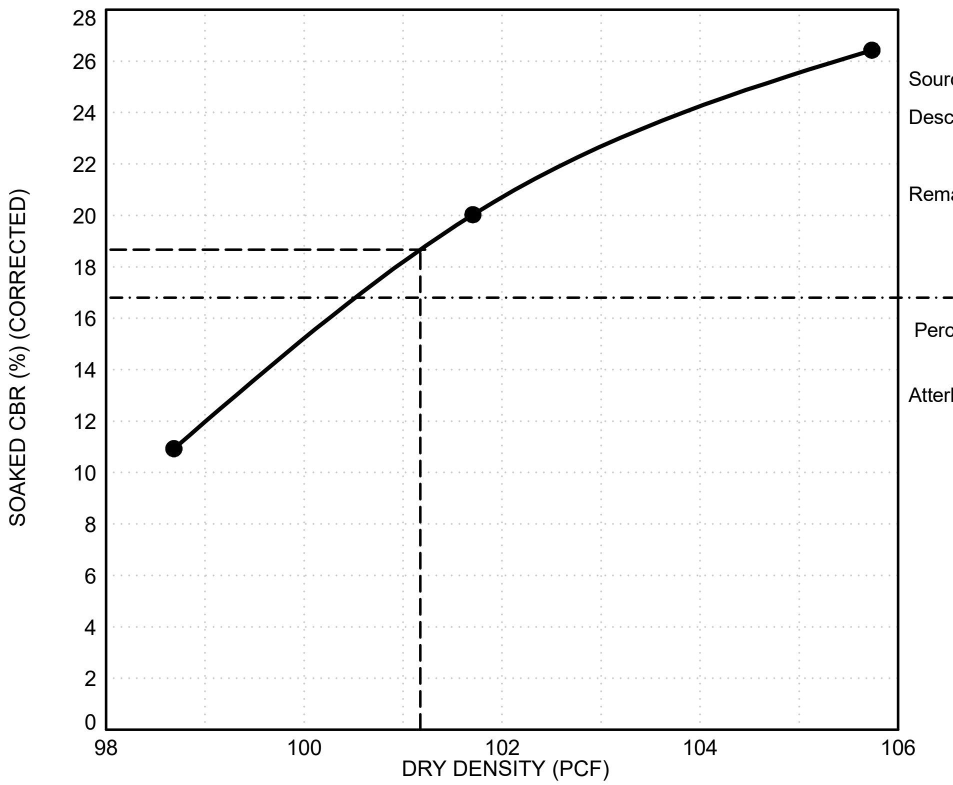
Sample No.	10	25	56
Sample Condition	Soaked		
Compaction Method	1557C		
Maximum Dry Density, (pcf)	118.2	118.2	118.2
Optimum Moisture Content, (%)	11.6	11.6	11.6
Dry Density before Soaking, (pcf)	101.30	106.16	118.38
Moisture Content, (%)			
After Compaction			
Top 1" After Soaking			
Surcharge,. (lbs)	10.00	10.00	10.00
Swell, (%)	0.07	0.10	-0.04
Bearing Ratio, (%)	10.6	35.6	53.8

Dry Density @ 90%	106.4	pcf	CBR @ 90% Density	36.4
Dry Density @ 95%	112.3	pcf	CBR @ 95% Density	50.2
Dry Density @ 100%	118.2	pcf	CBR @ 100% Density	53.7

PROJECT: UPS Boeing Field Parcel Distribution Facility	Terracon 21905 64th Ave W, Ste 100 Mountlake Terrace, WA	PROJECT NUMBER: 81185115
SITE: 7575 Perimeter Road S. Seattle, WA		CLIENT: United Parcel Service Omaha, NE
		EXHIBIT: B-9

CALIFORNIA BEARING RATIO

ASTM D1883-07[2]



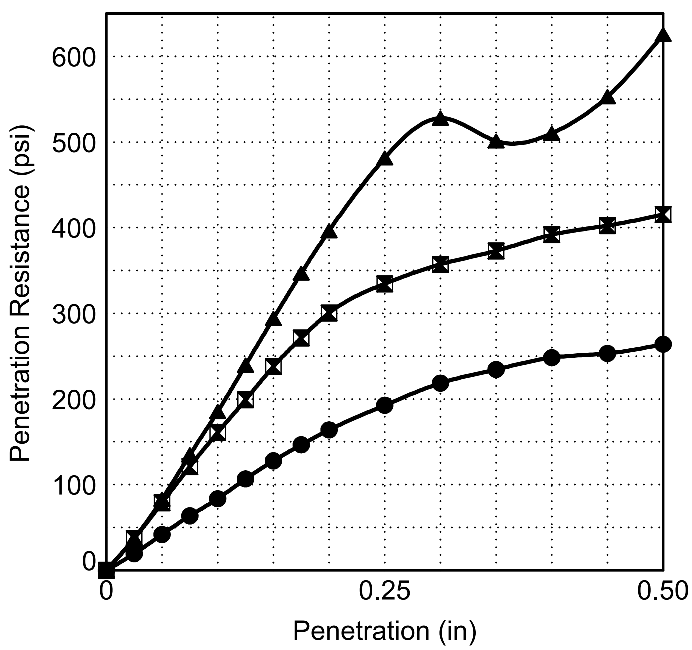
Source of Material **B-6 & B-7 1.0**

Description of Material **Fine to medium SAND with silt**

Remarks: **Composite sample from auger cuttings of Borings B-6 and B-7; sample interval from bottom of pavement to about 3'**

Percent Fines %

Atterberg Limits LL PL PI



Sample No.	10	25	56
Sample Condition	Soaked		
Compaction Method	1557C		
Maximum Dry Density, (pcf)	106.5	106.5	106.5
Optimum Moisture Content, (%)	15.3	15.3	15.3
Dry Density before Soaking, (pcf)	98.68	101.70	105.74
Moisture Content, (%)			
After Compaction			
Top 1" After Soaking			
Surcharge,. (lbs)	10.00	10.00	10.00
Swell, (%)	0.01	-0.03	-0.03
Bearing Ratio, (%)	10.9	20.0	26.4

Dry Density @ 90% 95.9 pcf

Dry Density @ 95% 101.2 pcf

Dry Density @ 100% 106.5 pcf

CBR @ 90% Density

CBR @ 95% Density 18.7

CBR @ 100% Density

PROJECT: UPS Boeing Field Parcel Distribution Facility

SITE: 7575 Perimeter Road S. Seattle, WA

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

PROJECT NUMBER: 81185115

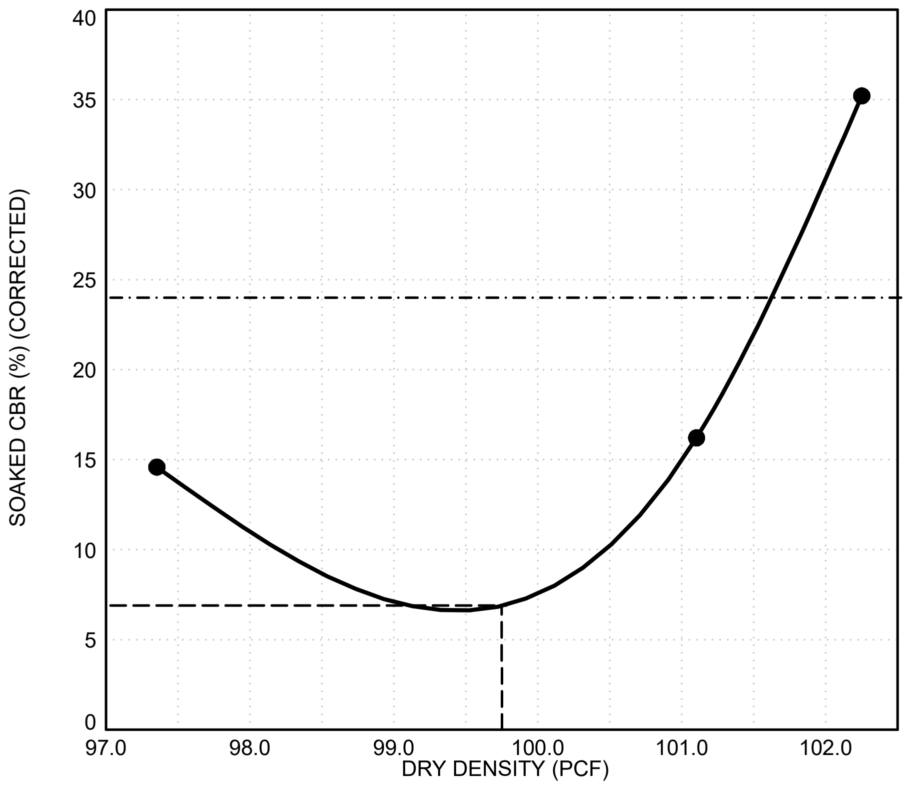
CLIENT: United Parcel Service Omaha, NE

EXHIBIT: B-10

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CBR 3PT REPORT 81185115 UPS BOEING FIELD .GPJ TERRACON_DATATEMPLATE.GDT 12/17/18

CALIFORNIA BEARING RATIO

ASTM D1883-07[2]



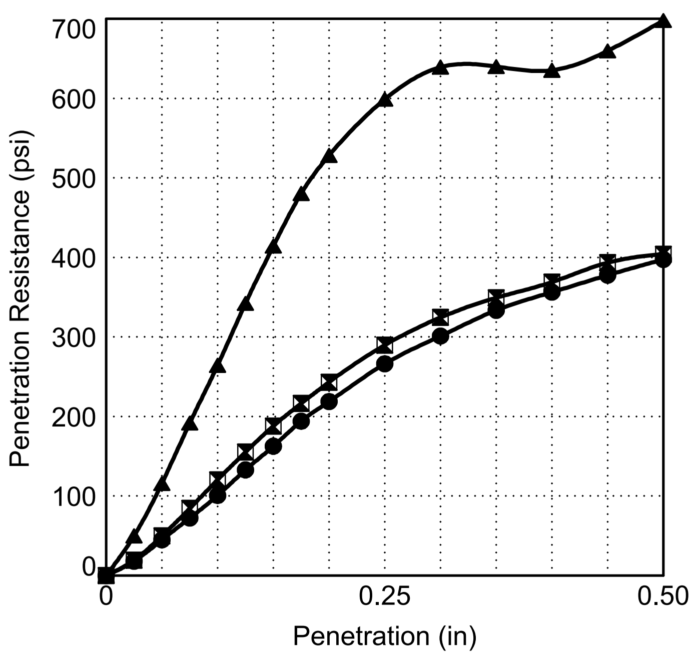
Source of Material **B-4 & B-15 1.0**

Description of Material **SAND with gravel and silt**

Remarks: **Composite sample from auger cuttings of Borings B-4 and B-15; sample interval from bottom of pavement to about 3'**

Percent Fines %

Atterberg Limits LL PL PI



Sample No.	10	25	56
Sample Condition	Soaked		
Compaction Method	1557C		
Maximum Dry Density, (pcf)	105	105	105
Optimum Moisture Content, (%)	14.7	14.7	14.7
Dry Density before Soaking, (pcf)	97.35	101.10	102.25
Moisture Content, (%)			
After Compaction			
Top 1" After Soaking			
Surcharge,. (lbs)	10.00	10.00	10.00
Swell, (%)	0.00	-0.04	-0.02
Bearing Ratio, (%)	14.6	16.2	35.2

Dry Density @ 90% 94.5 pcf

Dry Density @ 95% 99.8 pcf

Dry Density @ 100% 105.0 pcf

CBR @ 90% Density

CBR @ 95% Density 6.9

CBR @ 100% Density

PROJECT: UPS Boeing Field Parcel Distribution Facility

SITE: 7575 Perimeter Road S. Seattle, WA

Terracon
21905 64th Ave W, Ste 100
Mountlake Terrace, WA

PROJECT NUMBER: 81185115

CLIENT: United Parcel Service Omaha, NE

EXHIBIT: B-11

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger Cuttings

Standard Penetration Test

WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

EXHIBIT C-2 -- UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A” line		CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

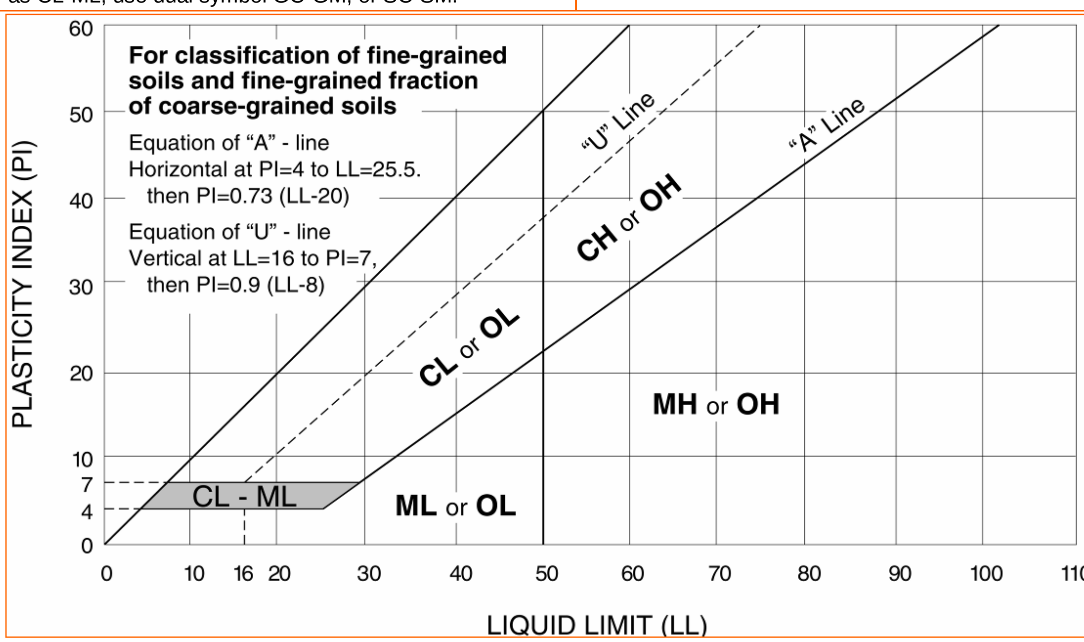
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.



Design Maps Detailed Report

2012/2015 International Building Code (47.53411°N, 122.30054°W)

Site Class D – “Stiff Soil”, Risk Category I/II/III

Section 1613.3.1 — Mapped acceleration parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2012/2015 International Building Code are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 1613.3.3.

From Figure 1613.3.1(1) [1]	S_S = 1.506 g
From Figure 1613.3.1(2) [2]	S_1 = 0.575 g

Section 1613.3.2 — Site class definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Section 1613.

2010 ASCE-7 Standard – Table 20.3-1
SITE CLASS DEFINITIONS

Site Class	$\bar{v}_S$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 1613.3.3 — Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters

TABLE 1613.3.3(1)
VALUES OF SITE COEFFICIENT F_a

Site Class	Mapped Spectral Response Acceleration at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.506 g, F_a = 1.000

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_v

Site Class	Mapped Spectral Response Acceleration at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.575 g, F_v = 1.500

Equation (16-37): $S_{MS} = F_aS_S = 1.000 \text{ x } 1.506 = 1.506$ g

Equation (16-38): $S_{M1} = F_vS_1 = 1.500 \text{ x } 0.575 = 0.863$ g

Section 1613.3.4 — Design spectral response acceleration parameters

Equation (16-39): $S_{DS} = ⅔\ S_{MS} = ⅔ \text{ x } 1.506 = 1.004$ g

Equation (16-40): $S_{D1} = ⅔\ S_{M1} = ⅔ \text{ x } 0.863 = 0.575$ g

Section 1613.3.5 — Determination of seismic design category

TABLE 1613.3.5(1)
SEISMIC DESIGN CATEGORY BASED ON SHORT-PERIOD (0.2 second) RESPONSE ACCELERATION

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \leq S_{DS} < 0.33g$	B	B	C
$0.33g \leq S_{DS} < 0.50g$	C	C	D
$0.50g \leq S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.004 g, Seismic Design Category = D

TABLE 1613.3.5(2)
SEISMIC DESIGN CATEGORY BASED ON 1-SECOND PERIOD RESPONSE ACCELERATION

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \leq S_{D1} < 0.133g$	B	B	C
$0.133g \leq S_{D1} < 0.20g$	C	C	D
$0.20g \leq S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.575 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is E for buildings in Risk Categories I, II, and III, and F for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 1613.3.5(1) or 1613.3.5(2)" = D

Note: See Section 1613.3.5.1 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 1613.3.1(1)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(1).pdf
2. *Figure 1613.3.1(2)*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/IBC-2012-Fig1613p3p1(2).pdf

Lighting Summary — LTG-SUM

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 — Revised Nov 2017

Project Info

Compliance forms do not require a password to use. *Instructional and calculating cells are write-protected.*

Project Title:	**UPS BFI Gateway Project - Main Sort Bldg**	Date **10/31/2019**
Applicant Information. Provide contact information for individual who can respond to inquiries about compliance form information provided.		For Building Department Use
Company Name:	**Design West Engineering**	
Company Address:	**110 James Street, Suite 106**	
Applicant Name:	**Leonard Maya**	
Applicant Phone:	**425-458-9700**	
Applicant Email:	**lmaya@designwesteng.com**	

Project Description

- [x] New Building
- [ ] Addition
- [ ] Alteration
- [ ] No Lighting Scope

Include PROJ-SUM form (included in envelope forms workbook) with lighting compliance forms.

Interior Lighting System Description

High bay warehouse lighting consisting of LED energy efficient fixtures. Office and support areas consiste of LED fixtures. Network lighting controls including Dimming low voltage controls, occupancy sensors and daylight controls with automatic shutoff.

- [x] Interior Lighting Plans Included

Interior Lighting Power Allowance Method

- [x] Building Area Method
- [ ] Space-by-space Method

Select method used in project.

Interior Lighting Controls

- [x] All C405.2.1 - C405.2.8 Lighting Controls
- [ ] C405.2 Exception 5 Luminaire Level Lighting Controls (LLLC)
- [x] Additional Efficiency Package Option C406.4 Enhanced Digital Lighting

To comply with C406.4, no less than 90% of the total installed interior lighting power shall comply with required controls per C406.4.

Dwelling Unit Interior Lighting

Permanently installed interior lighting fixtures in dwelling units comply with:

- ○ C405.2 thru C405.5 Commercial Lighting Controls and LPA
- ○ C406.3 High Efficacy Lighting
- ○ R404.1 Residential High Efficacy Lighting. *Dwelling unit lighting complies with WSEC Residential provisions in lieu of WSEC Commercial provisions.*
- ● No Dwelling Units

Exterior Lighting System Description

LED Wallpacks and LED pole mount fixtures will be provided to meet UPS and security exterior lighting requirements. Controls will be provided by exterior lighting controller with photocell and timeclock inputs.

- [x] Exterior Lighting Plans Included

Building Additions

Refer to Section C502.2.6 for additional requirements.

Compliance Method	Interior lighting	Exterior lighting
Lighting systems in addition area comply with all applicable provisions as a stand alone new construction project	☐	☐
Lighting systems in addition are combined with existing building lighting systems to demonstrate compliance	☐	☐

Addition is combined with existing:
*For **interior** lighting projects, include new + existing-to-remain interior lighting fixture wattage in Proposed Lighting Wattage table in LTG-INT-BLD or LTG-INT-SPACE form.*
*For **exterior** lighting projects, include new + existing-to-remain exterior lighting fixture wattage in Proposed Tradable and Proposed Non-Tradable Lighting Wattage tables in LTG-EXT form.*

Project Title:	UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

Change of Space Use

☐ Existing interior lighting systems in areas under-going a change in space use are upgraded to comply with LPAs for the new space types per Tables C405.4.2(1) or C405.4.2(2).

Identify interior spaces requiring LPD upgrade to the current Code in Proposed Lighting Wattage table in LTG-INT-BLD or LTG-INT-SPACE form.

Interior and Exterior Lighting Alterations

Select all Lighting Power and Lighting Control elements that apply to the scope of the retrofit project. If project includes a combination of spaces where less than 50% of the existing fixtures are replaced in some spaces, and 50% or more of the fixtures are replaced in others, then provide separate lighting power compliance forms for the two retrofit conditions. Spaces undergoing the same type of retrofit may be combined into one lighting power compliance form.

Refer to Section C503.6 for additional requirements.

All alteration lighting controls shall be commissioned per C408.3.

☐ ***No changes are being made to the interior or exterior lighting systems and existing space uses and configuration are not changed.***

Lighting Power	Interior lighting	Parking garage	Exterior lighting
50% or more of existing are replaced	☐	☐	☐
Less than 50% of existing are replaced	☐	☐	☐
Lamp and/or ballast replacement only – existing total wattage not increased	☐	☐	☐

50% or more replaced *- Total lighting power of new + existing-to-remain fixtures shall comply with total LPA per Sections C405.4.2 and C405.5.2. Include new + existing-to-remain fixtures in Proposed Lighting Wattage table in LTG-INT-BLD, LTG-INT-SPACE or LTG-EXT form.*

Less than 50% replaced *- Total lighting power of new + existing-to-remain fixtures shall not exceed the total lighting power prior to alteration. Include new + existing-to-remain fixtures in the Proposed Lighting Wattage table in LTG-INT-BLD, LTG-INT-SPACE or LTG-EXT form.*

50% threshold *applies to number of luminaires for interior spaces and parking garages, and total installed wattage for exterior luminaires.*

Lighting Controls	Interior lighting	Parking garage	Exterior lighting
New wiring installed to serve added fixtures and/or fixtures relocated to new circuit(s)	☐	☐	☐
New or moved lighting panel	☐	☐	☐
Interior space is reconfigured - luminaires unchanged or relocated	☐		

New wiring or circuit *- For interior lighting, provide required manual controls per C405.2.3, occupancy sensor controls per C405.2.1, daylight responsive controls per C405.2.4 and application specific lighting controls per C405.2.5. For exterior lighting, provide required controls per C405.2.7.*

New or moved panel *- Provide all applicable lighting controls as noted for New Wiring and automatic time switch controls per C405.2.2.*

Reconfigured interior space *- Provide all required lighting controls that apply to a new interior space. Application specific lighting control provisions per C405.2.5 do not apply to reconfigured*

Interior Lighting - Space-By-Space Method LTG-INT-SPACE

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 Revised Nov 2017

Project Title:	**UPS BFI Gateway Project - Main Sort Bldg**	Date	10/31/2019
Calculation Area NOTE 9	○ New Construction ○ Addition - ○ Addition ○ Spaces where < 50% of ○ Spaces where ≥ 50% of ○ Spaces where the Use	For Building Department Use	
LPA Calculation Type	● Standard ○ Additional Efficiency Package Option C406.3 Reduced Interior Lighting *To comply with C406.3, the Proposed LPD shall be 25% lower than the Target LPA. Refer to C406.3 for additional requirements.*	User Note	

Maximum Allowed Lighting Wattage NOTE 1

Location (plan #, room #)	Space Type	Ceiling Height NOTE 2	Gross Interior Area in ft^2	Allowed Watts per ft^2	Watts Allowed (watts/ft^2 x area)

Total Area

Retail Display Allowance from LTG-INT-DISPLAY

Lobby Art/Exhibit Display Allowance from LTG-INT-DISPLAY NOTE 8

Allowed Watts

Proposed Lighting Wattage NOTE 3

Location (plan #, room #)	Fixture Description NOTE 4, 5, 6	Number of Fixtures	Watts/ Fixture NOTE 7		Watts Proposed

Proposed Retail Display Lighting from LTG-INT-DISPLAY

Total Proposed Watts may not exceed Total Allowed Watts for Interior Lighting

Total Proposed Watts

Interior Lighting Power Allowance

Note 1 - List all unique space types per Table C405.4.2(2) that occur in the project scope. Select space type category from drop down menu.
Note 2 - Indicate ceiling height for atriums and spaces utilizing the ceiling height adjustment per Table C405.4.2(2), Footnotes d thru f.
Note 3 - List all proposed lighting fixtures including exempt lighting equipment and existing-to-remain fixtures.
Note 4 - For proposed Fixture Description, indicate fixture type, lamp type (e.g. T-8), number of lamps in the fixture, and ballast type (if included). For track lighting, list the length of the track (in feet) in addition to the fixture, lamp, and ballast information.
Note 5 - For lighting equipment eligible for exemption per C405.4.1, note exception number and leave Watts/Fixture blank.
Note 6 - Existing-to-remain fixtures shall be included in the Proposed Lighting Wattage table in the same manner as new fixtures. Identify as existing in fixture description.
Note 7 - For proposed Watts/Fixture enter the luminaire wattage for installed lamp and ballast using manufacturer or other approved source. For luminaires with screw-in lamps, enter the manufacturer's listed maximum input wattage of the fixture (not the lamp wattage). For low voltage lighting, enter the wattage of the transformer. For line voltage track/busway systems, enter the larger of the attached luminaire wattage or 50 watts/lineal foot, or enter the wattage limit of permanent current limiting device.
Note 8 - Lobby Art/Exhibit Display Allowance is independent of the Maximum Allowed Lighting Wattage. Enter all proposed lobby art/exhibit display fixtures in LTG-INT-DISPLAY form only.
Note 9 - Calculation Area Details:
a. Lighting fixtures in a building addition may comply as a stand alone project, or they may be combined with the overall existing building lighting systems to demonstrate compliance. Refer to C502.1.
b. For alterations and building additions, provide Space Types and gross interior areas in the Maximum Allowed Lighting Wattage table. If a building addition will comply as combined with the overall existing building lighting systems, include all applicable existing Space Types and gross interior areas.

Interior Display Lighting - Space-by-Space LTG-INT-DISPLAY

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 Revised Nov 2017

Project Title:	UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

***General Note** - In Sales areas, an increase in lighting power allowance is permitted for lighting installed specifically for the purpose of highlighting merchandise. Only Sales areas illuminated with eligible merchandise display lighting may be included in the Gross Interior Area under each Retail category. This lighting power allowance is the Maximum Retail Display Allowance OR the Total Retail Proposed Display Watts, whichever is less. Proposed retail display lighting wattage that exceeds this allowance is applied to general area lighting.*

For Building Department Use

User Note

Maximum Allowed Retail Display Lighting Wattage

Location (plan #, room #)	Retail Sales Area Type NOTE 1	Gross Interior Area in ft^2	Allowed Watts per ft^2 NOTE 2	Watts Allowed (watts/ft^2 x area) NOTE 3

Total Retail With Display Area	
Total Watts	
Retail Display Lighting Base Allowance	
Maximum Retail Display Allowance NOTE 4	

Proposed Retail Display Lighting Wattage NOTE 5

Retail Area	Location (plan #, room #)	Fixture Description NOTE 6	Number of Fixtures	Watts per Fixture NOTE 7	Watts Proposed

Total Retail Proposed Display Watts NOTE 8	
Retail Display Power Allowance NOTE 9	

Proposed Retail Display Lighting Totals from LTG-INT-DISPLAY

Retail 1	Retail 2	Retail 3	Retail 4

Note 1 - Select retail sales areas from drop down menu. Only retail sales areas that comply with C405.4.2.2.1 may be entered in this table.
Note 2 - Retail display lighting power allowances per C405.4.2.2.1, Equation 4-11.
*Note 3 - **Unlit Message** - Enter lighting fixture information for this retail sales area in Proposed Lighting Wattage table to generate Lighting Power Allowance.*
Note 4 - Maximum retail display wattage allowance as calculated per C405.4.2.2.1, Equation 4-11.
Note 5 - Only separately controlled retail display fixtures that are independent of general area lighting per C405.4.2.2.1 may be entered in this table.
Note 6 - For proposed Fixture Description, list ALL proposed display lighting fixtures. Indicate fixture type, lamp type (e.g. T-8), number of lamps in the fixture, and ballast type (if included). For track lighting, list the length of the track (in feet) in addition to the fixture, lamp, and ballast information.
Note 7 - For proposed Watts/Fixture enter the luminaire wattage for installed lamp and ballast using manufacturer or other approved source. For luminaries with screw-in lamps, enter the manufacturer's listed maximum input wattage of the fixture (not the lamp wattage). For low voltage lighting, enter the wattage of the transformer. For line voltage track/busway systems, enter the larger of the attached

low voltage lighting, enter the wattage of the transformer. For line voltage track/busway systems, enter the larger of the attached luminaire wattage or 50 watts/lineal foot, or enter the wattage limit of permanent current limiting device.

Note 8 - Total Retail Proposed Display Watts is automatically entered into the Proposed Fixture Wattage table in LTG-INT-SPACE.

Note 9 - Retail display lighting power allowance is the lesser of the Maximum Retail Display Allowance OR the Total Retail Proposed Display Watts. Retail display wattage allowance is automatically entered in the Maximum Allowed Lighting Wattage table in LTG-INT-SPACE.

Note 10 - Enter a unique title for each lobby area in the project that has seperately controlled art/exhibit display lighting. A lobby area title (Column A) and the gross interior sf of the lobby area are are both required to generate the maximum display allowance.

Note 11 - Lobby art and exhibit display wattage allowance per Table C405.4.2(2), Footnote c = 0.5 W/ft^2.

Note 12 - Proposed display lighting totals for each lobby area per information entered into Proposed Lobby Art/Display Lighting Wattage table.

Note 13 - Only separately controlled display fixtures installed in lobbies for the purpose of highlighting art and exhibits, that are independent of general area lighting, may be entered in this table.

Note 14 - Lobby Art/Exhibit Display Allowance is automatically entered in LTG-INT-SPACE.

Interior Display Lighting - Space-by-Space LTG-INT-DISPLAY

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 Revised July 2016

Project Title: UPS BFI Gateway Project - Main Sort Bldg	Date 10/31/2019
***General Note** - In Lobby areas, an additional wattage allowance is permitted for lighting installed specifically for the purpose of highlighting art and exhibits. Only Lobby areas with eligible display lighting may use this additional allowance. Proposed display lighting for each Lobby area may not exceed this allowance.*	For Building Department Use

Maximum Allowed Lobby Art/Exhibit Display Lighting Wattage

Lobby Area NOTE 10	Lobby Description including (plan # & room #)	Gross Interior Area in ft^2	Maximum Display Watts Allowed Per Area NOTE 11	Proposed Display Lighting Total Per Area NOTE 12

Total Lobby with Display Area

Total Lobby Art/Exhibit Display Allowance NOTE 14

Proposed Lobby Art/Exhibit Display Lighting Wattage NOTE 13

Lobby Area	Location (plan #, room #)	Fixture Description NOTE 6	Number of Fixtures	Watts per Fixture NOTE 6	Watts Proposed

Total Lobby Art/Exhibit Proposed Display Watts

Interior Lighting Power Allowance

* See footnotes on previous page

Interior Lighting - Building Area Method LTG-INT-BLD

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R Revised Nov 2017

Project Title:	**UPS BFI Gateway Project - Main Sort Bldg**	Date **10/31/2019**
Calculation Area NOTE 9	● New Construction ○ Addition - stand alone ○ Addition + existing ○ Spaces where < 50% of luminaires are replaced ○ Spaces where ≥ 50% of luminaires are replaced ○ Spaces where the Use is changing (C505)	For Building Department Use
LPA Calculation Type	● Standard ○ Additional Efficiency Package Option C406.3 Reduced Interior Lighting Power ○ *To comply with C406.3, the Proposed LPD shall be 25% lower than the Target LPA. Refer to C406.3 for additional requirements.*	User Note

Maximum Allowed Lighting Wattage NOTE 1

Building Area	Location (plan #, room #, or ALL)	Area Description	Gross Interior Area in ft^2	Allowed Watts per ft^2	Watts Allowed (watts/ft^2 x area) NOTE 2
Warehouse	Main/Small Sort	Bulk package handling	41854	0.40	16742
Office	1st Floor Admin	Admin Offices and Support Areas	7419	0.66	4897
Office	2nd Flr Flight Cont	Flight Control, Offices and Support Areas	2934	0.66	1937
Workshop	Maint Bldg	Repair bays, parts storage, offices and support areas	10000	0.95	9500
Office	Security Bldg	Security Screening Waiting and Support areas	1256	0.66	829
		Total	63463		

Proposed Lighting Wattage

Building Area	Location (plan #, room #)	Fixture Description NOTE 3, 4, 5, 6	Number of Fixtures	Watts per Fixture NOTE 7	Watts Proposed
Warehouse	Main/Small Sort	HBL(6) - LED Highbay	77	177	13629
Office	1st Floor Admin	L1/L1E - 2X4 Recessed LED Troffer	79	42	3318
Office	1st Floor Admin	L3 - 1X4 Surface LED	15	37	555
Office	1st Floor Admin	F2 - 2' Wall Vanity LED	4	26	104
Office	1st Floor Admin	F3 - 6" LED Recessed Downlight	6	36	216
Office	2nd Flr Flight Cont	L1/L1E - 2X4 Recessed LED Troffer	20	42	840
Office	2nd Flr Flight Cont	F1/F1E - 6" LED Recessed Downlight	12	36	432
Office	2nd Flr Flight Cont	L3 - 1X4 Surface LED	1	37	37
Workshop	Maint Bldg	L2/L2E - 2X2 Recessed LED Troffer	2	44	88
Workshop	Maint Bldg	L1/L1E - 2X4 Recessed LED Troffer	48	44	2112
Workshop	Maint Bldg	HBL(6) - LED Highbay	16	177	2832
Workshop	Maint Bldg	L3 - 1X4 Surface LED	12	37	444
Office	Security Bldg	L3 - 1X4 Surface LED	3	27	81
Office	Security Bldg	L1/L1E - 2X4 Recessed LED Troffer	18	42	756

Compliance by Building Area NOTE 8

Building Area	Warnings	Total Allowed Watts	Total Proposed Watts	Interior Lighting Power Allowance
Warehouse		**16742**	**13629**	**COMPLIES**
Office		**7663**	**6339**	**COMPLIES**
Workshop	Confirm all fixtures are reported under proposed lighting - low watts relative to maximum allowed.	**9500**	**5476**	**COMPLIES**
	Totals	**33905**	**25444**	

Note 1 - List all unique building areas per Table C405.4.2(1) that occur in the project scope. Select building area category from drop down menu.

*Note 2 - **Unlit Message** - Enter lighting fixture information for this building area surface in Proposed Lighting Wattage table to generate Lighting Power Allowance.*

Note 3 - Proposed fixtures must be listed in the building area in which they occur. List all proposed lighting fixtures including exempt *lighting equipment and existing-to-remain fixtures.*

Note 4 - For proposed Fixture Description, indicate fixture type, lamp type (e.g. T-8), number of lamps in the fixture, and ballast type (if included).

For track lighting, list the length of the track (in feet) in addition to the fixture, lamp, and ballast information.

Note 5 - For lighting equipment eligible for exemption per C405.4.1, note exception number and leave Watts/Fixture blank.

Note 6 - Existing-to-remain fixtures shall be included in the Proposed Lighting Wattage table in the same manner as new fixtures. Identify as existing in fixture description.

Note 7 - For proposed Watts/Fixture enter the luminaire wattage for installed lamp and ballast using manufacturer or other approved source. For luminaires with screw-in lamps, enter the manufacturer's listed maximum input wattage of the fixture (not the lamp wattage). For low voltage lighting, enter the wattage of the transformer. For line voltage track/busway systems, enter the larger of the attached luminaire wattage or 50 watts/lineal foot, or enter the wattage limit of permanent current limiting device.

Note 8 - Proposed Wattage for each Building Area type shall not exceed the Allowed Wattage for that Building Area type. Trading wattage between Building Area types is not allowed under the Building Area Method compliance path.

Note 9 - Calculation Area Details:

a. Lighting fixtures in a building addition may comply as a stand alone project, or they may be combined with the overall existing building

Exterior Lighting — LTG-EXT

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 Revised Nov 2017

Project Title:	**UPS BFI Gateway Project - Main Sort Bldg**	Date	10/31/2019
Exterior Lighting Zone	○ Zone 1 ○ Zone 2 ● Zone 3 ○ Zone 4 *Exterior Lighting Zone selection required to enable LTG-EXT form. Zones are defined in Table C405.5.2(1) and specified by the jurisdiction.*	For Building Department Use	
Calculation Area	● New construction ○ Addition - stand alone ○ Addition + existing ○ Alteration with < 50% ext. wattage replaced ○ Alteration with ≥ 50% ext. wattage replaced	User Note	
Building Grounds *Applies to individual luminaires > 100 Watts*	☑ Efficacy > 80 lumens/watt ☐ Exemption ☐ Controlled by motion sensor		

Tradable Maximum Allowed Lighting Wattage NOTE 1

Base Site Allowance: **750**

Tradable Surfaces	Surface Description	Area (ft^2), perimeter (lf) or # of items	Allowed Watts per ft^2 or per lf	Allowed Watts x ft^2 (or x lf) NOTE 2
Uncovered Parking and drives	Parking, Staging and circulations	387874	0.08 W/ft2	31030
Entry Canopies	Caster Deck Canopy	40386	0.4 W/ft2	16154
Entry Canopies	De-Icing Canopy	3213	0.4 W/ft2	1285

Total Allowed Tradable + Site Allowance Watts: **49220**

Tradable Proposed Lighting Wattage NOTE 3

Tradable Surface	Fixture Description NOTE 4, 5	Number of Fixtures	Watts per Fixture NOTE 6	Watts Proposed
Uncovered Parking and drives	LE1-XX - LED Pole Mount Fixture	45	161	7245
Uncovered Parking and drives	LE3-XX - LED Wallpack	19	161	3059
Uncovered Parking and drives	LE5-XX - LED Wallpack	32	48	1536
Entry Canopies	L13 - 4' Surface LED	88	65	5720
Entry Canopies	L13 - 4' Surface LED	15	65	975

Total proposed tradable watts may not exceed the sum of total allowed tradable watts plus the base site allowance. Any base site allowance not needed to make tradable watts comply can be applied to individual non-tradable

Total Proposed Tradable Watts: **18535**

Non-Tradable Maximum Allowed Lighting Wattage NOTE 1

Site Allowance Remaining: **750**

Non-Tradable Surfaces	Surface Description	Area (ft^2), perimeter (lf) or # of items	Allowed Watts per ft^2, lf or item	Allowed Watts x ft^2 (or x lf) NOTE 2

Non-Tradable Proposed Lighting Wattage NOTE 3, 7

Non-Tradable Surface	Fixture Description NOTE 4, 5	Number of Fixtures	Watts per Fixture NOTE 6	Watts Proposed

Non-tradable proposed watts may not exceed allowed watts for any individual surface unless the total excess watts for all non-tradable surfaces are less than the remaining site allowance.

Non-Tradable Watts Exceeding LPA: **0**

Remaining Site Allowance: **750**

Exterior Lighting — COMPLIES WITH MAX. ALLOWANCE

Note 1 - *List all exterior surfaces per Table C405.5.2(2) that occur in the project scope. Select exterior surface categories from drop down menu*
Note 2 - ***Unlit Message*** - *Enter lighting fixture information for this surface in Proposed Lighting Wattage table to generate Lighting Power Allowa*
Note 3 - *List all proposed lighting fixtures including existing-to-remain fixtures.*
Note 4 - *For proposed Fixture Description, indicate fixture type, lamp type, number of lamps in the fixture, and ballast type (if applicable).*
Note 5 - *Existing-to-remain fixtures shall be included in the Tradable and Non-Tradable Proposed Lighting Wattage tables in the same manner as new fixtures. Identify as existing in fixture description.*
Note 6 - *For proposed Watts/Fixture enter the luminaire wattage for installed lamp and ballast using manufacturer or other approved source. For luminaires with screw-in lamps, enter the manufacturer's listed maximum input wattage of the fixture (not the lamp wattage). For low voltage lighting, enter the wattage of the transformer.*

voltage lighting, enter the wattage of the transformer.

Note 7 - *Automated Teller and Night Depositories - For each location, enter the number of ATM machines or depositories within that location. If there are multiple locations in the project, enter each location individually in the Non-Tradable Maximum Allowed Lighting Wattage table and identify the location in the Surface Description section.*

Lighting, Motor, and Electrical Permit Checklist, Pg. 1 — LTG-CHK

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 — Revised Nov 2017

Project Title:	UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

The following information is necessary to check a permit application for compliance with the lighting, motor, and electrical requirements in the

Applicability (yes,no,na)	Code Section	Component	Compliance information required in permit documents	Location in Documents	Building Department Notes
LIGHTING CONTROLS					
Yes	C405.2	Lighting controls, general	For all lighting fixtures, indicate lighting control method on plans for spaces and lighting zone(s) served, or exception taken	**Lighting Plan, Lighting Control Details**	
NA	C405.2	Luminaire level lighting controls (LLLC)	Indicate on plans all fixtures provided with LLLC in lieu of C405.2 lighting controls; provide description of control capabilities and performance parameters		
NA	C405.1	Lighting in dwelling units	For permanently installed lighting fixtures in dwelling units, indicate lighting control method on plans for spaces and lighting zone(s) served, or demonstrate compliance with high efficacy exception		
Yes	C405.2.3 C405.2.1.1 C405.2.2.2 C405.2.4 C405.2.5	Manual controls	Indicate on plans the method of manual lighting control (whether combined with occupancy sensor, automatic light reduction, daylight responsive or specific application controls), location of manual control device and area or specific application it serves	**Lighting Plan, Lighting Control Details**	
Yes	C405.2.2.1 C405.2.2.2 C405.2.3	Manual interior light reduction controls	Indicate on plans which method of manual 50% lighting load reduction is provided, or whether lighting load is reduced via occupancy sensors or daylight responsive controls	**Lighting Plan, Lighting Control Details**	
Yes	C405.2.2	Method of automatic shut-off control	Indicate on plans the method of automatic shut-off control during unoccupied periods (occupancy sensor, time switch or digital timer switch) for all lighting zones;	**Lighting Plan, Lighting Control Details**	
			Indicate locations where automatic shutoff is provided by other methods (occupancy sensor or digital timer switch) or which time switch control exception applies	**Lighting Plan, Lighting Control Details**	
Yes	C405.2.1 C405.2.1.1	Occupancy sensor controls	Indicate on plans the spaces served by occupancy sensors;		
			Indicate whether occupancy sensor controls are configured to be manual-on, automatic 50%-on, or serve a space eligible for automatic 100%-on per exception	**Lighting Plan, Lighting Control Details**	
Yes	C405.2.1.2	Occupancy sensor controls - warehouses	Indicate aisleways and open areas in warehouse spaces provided with occupancy sensor controls that reduce lighting power by 50%	**Lighting Plan, Lighting Control Details**	
NA	C405.2.2.1	Automatic time switch controls	Indicate locations of override switches on plans and the lighting zone(s) served, include area sq. ft.		
NA	C405.2.6	Digital timer switch	Indicate digital timer switch control includes: manual on/off, time delay, audible and visual indication of impending time-out		
NA	C405.2.4.2 C405.2.4.3	Daylight zones - Sidelight and toplight	Indicate primary and secondary sidelight daylight zone areas on plans, include sq. ft.;		
			Indicate toplight daylight zone areas on plans, include sq. ft.;		
			For small vertical fenestration assemblies (rough opening less than 10 percent of primary daylight zone) where daylight responsive controls are not required, provide fenestration area to daylight zone calculation(s)		
NA	C405.2.4	Daylight responsive controls	Indicate on plans lighting zone(s) served by daylight responsive controls;		
			Identify sidelight and toplight daylight zones that are not provided with daylight sensing controls and the exception(s) that apply;		
			Indicate on plans the lighting load reduction method - continuous dimming, or stepped dimming that provides at least two even steps between 0%-100% of rated power;		
			Indicate that daylight sensing controls are configured to completely shut off all controlled lights in the lighting zone		
NA	C405.2.5	Additional controls - Specific application lighting controls	Identify spaces and lighting fixtures on plans that require specific application lighting controls per this section		
NA	C405.2.5 - Items 1&2	Display and accent lighting	Indicate on plans that display and accent lighting, and display case lighting are controlled independently from both general area lighting and other lighting applications within the same space;		
			Indicate manual and automatic lighting control method		

Lighting, Motor, and Electrical Permit Checklist, Pg. 2 — LTG-CHK

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 — Revised Nov 2017

Project Title:	UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

The following information is necessary to check a permit application for compliance with the lighting, motor, and electrical requirements in the

Applicability (yes,no,na)	Code Section	Component	Compliance information required in permit documents	Location in Documents	Building Department Notes
NA	C405.2.5 - Item 3	Hotel/motel guest rooms	Indicate method of automatic control - vacancy or captive key control of all installed luminaires and switched receptacles in guest room		
NA	C405.2.5 - Item 4	Supplemental task lighting	Indicate method and location of automatic shut-off vacancy control for supplemental task lighting, including under-shelf or under-cabinet lighting		
NA	C405.2.5 - Item 5	Lighting for non-visual applications	Indicate on plans eligible non-visual lighting applications, include sq. ft. area of each lighting control zone;		
			Indicate on plans that non-visual lighting are controlled independently from both general area lighting and other lighting applications within the same space;		
			Indicate method of manual lighting control and applicable automatic lighting control		
NA	C405.2.5 - Item 6	Lighting equipment for sale or demonstration	Indicate on plans that lighting equipment for sale or demonstration are controlled independently from both general area lighting and other lighting applications within the same space;		
			Indicate method of manual lighting control and applicable automatic lighting control		
Yes	C405.2.5 - Item 7	Means of egress lighting	Identify on plans egress fixtures that function as both normal and emergency means of egress illumination;	**Lighting plan, Egress Provided by Generator**	
			Provide calculation of lighting power density of total egress lighting;	**Lighting Plan**	
			If total egress lighting power density is greater than 0.02 W/sq. ft., indicate on plans egress fixtures requiring automatic shut-off during unoccupied periods;	**Lighting Plan**	
			Indicate method of automatic shut-off control	**Lighting Plan**	
Yes	C405.2.7	Exterior lighting controls	Indicate on exterior lighting plans and fixture schedules the automatic lighting control method, control sequence, and locations served;	**Electrical Site Plan**	
			For building facade and landscape lighting, indicate automatic controls shut off lighting as a function of dawn/dusk and fixed opening/closing time;	**N/A**	
			For all other exterior lighting, indicate automatic controls shut off lighting as a function of available daylight; include control sequence that also reduces lighting power by at least 30% between 12am-6am, or from 1 hour after closing to 1 hour before opening, or based upon motion sensor	**Electrical Site Plan**	
NA	C405.5.1	Exterior building grounds lighting controls	For building grounds fixtures greater than 100 watts, indicate on plans whether fixtures have efficacy greater than 80 lumens or; are controlled by motion sensor, or are exempt lighting per C405.5.2		
NA	C405.2.5 (listed after C405.2.7)	Area controls - Master control switches and circuit power limit	Indicate location(s) of master control switch(es) intended to control multiple independent switches; circuit breaker may not be used as a master control switch;		
			Verify that no 20 amp circuit controlled by a single switch or automatic control is loaded beyond 80%		
ADDITIONAL EFFICIENCY PACKAGE OPTION - ENHANCED DIGITAL LIGHTING CONTROLS					
Yes	C406.4	Enhanced digital lighting controls	To comply with additional efficiency package option, indicate on plans all interior lighting fixtures that are individually addressed and provided with continuous dimming, or exception taken;	**Lighting Control Details**	
			Include calculation of percent total installed interior lighting power that is configured with required enhanced lighting control functions (min 90% to comply with additional efficiency package option)	**Lighting Control Details**	

Lighting, Motor, and Electrical Permit Checklist, Pg. 3 LTG-CHK

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 — Revised Nov 2017

Project Title:	UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

The following information is necessary to check a permit application for compliance with the lighting, motor, and electrical requirements in the

Applicability (yes,no,na)	Code Section	Component	Compliance information required in permit documents	Location in Documents	Building Department Notes
INTERIOR LIGHTING POWER & EFFICACY					
Yes	C405.4.1 C405.4.2	Total connected interior lighting power	Include all luminaires in lighting fixture schedule; indicate fixture types, lamps, ballasts, and manufacturer's rated watts per fixture;	**Fixture Schedule**	
			Identify spaces eligible for lighting power exemption on plans and in compliance forms; indicate the exception applied;	**N/A**	
			Identify lighting equipment eligible for lighting power exemption in fixture schedule and in compliance forms; indicate the exception applied;	**N/A**	
			Indicate that exempt lighting equipment is in addition to general area lighting and is controlled independently	**N/A**	
Yes	C405.3	Exit signs	Indicate location of exit signs on plans and rated watts per fixture in lighting fixture schedule (maximum 5 watts per side)	**Lighting Floor Plan**	
NA	C405.1	Lighting in dwelling units - lamp efficacy	If high efficacy exception is applied to permanently installed lighting fixtures in dwelling units, indicate in lighting fixture schedule if lamps in fixtures are high efficacy per R404.1. Calculate percentage of fixtures with high efficacy lamps in project (min 75% to comply with exception).		
Interior Lighting Power Calculation - Indicate compliance path taken					
NA	C405.4.2.1	Building Area Method	Complete required compliance forms – proposed wattage per building area does not exceed maximum allowed wattage per building area; identify locations of building areas on plans		
Yes	C405.4.2.2	Space-By-Space Method	Complete required compliance forms – total proposed wattage does not exceed maximum allowed wattage; identify locations of space types on plans, including retail display areas, lobby art & exhibit display areas, and ceiling heights as applicable		
ADDITIONAL EFFICIENCY PACKAGE OPTION - REDUCED INTERIOR LIGHTING POWER DENSITY					
No	C406.3	Reduced lighting power density	To comply with additional efficiency package option, demonstrate in compliance forms that total connected interior lighting wattage is 25% less than the total maximum allowed lighting wattage via Building Area Method or Space-By-Space Method		
No	C406.3	Reduced lighting power density - dwelling unit lamp efficacy	For project with dwelling units, to comply with additional efficiency package option indicate in lighting fixture schedule if lamps in interior fixtures have efficacy rating of 60 lumens per watt or more. Calculate percentage of fixtures with lamps that have this efficacy rating (min 95% to comply with option)		
EXTERIOR LIGHTING POWER & EFFICACY					
Yes	C405.5.2	Total connected exterior lighting power	Include all luminaires in lighting fixture schedule; indicate fixture types, lamps, ballasts, and manufacturer's rated watts per fixture;	**Lighting Fixture Schedule**	
			Identify exterior applications eligible for lighting power exemption on plans and in compliance forms; indicate exception applied;	**N/A**	
			Indicate that exempt exterior lighting is controlled independently from non-exempt exterior lighting; include exception claimed for each fixture or group of fixtures under exception category	**N/A**	
Yes	Table C405.5.2(1)	Exterior lighting zone	Indicate building exterior lighting zone as defined by the AHJ	**Lighting Plan**	
NA	C405.5.1	Exterior building grounds lighting	For building grounds fixtures rated at greater than 100 watts that are complying based on efficacy, indicate rated lamp efficacy (in lumens per watt) in fixture schedule		
Yes	C405.5.2	Exterior lighting power calculations	Complete required compliance form – proposed wattage for exterior lighting plus base site allowed does not exceed maximum allowed		

Lighting, Motor, and Electrical Permit Checklist, Pg. 4 — LTG-CHK

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 — Revised Nov 2017

UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

The following information is necessary to check a permit application for compliance with the lighting, motor, and electrical requirements in the

Applicability (yes,no,na)	Code Section	Component	Compliance information required in permit documents	Location in Documents	Building Department Notes
LIGHTING ALTERATIONS					
Yes	C503.6	Interior and parking garage lighting fixture alterations	Where ≥ 50% of existing luminaires in interior space(s) or parking garage are replaced; indicate compliance path (building area or space-by-space method); include all new and existing-to remain luminaires in compliance form (LTG-INT-BLD or LTG-INT-SPACE); indicate proposed lighting wattage does not exceed maximum allowed per compliance path	**Lighting Floor Plan**	
			Where < 50% of existing luminaires in interior space(s) or parking garage are replaced; indicate total existing lighting wattage in each space prior to alteration; include all new and existing-to-remain luminaires in LTG-INT-SPACE form; indicate proposed total lighting wattage in alteration area does not exceed total existing lighting wattage prior to alteration		
Yes	C503.6	Exterior lighting fixture alterations	Where ≥ 50% of existing exterior lighting wattage is replaced; include all new and existing-to-remain luminaires in LTG-EXT form; indicate proposed total exterior lighting wattage does not exceed maximum allowed	**Electrical Site Plan**	
			Where < 50% of existing exterior lighting wattage is replaced; indicate total existing lighting wattage prior to alteration; include all new and existing-to-remain luminaires in LTG-EXT form; indicate proposed total exterior lighting wattage does not exceed total existing wattage prior to alteration		
Yes	C503.6	Interior lighting wiring alterations	Where new wiring is installed to serve new interior luminaires and /or luminaires are relocated to a new circuit; indicate lighting controls are provided (as applicable) - manual (C405.2.3); occupancy sensor (C405.2.1); daylight responsive (C405.2.4); specific application (C405.2.5); exit signs (C405.3)	**Lighting Floor Plan**	
Yes	C503.6	Exterior lighting wiring alterations	Where new wiring is installed to serve new exterior luminaires and /or luminaires are relocated to new circuit; indicate exterior lighting controls are provided (C405.2.7)	**Electrical Site Plan**	
Yes	C503.6	Lighting panel alterations	Where a new lighting panel is installed or an existing panel is moved (all new raceway and conductor wiring); indicate lighting controls are provided (as applicable) - same provisions as wiring alterations; time switch controls and manual light reduction controls (C405.2.2)	**Lighting Floor Plan**	
Yes	C503.6	Interior space reconfiguration	Where interior space(s) is reconfigured (permanently installed walls or ceiling-height partitions); indicate lighting controls are provided (as applicable) - same provisions as lighting panel alterations	**Lighting Floor Plan**	
NA	C504.2	Lighting repairs	Identify existing luminaires being upgraded with bulb and / or ballast replacement; indicate fixture alteration does not increase existing fixture wattage		
NA	C505.1	Change of space use	Identify spaces on plans where the building area type or space use type is being changed from one type to another per Tables C405.4.2(1) or (2)		
			Indicate compliance path (building area or space-by-space method); include all new and existing-to-remain luminaires in compliance form (LTG-INT-BLD or LTG-INT-SPACE); indicate proposed lighting wattage does not exceed maximum allowed per compliance path		
RECEPTACLES					
	C405.10	Controlled receptacles	Identify all controlled and uncontrolled receptacles on electrical plans in each space in which they are required; include receptacle configuration such as spacing between controlled and uncontrolled, duplex devices, etc;		
			Indicate on plans whether the method of automatic control for each controlled receptacle zone is by occupant sensor or programmable time-of-day control		

Lighting, Motor, and Electrical Permit Checklist, Pg. 5 LTG-CHK

2015 Washington State Energy Code Compliance Forms for Commercial Buildings including R2, R3, R4 over 3 stories and all R1 — Revised Nov 2017

UPS BFI Gateway Project - Main Sort Bldg	Date	10/31/2019

The following information is necessary to check a permit application for compliance with the lighting, motor, and electrical requirements in the

Applicability (yes,no,na)	Code Section	Component	Compliance information required in permit documents	Location in Documents	Building Department Notes
MOTORS, TRANSFORMERS, ELECTRIC METERS, INTERIOR TRANSPORTATION					
NA	C405.6	Electrical transformers	Include electrical transformer schedule on electrical plans; indicate transformer size, efficiency, or exception taken		
NA	C405.7	Dwelling unit electrical energy consumption	Indicate on electrical plans that each dwelling unit in Group R-2 has a separate electrical energy meter		
NA	C405.8	Electric motor efficiency	Include all motors, including fractional hp motors, in electric motor schedule on electrical plans; indicate hp, rpm, rated efficiency, or exception applied		
NA	C405.9.1	Elevator cabs	For luminaires in each elevator cab, provide calculated average efficacy of combined fixtures that indicates efficacy is not less than 35 lumens per watt;		
			Indicate rated watts per cfm for elevator cab ventilation fans do not exceed 0.33 watts per cfm;		
			Indicate automatic controls that de-energize lighting and ventilation fans when elevator is stopped and unoccupied for a period of 15 minutes or more		
NA	C405.9.2	Escalators and moving walks	Indicate escalators comply with ASME A17.1/CSA B44; automatic controls are configured to reduce operational speed to the minimum permitted when not in use		
NA	C405.9.3	Regenerative drive	Indicate all one-way down or reversible escalators are provided with a variable frequency regenerative drive		
DOCUMENTATION AND SYSTEM REQUIREMENTS TO SUPPORT COMMISSIONING (Cx)					
NA	C408.3	Scope of electrical power and lighting systems commissioning	Indicate that all electrical systems (receptacles, transformers, motors, vertical and horizontal transportation) for which the WSEC requires control functions and / or configuration to perform specific functions are required to be commissioned;		
			Where total building lighting load is > 20 kW, or where total lighting load of luminaires requiring daylight sensing and / or occupancy control > 10 kW, indicate that all automatic lighting control systems are required to be commissioned; or provide building lighting power calculation demonstrating eligibility for exception;		
NA	C405.13 C408.1.1 C408.1.2 C408.1.4.2 C103.6	Commissioning requirements in construction documents	Indicate Cx requirements in plans and specifications for all applicable electrical and lighting control systems per C408;		
			Include general summary with at minimum Items 1 thru 4 of the Cx plan per C408.1.2 including: narrative description of activities, responsibilities of the Cx team, schedule of activities including verification of project close out documentation per C103.6, and conflict of interest plan (if required);		
			Include in general summary that a Cx project report or Compliance Checklist (Figure C408.1.4.2) shall be completed by the Certified Cx Professional and provided to the owner prior to the final electrical inspection		
NA	C408.3.1	Functional performance testing criteria	Identify in plans and specifications the intended operation of all equipment and controls during all modes of operation, including interfacing between new and existing-to-remain systems		
PROJECT CLOSE OUT DOCUMENTATION					
Yes	C103.6.3	Project close out documentation requirements	Indicate in plans that project close out documentation is required including WSEC lighting compliance forms and calculations that document all interior and exterior lighting area and / or surface types, lighting power allowances and installed densities	**General Notes, E002**	

If "no" is selected for any question, provide explanation:

End of Lighting, Motor & Transformer Permit Documents Checklist

PSM
CONSULTING ENGINEERS

Structural Calculations for

UPS BFI
Gateway Project

King County International Airport
Boeing Field
Seattle, WA

November 2019

PSM #18188

MARC DAVID STUBBS
STATE OF WASHINGTON
STRUCTURAL
PROFESSIONAL ENGINEER
11-1-19

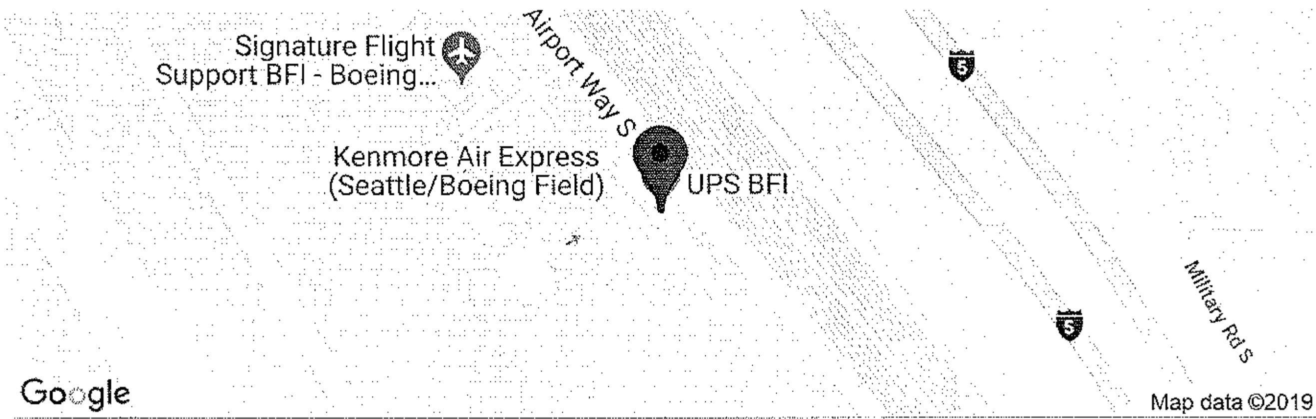
2200 6TH AVENUE, #601
SEATTLE WASHINGTON 98121 USA
WWW.PSM-ENGINEERS.COM
PHONE 206-622-4580
FAX 206-622-0422

OSHPD

UPS BFI Bldg

7300 Perimeter Rd S, Seattle, WA 98108, USA

Latitude, Longitude: 47.5367751, -122.3019577



Date	8/13/2019, 12:59:05 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.518	MCE_R ground motion. (for 0.2 second period)
S_1	0.524	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.518	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.012	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

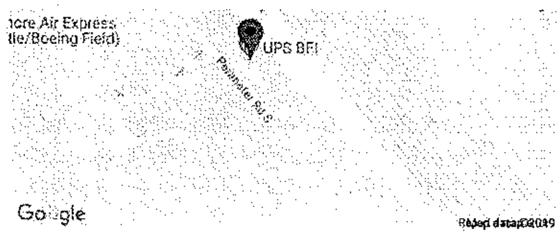
Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.65	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.715	Site modified peak ground acceleration
T_L	6	Long-period transition period in seconds
SsRT	1.518	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.683	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	4.302	Factored deterministic acceleration value. (0.2 second)
S1RT	0.524	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.586	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	1.639	Factored deterministic acceleration value. (1.0 second)
PGAd	1.422	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.902	MAPPED VALUE OF THE RISK COEFFICIENT AT SHORT PERIODS
C_{R1}	0.895	" " " " " " AT A PERIOD OF 1S.

3

ATC Hazards by Location

Search Information

Address:	7300 Perimeter Rd S, Seattle, WA 98108, USA
Coordinates:	47.5367751, -122.3019577
Elevation:	ft
Timestamp:	2019-08-13T20:01:50.372Z
Hazard Type:	Wind



ASCE 7-16

MRI 10-Year	67 mph
MRI 25-Year	74 mph
MRI 50-Year	78 mph
MRI 100-Year	83 mph
Risk Category I	92 mph
Risk Category II	98 mph
Risk Category III	105 mph
Risk Category IV	109 mph

ASCE 7-10

MRI 10-Year	72 mph
MRI 25-Year	79 mph
MRI 50-Year	85 mph
MRI 100-Year	91 mph
Risk Category I	100 mph
Risk Category II	110 mph
Risk Category III-IV	115 mph

ASCE 7-05

ASCE 7-05 Wind Speed	85 mph

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

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Job: UPS BFI Seattle, WA (Maintenance Bldg)

Job No.: 18188-003

Date: 8/28/2019

By: TCL

ASCE 7-10 WIND

General Requirements - Chapter 26

Risk category =	II		Table 1.5-1*
V =	110	mph	Figure 26.5-1A, B, or C based on risk category*
Kd =	0.85		Table 26.6-1*, 0.85 except chimneys, tanks, similar structures, and trusses towers
Exposure	C		Section 26.7.2* http://www.seattle.gov/DPD/toolsresources/windloadfactors/default.htm
Kzt =	1		Figure 26.8-1*
h =	28.875	ft	(Average of 27.25' - Bldg Eave & 30.5' - Ridge)
G =	0.85		

* indicates table or figure on separate excel tab

MWFRS (Directional = all heights) - Chapter 27

qz =	25.7	psf	
L=	102.167	ft	horz dim parallel to wind (long dim)
B =	97.333	ft	horz dim normal to wind (short dim)
θroof =	1.35	degrees	roof slope
GCpi =	0.18		Table 26.11-1, enclosed=0.18, partially enclosed=0.55, open=0

Wall net pressure

p = max of: qz*G*Cp-qh*(GCpi) windward + internal
qz*G*Cp-qh*G*Cp windward + leeward
Windward pressure varies with height (qz), leeward & internal are for max height (qh)

z, ft	Kz	qz, psf	p_{net_short}, psf wind perp to short dim, B	p_{net_long}, psf wind perp to long dim, L	$p_{net\_parapet\_ww}$, psf
15	0.85	22.4	25.9	26.1	50.3
20	0.90	23.7	26.8	27.1	53.4
25	0.95	24.9	27.6	27.8	56.0
30	0.98	25.9	28.3	28.5	58.2
40	1.04	27.5	29.4	29.6	61.8
50	1.09	28.8	30.3	30.5	64.8
60	1.14	29.9	31.0	31.3	67.3
70	1.17	30.9	31.7	31.9	69.6

Roof net pressure

p = max of: qz*G*Cp-qh*(GCpi) windward + internal
qz*G*Cp-qh*G*Cp windward + leeward
All pressures are for qh

θ ≥ 10°

$p_{roof,ww}$ = -19.63
-3.93
$p_{roof,lw}$ = -10.9

$p_{roof,horz}$ = not valid psf
$p_{roof,vert}$ = not valid psf

θ < 10°

	< h/2	h/2-h	h-2h	> 2h
$p_{roof,perp}$	-24.3	-19.9	-15.5	-11.2

*monoslope roofs are either entirely WW or LW

Job: UPS BFI Seattle, WA (Maintenance Bldg)

Job No.: 18188-003
Date: 8/28/2019 By: TCL

ASCE 7-10 WIND

General Requirements - Chapter 26

Risk category =	II		Table 1.5-1*
V =	110	mph	Figure 26.5-1A, B, or C based on risk category*
Kd =	0.85		Table 26.6-1*, 0.85 except chimneys, tanks, similar structures, and trusses towers
Exposure	C		Section 26.7.2*
Kzt =	1		Figure 26.8-1*
h =	28.875	ft	
G =	0.85		

* indicates table or figure on separate excel tab

MWFRS (Envelope = low rise) - Chapter 28

qz =	25.7	psf	
L=	102.167	ft	horz dim parallel to wind (long dim)
B =	97.333	ft	horz dim normal to wind (short dim)
θroof =	1.35	degrees	roof slope
GCpi =	0.18		Table 26.11-1, enclosed=0.18, partially enclosed=0.55, open=0
a =	9.7	ft	

Wall net pressure

p = max of: qh*(GCpf-GCpi) windward + internal
qh*(GCpf-GCpf) windward + leeward
All pressures are for max height (qh)

Zone	1+4	1E+4E	5+6	5E+6E	parapet ww	parapet lw
Pressure, psf	17.7	26.7	17.7	26.7	38.5	25.7

Parapets

p = qpGCpn
p = 38.48 psf

Roof net pressure

p = max of: qh*(GCpf-GCpi) windward + internal
qh*(GCpf-GCpf) windward + leeward
All pressures are for qh

Zone	2+3	2+3, horz	2+3, vert	2E+3E	2E+3E, horz	2E+3E, vert
Pressure, psf	22.3	22.3	0.5	32.1	32.1	0.8

2-13

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PSM
CONSULTING ENGINEERS
2200 SIXTH AVENUE, SUITE 601, SEATTLE, WASHINGTON 98121
OFFICE 206.622.4580 www.psm-engineers.com

JOB: 18188-003 UPS BFI SEATTLE
DATE: SEPT, 19 BY: TCL
SUBJECT: MAINTENANCE BLDG 400
PEMB FOUNDATION

Brief:
A new pre-engineered metal maintenance building will be added to UPS BFI campus located at 7300 Perimeter Rd. S., Seattle WA 98108. The metal building column reactions will be evaluated for the builidng column foundation design. The design shall conform to the design codes of IBC 2018 and ASCE 7-16. The design loads are noted in the following:

Design Data [Pre-engineered steel building is located at Lat = 47.5367751, Longit = -122.3019577]

Ht. of building eave, h_1 = 27.25 ft
Ht. of building ridge, h_2 = 30.50 ft (Average Bldg Height = 28.875 ft)
Length of metal bldg., L = 102.17 ft
Width of metal bldg., W = 97.33 ft

Loads on new metal building	psf
Assumed DL of new metal bldg roof =	12.0
Assumed DL (Collated-Mech & Elect)of new metal bldg =	8.0
Assumed DL of exterior wall =	8.0
Snow:	25.0

Wind (Per ASCE 7-16)
Wind Exposure C
Gust effect factor, G = 0.85
Ultimate Design Wind Speed, V_{ULT} = 110.0 mph
Ultimate Velocity pressure, $q_{h(ULT)}=0.00256\,K_z\,K_{Zt}\,K_d\,V^2$ (psf) = 25.7 PSF
Nominal Design Wind Speed, V_{ASD} = 85.2 mph
Wind directionality factor, K_d = 0.90
Risk Category II
Velocity pressure coeff, K_z = 0.96
Topographic factor, K_{Zt} = 1.00

Seismic (Per IBC 2018 & ASCE 7-16)
Seismic Design Category D; Site Class D; Risk Category II

S_s =	1.505	S_{MS} =	$F_a * S_s$ =	1.505
S_1 =	0.576	S_{M1} =	$F_v * S_1$ =	0.864
F_a =	1.000	S_{DS} =	S_{MS} * 2/3 =	1.004
F_v =	1.500	S_{D1} =	S_{M1} * 2/3 =	0.576
I_E =	1.000			

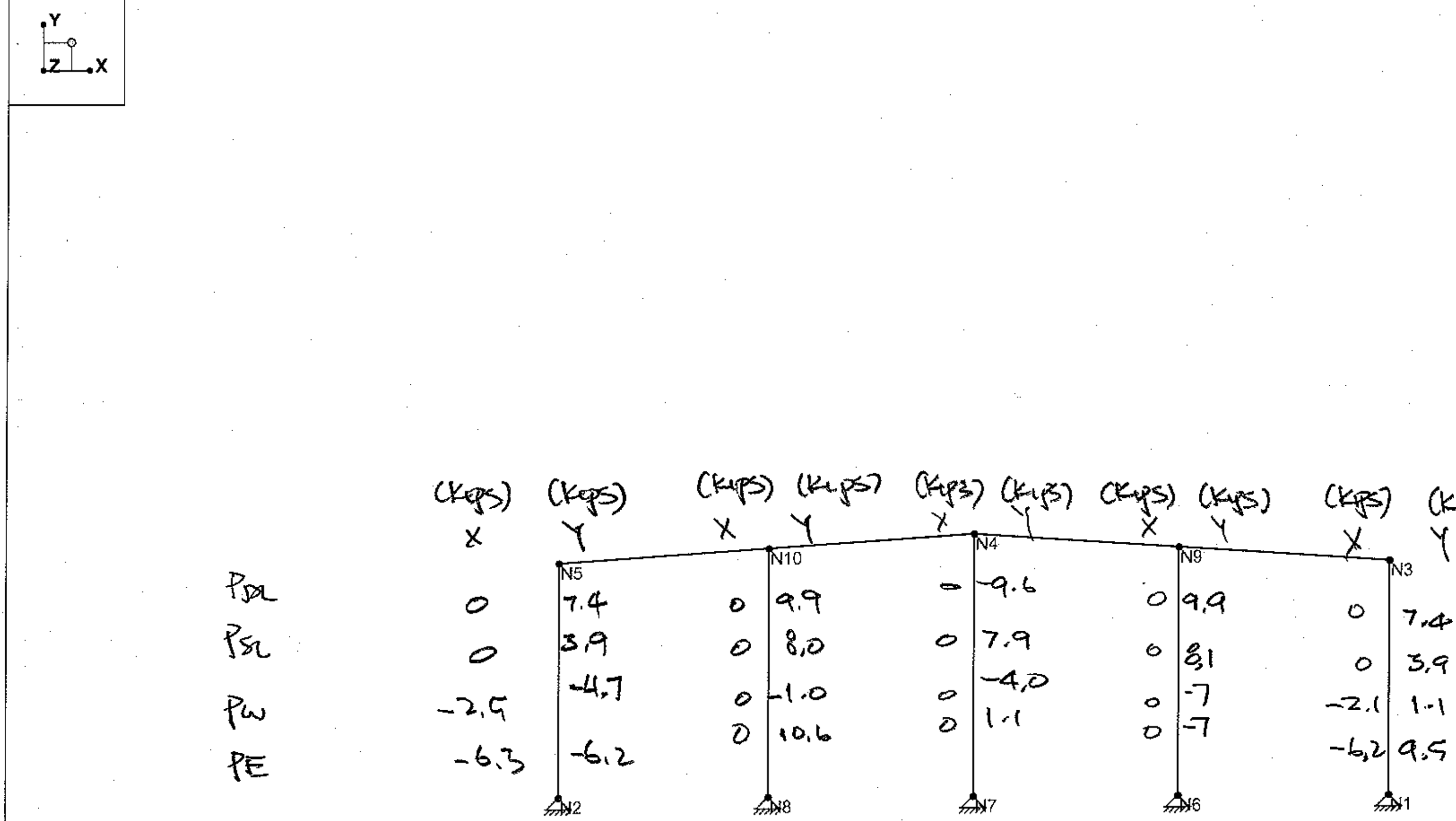
Table 12.2-1 Pre-Engineered Bldg-Ordinary Moment Frames (C_d = 3.0, Ω = 3.0)
R = 3.250 Table 12.2-1 Pre-Engineered Bldg-Ordinary Concentrically Braced Frames (C_d = 3.25, Ω = 2.0)
$V = C_s * W$

C_s =	$S_{DS}/(R/I)$ =	0.3089	<-- For Metal Pre-Engineered Builidng	Building weights: Kips		T =	0.249 second
C_s =	$S_{D1}/T(R/I)$ =	0.7114		Roof =	198.9	Roof area =	9944.2 ft^2
C_s =	$0.044S_{DS}$ I =	0.0442		Exterior long walls =	31.9	Length of Ext. Long Wall =	204.3 ft
C_s =	$0.8S_1/(R/I)$ =	0.1418		Exterior short walls =	36.3	Length of Ext. Short Wall =	194.7 ft
$V = C_s * W$ =		83.4 Kips	Say 100.0 Kips	Σ W =	267.1	<--- Say	270.0 Kips

Along Long Side of Metal Building,
Assume Steel Braced Frames at line A/2-3 and at line E/3-4 to resist the lateral forces (wind and seismic).

Along Short Side of Metal Building,
The lateral forces shall be resisted by the portal frames at lines 1/A-E, 2/A-E, 3/A-E, 4/A-E & 5/A-E.

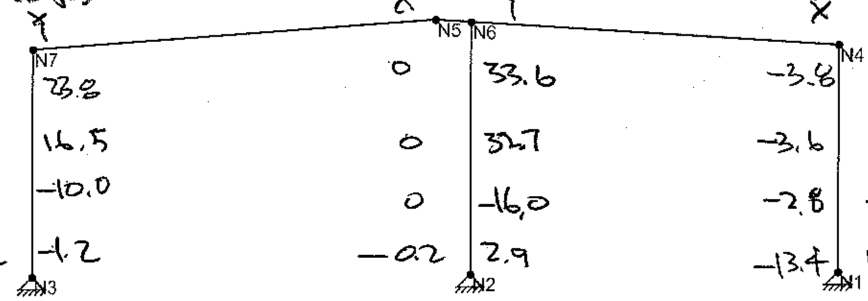
Allowable Soil Bearing Pressure = 3000.0 PSF (Per Soil Report)



	N5 X (Kips)	N5 Y (Kips)	N10 X (Kips)	N10 Y (Kips)	N4 X (Kips)	N4 Y (Kips)	N9 X (Kips)	N9 Y (Kips)	N3 X (Kips)	N3 Y (Kips)
PDL	0	7.4	0	9.9	–	-9.6	0	9.9	0	7.4
PSL	0	3.9	0	8.0	0	7.9	0	8.1	0	3.9
PW	-2.5	-4.7	0	-1.0	0	-4.0	0	-.7	-2.1	1.1
PE	-6.3	-6.2	0	10.6	0	1.1	0	-.7	-6.2	9.5

PSM Engineers, Inc	UPS BFI Seattle-Maintenance Bldg 400 Factor one Frame 1 & 5 W/Wind C...	SK - 1
TCL		Sept 10, 2019 at 11:26 AM
18188-003		UPS 400 Bldg - Factor one Frame 1 & 5 with Wi...

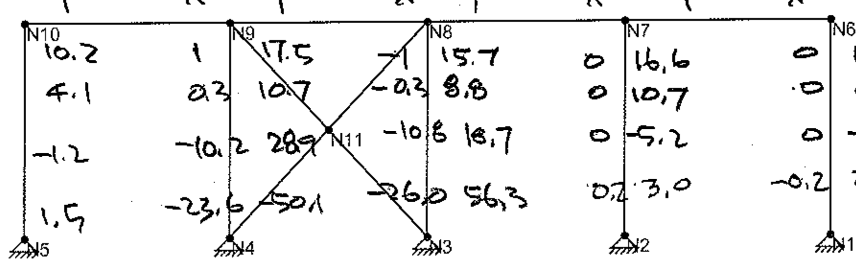
Y
Z X



	(kips) X	(kips) Y	(kips) X	(kips) Y	(kips) X	(kips) Y
PDL	3.8	23.8	0	33.6	-3.8	20.9
PSL	3.6	16.5	0	32.7	-3.6	13.8
PW	-6.0	-10.0	0	-16.0	-2.8	-3.5
PE	-11.4	-1.2	-0.2	2.9	-13.4	12.6

PSM Engineers, Inc	UPS BFI Seattle-Maintenance Bldg 400 Factor one Frame 2,3 & 4@ Line 2...	SK - 1
TCL		Sept 10, 2019 at 11:25 AM
18188-003		UPS 400 Bldg - Factor one Wind Pt Load-Fram...

/8



	(Kips) X	(Kips) Y	(Kips) X	(Kips) Y	(Kips) X	(Kips) Y	(Kips) X	(Kips) Y	(Kips) X	(Kips) Y.
PDL	0	10.2	1	17.5	-1	15.7	0	16.6	0	10.2
PSL	0	4.1	0.3	10.7	-0.3	8.8	0	10.7	0	4.1
PW	-3.0	-1.2	-10.2	28.9	-10.8	18.7	0	-5.2	0	-1.9
PE	-0.2	1.5	-23.6	-50.1	-26.0	56.3	0.2	3.0	-0.2	2.1
	A/1		A/2		A/3		A/4		A/5 (INSIDE BLDG & Look AT FRAME)	
	C/5.		C/4		C/3		C/2		C/1 (INSIDE BLDG & Look AT FRAME)	

PSM Engineers, Inc	
TCL	UPS BFI Seattle-Maintenance Bldg 400 Factor one "BF" A @ Line A/1-5 H...
18188-003	

SK - 1
Sept 10, 2019 at 11:24 AM
UPS 400 Bldg - Factor one Wind Pt Load-Fram...

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JOB: 18188-0253 UPS BFI SEATTLE

DATE: AUG, 19 BY: TCL

SUBJECT: MAINTENANCE 400

INTERIOR BAY PORTAL FRAME (AT LINES 2/A-E, 3/A-E, & 4/A-E)

MAXIMUM DISPLACEMENT, $\delta_{INT} = 1.755''$ $(C_d = 3.25, I = 1.0)$

AMPLIFIED DISPLACEMENT, $\delta'_{INT} = \dfrac{C_d \delta}{I}$

$= \dfrac{(3.25)(1.755)}{1.0}$

$= 5.7''$

ALLOWABLE STORY DRIFT, $\delta_a = 0.02 h_{sx}$

$= (0.02)(27.25' \times 12)$

$= 6.54''$ $> \delta'$ ok.

EXTERIOR BAY PORTAL FRAME (AT LINES 1/A-E & 5/A-E)

MAXIMUM DISPLACEMENT, $\delta_{EXT} = 1.639''$ $(C_d = 3.25, I = 1.0)$

AMPLIFIED DISPLACEMENT, $\delta'_{EXT} = \dfrac{(3.25)(1.639)}{1.0}$

$= 5.3''$ $< \delta_a$ ok

BRACED FRAMES (AT LINES A/1-5 & E/1-5)

MAXIMUM DISPLACEMENT, $\delta_{BF} = 0.3''$

AMPLIFIED DISPLACEMENT, $\delta'_{BF} = \dfrac{(3.25)(0.3)}{1.0}$

$= 0.98''$ SAY $1''$ $< \delta_a$ ok.

FOOTING FOR EXTERIOR BAY FRAME COLUMN (AT LINES A/1, C/1, A/5, C/5)

USE 4'-6" X 4'-6" X 24" DP.
W/(6) #6 AT 10½" OC EA WAY BOT.

CHECK OVERALL STABILITY

UPLIFT = -6.2

WT OF 6" SOIL (45#) = 3.4K
WT OF FOOTING = 6.1K
DEAD LOAD = 17.6K (10.2+7.4)
WT OF PLINTH (2' WIDE) = 2.0K
WT OF SOIL BTWN T.OF & SLAB = 7.4
Σ = 36.5K

F.O.S. AGAINST UPLIFT = $\frac{(0.6)(36.5)}{6.2}$ = 3.5 > 1.50 OK.

SLIDING

SLIDING = 6.3K

SLIDING RESISTANCE = (0.35)(36.5) = 12.8K

F.O.S AGAINST SLIDING = $\frac{12.8}{6.3}$ = 2.0 > 1.0 OK

OVERTURNING

OVERTURNING, MOT = (6.3)(5') = 31.5 K'

MOMENT RESISTANCE, MR = (36.5)(4.5/2) = 82.1 K'

F.O.S. AGAINST OVERTURNING = $\frac{(0.6)(82.1)}{31.5}$ = 1.56 > 1.0 OK

HENCE, OVERALL STABILITY CHECK IS SATISFACTORY

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General Footing

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for (No Factor) Ext. Bay Frame Col-Maintenance Bldg 400 (At Lines A/1, A/5, C/1 & C/5)

Code References ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10 , ASCE 7-16
Load Combinations Used : IBC 2015 , IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	145.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	No
Add Pedestal Wt for Soil Pressure	:	Yes
Use Pedestal wt for stability, mom & shear	:	Yes

Soil Design Values

Allowable Soil Bearing	=	3.0 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.350

Increases based on footing Depth

Footing base depth below soil surface	=	4.50 ft
Allow press. increase per foot of depth	=	ksf
when footing base is below	=	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=	ksf
when max. length or width is greater than	=	ft

Dimensions

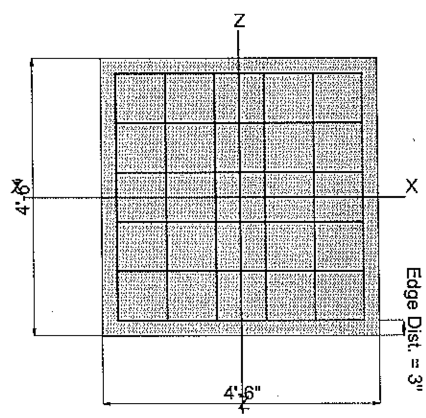
Width parallel to X-X Axis	=	4.50 ft
Length parallel to Z-Z Axis	=	4.50 ft
Footing Thickness	=	24.0 in

Pedestal dimensions...

px : parallel to X-X Axis	=	30.0 in
pz : parallel to Z-Z Axis	=	30.0 in
Height	=	in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0 in



Reinforcing

Bars parallel to X-X Axis

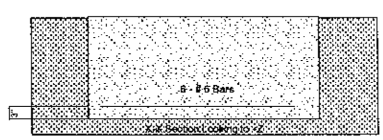
Number of Bars	=	6
Reinforcing Bar Size	=	# 6

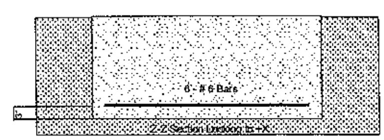
Bars parallel to Z-Z Axis

Number of Bars	=	6
Reinforcing Bar Size	=	# 6

Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a





Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	7.40			3.90	1.10	9.50		k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=					0.0	0.0		k
V-z	=					0.0	0.0		k

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\12

General Footing

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for (No Factor) Ext. Bay Frame Col-Maintenance Bldg 400 (At Lines A/1, A/5, C/1 & C/5)

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.8970	Soil Bearing	2.691 ksf	3.0 ksf	+2.406D+1.40E+H about Z-Z axis
PASS	n/a	Overturning - X-X	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Sliding - Z-Z	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift
PASS	0.01359	Z Flexure (+X)	0.7326 k-ft	53.922 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.01359	Z Flexure (-X)	0.7326 k-ft	53.922 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.01359	X Flexure (+Z)	0.7326 k-ft	53.922 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.01359	X Flexure (-Z)	0.7326 k-ft	53.922 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	n/a	1-way Shear (+X)	0.0 psi	82.158 psi	n/a
PASS	0.0	1-way Shear (-X)	0.0 psi	0.0 psi	n/a
PASS	n/a	1-way Shear (+Z)	0.0 psi	82.158 psi	n/a
PASS	n/a	1-way Shear (-Z)	0.0 psi	82.158 psi	n/a
PASS	n/a	2-way Punching	0.8932 psi	82.158 psi	+1.401D+0.50L+0.70S+2.0E+1.60H

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, +D+H	3.0	n/a	0.0	0.8456	0.8456	n/a	n/a	0.282
X-X, +D+L+H	3.0	n/a	0.0	0.8456	0.8456	n/a	n/a	0.282
X-X, +D+Lr+H	3.0	n/a	0.0	0.8456	0.8456	n/a	n/a	0.282
X-X, +D+S+H	3.0	n/a	0.0	1.038	1.038	n/a	n/a	0.346
X-X, +D+0.750Lr+0.750L+H	3.0	n/a	0.0	0.8456	0.8456	n/a	n/a	0.282
X-X, +D+0.750L+0.750S+H	3.0	n/a	0.0	0.990	0.990	n/a	n/a	0.330
X-X, +D+0.60W+H	3.0	n/a	0.0	0.8781	0.8781	n/a	n/a	0.293
X-X, +D-0.60W+H	3.0	n/a	0.0	0.8130	0.8130	n/a	n/a	0.271
X-X, +2.406D+1.40E+H	3.0	n/a	0.0	2.691	2.691	n/a	n/a	0.897
X-X, +2.406D-1.40E+H	3.0	n/a	0.0	1.377	1.377	n/a	n/a	0.459
X-X, +D+0.750Lr+0.750L+0.450W+H	3.0	n/a	0.0	0.870	0.870	n/a	n/a	0.290
X-X, +D+0.750Lr+0.750L-0.450W+H	3.0	n/a	0.0	0.8211	0.8211	n/a	n/a	0.274
X-X, +D+0.750L+0.750S+0.450W+H	3.0	n/a	0.0	1.014	1.014	n/a	n/a	0.338
X-X, +D+0.750L+0.750S-0.450W+H	3.0	n/a	0.0	0.9656	0.9656	n/a	n/a	0.322
X-X, +2.054D+0.750L+0.750S+1.050E+	3.0	n/a	0.0	2.374	2.374	n/a	n/a	0.791
X-X, +2.054D+0.750L+0.750S-1.050E+	3.0	n/a	0.0	1.389	1.389	n/a	n/a	0.463
X-X, +0.60D+0.60W+0.60H	3.0	n/a	0.0	0.5399	0.5399	n/a	n/a	0.180
X-X, +0.60D-0.60W+0.60H	3.0	n/a	0.0	0.4747	0.4747	n/a	n/a	0.158
X-X, -0.8056D+1.40E+0.60H	3.0	n/a	0.0	-0.02439	-0.02439	n/a	n/a	0.008
X-X, -0.8056D-1.40E+0.60H	3.0	n/a	0.0	-1.338	-1.338	n/a	n/a	0.446
Z-Z, +D+H	3.0	0.0	n/a	n/a	n/a	0.8456	0.8456	0.282
Z-Z, +D+L+H	3.0	0.0	n/a	n/a	n/a	0.8456	0.8456	0.282
Z-Z, +D+Lr+H	3.0	0.0	n/a	n/a	n/a	0.8456	0.8456	0.282
Z-Z, +D+S+H	3.0	0.0	n/a	n/a	n/a	1.038	1.038	0.346
Z-Z, +D+0.750Lr+0.750L+H	3.0	0.0	n/a	n/a	n/a	0.8456	0.8456	0.282
Z-Z, +D+0.750L+0.750S+H	3.0	0.0	n/a	n/a	n/a	0.990	0.990	0.330
Z-Z, +D+0.60W+H	3.0	0.0	n/a	n/a	n/a	0.8781	0.8781	0.293
Z-Z, +D-0.60W+H	3.0	0.0	n/a	n/a	n/a	0.8130	0.8130	0.271
Z-Z, +2.406D+1.40E+H	3.0	0.0	n/a	n/a	n/a	2.691	2.691	0.897
Z-Z, +2.406D-1.40E+H	3.0	0.0	n/a	n/a	n/a	1.377	1.377	0.459
Z-Z, +D+0.750Lr+0.750L+0.450W+H	3.0	0.0	n/a	n/a	n/a	0.870	0.870	0.290
Z-Z, +D+0.750Lr+0.750L-0.450W+H	3.0	0.0	n/a	n/a	n/a	0.8211	0.8211	0.274
Z-Z, +D+0.750L+0.750S+0.450W+H	3.0	0.0	n/a	n/a	n/a	1.014	1.014	0.338
Z-Z, +D+0.750L+0.750S-0.450W+H	3.0	0.0	n/a	n/a	n/a	0.9656	0.9656	0.322
Z-Z, +2.054D+0.750L+0.750S+1.050E+	3.0	0.0	n/a	n/a	n/a	2.374	2.374	0.791
Z-Z, +2.054D+0.750L+0.750S-1.050E+	3.0	0.0	n/a	n/a	n/a	1.389	1.389	0.463
Z-Z, +0.60D+0.60W+0.60H	3.0	0.0	n/a	n/a	n/a	0.5399	0.5399	0.180
Z-Z, +0.60D-0.60W+0.60H	3.0	0.0	n/a	n/a	n/a	0.4747	0.4747	0.158
Z-Z, -0.8056D+1.40E+0.60H	3.0	0.0	n/a	n/a	n/a	-0.02439	-0.02439	0.008
Z-Z, -0.8056D-1.40E+0.60H	3.0	0.0	n/a	n/a	n/a	-1.338	-1.338	0.446

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JOB: 18188-003 UPS BFI SEATTLE
DATE: AUG, 19 BY: RL
SUBJECT: MAINTENANCE BLDG 400

FOOTING FOR INTERIOR BAY FRAME COLUMN (AT LINE A/2, C/2
A/3, C/3
A/4, C/4)

USE 7'-0" X 7'-0" X 24" DP
W/ (9) #6 AT 10.0" OC EA WAY BOT.

CHECK OVERALL STABILITY

UPLIFT = (50.1)(0.3) + 1.2 = 16.2

WEIGHT OF 6" SOG (90#)	=	6.8	
WT OF FTG	=	14.7	
DEAD LOAD	=	20.9	(23.8 OR 20.9)
WT OF PLINTH (2'-0" WIDE)	=	2.0	
WT OF SOIL BTW TOP & SLAB	=	12.4	
	Σ =	56.8	

F.O.S. AGAINST UPLIFT = (56.8)(0.6)/16.2 = 2.10 > 1.50 OK

SLIDING

SLIDING = 13.4^K

SLIDING RESISTANCE, = (56.8)(0.35) = 19.9^K

F.O.S. AGAINST SLIDING = 19.9/13.4 = 1.49 > 1.0 OK

OVERTURNING

OVERTURNING MOMENT = (13.4)(5') = 67.0K'

MOMENT RESISTANCE, MR = (56.8)(7.0/2)
= 198.8K'

F.O.S. AGAINST OVERTURNING = 198.8/67
= 2.97 > 1.0 OK

HENCE, OVERALL STABILITY CHECK IS SATISFACTORY

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General Footing

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for (No Factor) Int. Bay Frame Col-Maintenance Bldg 400 (At Lines A/2, C/2, A/3, C/3, A/4 & C/4)

Code References ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015 , IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	=	3.0	ksi
fy : Rebar Yield	=	60.0	ksi
Ec : Concrete Elastic Modulus	=	3,122.0	ksi
Concrete Density	=	145.0	pcf
φ Values Flexure	=	0.90	
Shear	=	0.750	

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
Add Ftg Wt for Soil Pressure	:	Yes
Use ftg wt for stability, moments & shears	:	No
Add Pedestal Wt for Soil Pressure	:	Yes
Use Pedestal wt for stability, mom & shear	:	Yes

Soil Design Values

Allowable Soil Bearing	=	3.0	ksf
Increase Bearing By Footing Weight	=	No	
Soil Passive Resistance (for Sliding)	=	250.0	pcf
Soil/Concrete Friction Coeff.	=	0.350	

Increases based on footing Depth

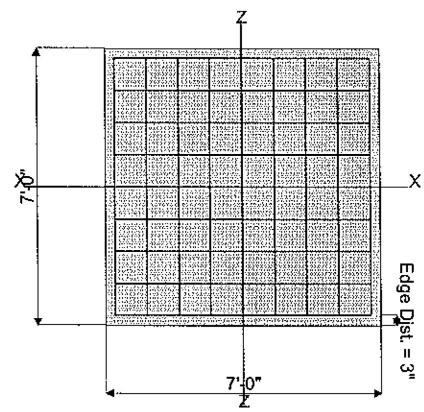
Footing base depth below soil surface	=	4.50	ft
Allow press. increase per foot of depth	=	4.0	ksf
when footing base is below	=	4.250	ft

Increases based on footing plan dimension

Allowable pressure increase per foot of depth	=		ksf
when max. length or width is greater than	=		ft

Dimensions

Width parallel to X-X Axis	=	7.0	ft
Length parallel to Z-Z Axis	=	7.0	ft
Footing Thickness	=	24.0	in



Pedestal dimensions...

px : parallel to X-X Axis	=	24.0	in
pz : parallel to Z-Z Axis	=	24.0	in
Height	=		in

Rebar Centerline to Edge of Concrete...

at Bottom of footing	=	3.0	in

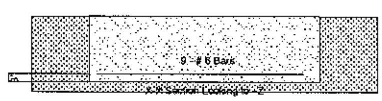
Reinforcing

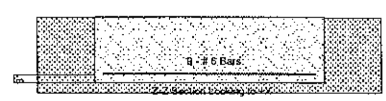
Bars parallel to X-X Axis

Number of Bars	=	9
Reinforcing Bar Size	=	# 6

Bars parallel to Z-Z Axis

Number of Bars	=	9
Reinforcing Bar Size	=	# 6





Bandwidth Distribution Check (ACI 15.4.4.2)

Direction Requiring Closer Separation	n/a
# Bars required within zone	n/a
# Bars required on each side of zone	n/a

Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	23.80			16.50	-10.0	-1.20		k
OB : Overburden	=								ksf
M-xx	=								k-ft
M-zz	=								k-ft
V-x	=	3.80			3.60	10.20	23.60		k
V-z	=	0.0			3.60	0.0	0.0		k

General Footing

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for (No Factor) Int. Bay Frame Col-Maintenance Bldg 400 (At Lines A/2, C/2, A/3, C/3, A/4 & C/4)

DESIGN SUMMARY

Design OK

	Min. Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9725	Soil Bearing	3.890 ksf	4.0 ksf	+2.406D+1.40E+H about Z-Z axis
PASS	8.034	Overturning - X-X	21.150 k-ft	169.925 k-ft	+D+0.750L+0.750S+0.450W+H
PASS	2.010	Overturning - Z-Z	37.80 k-ft	75.968 k-ft	+0.60D+0.60W+0.60H
PASS	1.653	Sliding - X-X	25.661 k	42.414 k	+2.406D+1.40E+H
PASS	8.524	Sliding - Z-Z	3.60 k	30.686 k	+D+S+H
PASS	3.618	Uplift	-6.0 k	21.705 k	+0.60D+0.60W+0.60H
PASS	0.1597	Z Flexure (+X)	8.313 k-ft	52.048 k-ft	+0.6992D+2.0E+0.90H
PASS	0.04919	Z Flexure (-X)	2.560 k-ft	52.048 k-ft	+1.20D+0.50L+1.60S+1.60H
PASS	0.07491	X Flexure (+Z)	3.899 k-ft	52.048 k-ft	+1.20D+0.50L+1.60S+1.60H
PASS	0.05649	X Flexure (-Z)	2.940 k-ft	52.048 k-ft	+1.20D+0.50L+1.60S+1.60H
PASS	0.1575	1-way Shear (+X)	12.941 psi	82.158 psi	+0.6992D+2.0E+0.90H
PASS	0.02676	1-way Shear (-X)	2.198 psi	82.158 psi	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.04314	1-way Shear (+Z)	3.545 psi	82.158 psi	+1.20D+0.50L+1.60S+1.60H
PASS	0.03088	1-way Shear (-Z)	2.537 psi	82.158 psi	+1.20D+0.50L+1.60S+1.60H
PASS	0.06180	2-way Punching	10.154 psi	164.317 psi	+1.20D+0.50L+1.60S+1.60H

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc (in)	Zecc (in)	Actual Soil Bearing Stress @ Location: Bottom, -Z	Top, +Z	Left, -X	Right, +X	Actual / Allow Ratio
X-X, +D+H	4.0	n/a	0.0	1.028	1.028	n/a	n/a	0.257
X-X, +D+L+H	4.0	n/a	0.0	1.028	1.028	n/a	n/a	0.257
X-X, +D+Lr+H	4.0	n/a	0.0	1.028	1.028	n/a	n/a	0.257
X-X, +D+S+H	4.0	n/a	1.292	1.241	1.489	n/a	n/a	0.372
X-X, +D+0.750Lr+0.750L+H	4.0	n/a	0.0	1.028	1.028	n/a	n/a	0.257
X-X, +D+0.750L+0.750S+H	4.0	n/a	1.033	1.188	1.374	n/a	n/a	0.344
X-X, +D+0.60W+H	4.0	n/a	0.0	0.9058	0.9058	n/a	n/a	0.227
X-X, +D-0.60W+H	4.0	n/a	0.0	1.151	1.151	n/a	n/a	0.288
X-X, +2.406D+1.40E+H	4.0	n/a	0.0	2.439	2.439	n/a	n/a	0.610
X-X, +2.406D-1.40E+H	4.0	n/a	0.0	2.508	2.508	n/a	n/a	0.627
X-X, +D+0.750Lr+0.750L+0.450W+H	4.0	n/a	0.0	0.9364	0.9364	n/a	n/a	0.234
X-X, +D+0.750Lr+0.750L-0.450W+H	4.0	n/a	0.0	1.120	1.120	n/a	n/a	0.280
X-X, +D+0.750L+0.750S+0.450W+H	4.0	n/a	1.112	1.096	1.282	n/a	n/a	0.321
X-X, +D+0.750L+0.750S-0.450W+H	4.0	n/a	0.9634	1.280	1.466	n/a	n/a	0.367
X-X, +2.054D+0.750L+0.750S+1.050E+	4.0	n/a	0.5654	2.246	2.432	n/a	n/a	0.608
X-X, +2.054D+0.750L+0.750S-1.050E+	4.0	n/a	0.5532	2.298	2.483	n/a	n/a	0.621
X-X, +0.60D+0.60W+0.60H	4.0	n/a	0.0	0.4945	0.4945	n/a	n/a	0.124
X-X, +0.60D-0.60W+0.60H	4.0	n/a	0.0	0.7394	0.7394	n/a	n/a	0.185
X-X, -0.8056D+1.40E+0.60H	4.0	n/a	0.0	-0.8627	-0.8627	n/a	n/a	0.216
X-X, -0.8056D-1.40E+0.60H	4.0	n/a	0.0	-0.7941	-0.7941	n/a	n/a	0.199
Z-Z, +D+H	4.0	1.810	n/a	n/a	n/a	0.8975	1.159	0.290
Z-Z, +D+L+H	4.0	1.810	n/a	n/a	n/a	0.8975	1.159	0.290
Z-Z, +D+Lr+H	4.0	1.810	n/a	n/a	n/a	0.8975	1.159	0.290
Z-Z, +D+S+H	4.0	2.655	n/a	n/a	n/a	1.110	1.620	0.405
Z-Z, +D+0.750Lr+0.750L+H	4.0	1.810	n/a	n/a	n/a	0.8975	1.159	0.290
Z-Z, +D+0.750L+0.750S+H	4.0	2.486	n/a	n/a	n/a	1.057	1.504	0.376
Z-Z, +D+0.60W+H	4.0	5.364	n/a	n/a	n/a	0.5645	1.247	0.312
Z-Z, +D-0.60W+H	4.0	-0.9875	n/a	n/a	n/a	1.231	1.071	0.308
Z-Z, +2.406D+1.40E+H	4.0	8.470	n/a	n/a	n/a	0.9882	3.890	0.973
Z-Z, +2.406D-1.40E+H	4.0	-4.667	n/a	n/a	n/a	3.330	1.686	0.833
Z-Z, +D+0.750Lr+0.750L+0.450W+H	4.0	4.388	n/a	n/a	n/a	0.6478	1.225	0.306
Z-Z, +D+0.750Lr+0.750L-0.450W+H	4.0	-0.3455	n/a	n/a	n/a	1.147	1.093	0.287
Z-Z, +D+0.750L+0.750S+0.450W+H	4.0	4.568	n/a	n/a	n/a	0.8075	1.571	0.393
Z-Z, +D+0.750L+0.750S-0.450W+H	4.0	0.6815	n/a	n/a	n/a	1.307	1.438	0.360
Z-Z, +2.054D+0.750L+0.750S+1.050E+	4.0	7.389	n/a	n/a	n/a	1.125	3.553	0.888
Z-Z, +2.054D+0.750L+0.750S-1.050E+	4.0	-2.925	n/a	n/a	n/a	2.882	1.899	0.721
Z-Z, +0.60D+0.60W+0.60H	4.0	8.320	n/a	n/a	n/a	0.2055	0.7835	0.196
Z-Z, +0.60D-0.60W+0.60H	4.0	-2.544	n/a	n/a	n/a	0.8715	0.6073	0.218
Z-Z, -0.8056D+1.40E+0.60H	4.0	-17.021	n/a	n/a	n/a	-1.916	0.0	0.000
Z-Z, -0.8056D-1.40E+0.60H	4.0	22.267	n/a	n/a	n/a	0.0	-2.227	0.000

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JOB: 18188-003 UPS BFI SEATTLE
DATE: SEPT, 19 BY: TCL
SUBJECT: MAINTENANCE BLDG 400

16

INTERIOR BLDG COL FTG (6'-0" x 6'-0" x 2'-0" DEEP).

UPLIFT = 16.0^K

DEAD LOAD = 33.6K
WT OF FTG = 10.8^K
Σ = 44.4^K

F.O.S. AGAINST UPLIFT $= \frac{(0.6)(44.4)}{16.0} = 1.67 \geq 1.50$ OK

SLIDING
SLIDING = 0.0^K

OVERTURNING
$M_{OT} = 0.0^{K'}$

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JOB: 18188-003 UPS BFI SEATTLE
DATE: SEPT, 19 BY: TCL
SUBJECT: MAINTENANCE BLDG 400

PERIMETER WIND COL. AT GRIDLINE 1/A-C, 5/A-C. (INTERIOR COL) AT LINES 1/A-C & 5/A-C

USE 4'-6" x 4'-6" x 2'-0" DEEP FTG
W/(6) #6 T & B EW

CHECK OVERALL STABILITY

UPLIFT = 7^k

DEAD LOAD	=	9.9^k
WT OF FTG	=	6.1
WT OF SOIL	=	5.6
WT OF SLAB	=	3.7
Σ	=	24.3^k

F.O.S. AGAINST UPLIFT $= \dfrac{(0.6)(24.3)}{7} = 2.1 > 1.5$ OK

~~SLIDING~~

SLIDING $= [(25.7\text{ PSF})(25')(27.25/2)/10^3]\,0.6 = 5.25^k$ ASD (WIND)

SLIDING RESISTANCE $= (0.35)(24.3) = 8.5^k$

F.O.S. AGAINST SLIDING $= \dfrac{8.5}{5.25} = 1.6 > 1.0$ OK

OVERTURNING

$M_{OT} = (5.25)(5) = 26.25\,k'$

M_R = MOMENT RESISTANCE $= (24.3)(4.5/2) = 54.7^{k'}$

F.O.S. AGAINST OVERTURNING $= 54.7/26.25 = 2.1 > 1.0$ OK

HENCE, OVERALL STABILITY CHECK IS SATISFACTORY.

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JOB: 18188-003 UPS · BFI SEATTLE
DATE: AUG, 19 BY: TCL
SUBJECT: MAINTENANCE BLDG 400

SLAB EDGE

FUNCTIONS OF SLAB EDGE

1. AS A TIE BEAM ALONG BLDG PERIMETER.
2. SUPPORT WIND COLUMNS AT BUILDING PERIMETER

WIND COLUMN

WIND PRESSURE = 25.7 PSF

MAX TRIBUTARY WIDTH BETWEEN THE WIND COLUMNS $= \frac{(24 + 24.667)}{2} = 24.3'$

WIND LOAD AT COL BASE (AVERAGE HEIGHT)

$= (25.7\,psf)\left(\frac{28.0'}{2}\right)(24.3')/10^3$

$= 8.7^K$

GRAVITY LOADS :- (ASSUME 1/3 OF DISTANCE OF EXTERIOR COL BAY)

$P_{DL_{max}} = (20\,psf)(24.667)(26.083/3)/10^3 = 4.3^K$

$P_{SL_{max}} = (25\,psf)(24.667)(26.083/3)/10^3 = 5.4^K$

SEE ATTACHED ENERCALC OUTPUTS.

CHECK TRANSVERSE SLIDING

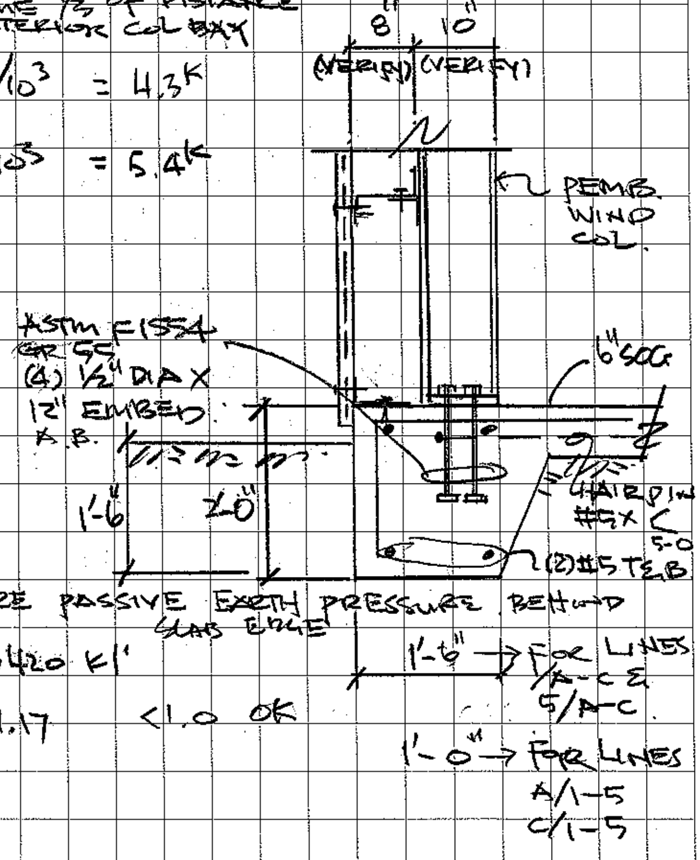
$V_W = 8.7^K$ OR $8.7/24.3 = 0.360$ KLF

		KLF
WT OF SLAB EDGE	=	0.450
WT OF SLAB (10 WIDE) (ASSUME STRIP)	=	0.750
	=	1.200 ← IGNORE PASSIVE EARTH PRESSURE BEHIND SLAB EDGE

SLIDING RESISTANCE $= (1.20)(0.35) = 0.420$ K/'

F.O.S AGAINST SLIDING $= \frac{0.420}{0.36} = 1.17$ <1.0 OK

SLIDING CHECK IS SATISFACTORY.



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Beam on Elastic Foundation

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ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Slab edge around maintenance building 400 perimeter PEMB WIND COLS.

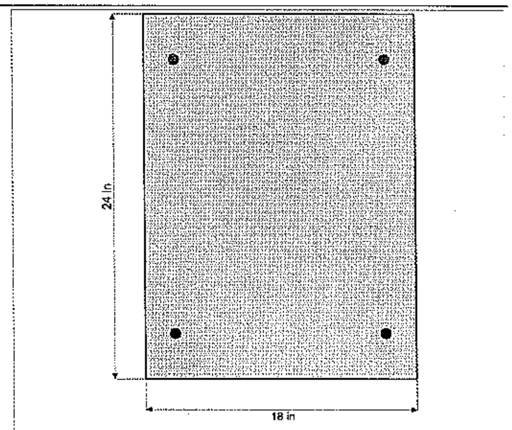
CODE REFERENCES

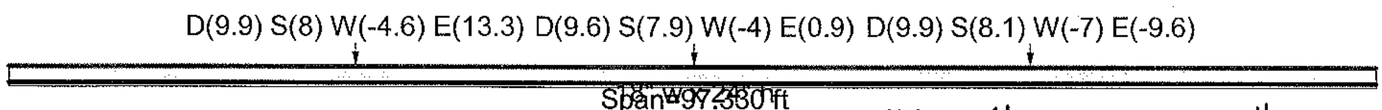
Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2015

Material Properties

f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
Ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			
Soil Subgrade Modulus	=	250.0 psi / (inch deflection)			
Load Combination IBC 2015					
fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2

Beam is supported on an elastic foundation.





USE SLAB EDGE 18" WIDE X 24" D
W/ (2) #6 T & B CONT.

Cross Section & Reinforcing Details

Rectangular Section, Width = 18.0 in, Height = 24.0 in
Span #1 Reinforcing....
2-#6 at 3.0 in from Bottom, from 0.0 to 97.330 ft in this span
2-#6 at 3.0 in from Top, from 0.0 to 97.330 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Point Load : D = 9.90, S = 8.0, W = -4.60, E = 13.30 k @ 24.667 ft
Point Load : D = 9.60, S = 7.90, W = -4.0, E = 0.90 k @ 48.667 ft
Point Load : D = 9.90, S = 8.10, W = -7.0, E = -9.60 k @ 72.667 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.831 : 1**		Maximum Deflection	
Section used for this span	**Typical Section**		Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	70.092 k-ft		Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	84.373 k-ft		Max Downward Total Deflection	0.045 in
Load Combination	+1.401D+0.50L+0.70S+2.0E		Max Upward Total Deflection	-0.208 in
Location of maximum on span	25.191 ft			
Span # where maximum occurs	Span # 1			

Maximum Soil Pressure = **1.606 ksf** at 24.87 ft < 3.0 KSF OK.

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	25.191	70.09	84.37	0.83
+1.40D+1.60H					
Span # 1	1	25.191	20.62	84.37	0.24
+1.20D+0.50Lr+1.60L+1.60H					
Span # 1	1	25.191	17.67	84.37	0.21
+1.20D+1.60L+0.50S+1.60H					
Span # 1	1	72.139	23.67	84.37	0.28

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HAIRPIN BAR

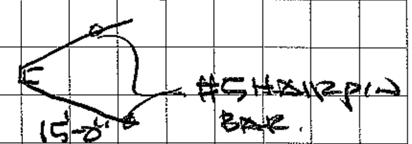
MAX FRAME COL. (PEMB) SHEAR. = 13.4^K

$$\frac{A_{vf}}{s} = \frac{V_u}{\phi \mu f_y d}$$

$$= \frac{(1.4)(13.4)}{(0.75)(1.0)(60)(3)}$$

$$= 0.14 \text{ in}^2$$

USE #5 HAIRPIN BAR
(A_s = 0.31 in²).



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UPS BFI SEATTLE

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JOB: 18188-003
DATE: AUG, 19 BY: TCL
SUBJECT: BLDG 100.
PEMB FDN

Brief:
A new pre-engineered metal building will be added to UPS BFI campus located at 7300 Perimeter Rd. S., Seattle WA 98108. The metal building column reactions will be evaluated for the builidng column foundation design. The design shall conform to the design codes of IBC 2018 and ASCE 7-16. The design loads are noted in the following:

Design Data [Pre-engineered steel building is located at Lat = 47.5367751, Longit = -122.3019577]

Ht. of building eave, h_1 = 27.25 ft
Ht. of building ridge, h_2 = 30.50 ft (Average Bldg Height = 28.875 ft)
Length of metal bldg., L = 275.83 ft
Width of metal bldg., W = 166.67 ft (166.667'; 132.083')

Loads on new metal building	psf
Assumed DL of new metal bldg roof =	12.0
Assumed DL (Collated-Mech & Elect)of new metal bldg =	8.0
Assumed DL of exterior wall =	5.0
Snow:	25.0

Wind (Per ASCE 7-16)
Wind Exposure C
Gust effect factor, G = 0.85
Ultimate Design Wind Speed, V_{ULT} = 110.0 mph
Ultimate Velocity pressure, $q_{h(ULT)}=0.00256\,K_z\,K_{zt}\,K_d\,V^2$ (psf) = 25.7 PSF
Nominal Design Wind Speed, V_{ASD} = 85.2 mph
Wind directionality factor, K_d = 0.90
Risk Category II
Velocity pressure coeff, K_z = 0.96
Topographic factor, K_{zt} = 1.00

Seismic (Per IBC 2018 & ASCE 7-16)
Seismic Design Category D; Site Class D; Risk Category II

S_s =	1.505	S_{MS} =	$F_a * S_s$ =	1.505
S_1 =	0.576	S_{M1} =	$F_v * S_1$ =	0.864
F_a =	1.000	S_{DS} =	S_{MS} * 2/3 =	1.004
F_v =	1.500	S_{D1} =	S_{M1} * 2/3 =	0.576
I_E =	1.000			

Table 12.2-1 Pre-Engineered Bldg-Ordinary Moment Frames (C_d = 3.0, Ω = 3.0)
R = 3.250 Table 12.2-1 Pre-Engineered Bldg-Ordinary Concentrically Braced Frames (C_d = 3.25, Ω = 2.0)

$V = C_s * W$
T = 0.249 second

C_s =	$S_{DS}/(R/I)$ =	0.3089	<-- For Metal Pre-Engineered Builidng
C_s =	$S_{D1}/T(R/I)$ =	0.7114	
C_s =	$0.044S_{DS}$ I =	0.0442	
C_s =	$0.8S_1/(R/I)$ =	0.1418	
$V = C_s * W$ =		327.5	Kips

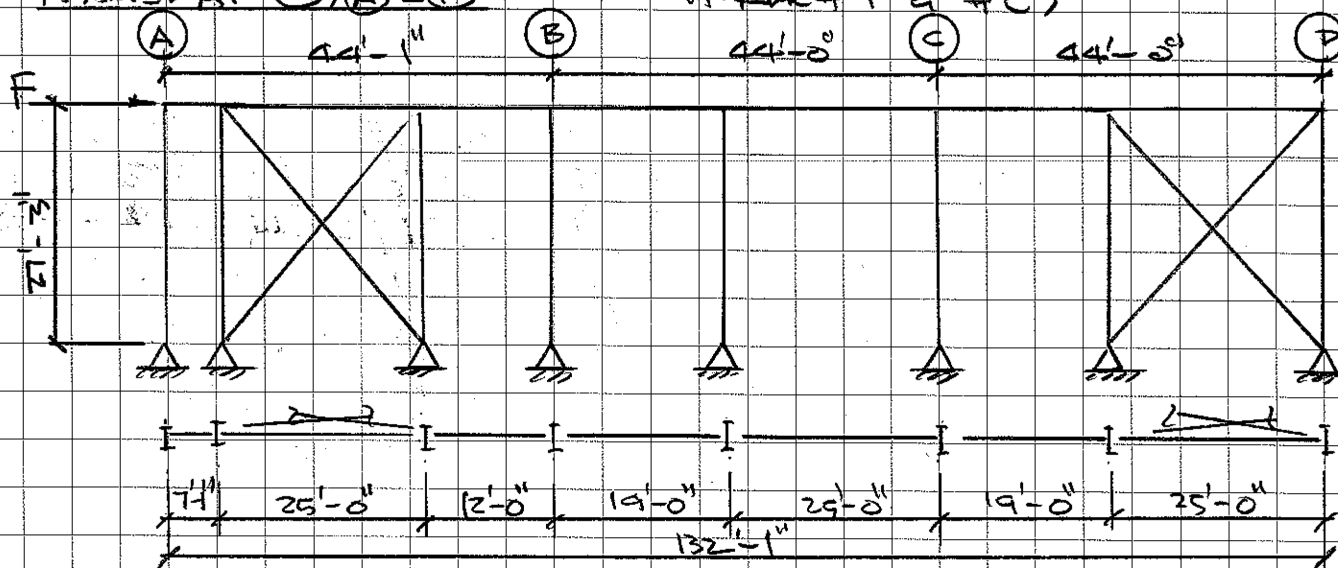
Building weights:	Kips		
Roof =	973.7	Roof area =	48683.4 ft^2
Exterior long walls =	19.9	Length of Ext. Long Wall =	696.5 ft
Exterior short walls =	22.7	Length of Ext. Short Wall =	434.3 ft
Σ W =	1016.3	<--- Say	1060.0 Kips

Along Long Side of Metal Building,
Assume Portal Frames at lines A, B, C and D and Braced Frame at line E resist the lateral forces (wind and seismic).

Along Short Side of Metal Building,
The lateral forces shall be resisted by the steel braced frames and wind columns.

Allowable Soil Bearing Pressure = 3000.0 PSF (Per Soil Report)

FRAMES AT (7)/(A)-(D) (FRAME #1 & #2)



DESIGN LOADS

DEAD LOAD : $W_{DL} = (12+8\text{ PSF})(28.833/2)/10^3 = 0.288\text{ K/'}$ SAY 0.3 K/'

SNOW LOAD : $W_{SL} = (25\text{PSF})(28.833/2)/10^3 = 0.36\text{ K/'}$ SAY 0.4 K/'

LATERAL LOADS

SEISMIC LOAD : $Q_E = 58.3 + 58.3 = 116.6^K$

WIND LOAD : $F_W = (25.7\text{PSF})(375.833/2)(27.25/2)/10^3 = 48.3^K$ SAY 50^K

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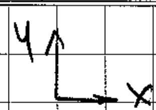
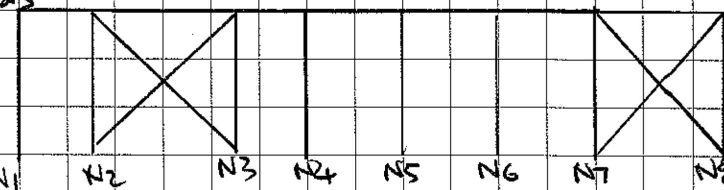
JOB: 18188-005 UPS BFI SEATTLE
DATE: AUG, 19 BY: TCL
SUBJECT: BLDG 100.

FRAME #1 & #2

RISA-2D OUTPUT: COLUMN REACTIONS





NODE	DL X	DL Y	SL X	SL Y	W X	W Y	E X	E Y
N1	0.3	7.5	0.2	0.3	1.0	5.1	3.7	13.7
N2	11.4	12.2	0.9	7.9	9.3	11.7	23.0	37.7
N3	-1.0	12.1	-0.5	7.8	9.7	-23.2	22.1	-43.8
N4	–	8.0	–	4.9	–	-3.1	–	-0.6
N5	–	12.8	–	9.4	–	-4.2	–	2.5
N6	–	12.2	–	8.8	–	-3.9	–	2.5
N7	1.0	13.0	0.5	8.7	15.6	28.2	37.1	77.2
N8	-1.7	13.6	-1.2	5.1	14.2	-34.5	31.6	-72.6

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FOOTING FOR FRAME #1 & #2

ENERCALC OUTPUT : USE 4'-3" WIDE x 24" DEEP CONTINUOUS FTG (W/3' OVERHANG AT EA END COL).
W/(8) #6 AT 6.4" OC T & B LONGITUDINAL
(139) #6 AT 12" OC T & B TRANSVERSE

CHECK OVERALL STABILITY.

UPLIFT = 43.8 + 72.6 + 0.6 (SEISMIC)
= 117.0 K

DEAD WEIGHT = 7.5 + 12.2 + 12.1 + 8 + 12.0 + 12.2 + 13 + 13.6 = 91.4 K
WALL + FTG WT = (8/12)(132.083)(2')(0.15) + 132.083 x 2 x 4.25 x 0.15 = 202.5
SOIL WT = (132.083)(2 - 1)(4.25/2 - 8/12 x 1/2)(2)(110)/10^3 = 52.0
7" SOG WT = (7/12)(14.42'/2)(132.083)(0.15) = 83.3
Σ = 429.2 K

F.O.S. AGAINST UPLIFT = (0.6)(429.2)/117.0 = 2.20 > 1.50 OK

SLIDING

TOTAL HORIZONTAL LOAD = 2.7 + 23.0 + 22.1 + 37.1 + 31.6 = 116.5 K

SLIDING RESISTANCE = (0.35)(429.2) = 150.2 K

F.O.S. AGAINST SLIDING = 150.2/116.5 = 1.29 > 1.0 OK

OVERTURNING

M_R = (429.2)(4.25/2) = 912.05 k'

M_{OT} = (116.5)(4) = 466.0 k'

F.O.S. AGAINST OVERTURNING = (0.6)(1384.1)/605.2 = 1.17 > 1.0 OK

OVERALL STABILITY CHECK IS SATISFACTORY.

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Beam on Elastic Foundation

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 — **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for Frame #1 & # 2 Columns

CODE REFERENCES ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015, IBC 2018

Material Properties

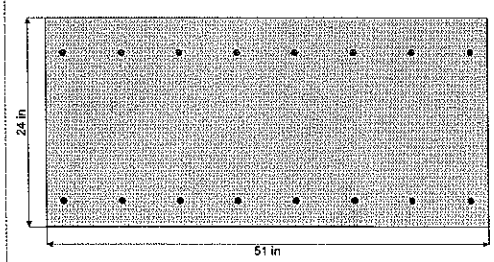
f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

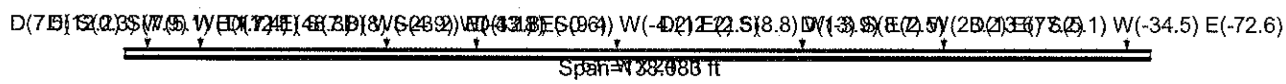
Soil Subgrade Modulus = 250.0 psi / (inch deflection)

Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2

Beam is supported on an elastic foundation.





Cross Section & Reinforcing Details

Rectangular Section, Width = 51.0 in, Height = 24.0 in
Span #1 Reinforcing....
8-#6 at 3.0 in from Bottom, from 0.0 to 138.083 ft in this span
8-#6 at 4.0 in from Top, from 0.0 to 138.083 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

- Point Load : D = 7.50, S = 0.30, W = 5.10, E = 17.40 k @ 3.0 ft
- Point Load : D = 12.20, S = 7.90, W = 11.70, E = 48.30 k @ 10.083 ft
- Point Load : D = 12.10, S = 7.80, W = -23.20, E = -43.80 k @ 35.083 ft
- Point Load : D = 8.0, S = 4.90, W = -3.10, E = -0.60 k @ 47.083 ft
- Point Load : D = 12.80, S = 9.40, W = -4.20, E = 2.50 k @ 66.083 ft
- Point Load : D = 12.20, S = 8.80, W = -3.90, E = 2.50 k @ 91.083 ft
- Point Load : D = 13.0, S = 8.70, W = 28.20, E = 77.20 k @ 110.083 ft
- Point Load : D = 13.60, S = 5.10, W = -34.50, E = -72.60 k @ 135.083 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.840** : 1	Maximum Deflection	
Section used for this span	**Typical Section**	Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	282.525 k-ft	Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	336.155 k-ft	Max Downward Total Deflection	0.080 in
Load Combination	+1.401D+0.50L+0.70S+2.0E	Max Upward Total Deflection	-8.928 in
Location of maximum on span	##.### ft		
Span # where maximum occurs	Span # 1		
Maximum Soil Pressure =	**2.878** ksf at 0.00 ft		

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	##.###	282.52	336.16	0.84

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JOB: 18188-003 UPS BFI SEATTLE
DATE: Aug, 19 BY: TCL
SUBJECT: FRAMES AT LINE (D)

FRAMES AT LINE (D)/(5) - (7) (FRAME #3)

WIND COL & PORTAL FRAMES

DESIGN LOADS:-

DEAD LOAD : $W_{DL} = (12 + 8\ psf)(44/2)/10^3$ = 0.44 K/' say 0.5K/'

SNOW LOAD : $W_{SL} = (25\ psf)(44/2)/10^3$ = 0.59 K/' say 0.6K/'

LATERAL LOAD

SEISMIC LOAD $Q_E = 28^K$ AT FRAME (3) (IN LINE (D))

WIND LOAD $F_W = (25.7\ psf)(44/2)(27.25/2)/10^3 = 7.7^K$ say 10^K (IN LINE (D))

$f_W = (25.7\ psf)(18')/10^3 = 0.463^{K}/'$ say 0.5K/' (PERPENDICULAR) TO LINE (D).

SEE RISA-2D for OUTPUTS.

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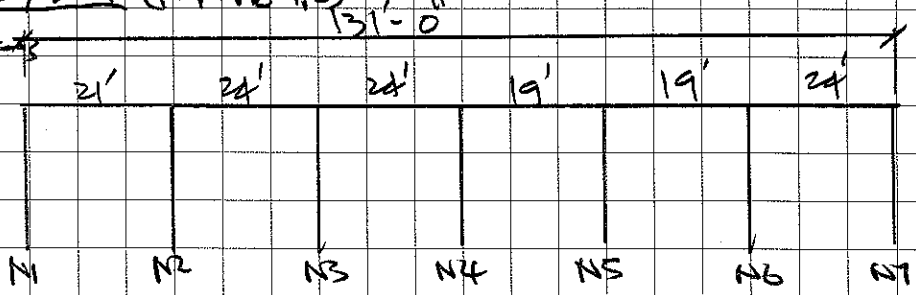
JOB: 18188-003 UPS BFI SEATTLE
DATE: Aug/19 BY: TCL
SUBJECT: BLDG 700

FRAME AT LINES D/5-7 (FRAME #3)
RISA-2D column REACTIONS



	DL		SL		W		E	
NODE	X	Y	X	Y	X	Y	X	Y
N1	–	8.1	–	5.1	1.0	-0.6	2.8	6.4
N2	–	18.8	–	15.0	0.4	-8.4	1.0	4.1
N3	–	18.4	–	14.7	0.3	-6.4	0.9	4.0
N4	–	16.6	–	12.9	0.3	-5.3	0.9	4.6
N5	–	14.5	–	10.9	0.3	-8.2	1.0	-6.6
N6	–	17.3	–	13.9	0.3	6.8	0.8	40.4
N7	–	13.5	–	6.1	7.3	-13.5	20.6	-28.1

FOOTING FOR FRAME #3

ENERCALC OUTPUT : USE 3'-0" WIDE X 24" DEEP CONTINUOUS FTG (W/3'-0" OVERHANG AT EACH END

USE (7) INSTEAD OF (6)
W/(6) #6 AT 6" OC T & B LONGITUDINAL
(130) # 6 AT 12" OC T & B TRANSVERSE

CHECK OVERALL STABILITY (QE) (W)

UPLIFT = 1.1 + 6.6 + 28.1 = 35.8 K 49.2

DEAD WEIGHT = 8.1 + 12.6 + 18.4 + 16.6 + 14.5 + 17.3 + 13.5 = 107.2 K

WALL + FTG WEIGHT = (8/2)(2')(131)(0.15) + (131)(2)(3)(0.15) = 149.5 (26.2, 123.3)

SOIL WEIGHT = (131)(2-1)(3 - 8/12)(110)/10^3 = 28.8

7" SOG WEIGHT = (7/12)(131)(3/2 - 10/24)(0.15) = 12.4

Σ = 297.9 K

F.O.S. AGAINST UPLIFT = $\frac{(0.6)(297.9)}{35.8\ (QE)\ (49.2)\ W}$ = 5.0 (QE) (3.6) W ≥ 1.50 OK

SLIDING

TOTAL HORIZONTAL LOADS = 2.8 + 1.0 + 0.9 + 0.9 + 1.0 + 0.8 + 20.6 = 28.0

SLIDING RESISTANCE = (297.9)(0.35) = 104.3 K

F.O.S. AGAINST SLIDING = $\frac{104.3}{28}$ = 3.7 ≥ 1.0 OK

OVERTURNING

M_R = (297.9)(3/2) = 446.9 K'

M_{OT} = (28.0)(4') = 112 K'

F.O.S. AGAINST OVERTURNING = $\frac{(0.6)(446.9)}{112}$ = 2.4 ≥ 1.0 OK

OVERALL STABILITY CHECK IS SATISFACTORY.

~~24~~
29

Beam on Elastic Foundation

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for Frame #3 Columns

CODE REFERENCES ACI 318-14

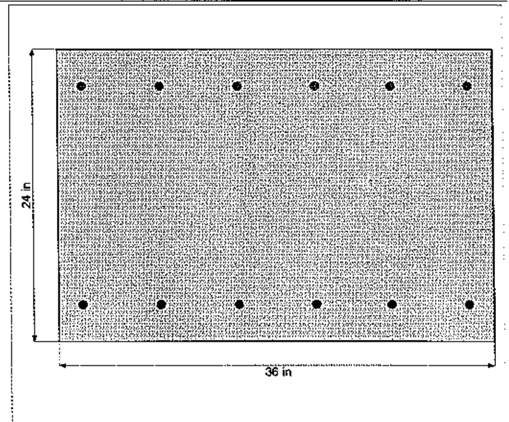
Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE7-16
Load Combinations Used : IBC 2015, IBC 2018

Material Properties

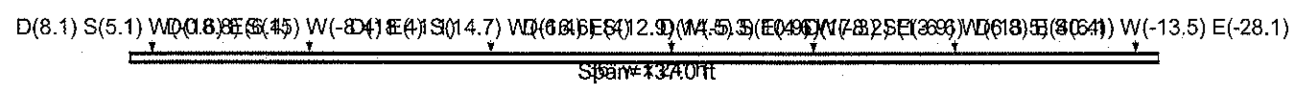
f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

Soil Subgrade Modulus = 250.0 psi / (inch deflection)
Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2



Beam is supported on an elastic foundation.



Cross Section & Reinforcing Details

Rectangular Section, Width = 36.0 in, Height = 24.0 in
Span #1 Reinforcing....
6-#6 at 3.0 in from Bottom, from 0.0 to 137.0 ft in this span
6-#6 at 3.0 in from Top, from 0.0 to 137.0 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

Point Load : D = 8.10, S = 5.10, W = -0.60, E = 6.40 k @ 3.0 ft
Point Load : D = 18.80, S = 15.0, W = -8.40, E = -1.10 k @ 24.0 ft
Point Load : D = 18.40, S = 14.70, W = -6.40, E = 4.0 k @ 48.0 ft
Point Load : D = 16.60, S = 12.90, W = -5.30, E = 4.60 k @ 72.0 ft
Point Load : D = 14.50, S = 10.90, W = -8.20, E = -6.60 k @ 91.0 ft
Point Load : D = 17.30, S = 13.90, W = 6.80, E = 40.40 k @ 110.0 ft
Point Load : D = 13.50, S = 6.10, W = -13.50, E = -28.10 k @ 134.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.749 : 1	Maximum Deflection	
Section used for this span	Typical Section	Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	181.503 k-ft	Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	242.435 k-ft	Max Downward Total Deflection	0.063 in
Load Combination	+1.401D+0.50L+0.70S+2.0E	Max Upward Total Deflection	-3.673 in
Location of maximum on span	##.### ft		
Span # where maximum occurs	Span # 1		

< 3.0ksf

Maximum Soil Pressure = 2.264 ksf at 108.08 ft

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	##.###	181.50	242.44	0.75
+1.40D+1.60H					

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FRAMES AT LINE B/1-7 & C/1-7 (FRAME #4 & #5)

PORTAL FRAMES

DESIGN LOADS:

DEAD LOAD : $w_{DL} = (12 + 8 PSF)(44')/10^3 = 0.88 K/'$

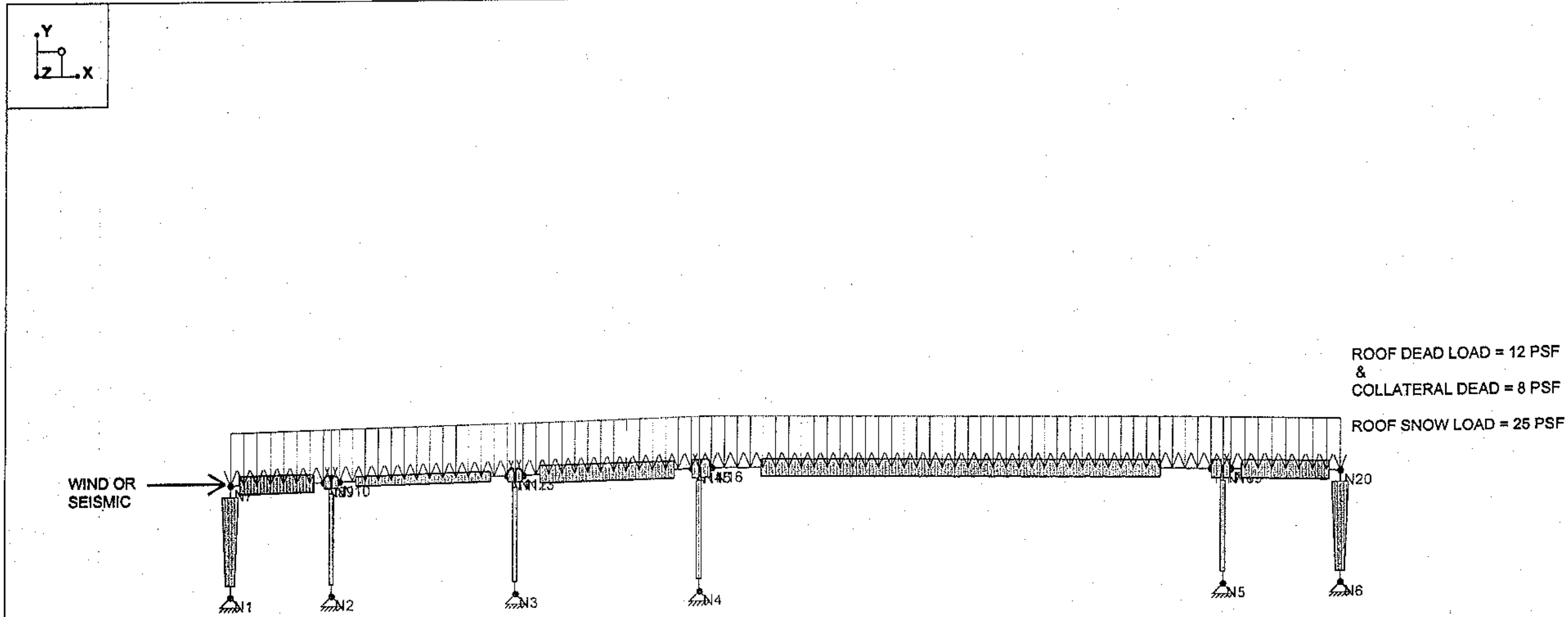
SNOW LOAD $w_{SL} = (25 PSF)(44)/10^3 = 1.10 K/'$

LATERAL LOAD

SEISMIC LOAD : $QE = 72.5^K$ SAY 73.5^K FOR FRAME ~~ANALYSIS~~

WIND LOAD $F_W = 1.13 K/'$ & WIND UPLIFT (NET) 0.22 K/'

SEE RISA-2D FOR OUTPUTS.



PORTAL FRAME COLUMN REACTIONS								
COLUMN LOCATION	DEAD LOAD		SNOW LOAD		WIND LOAD*		SEISMIC LOAD*	
	F_H (KIPS)	F_V (KIPS)	F_H (KIPS)	F_V (KIPS)	F_H (KIPS)	F_V (KIPS)	F_H (KIPS)	F_V (KIPS)
N1 = B/1, C/1	-1.6	15.6	-1.6	4.4	-25.1	-8.7	-56.5	-60.5
N2 =B/2, C/2	0.0	66.8	0.0	62.4	0.0	-4.3	0.0	77.6
N3 = B/3, C/3	0.0	28.7	0.0	26.8	0.0	-5.9	0.0	1.9
N4 = B/4, C/4	0.0	156.1	0.0	144.7	0.0	-28.8	0.0	29.5
N5 = B/6, C/6	0.0	182.6	0.0	168.4	0.0	-44.4	0.0	-21.3
N6 = B/7, C/7	1.8	-34.9	1.8	-43.1	-10.4	19.2	-51.0	48.3

NOTES:
1. WIND AND SEISMIC LOADS ARE SPECIFIED AT STRENGTH LEVEL PER ASCE 7-16.
2. F_H = HORIZONTAL LOAD; - F_H: NEGATIVE SIGN INDICATES THE LOAD IS IN OPPOSITE DIRECTION OF X-AXIS
3. F_V = VERTICAL LOAD; - F_V: NEGATIVE SIGN INDICATES THE LOAD IS IN UPWARD DIRECTION (UPLIFT)
4. WIND LOAD* PER CODE. WIND SPEED, $V_{ULTIMATE}$ = 110 MPH, WIND EXPOSURE C
5. SEISMIC LOAD* PER CODE. S_{DS} = 1.004, R = 3.25, SEISMIC SHEAR, V = C_S W = 0.3089 W (W = SEISMIC WEIGHT)

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PSM #18188-003		AUG14, 2019 AT1:16 PM

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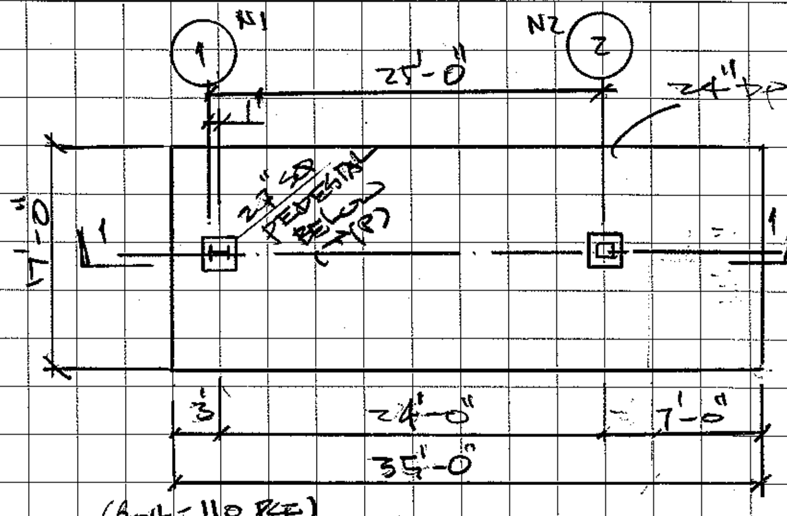
FRAME #4
COLS AT GRIDLINE (B), (C)

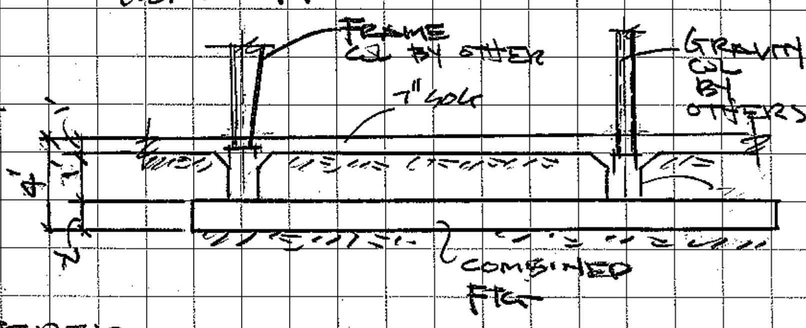
FRAME COL AT (B)/(1)
MAX UPWARD LOAD = 60.5^K

MAX HORIZONTAL SHEAR = 56.5^K



DEAD WEIGHTS :-	
GRAVITY COL	= 66.8
FRAME COL. DEAD	= 15.6
27" SQ X 2'-3" HIGH PEDESTAL	= 3.4
1' DEEP SOIL BELOW SOG	= 64.6
FTG	= 178.5
7" SOG	= 51.3
	Σ = 380.2^K

(SOIL = 110 PCF)



SECTION 1-1

OVERALL STABILITY CHECK
AS PER SOIL REPORT, THE GROUNDWATER IS ENCOUNTERED AT A DEPTH OF BETWEEN 8' & 11' AT EACH OF THE EXPLORATION LOCATIONS
BUOYANCE FORCE WILL NOT CONSIDER AT BOTTOM OF FOOTING WHERE IS LOCATED AT 5'-7" BELOW TOP OF SLAB-ON-GRADE.

UPLIFT
UPLIFT RESISTANCE, FR = 380.2^K
UPLIFT FORCE F = 60.5^K
F.O.S. AGAINST UPLIFT = (0.6)FR/F = (0.6)(380.2)/60.5
= 3.77 > 1.50 OK

SLIDING
SLIDING RESISTANCE, SR = (380.2^K)(0.35) = 133.1
SLIDING FORCE, S = 56.5^K
F.O.S AGAINST SLIDING = 133.1/56.5 = 2.36 > 1.0^K OK

OVERTURNING
MOMENT RESISTANCE, MR = (380.2)(17/2) = 3231.7 K'
OVERTURNING MOMENT, MOT = (56.5)(4) = 226 K'
F.O.S. AGAINST OVERTURNING = (0.6)(3231.7)/226 = 8.6 > 1.0 OK
HENCE, OVERALL STABILITY ON COMBINED FOOTING IS SATISFACTORY.

33

Beam on Elastic Foundation

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

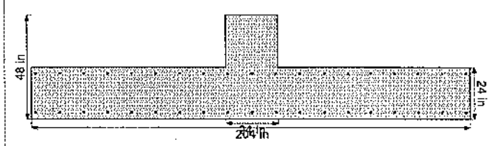
Description : Check combined footing for frame col at B/1 & gravity col at B/2 (C/1 & C/2, Similar) with grade beam between the concrete pedestals

CODE REFERENCES ACI 318-14

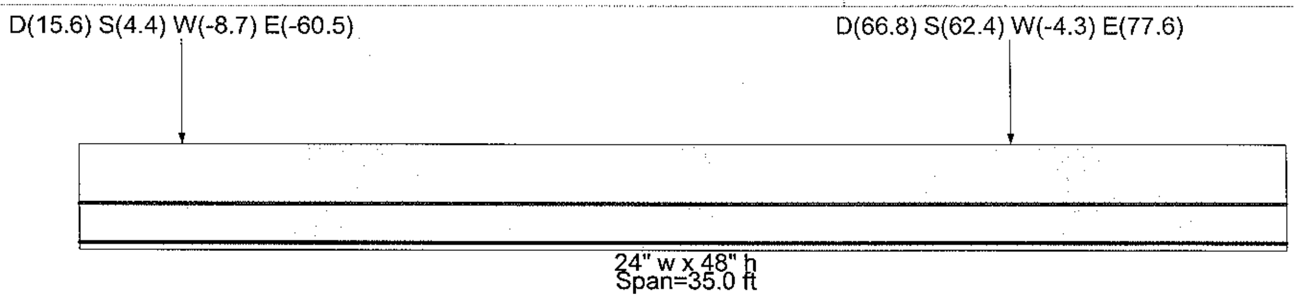
Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015, IBC 2018

Material Properties

f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
fr = $f'c^{1/2}$ * 7.50	=	410.792 psi		Shear :	0.750
Ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			
Soil Subgrade Modulus	=	250.0 psi / (inch deflection)			
Load Combination IBC 2015					
fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2



Beam is supported on an elastic foundation.



Cross Section & Reinforcing Details

Inverted Tee Section, Stem Width = 24.0 in, Total Height = 48.0 in, Top Flange Width = 204.0 in, Flange Thickness = 24.0 in
Span #1 Reinforcing....
19-#7 at 3.0 in from Bottom, from 0.0 to 35.0 ft in this span   19-#7 at 21.0 in from Bottom, from 0.0 to 35.0 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Point Load : D = 15.60, S = 4.40, W = -8.70, E = -60.50 k @ 3.0 ft
Point Load : D = 66.80, S = 62.40, W = -4.30, E = 77.60 k @ 27.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.239 : 1	Maximum Deflection	
Section used for this span	Typical Section	Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	563.97 k-ft	Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	2,363.91 k-ft	Max Downward Total Deflection	0.057 in
Load Combination	+1.401D+0.50L+0.70S+2.0E	Max Upward Total Deflection	-0.385 in
Location of maximum on span	27.176 ft		
Span # where maximum occurs	Span # 1		

< 3.0ksf ok

Maximum Soil Pressure = **2.060 ksf** at 35.00 ft

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	27.176	563.97	2,363.91	0.24
+1.40D+1.60H					
Span # 1	1	27.176	171.12	2,363.91	0.07
+1.20D+0.50Lr+1.60L+1.60H					
Span # 1	1	27.176	146.67	2,363.91	0.06
+1.20D+1.60L+0.50S+1.60H					
Span # 1	1	27.176	204.65	2,363.91	0.09
+1.20D+1.60Lr+0.50L+1.60H					

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Combined Footing

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Bldg Frame Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Combined Footing for Frame Col B/1 & Gravity Col B/2 (Footing for C/1 & C/2, Similar)

Code References ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10 , ASCE 7-16
Load Combinations Used : IBC 2015 , IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength	3	ksi
fy : Rebar Yield	60	ksi
Ec : Concrete Elastic Modulus	3122	ksi
Concrete Density	145	pcf
ϕ : Phi Values — Flexure :	0.9	
Shear :	0.75	

Analysis/Design Settings

Calculate footing weight as dead load ?	Yes
Calculate Pedestal weight as dead load ?	No
Min Steel % Bending Reinf (based on 'd')	
Min Allow % Temp Reinf (based on thick)	0.0018
Min. Overturning Safety Factor	1 : 1
Min. Sliding Safety Factor	1 : 1

Soil Information

Allowable Soil Bearing	3.0	ksf
Increase Bearing By Footing Weight	No	
Soil Passive Sliding Resistance *(Uses entry for "Footing base depth below soil surface" for force)*	250	pcf
Coefficient of Soil/Concrete Friction	0.350	

Soil Bearing Increase

Footing base depth below soil surface	5.0 ft
Increases based on footing Depth	
Allowable pressure increase per foot	ksf
when base of footing is below	ft
Increases based on footing Width . . .	
Allowable pressure increase per foot	ksf
when maximum length or width is greater than	ft
Maximum Allowed Bearing Pressure *(A value of zero implies no limit)*	10 ksf
Adjusted Allowable Soil Bearing *(Allowable Soil Bearing adjusted for footing weight and depth & width increases as specified by user.)*	3.0 ksf

Dimensions & Reinforcing

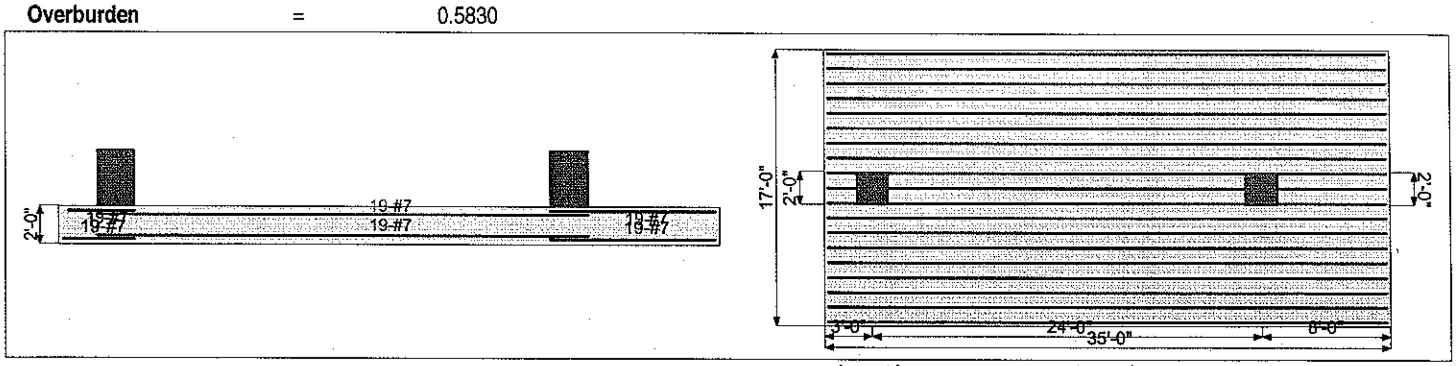
Distance Left of Column #1 =	3.0 ft	
Between Columns =	24.0 ft	
Distance Right of Column #2 =	8.0 ft	
Total Footing Length =	35.0 ft	
Footing Width =	17.0 ft	
Footing Thickness =	24.0 in	
Rebar Center to Concrete Edge @ Top =	3 in	
Rebar Center to Concrete Edge @ Bottom =	3 in	

Pedestal dimensions...	Col #1	Col #2
Sq. Dim. =	24.0	24.0 in
Height =	36.0	36.0 in

	Count	Size #	As Actual	As Req'd
Bars left of Col #1				
Bottom Bars	19.0	7	11.40	8.813 in^2
Top Bars	19.0	7	11.40	0.0 in^2
Bars Btwn Cols				
Bottom Bars	19.0	7	11.40	8.813 in^2
Top Bars	19.0	7	11.40	8.813 in^2
Bars Right of Col #2				
Bottom Bars	19.0	7	11.40	8.813 in^2
Top Bars	19.0	7	11.40	8.813 in^2

Applied Loads

		D	Lr	L	S	W	E	H	
Applied @ Left Column									
Axial Load Downward	=	15.60			4.40	-8.70	-60.50		k
Moment (+CW)	=								k-ft
Shear (+X)	=	-1.60			-1.60	-25.10	-56.50		k
Applied @ Right Column									
Axial Load Downward	=	66.80			62.40	-4.30	77.60		k
Moment (+CW)	=								k-ft
Shear (+X)	=								k
Overburden	=	0.5830							



USE 17'-0" WIDE X 35'-0" LONG X 24" DEEP
W/(19) #7 AT 11" OC T&B LONGITUDINAL
W/(26) #6 AT 11.84" OC T&B TRANSVERSE

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Combined Footing

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Bldg Frame Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Combined Footing for Frame Col B/1 & Gravity Col B/2 (Footing for C/1 & C/2, Similar)

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	2.689	Overturning	2,710.40 k-ft	7,287.68 k-ft	+0.60D+1.40E+0.60H
PASS	2.604	Sliding	-80.060 k	208.464 k	+0.60D+1.40E+0.60H
PASS	6.885	Uplift	84.70 k	583.17 k	+0.60D+1.40E+0.60H

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.6599	Soil Bearing	1.980 ksf	3.0 ksf	+D+0.750L+0.750S+1.050E+H
PASS	0.2279	1-way Shear - Col #1	18.725 psi	82.158 psi	+1.401D+0.50L+0.70S-2.0E+1.60H
PASS	0.3038	1-way Shear - Col #2	24.962 psi	82.158 psi	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.1976	2-way Punching - Col #1	32.476 psi	164.317 psi	+1.401D+0.50L+0.70S-2.0E+1.60H
PASS	0.2131	2-way Punching - Col #2	35.009 psi	164.317 psi	+1.401D+0.50L+0.70S-2.0E+1.60H
PASS	0.02084	Flexure - Left of Col #1 - Top	-21.749 k-ft	1,043.57 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.02079	Flexure - Left of Col #1 - Bottom	21.699 k-ft	1,043.57 k-ft	+0.6992D-2.0E+0.90H
PASS	0.5437	Flexure - Between Cols - Top	-567.44 k-ft	1,043.57 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.4990	Flexure - Between Cols - Bottom	520.73 k-ft	1,043.57 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H
PASS	0.2240	Flexure - Right of Col #2 - Top	-233.787 k-ft	1,043.57 k-ft	+0.6992D-2.0E+0.90H
PASS	0.4851	Flexure - Right of Col #2 - Bottom	506.27 k-ft	1,043.57 k-ft	+1.401D+0.50L+0.70S+2.0E+1.60H

Soil Bearing

Load Combination...	Total Bearing	Eccentricity from Ftg CL	Actual Soil Bearing Stress @ Left Edge	Actual Soil Bearing Stress @ Right Edge	Allowable	Actual / Allow Ratio
+D+H	732.61 k	0.569 ft	1.11 ksf	1.35 ksf	3.00 ksf	0.450
+D+L+H	732.61 k	0.569 ft	1.11 ksf	1.35 ksf	3.00 ksf	0.450
+D+Lr+H	732.61 k	0.569 ft	1.11 ksf	1.35 ksf	3.00 ksf	0.450
+D+S+H	799.41 k	1.173 ft	1.07 ksf	1.61 ksf	3.00 ksf	0.538
+D+0.750Lr+0.750L+H	732.61 k	0.569 ft	1.11 ksf	1.35 ksf	3.00 ksf	0.450
+D+0.750L+0.750S+H	782.71 k	1.032 ft	1.08 ksf	1.55 ksf	3.00 ksf	0.516
+D+0.60W+H	724.81 k	0.542 ft	1.11 ksf	1.33 ksf	3.00 ksf	0.444
+D+1.40E+H	756.55 k	3.016 ft	0.62 ksf	1.93 ksf	3.00 ksf	0.642
+D+0.750Lr+0.750L+0.450W+H	726.76 k	0.548 ft	1.11 ksf	1.34 ksf	3.00 ksf	0.445
+D+0.750L+0.750S+0.450W+H	776.86 k	1.016 ft	1.08 ksf	1.53 ksf	3.00 ksf	0.511
+D+0.750L+0.750S+1.050E+H	800.67 k	2.755 ft	0.71 ksf	1.98 ksf	3.00 ksf	0.660
+0.60D+0.60W+0.60H	485.94 k	0.469 ft	0.75 ksf	0.88 ksf	3.00 ksf	0.294
+0.60D+1.40E+0.60H	517.68 k	4.089 ft	0.26 ksf	1.48 ksf	3.00 ksf	0.493

Overturning Stability

Load Combination...	Moments about Left Edge k-ft Overturning	Resisting	Ratio	Moments about Right Edge k-ft Overturning	Resisting	Ratio
+D+H	8.00	10,870.55	999.000	0.00	0.00	999.000
+D+L+H	8.00	10,870.55	999.000	0.00	0.00	999.000
+D+Lr+H	8.00	10,870.55	999.000	0.00	0.00	999.000
+D+S+H	16.00	12,568.55	785.535	0.00	0.00	999.000
+D+0.750Lr+0.750L+H	8.00	10,870.55	999.000	0.00	0.00	999.000
+D+0.750L+0.750S+H	14.00	12,144.05	867.432	0.00	0.00	999.000
+D+0.60W+H	168.62	10,870.55	64.468	187.68	10,113.73	53.888
+D+1.40E+H	657.60	13,803.83	20.991	2,710.40	11,303.05	4.170
+D+0.750Lr+0.750L+0.450W+H	128.47	10,870.55	84.619	140.76	10,094.91	71.717
+D+0.750L+0.750S+0.450W+H	134.47	12,144.05	90.314	140.76	10,580.91	75.170
+D+0.750L+0.750S+1.050E+H	501.20	14,344.01	28.619	2,032.80	11,472.90	5.644
+0.60D+0.60W+0.60H	165.42	6,522.33	39.429	187.68	6,098.36	32.493
+0.60D+1.40E+0.60H	654.40	9,455.61	14.449	2,710.40	7,287.68	2.689

Sliding Stability

Load Combination...	Sliding Force	Resisting Force	Sliding SafetyRatio
+D+H	-1.60 k	310.81 k	194.255
+D+L+H	-1.60 k	310.81 k	194.255
+D+Lr+H	-1.60 k	310.81 k	194.255
+D+S+H	-3.20 k	334.19 k	104.434
+D+0.750Lr+0.750L+H	-1.60 k	310.81 k	194.255
+D+0.750L+0.750S+H	-2.80 k	328.34 k	117.265

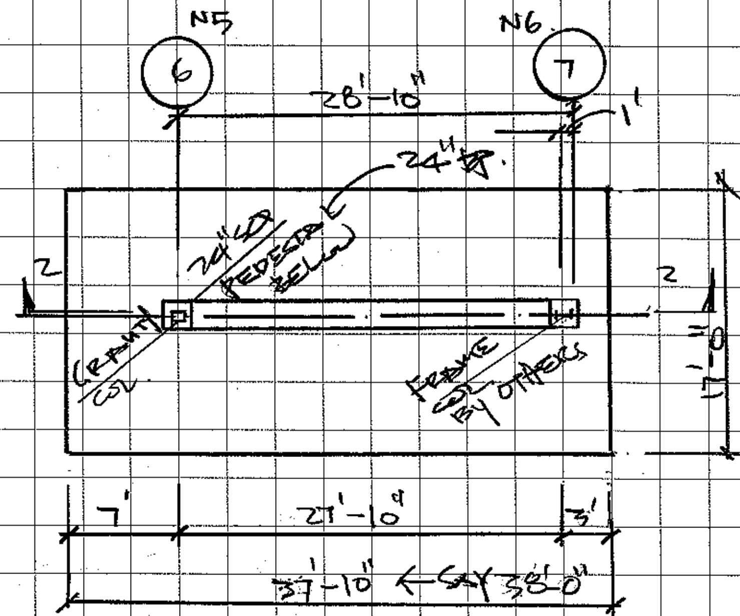
FRAME #5

COLS AT GRIDLINES (B) & (C)

FRAME COL AT (B)/(7)

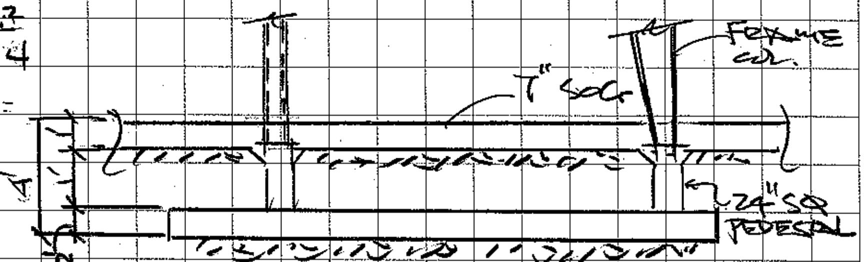
MAX UPWARD LOAD = ± 48.3^K
34.9^K

MAX HORIZONTAL SHEAR = 51^K



DEAD WEIGHT -

GRAVITY COL	= 182.6
FRAME COL	= –
27" SQ PEDESTAL	= 3.4
1' DEEP SOIL BELOW SOG	= 70.2
FTG	= 193.0
7" SOG	= 56.2
	Σ = 505.4



THE GROUNDWATER INFO - SEE PREVIOUS PAGE & SOIL REPORT.
NO BUOYANCY FORCE BELOW BOTTOM OF FTG AT 6'-1" BELOW TOP OF SOG

UPLIFT

UPLIFT RESISTANCE, FR = 505.4^K
UPLIFT FORCE, F = 48.3 + 34.9 = 83.2^K
F.O.S AGAINST UPLIFT = (0.6)(505.4)/83.2
= 3.64 ≥ 1.50 OK

SLIDING

SLIDING RESISTANCE, SR = 505.4 (0.35) = 176.9^K
SLIDING FORCE, S = 51^K
F.O.S AGAINST SLIDING = 176.9/51 = 3.47 ≥ 1.0 OK

OVERTURNING

MOMENT RESISTANCE, MR = (505.4)(17/2) = 4296 K'
OVERTURNING MOMENT, MOT = (51)(4) = 204 K'
F.O.S AGAINST OVERTURNING = (4296.0)(0.6)/204 = 12.6 ≥ 1.5 OK
HENCE, OVERALL STABILITY OF COMBINED FTG IS SATISFACTORY.

TS
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Beam on Elastic Foundation

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ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Check combined footing for frame col at B/7 & gravity col at B/6 (C/7 & C/6, Similar) with grade beam between the concrete pedestals

CODE REFERENCES ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015, IBC 2018

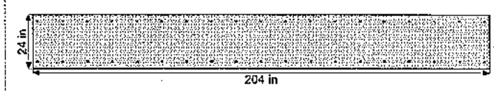
Material Properties

f'c	=	3.0 ksi	φ Phi Values	Flexure :	0.90
fr = $f'c^{1/2}$ * 7.50	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

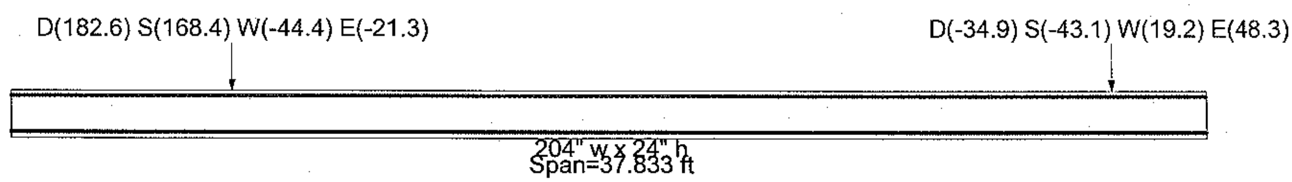
Soil Subgrade Modulus = 250.0 psi / (inch deflection)

Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2



Beam is supported on an elastic foundation.



Cross Section & Reinforcing Details

Rectangular Section, Width = 204.0 in, Height = 24.0 in
Span #1 Reinforcing....
19-#7 at 3.0 in from Bottom, from 0.0 to 37.833 ft in this span
19-#7 at 3.0 in from Top, from 0.0 to 37.833 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Point Load : D = 182.60, S = 168.40, W = -44.40, E = -21.30 k @ 7.0 ft
Point Load : D = -34.90, S = -43.10, W = 19.20, E = 48.30 k @ 34.833 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.757 : 1	Maximum Deflection	
Section used for this span	Typical Section	Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	814.93 k-ft	Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	1,076.59 k-ft	Max Downward Total Deflection	0.058 in
Load Combination	+1.20D+1.60S-0.50W+1.60H	Max Upward Total Deflection	-0.285 in
Location of maximum on span	7.122 ft		
Span # where maximum occurs	Span # 1		
Maximum Soil Pressure =	2.076 ksf at 6.31 ft		

USE 17'-0" WIDE x 38'-0" LONG x 24" DEEP
W/ (19) #7 AT 11" OC T & B LONGITUDINAL
(39) #6 AT 11 3/4" OC T & B TRANSVERSE
~~USE PEDESTAL 2'-3" SQ &~~
27" THICK INFILL WALL BTWN PEDESTALS
PEDESTAL: W/(8) #9 VERT & TIES #4 AT 4" oc
3" oc (SKY)

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	7.122	814.93	1,076.59	0.76
+1.40D+1.60H					
Span # 1	1	7.122	408.00	1,076.59	0.38
+1.20D+0.50Lr+1.60L+1.60H					
Span # 1	1	7.122	349.71	1,076.59	0.32
+1.20D+1.60L+0.50S+1.60H					
Span # 1	1	7.122	484.03	1,076.59	0.45
+1.20D+1.60Lr+0.50L+1.60H					

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Combined Footing

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ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Combined Footing for Frame Col B/7 & Gravity Col B/6 (Footing for C/7 & C/6, Similar)

Code References ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10 , ASCE 7-16
Load Combinations Used : IBC 2015 , IBC 2018

General Information

Material Properties

f'c : Concrete 28 day strength		3 ksi
fy : Rebar Yield		60 ksi
Ec : Concrete Elastic Modulus		3122 ksi
Concrete Density		145 pcf
ϕ : Phi Values	Flexure :	0.9
	Shear :	0.75

Analysis/Design Settings

Calculate footing weight as dead load ?	Yes
Calculate Pedestal weight as dead load ?	No
Min Steel % Bending Reinf (based on 'd')	
Min Allow % Temp Reinf (based on thick)	0.0018
Min. Overturning Safety Factor	1 : 1
Min. Sliding Safety Factor	1 : 1

Soil Information

Allowable Soil Bearing	3 ksf
Increase Bearing By Footing Weight	No
Soil Passive Sliding Resistance	250 pcf
(Uses entry for "Footing base depth below soil surface" for force)	
Coefficient of Soil/Concrete Friction	0.350

Soil Bearing Increase

Footing base depth below soil surface	5.0 ft
Increases based on footing Depth	
Allowable pressure increase per foot	ksf
when base of footing is below	ft
Increases based on footing Width . . .	
Allowable pressure increase per foot	ksf
when maximum length or width is greater than	ft
Maximum Allowed Bearing Pressure	10 ksf
(A value of zero implies no limit)	
Adjusted Allowable Soil Bearing	3.0 ksf
(Allowable Soil Bearing adjusted for footing weight and depth & width increases as specified by user.)	

Dimensions & Reinforcing

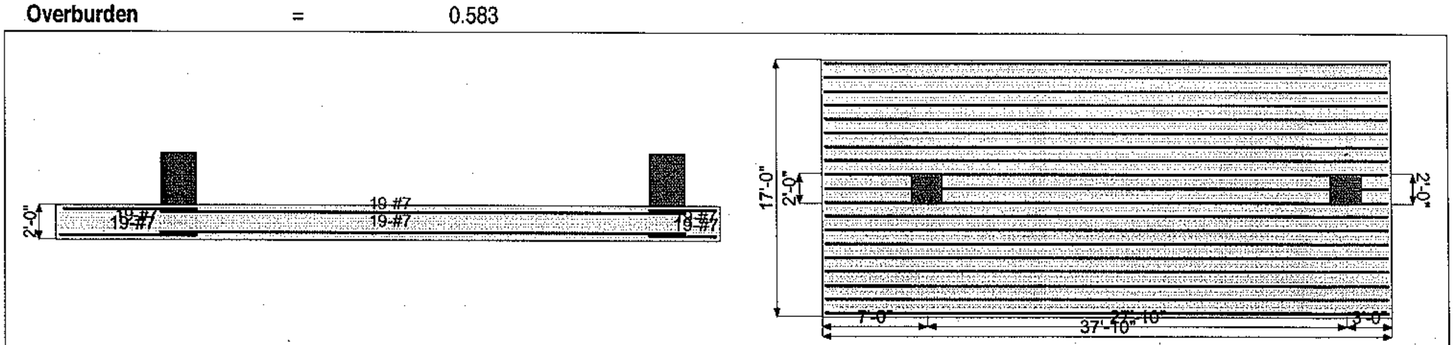
Distance Left of Column #1	=	7.0 ft
Between Columns	=	27.833 ft
Distance Right of Column #2	=	3.0 ft
Total Footing Length	=	37.833 ft
Footing Width	=	17.0 ft
Footing Thickness	=	24.0 in
Rebar Center to Concrete Edge @ Top	=	3 in
Rebar Center to Concrete Edge @ Bottom	=	3 in

Pedestal dimensions...		Col #1	Col #2
Sq. Dim.	=	24	24 in
Height	=	36	36 in

	Count	Size #	As Actual	As Req'd
Bars left of Col #1				
Bottom Bars	19.0	7	11.40	8.813 in^2
Top Bars	19.0	7	11.40	0.0 in^2
Bars Btwn Cols				
Bottom Bars	19.0	7	11.40	10.470 in^2
Top Bars	19.0	7	11.40	8.813 in^2
Bars Right of Col #2				
Bottom Bars	19.0	7	11.40	8.813 in^2
Top Bars	19.0	7	11.40	8.813 in^2

Applied Loads

		D	Lr	L	S	W	E	H	
Applied @ Left Column									
Axial Load Downward	=	182.60			168.30	-44.40	-21.30		k
Moment (+CW)	=								k-ft
Shear (+X)	=								k
Applied @ Right Column									
Axial Load Downward	=	-34.90			-43.10	19.20	48.30		k
Moment (+CW)	=								k-ft
Shear (+X)	=	1.80			1.80	-10.40	-51.0		k
Overburden	=	0.583							



Combined Footing

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ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 | Licensee : PETERSON-STREHLE-MARTINSON, INC

Description : Combined Footing for Frame Col B/7 & Gravity Col B/6 (Footing for C/7 & C/6, Similar)

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	4.784	Overturning	2,716.97 k-ft	12,998.0 k-ft	+D+S+H
PASS	3.402	Sliding	-70.320 k	239.195 k	+0.60D+1.40E+0.60H
PASS	12.210	Uplift	47.580 k	580.93 k	+0.60D+0.60W+0.60H

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9502	Soil Bearing	2.851 ksf	3.0 ksf	+D+S+H
PASS	0.4808	1-way Shear - Col #1	39.502 psi	82.158 psi	+1.20D+1.60S-0.50W+1.60H
PASS	0.1930	1-way Shear - Col #2	15.853 psi	82.158 psi	+1.401D+0.50L+0.70S-2.0E+1.60H
PASS	0.7598	2-way Punching - Col #1	124.846 psi	164.317 psi	+1.20D+1.60S-0.50W+1.60H
PASS	0.8260	2-way Punching - Col #2	135.727 psi	164.317 psi	+1.20D+1.60S-0.50W+1.60H
PASS	No Bending	Flexure - Left of Col #1 - Top	0.0 k-ft	0.0 k-ft	N/A
PASS	0.680	Flexure - Left of Col #1 - Bottom	709.67 k-ft	1,043.57 k-ft	+1.20D+1.60S-0.50W+1.60H
PASS	0.4972	Flexure - Between Cols - Top	-518.91 k-ft	1,043.57 k-ft	+1.401D+0.50L+0.70S-2.0E+1.60H
PASS	0.6957	Flexure - Between Cols - Bottom	726.05 k-ft	1,043.57 k-ft	+1.20D+1.60S-0.50W+1.60H
PASS	0.04391	Flexure - Right of Col #2 - Top	-45.819 k-ft	1,043.57 k-ft	+1.401D+0.50L+0.70S-2.0E+1.60H
PASS	0.004708	Flexure - Right of Col #2 - Bottom	4.913 k-ft	1,043.57 k-ft	+0.6992D+2.0E+0.90H

Soil Bearing

Load Combination...	Total Bearing	Eccentricity from Ftg CL	Actual Soil Bearing Stress @ Left Edge	Actual Soil Bearing Stress @ Right Edge	Allowable	Actual / Allow Ratio
+D+H	851.07 k	-3.214 ft	2.00 ksf	0.65 ksf	3.00 ksf	0.665
+D+L+H	851.07 k	-3.214 ft	2.00 ksf	0.65 ksf	3.00 ksf	0.665
+D+Lr+H	851.07 k	-3.214 ft	2.00 ksf	0.65 ksf	3.00 ksf	0.665
+D+S+H	976.27 k	-5.550 ft	2.85 ksf	0.19 ksf	3.00 ksf	0.950
+D+0.750Lr+0.750L+H	851.07 k	-3.214 ft	2.00 ksf	0.65 ksf	3.00 ksf	0.665
+D+0.750L+0.750S+H	944.97 k	-5.024 ft	2.64 ksf	0.30 ksf	3.00 ksf	0.879
+D+0.60W+H	835.95 k	-2.711 ft	1.86 ksf	0.74 ksf	3.00 ksf	0.619
+D+1.40E+H	888.87 k	-1.868 ft	1.79 ksf	0.97 ksf	3.00 ksf	0.597
+D+0.750Lr+0.750L+0.450W+H	839.73 k	-2.838 ft	1.89 ksf	0.72 ksf	3.00 ksf	0.631
+D+0.750L+0.750S+0.450W+H	933.63 k	-4.708 ft	2.53 ksf	0.37 ksf	3.00 ksf	0.844
+D+0.750L+0.750S+1.050E+H	973.32 k	-4.049 ft	2.48 ksf	0.54 ksf	3.00 ksf	0.828
+0.60D+0.60W+0.60H	554.14 k	-2.117 ft	1.15 ksf	0.57 ksf	3.00 ksf	0.383
+0.60D+1.40E+0.60H	607.06 k	-0.936 ft	1.08 ksf	0.80 ksf	3.00 ksf	0.361

Overturning Stability

Load Combination...	Moments about Left Edge k-ft Overturning	Resisting	Ratio	Moments about Right Edge k-ft Overturning	Resisting	Ratio
+D+H	1,215.67	11,810.87	9.716	113.70	16,172.44	142.238
+D+L+H	1,215.67	11,810.87	9.716	113.70	16,172.44	142.238
+D+Lr+H	1,215.67	11,810.87	9.716	113.70	16,172.44	142.238
+D+S+H	2,716.97	12,997.97	4.784	252.00	21,361.63	84.768
+D+0.750Lr+0.750L+H	1,215.67	11,810.87	9.716	113.70	16,172.44	142.238
+D+0.750L+0.750S+H	2,341.65	12,701.20	5.424	217.43	20,064.33	92.282
+D+0.60W+H	1,433.35	12,212.15	8.520	935.09	16,238.20	17.365
+D+1.40E+H	1,781.41	14,166.28	7.952	1,033.14	16,732.30	16.196
+D+0.750Lr+0.750L+0.450W+H	1,378.93	12,111.83	8.783	729.74	16,221.76	22.229
+D+0.750L+0.750S+0.450W+H	2,504.91	13,002.16	5.191	833.47	20,113.65	24.132
+D+0.750L+0.750S+1.050E+H	2,765.95	14,467.75	5.231	907.01	20,484.23	22.584
+0.60D+0.60W+0.60H	947.08	7,487.80	7.906	889.61	9,769.22	10.981
+0.60D+1.40E+0.60H	1,295.14	9,441.93	7.290	987.66	10,263.32	10.392

Sliding Stability

Load Combination...	Sliding Force	Resisting Force	Sliding SafetyRatio
+D+H	1.80 k	353.94 k	196.634
+D+L+H	1.80 k	353.94 k	196.634
+D+Lr+H	1.80 k	353.94 k	196.634
+D+S+H	3.60 k	397.76 k	110.489
+D+0.750Lr+0.750L+H	1.80 k	353.94 k	196.634
+D+0.750L+0.750S+H	3.15 k	386.81 k	122.796

FOOTING FOR FRAME #6

ENERCALC OUTPUTS : USE 4-3" WIDE X 24" DEEP CONTINUOUS FTG (2' MIN OVERHANG AT EA END (OL)
W/ (8) #6 AT 12" OC T & B LONGITUDINAL
#6 AT 12" OC T & B TRANSVERSE

CHECK OVERALL STABILITY USE b = 4.25' INSTEAD OF 4'

UPLIFT = 58.1

DEAD WEIGHT	= 6.1 + 14.3 + 9.2 (6.9)	= 29.6
WALL + FTG	= (8/12)(34.583)(2')(0.15) + (80')(4.25)(2)(0.15)	= 108.9
SOIL WEIGHT	= (80')(2-1)(4.25/2 - 8/24)(2)(110)/10³	= 31.5
7' SOIL WT	= (7/2)(100')(6.333')(0.19)	= 55.4
	Σ	= 225.4

34.583 + 13.1/3 ADD'L FOR CONT FTG 80
102

F.O.S. AGAINST UPLIFT = (0.6)(225.4)/58.1 = 2.32 ≥ 1.50 OK

SLIDING

SLIDING FORCE = 3.5 + 31.6 + 30.2 = 65.3^K

SLIDING RESISTANCE = (225.4)(0.35) = 78.9^K

F.O.S. AGAINST SLIDING = $\frac{78.9}{65.3}$ = 1.21 ≥ 1.0 OK

OVERTURNING

M_R = (225.4)(4.25/2) = 479 K'

M_{OT} = (65.3)(4) = 261.2K'

F.O.S. AGAINST OVERTURNING = $\frac{(0.6)(479.0)}{261.2}$ = 1.10 ≥ 1.0 OK

OVERALL STABILITY CHECK IS SATISFACTORY.

Beam on Elastic Foundation

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for Frame #6 Columns

CODE REFERENCES ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015, IBC 2018

Material Properties

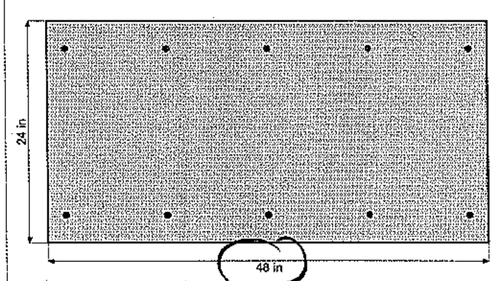
f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

Soil Subgrade Modulus = 250.0 psi / (inch deflection)

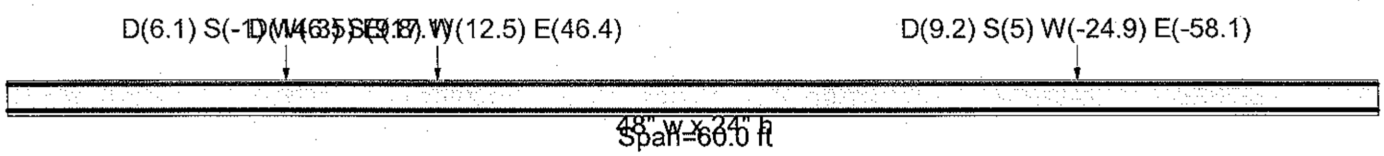
Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2

Beam is supported on an elastic foundation.



USE 51" WIDE FTG AS FTG FOR FRAME #1 & #2



Cross Section & Reinforcing Details

USE (8) #6 T & B CONT (LONGIT) AS FTG FOR FRAME #1 & #2

Rectangular Section, Width = 48.0 in, Height = 24.0 in
Span #1 Reinforcing....
5-#6 at 3.0 in from Bottom, from 0.0 to 60.0 ft in this span
5-#6 at 3.0 in from Top, from 0.0 to 60.0 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads
Point Load : D = 6.10, S = -1.0, W = 6.50, E = 17.10 k @ 12.20 ft
Point Load : D = 14.30, S = 9.80, W = 12.50, E = 46.40 k @ 18.783 ft
Point Load : D = 9.20, S = 5.0, W = -24.90, E = -58.10 k @ 46.783 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.865 : 1	Maximum Deflection	
Section used for this span	Typical Section	Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	183.853 k-ft	Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	212.554 k-ft	Max Downward Total Deflection	0.063 in
Load Combination	+1.401D+0.50L+0.70S-1.50	Max Upward Total Deflection	-3.314 in
Location of maximum on span	46.588 ft		
Span # where maximum occurs	Span # 1		

< 3.0 KSF

Maximum Soil Pressure = 2.269 ksf at 12.67 ft

Maximum Forces & Stresses for Load Combinations

Load Combination / Segment Length	Span #	Location (ft) in Span	Bending Stress Results (k-ft) Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					
Span # 1	1	46.588	183.85	212.55	0.86
+1.40D+1.60H					
Span # 1	1	19.059	32.06	212.55	0.15
+1.20D+0.50Lr+1.60L+1.60H					
Span # 1	1	19.059	27.47	212.55	0.13
+1.20D+1.60L+0.50S+1.60H					
Span # 1	1	19.059	35.77	212.55	0.17

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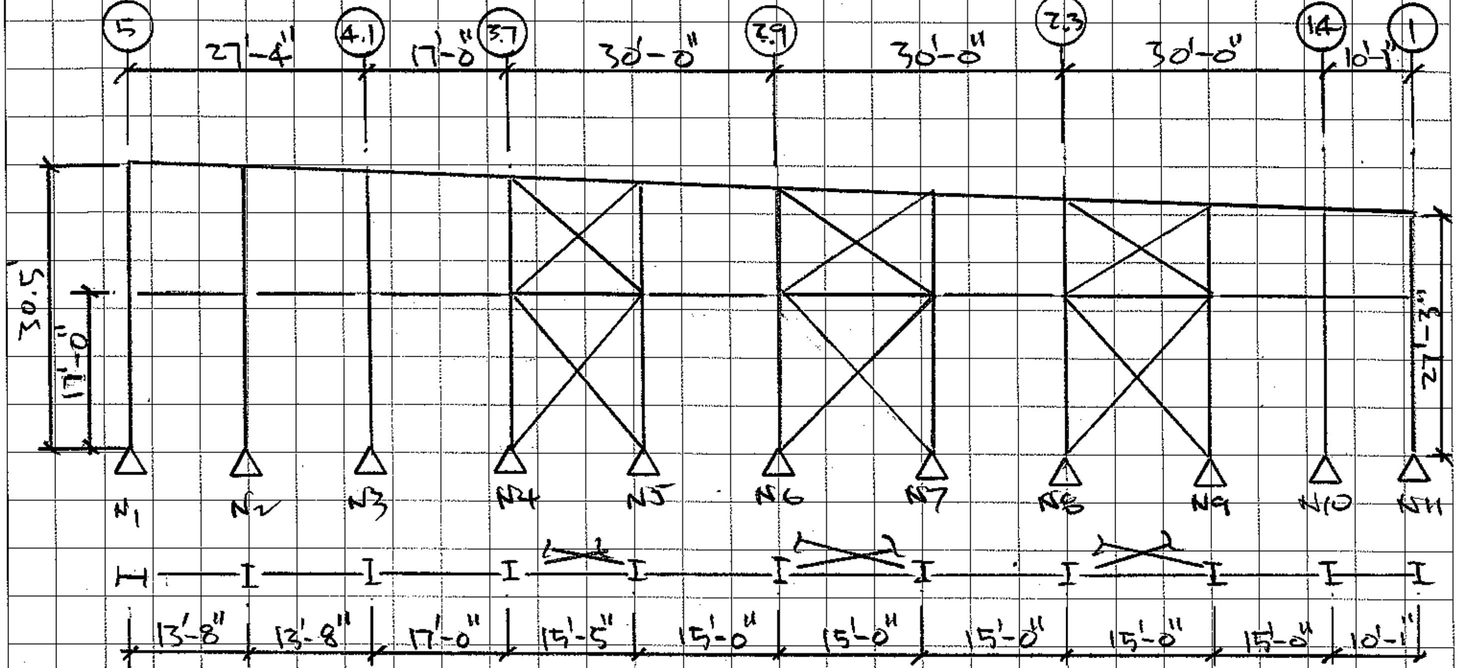
JOB: 18188-003 UPS BFI SEATTLE
DATE: AUG, 19 BY: TCL
SUBJECT: FRAMES AT LINE (E)

FRAMES AT LINES (E)/(1)-(5) (FRAME # 7)



DESIGN LOADS:

(HIGH ROOF) DEAD LOAD : $W_{DLR} = (12+8\ psf)(34.583/2)/10^3 = 0.35\ k/' $ SAY $0.4\ k/'$

SNOW LOAD (HIGH R.) $W_{SL} = (25 psf)(34.583/2)/10^3 = 0.43\ k/'$ SAY $0.5\ k/'$

(LOW ROOF) ~~DEAD~~ LOAD : $W_{DLR} = (12+8\ psf)(50/2)/10^3 = 0.5\ k/'$

$W_{SL} = (25 psf)(50/2)/10^3 = 0.63\ k/'$ SAY $0.7\ k/'$

LATERAL LOAD

SEISMIC LOAD : $Q_E = 87.9^k$ (FRAME (7) IN LINE (E))

$(27.25/2) \leftarrow 14.8^k$

WIND LOAD : $F_W = (25.7\ psf)(34.583+50)(30.5/2)/2\times10^3 = 16.6^k$ ← GOVERNS

$F_W' = (25.7 psf)(18')/10^3 = 0.463\ k/'$ SAY $0.5\ k/'$
(PERPENDICULAR TO LINE (E))

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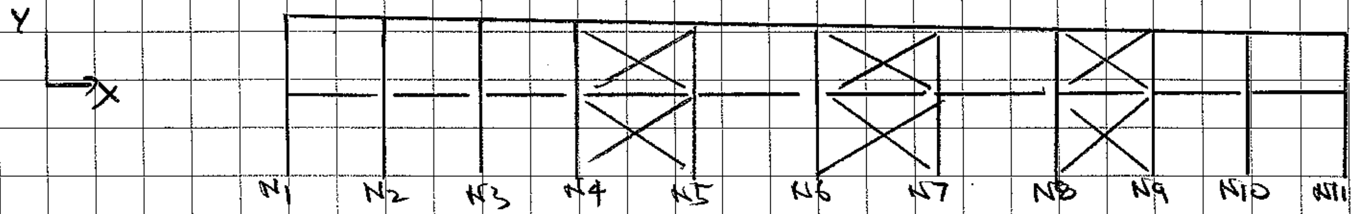
JOB: 18188-003 UPS BFI SEATTLE
DATE: Aug, 19 BY: TCL
SUBJECT: BLDG 100.

FRAME #7 RISA-2D COLUMN REACTIONS: -



	DL		SL		W		E	
NODE	X	Y	X	Y	X	Y	X	Y
N1	0.4	12.5	0.5	6.4	0.1	-1.8	1.8	7.3
N2	–	13.3	–	14.0	–	-6.6	–	-0.6
N3	1.6	18.8	1.5	18.7	2.0	–	14.5	44.7
N4	-1.4	18.5	-1.3	18.1	3.2	-15.0	13.5	-34.9
N5	1.5	18.5	1.4	18.0	2.2	0.2	15.0	45.7
N6	-1.5	18.5	-1.4	18.0	3.4	-15.5	14.4	-37.9
N7	-1.5	19.8	1.4	18.3	2.4	1.3	16.4	52.3
N8	-1.6	19.8	-1.5	19.6	3.7	-48.1	15.8	-47.3
N9	–	17.5	–	18.8	–	-8.7	–	0.1
N10	–	14.5	–	15.2	–	-4.7	–	12.4
N11	-0.5	15.4	-0.6	8.7	-0.4	-5.8	-3.6	-8.0
		Σ=186.1					Σ = 87.8	

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JOB: 18188-003 UPS BFI SEATTLE
DATE: AUG, 19 BY: TCL
SUBJECT: BLDG 100

FOOTING FOR FRAME #7

ENERCALC OUTPUT USE (3'-0" WIDE X 24" DEEP CONTINUOUS FTG
W/ (6) #6 AT 5" OC T & B
LONGITUDINAL
#6 AT 12" OC T & B TRANSVERSE

CHECK OVERALL STABILITY.

UPLIFT = 20.6 + 34.9 + 37.9 + 47.3 + 8.0 = 128.7 K

DEAD WEIGHT = 186.1 = 186.1

WALL + FTG WT = (8/2)(144.833)(2')(0.15) + (3)(148.833)(2)(0.15) = 162.9 (29.0, 133.9)

SOIL WT = 0

7" SOG WT = (7/12)(144.833)(5.0')(0.15) = 63.4

Σ = 412.4

F.O.S AGAINST UPLIFT = $\frac{(0.6)(412.4)}{128.7}$ = 1.92 > 1.50 OK

SLIDING

TOTAL HORIZONTAL LOAD = 1.8 + 14.5 + 13.5 + 15.0 + 14.4 + 16.4 + 15.8 - 3.6
= 87.8

SLIDING RESISTANCE = (412.4)(0.35) = 144.3 K

F.O.S. AGAINST SLIDING = $\frac{144.3}{87.8}$ = 1.64 > 1.0 OK

OVERTURNING

MR = (412.4)(3/2) = 618.6 K'

MOT = (87.8)(4) = 351.2 K'

F.O.S. AGAINST OVERTURNING = (0.6)(618.6)/351.2 = 1.06 > 1.0 OK

OVERALL STABILITY CHECK IS SATISFACTORY

89
45

Beam on Elastic Foundation

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ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for Frame #7 Columns

CODE REFERENCES ACI 318-14

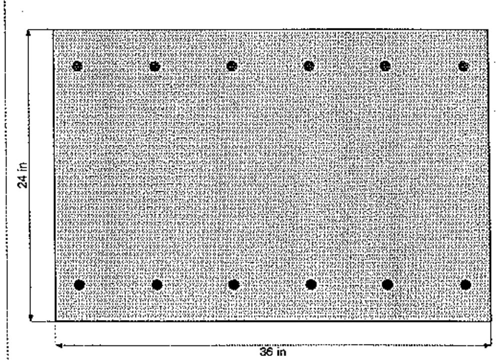
Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10 , ASCE 7-16
Load Combinations Used : IBC 2015 , IBC 2018

Material Properties

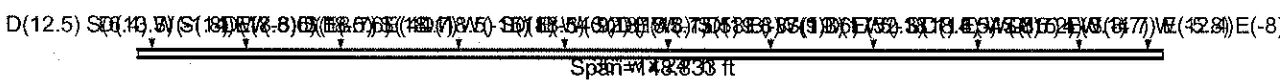
f'c = 3.0 ksi
fr = $f'c^{1/2}$ * 7.50 = 410.792 psi
Ψ Density = 145.0 pcf
λ Lt Wt Factor = 1.0
Elastic Modulus = 3,122.0 ksi
Soil Subgrade Modulus = 250.0 psi / (inch deflection)
Load Combination IBC 2015

φ Phi Values Flexure : 0.90
Shear : 0.750
β_1 = 0.850

fy - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Fy - Stirrups = 40.0 ksi
E - Stirrups = 29,000.0 ksi
Stirrup Bar Size # = # 3
Number of Resisting Legs Per Stirrup 2



Beam is supported on an elastic foundation.



Cross Section & Reinforcing Details

Rectangular Section, Width = 36.0 in, Height = 24.0 in
Span #1 Reinforcing....
6-#7 at 3.0 in from Bottom, from 0.0 to 148.833 ft in this span
6-#7 at 3.0 in from Top, from 0.0 to 148.833 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

Point Load : D = 12.50, S = 6.40, W = -1.80, E = 7.30 k @ 2.0 ft
Point Load : D = 13.30, S = 14.0, W = -6.60, E = -0.60 k @ 15.667 ft
Point Load : D = 18.80, S = 18.70, E = 44.70 k @ 29.334 ft
Point Load : D = 18.50, S = 18.10, W = -15.0, E = -34.90 k @ 46.334 ft
Point Load : D = 18.50, S = 18.0, W = 0.20, E = 45.70 k @ 61.750 ft
Point Load : D = 18.50, S = 18.0, W = -15.50, E = -37.90 k @ 76.750 ft
Point Load : D = 18.80, S = 18.30, W = 1.30, E = 52.30 k @ 91.750 ft
Point Load : D = 19.80, S = 19.60, W = -18.10, E = -47.30 k @ 106.750 ft
Point Load : D = 17.50, S = 18.80, W = -8.70, E = 0.10 k @ 121.750 ft
Point Load : D = 14.50, S = 15.20, W = -4.70, E = 12.40 k @ 136.750 ft
Point Load : D = 15.40, S = 8.70, W = -5.80, E = -8.0 k @ 146.833 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =		0.778 : 1
Section used for this span		**Typical Section**
	Mu : Applied	250.137 k-ft
	Mn * Phi : Allowable	321.606 k-ft
Load Combination		+1.401D+0.50L+0.70S-2.0E
Location of maximum on span		##.### ft
Span # where maximum occurs		Span # 1
Maximum Soil Pressure =		**2.107** ksf at 90.95 ft

< 3.0 ksf

Maximum Deflection	
Max Downward L+Lr+S Deflection	0.000 in
Max Upward L+Lr+S Deflection	0.000 in
Max Downward Total Deflection	0.059 in
Max Upward Total Deflection	-0.510 in

Maximum Forces & Stresses for Load Combinations

~~92~~ 46

Beam on Elastic Foundation

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ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for Frame #8 & #9 Columns

CODE REFERENCES

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2015

Material Properties

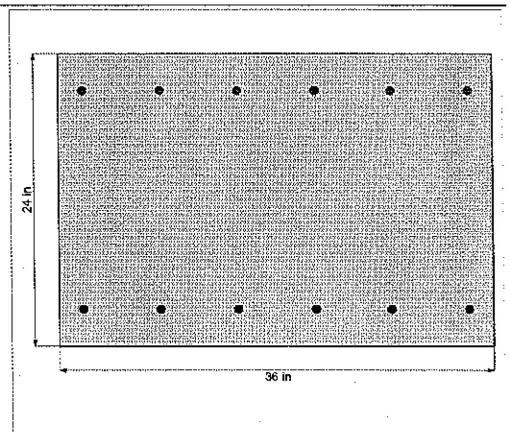
f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

Soil Subgrade Modulus = 250.0 psi / (inch deflection)

Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2

Beam is supported on an elastic foundation.



Cross Section & Reinforcing Details

Rectangular Section, Width = 36.0 in, Height = 24.0 in
Span #1 Reinforcing....
6-#6 at 3.0 in from Bottom, from 0.0 to 285.833 ft in this span
6-#6 at 3.0 in from Top, from 0.0 to 285.833 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

Point Load : D = 12.60, S = 5.30, W = -7.70, E = -32.30 k @ 5.0 ft
Point Load : D = 14.30, S = 10.0, W = 1.50, E = 41.80 k @ 25.0 ft
Point Load : D = 14.10, S = 9.70, W = -5.50, E = -5.0 k @ 40.0 ft
Point Load : D = 14.80, S = 11.0, W = -4.90, E = 2.90 k @ 58.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.80, E = 3.0 k @ 76.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.90, E = 2.70 k @ 94.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.80, E = 2.90 k @ 112.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.90, E = 2.30 k @ 130.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.80, E = 3.0 k @ 148.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.90, E = 2.70 k @ 156.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.80, E = 2.90 k @ 184.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.90, E = 2.30 k @ 202.0 ft
Point Load : D = 45.40, S = 32.80, W = -14.40, E = 2.80 k @ 220.0 ft
Point Load : D = 11.50, S = 7.90, W = -14.70, E = -75.0 k @ 247.130 ft
Point Load : D = 9.70, S = 2.50, W = 10.20, E = 80.0 k @ 267.0 ft

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FRAMES AT LINE (A)/(1) - (7) (FRAME #8 & #9)

WIND COL & PORTAL FRAMES.

DESIGN LOADS

DEAD LOAD : $W_{DL} = (12+8\ psf)(44.083/2)/10^3 = 0.44\ k/'$ SAY $0.5\ k/'$

SNOW LOAD : $W_{SL} = (25\ psf)(44.083/2)/10^3 = 0.55\ k/'$ SAY $0.6\ k/'$

LATERAL LOAD:

SEISMIC LOAD $Q_E = 28^k$ AT FRAME 8 (IN LINE (A))

39^k AT FRAME 9 (IN LINE (A))

WIND LOAD $F_W = (25.7\ psf)(44.083/2)(27.25/2)/10^3 = 7.7^k$ SAY 10^k (IN LINE (A))

$F_W = (25.7\ psf)(18')/10^3 = 0.463\ k/'$ SAY $0.5\ k/'$ (PERPENDICULAR) TO LINE (A)

SEE RISA-2D FOR OUTPUTS

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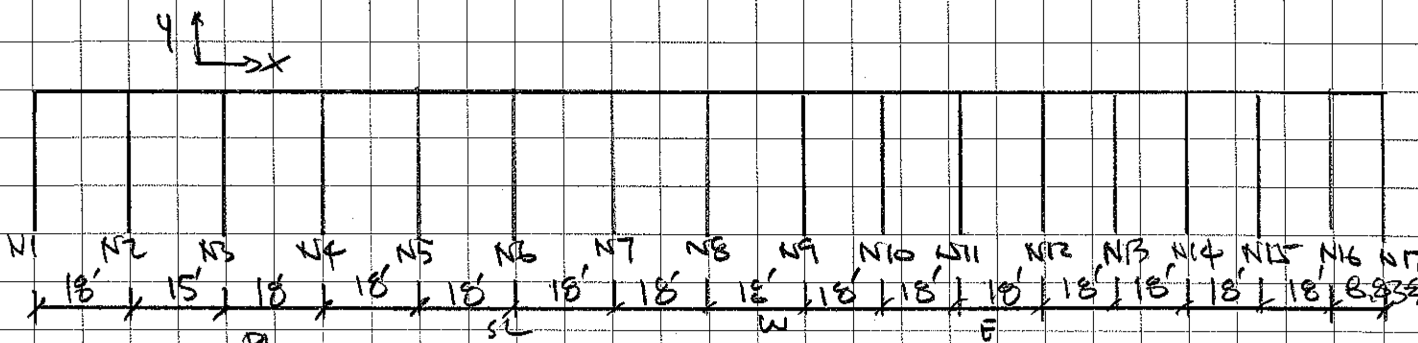
JOB: 18188-003 UPS BFI SEATTLE
DATE: Aug 5, 19 BY: TC
SUBJECT: BLDG 100

FRAME #8 & #9 RISA-2D COLUMN REACTIONS



	DL		SL		W		E	
NODE	X	Y	X	Y	X	Y	X	Y
N1	0.5	12.6	0.4	5.3	-2.9	-7.7	-18.1	-32.3
N2	–	14.3	–	10.0	-0.3	17.5	-1.6	4.8
N3	–	14.1	–	9.7	-0.3	-5.5	-1.7	-5.0
N4	–	14.8	–	11.0	-0.3	-4.9	-1.8	2.9
N5	–	14.6	–	10.8	-0.3	-4.8	-1.8	3.0
N6	–	15.2	–	10.8	-0.3	-4.9	-1.6	2.7
N7	–	15.2	–	10.8	-0.3	-4.8	-1.6	2.9
N8	–	14.6	–	10.8	-0.3	-4.9	-1.8	2.3
N9	–	14.6	–	10.8	-0.3	-4.8	-1.8	3.0
N10	–	15.2	–	10.8	-0.3	-4.9	-1.6	2.7
N11	–	15.2	–	10.8	-0.3	-4.8	-1.6	2.9
N12	–	14.6	–	10.8	-0.3	-4.9	-1.8	2.3
N13	–	14.6	–	10.8	-0.3	-4.8	-1.8	3.0
N14	–	15.1	–	10.7	-0.3	-4.8	-1.6	2.8
N15	–	15.7	–	11.3	-0.3	-4.8	-1.6	4.2
N16	–	11.5	–	7.9	-0.3	-14.7	-7.5	-7.5
N17	-0.3	9.7	-0.3	2.5	-3.2	-10.2	-22.8	80.0

$\Sigma = 241.6$ $\Sigma = 67.1$

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FOOTING FOR FRAME # 8 & #9

ENERCALC OUTPUTS : USE 3'-0" WIDE X 24" DEEP X CONTINUOUS FTG W/ (6) #6 AT 4.3" OC T & B LONGITUDINAL #6 AT 12" OC T & B TRANSVERSE

CHECK OVERALL STABILITY

UPLIFT = 32.3 + 5.0 + 75.0 = 112.3^K

DEAD WEIGHT = 241.6 = 241.6

WALL + FTG WEIGHT = $\overset{55.2}{(18/12)(275.833)(2)(0.15)}$ + $\overset{248.2}{(2)(3.0)(275.833)(0.15)}$ = 303.4

SOIL WEIGHT = $(275.833)(2-1)(3.0/2 - 8/24)(2)(110)/10^3$ = 70.8

7" SOG WEIGHT = $(7/12)(275.833)(3.833)(0.15)$ = 92.5

Σ = 708.3

F.O.S. AGAINST UPLIFT = $\frac{(0.6)(708.3)}{112.3}$ = 3.8 > 1.50 OK

SLIDING

TOTAL HORIZONTAL LOAD = 67.1

SLIDING RESISTANCE = (708.3)(0.35) = 248^K

F.O.S. AGAINST SLIDING = $\frac{248}{67.1}$ = 3.7 > 1.0 OK

OVERTURNING

M_R = (708.3)(3.0/2) = 1062.4$^{K'}$

M_{OT} = (67.1)(4) = 268.4$^{K'}$

F.O.S. AGAINST OVERTURNING = (1062.4)(0.6)/268.4 = 2.4 > 1.0 OK

OVERALL STABILITY CHECK IS SATISFACTORY

Beam on Elastic Foundation

Description : Footing for Frame #8 & #9 Columns

CODE REFERENCES ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015, IBC 2018

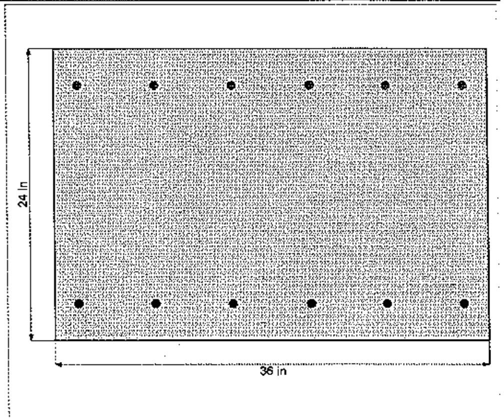
Material Properties

f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

Soil Subgrade Modulus = 250.0 psi / (inch deflection)

Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2



Beam is supported on an elastic foundation.

Cross Section & Reinforcing Details

Rectangular Section, Width = 36.0 in, Height = 24.0 in
Span #1 Reinforcing....
6-#6 at 3.0 in from Bottom, from 0.0 to 285.833 ft in this span
6-#6 at 3.0 in from Top, from 0.0 to 285.833 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

Point Load : D = 12.60, S = 5.30, W = -7.70, E = -32.30 k @ 5.0 ft
Point Load : D = 14.30, S = 10.0, W = 1.50, E = 41.80 k @ 25.0 ft
Point Load : D = 14.10, S = 9.70, W = -5.50, E = -5.0 k @ 40.0 ft
Point Load : D = 14.80, S = 11.0, W = -4.90, E = 2.90 k @ 58.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.80, E = 3.0 k @ 76.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.90, E = 2.70 k @ 94.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.80, E = 2.90 k @ 112.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.90, E = 2.30 k @ 130.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.80, E = 3.0 k @ 148.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.90, E = 2.70 k @ 156.0 ft
Point Load : D = 15.20, S = 10.80, W = -4.80, E = 2.90 k @ 184.0 ft
Point Load : D = 14.60, S = 10.80, W = -4.90, E = 2.30 k @ 202.0 ft
Point Load : D = 45.40, S = 32.80, W = -14.40, E = 2.80 k @ 220.0 ft
Point Load : D = 11.50, S = 7.90, W = -14.70, E = -75.0 k @ 247.130 ft
Point Load : D = 9.70, S = 2.50, W = 10.20, E = 80.0 k @ 267.0 ft

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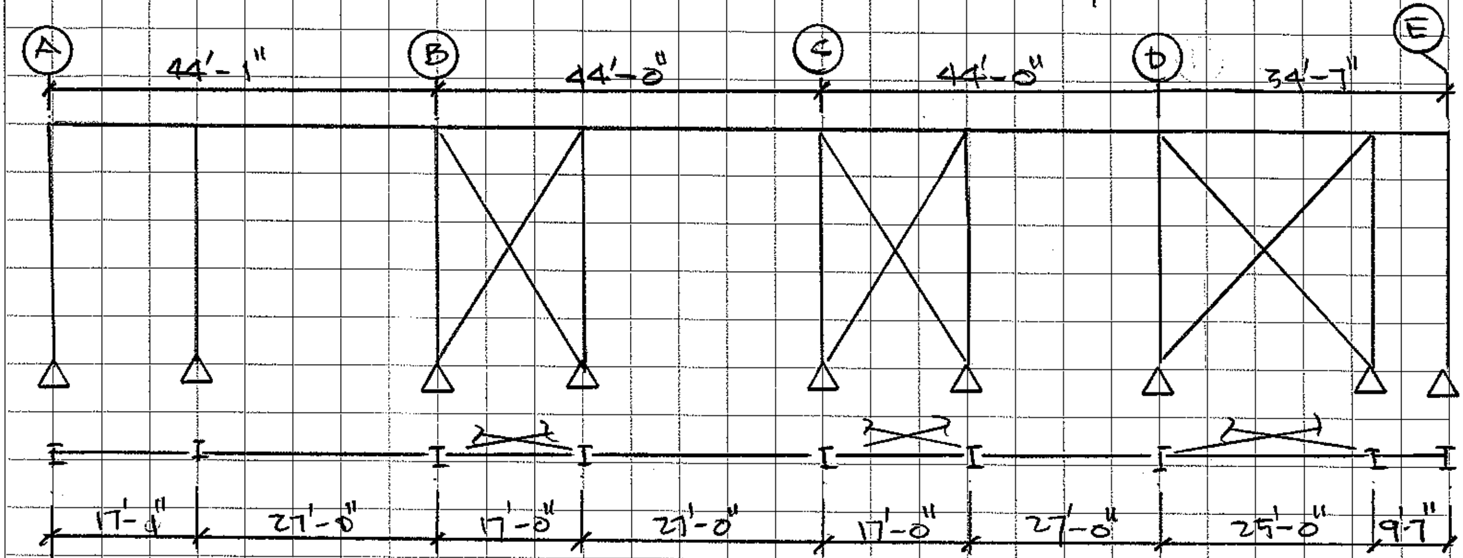
JOB: 18188-003 UPS RFI SEATTLE
DATE: AUG, 19 BY: TCL
SUBJECT: FRAMES AT LINE ①.

FRAMES AT LINES ①/Ⓐ-Ⓔ (FRAME #10, #11 & #12)



DESIGN LOADS

DEAD LOAD : $W_{DL} = (12 + 8psf)(25/2)/10^3 = 0.25\ k/'$ SAY $0.3\ k/'$

SNOW LOAD : $W_{SL} = (25psf)(25/2)/10^3 = 0.313\ k/'$ SAY $0.4\ k/'$

LATERAL LOADS

SEISMIC LOAD : $Q_E = 65.1 + 40.7 + 40.7 = 146.5^k$

WIND LOAD : $F_W = (25.7psf)(275.833/2)(27.25/2)/10^3 = 48.3^k$ SAY 50^k

SEE RISA-2D FOR OUTPUTS

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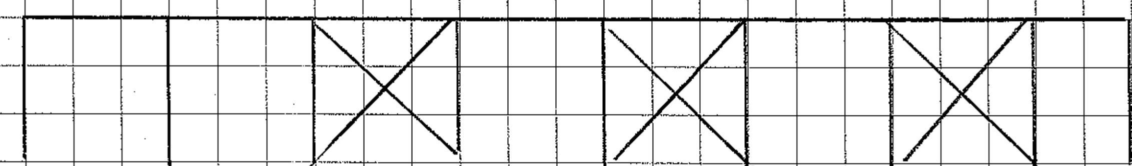
JOB: 18188-003 UPS BFI SEATTLE
DATE: Aug, 19 BY: TCL
SUBJECT: BLDG 100

FRAME #10, #11 & #12 RISA-2D OUTPUT COLUMN REACTIONS



	DL		SL		W		E	
NODE	X	Y	X	Y	X	Y	X	Y
N1	0.2	9.9	0.2	2.6	0.4	-0.3	1.5	4.4
N2	–	12.8	–	9.7	–	-5.1	–	–
N3	1.0	12.9	0.7	8.7	5.3	13.0	16.6	52.0
N4	-1.0	13.1	-0.7	8.8	5.6	-20.6	15.4	-46.4
N5	1.0	13.3	0.6	9.0	6.3	15.2	19.5	59.6
N6	-0.9	12.4	-0.5	8.3	6.4	-23	17.8	-54.1
N7	1.2	15.6	0.7	11.0	13.0	20.4	39.3	77.2
N8	-1.4	11.8	-0.9	7.5	11.4	-24	32.0	-58.2
N9	-0.1	8.1	-0.1	1.0	1.5	-5.7	14.3	-13.9

$\Sigma = 109.9$ $\Sigma = 49.9$ $\Sigma = 190.3$

FOOTING FOR FRAME #10, #11 & #12

ENERCALC OUTPUTS

USE 4'-3" WIDE X 24" DEEP X CONTINUOUS FTG
W/ (8) #6 AT 6.4" OC T&B LONGITUDINAL
#6 AT 12" OC T & B TRANSVERSE

OVERALL STABILITY CHECK

UPLIFT = 0.6 + 61.0 + 71 + 76 + 18.5 = 227.1

DEAD WEIGHT	$= 109.9^K$	$= 109.9$
WALL + FTG WT	$= (10/12)(2')(166.666')(0.15) + (2)(170.666)(5.5)(0.15)$ (41.7, 281.6)	$= 323.3$
SOIL WT.	$= (2-1)(170.666)(\frac{5.5}{2} - 10/24)(2)(110)/10^3$	$= 87.6$
7" SOIL	$= (7/12)(166.666)(15)(0.15)$	$= 218.7$
	Σ	$= 739.5$

F.O.S. AGAINST UPLIFT $= \frac{(0.6)(739.5)}{227.1} = 1.95 > 1.5$ OK

SLIDING

TOTAL HORIZONTAL LOAD $= 190.3^K$

SLIDING RESISTANCE $= (739.5)(0.35) = 259^K$

F.O.S AGAINST SLIDING $= \frac{259}{190.3} = 1.36 > 1.0$ OK

OVERTURNING

$M_R = (739.5)(5.5/2) = 2033.6\ K'$

$M_{OT} = (190.3)(4') = 761.2\ K'$

F.O.S. AGAINST OVERTURNING $= \frac{(0.6)(2033.6)}{761.2} = 1.60 > 1.0$ OK

OVERALL STABILITY CHECK IS SATISFACTORY.

~~704~~
54

Beam on Elastic Foundation

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Main Bldg Frame 100 Col Reactions\Design\design.ec6
ENERCALC, INC. 1983-2016, Build:6.16.2.18, Ver:6.16.2.18

Lic. # : KW-06001622 **Licensee : PETERSON-STREHLE-MARTINSON, INC**

Description : Footing for Frame #10, #11 & #12 Columns

CODE REFERENCES

ACI 318-14

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10, ASCE 7-16
Load Combinations Used : IBC 2015, IBC 2018

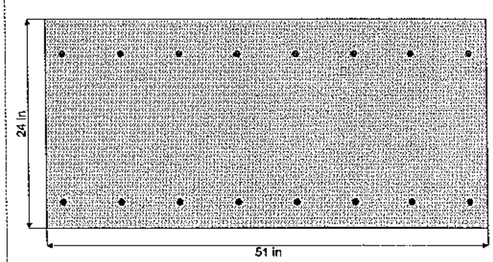
Material Properties

f'c	=	3.0 ksi	ϕ Phi Values	Flexure :	0.90
$fr = f'c^{1/2} * 7.50$	=	410.792 psi		Shear :	0.750
ψ Density	=	145.0 pcf	β_1	=	0.850
λ Lt Wt Factor	=	1.0			
Elastic Modulus	=	3,122.0 ksi			

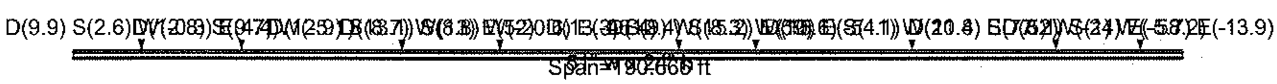
Soil Subgrade Modulus = 250.0 psi / (inch deflection)

Load Combination IBC 2015

fy - Main Rebar	=	60.0 ksi	Fy - Stirrups	=	40.0 ksi
E - Main Rebar	=	29,000.0 ksi	E - Stirrups	=	29,000.0 ksi
			Stirrup Bar Size #	=	# 3
			Number of Resisting Legs Per Stirrup		2



Beam is supported on an elastic foundation.



Cross Section & Reinforcing Details

Rectangular Section, Width = 51.0 in, Height = 24.0 in
Span #1 Reinforcing....
8-#6 at 3.0 in from Bottom, from 0.0 to 190.666 ft in this span 8-#6 at 4.0 in from Top, from 0.0 to 190.666 ft in this span

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loads

Point Load : D = 9.90, S = 2.60, W = -0.30, E = 4.40 k @ 12.0 ft
Point Load : D = 12.80, S = 9.70, W = -5.10 k @ 29.083 ft
Point Load : D = 12.90, S = 8.70, W = 13.0, E = 52.0 k @ 56.083 ft
Point Load : D = 13.10, S = 8.80, W = -20.60, E = -46.40 k @ 73.083 ft
Point Load : D = 13.30, S = 9.0, W = 15.20, E = 59.0 k @ 104.083 ft
Point Load : D = 12.40, S = 8.30, W = 10.0, E = -54.10 k @ 117.083 ft
Point Load : D = 15.60, S = 11.0, W = 20.40, E = 77.20 k @ 144.083 ft
Point Load : D = 11.80, S = 7.50, W = -24.0, E = -58.20 k @ 169.083 ft
Point Load : D = 8.10, S = 1.0, W = -5.70, E = -13.90 k @ 183.666 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	0.855 : 1	Maximum Deflection	
Section used for this span	**Typical Section**	Max Downward L+Lr+S Deflection	0.000 in
Mu : Applied	287.251 k-ft	Max Upward L+Lr+S Deflection	0.000 in
Mn * Phi : Allowable	336.155 k-ft	Max Downward Total Deflection	0.075 in
		Max Upward Total Deflection	-4.116 in
Load Combination	+1.401D+0.50L+0.70S+2.0E		
Location of maximum on span	##.### ft		
Span # where maximum occurs	Span # 1		

Maximum Soil Pressure = **2.704** ksf at 137.70 ft

Maximum Forces & Stresses for Load Combinations

Load Combination		Location (ft)	Bending Stress Results (k-ft)		
Segment Length	Span #	in Span	Mu : Max	Phi*Mnx	Stress Ratio
MAXimum Bending Envelope					

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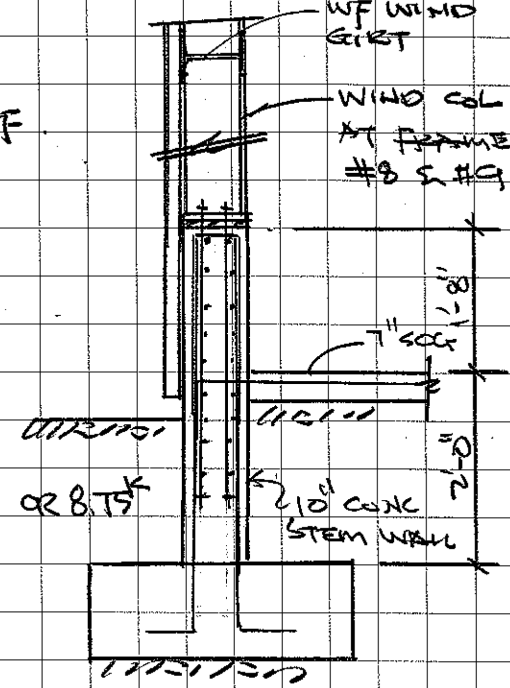
10" CONC STEM WALL BELOW WIND COL.



- MAX ULTIMATE WIND PRESSURE = 25.7 psf
- MAX TRIBUTARY WIDTH BTWN WIND COLS = 25'-0"
- HEIGHT OF WIND COL BTWN SUPPORTS = 27.25'
- MAX HORIZONTAL LOAD AT WIND COL BASE DUE TO WIND = 0.35 K/' OR 8.75^K
- MAX HORIZONTAL LOAD AT WIND COL BASE DUE TO SEISMIC = 5^K 15^K SAY (12.2^K)
  (0.3089)(25' x 44.083/2 x 20/10³ + 25 x 27.25/2 x 5/10³)
- GRAVITY LOAD ; CONSERVATIVE P_{DL} = (20 psf)(44.083/2)(25')/10³ = 11^K
  P_{SL} = (25/20)(11) = 13.8^K

SEE ATTACHED ENERCALC OUTPUTS
- 10" CONCRETE STEM WALL WITH #5 AT 12" oc EF (VERTICAL) IS ADEQUATE FOR WIND COL W/O (BY METAL BLDG MANUFACTURER) LOADS.

- USE SHEAR REINF #4 x ⊂⊃ AT 6" oc. ONLY AT WIND COL ANCHOR BOLTS.

$$\frac{A_{sv}}{s_v} = \frac{V_u}{\phi f_y d} = \frac{(8.75)(1.4)}{(0.75)(60)(6)} = 0.05\ \text{in}^2/\text{ft}$$

ONLY AT ANCHOR BOLTS.
USE #4 ⊂⊃ AT 6" oc

$\frac{A_{sv}}{s_v} = 0.4\ \text{in}^2/\text{ft}$.

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DATE: AUG, 19 BY: TCL
SUBJECT: BLDG 100.

PERIMETER FOOTING TIE

MAX COLUMN AXIAL LOAD, P_{max} = 123K

PER ASCE 12.13.5.2
ALL TIES SHALL HAVE A DESIGN STRENGTH IN TENSION OR COMPRESSION

$V_{ert}T_u = \left(\frac{S_{DS}}{10}\right) P_{max}$

$= \left(\frac{1.004}{10}\right)(123)$

V_u or T_u = 12.3K SAY 14K

CONSERVATIVE
(IGNORE NOMINAL SHEAR STRENGTH OF 7" SLAB)

$\frac{A_{sv}}{s} = \frac{V_u}{\phi \mu f_y d} = \frac{(14)(1.4)\text{ FACTOR}}{(0.75)(1.0)(60)(3.5)\cos 30}$

(d = 3.5")

USE 15-0 HAIRPIN #5 × PER COL.

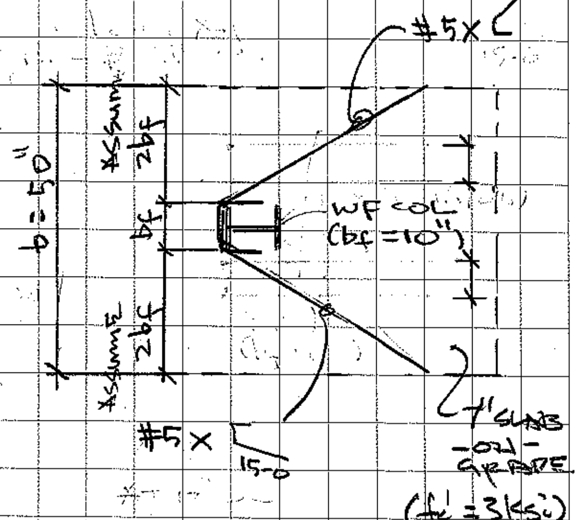
$= 0.14 \text{ in}^2/\text{FT}$

(A_s = 0.31 in²/FT)

LENGTH OF HAIRPIN, l = 15'-0" AT
CONSIDER 7" SLAB ON GRADE

$\phi V_n = (2)(0.75)(50)(3.5)(3000)^{1/2}/10^3$

$= 14.4^K \quad > T_u \quad$ OK



$WL = 22.8$ psf (ULT)
$= 16.3$ psf (ASD)

EXP = 'C'

WORST CASE UPLIFT (ASD)

$$UPLIFT = \frac{60+48}{2} \times \frac{41'}{2} \times 0.0163\ Ksf$$
$$= 18.1^{K}$$

$0.6DL = 19.6^{K} > 18.1^{K}$ $\boxed{OK}$

USE 6'-0' x 6'-0" x 2'-0" FTG
1'-6" x 1'-6" x 3'-8" PLINTH
TOP OF FTG (-) 2'-0"

SECURITY BLDG

DESIGN CRITERIA [SBC 2015]

- ROOF LOADING $DL_R = 15$ PSF
  $LL_R = 25$ PSF (SNOW)

- SEISMIC CRITERIA (RISK CAT II)
  LAT: 47.53411 $S_S = 1.506$ $\xrightarrow{\text{SITE CLASS 'D}}$ $S_{DS} = 1.004$
  LONG: -122.30054 $S_1 = 0.575$ $S_{D1} = 0.577$

- WIND CRITERIA (RISK CAT II)
  110 MPH, EXPOSURE 'C' $K_{zt} = 1.0$

- SOIL CRITERIA (PER SOILS TERRACON REPORT # 81185115, DATED 12/20/2018)
  ALLOW BRG PRESSURE = 3000 PSF
  FROST DEPTH = 18"
  MIN CONT FTG WIDTH = 18"
  MIN SQUARE FTG WIDTH = 24"
  6" MIN CONCRETE SLAB w/ CRUSHED ROCK BASE COURSE
  MODULUS OF SUB GRADE = 250 PCI

ROOF FRAMING

▫ DESIGN LOAD

$DL_R = 15$ PSF
$LL_R = 25$ PSF

▫ TYPICAL ROOF JOISTS

$L_{max} = 18'$
$w = 2'(15+25) = 80$ PLF
$M_x = 3240^{\#'}$
$V_x = 720^{\#}$
$\Longrightarrow$
2x12 DF #1
$f_b = 1223^{PSI} < 1275^{PSI}$
$f_v = 58^{PSI}$
$\delta_{TL} = 0.625''$ L/346

▫ TYPICAL HEADER AT DOORS

$L_{max} = 4'$
$w_{max} = 460$ PLF
$M_x = 920^{\#'}$
$V_x = 920^{\#}$
$\Longrightarrow$
DBL 2x6
$f_b = 730^{PSI}$
$f_v = 65^{PSI}$
$\delta_{TL} = 0.037''$

▫ TYP. HEADER AT WINDOW

$L_{max} = 6'$
$w = 460$ PLF
$M_x = 2070^{\#'}$
$V_x = 1380^{\#}$
$\Longrightarrow$
4x8 DF #1
$f_b = 810$
$f_v = 65$
$\delta_{TL} = 0.07''$

▫ INTERIOR BRG LINE

HEADER
$L_{max} = 4'$
$w = 820^{PLF}$
$M_x = 1640^{\#'}$
$V_x = 1640^{\#}$
$\Longrightarrow$
4x8 DF #1
$f_b = 642^{PSI}$
$f_v = 68^{PSI}$
$\delta_{TL} = 0.03''$

BEAM
$L_{max} = 9'$
$w = 820^{PLF}$
$M_x = 8300^{\#'}$
$V_x = 3690^{\#}$
$\Longrightarrow$
3 1/8 x 10 1/2 GLB
$f_b = 1735^{PSI}$
$f_v = 136^{PSI}$
$\delta_{TL} = 0.236''$ L/457

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JOB: UPS BFI - SEATTLE (#18188)
DATE: 9/4/2019 BY: R. CRUZ
SUBJECT: SECURITY BLDG

- INTERMEDIATE HDR AT WINDW

$L = 12'$

$w = 460$ PLF
$M_x = 8280^{\#'}$
$V_x = 2760^{\#}$

⟹

$3\frac{1}{8} \times 12$ GLB
$f_b = 1325^{PSI}$
$f_v = 92^{PSI}$
$\delta_{TL} = 0.265''$ L/543

— OKAY

- LONG SPAN HEADER AT VIEW WINDOW

$L = 24'$

$w = 500$ PLF
$M_x = 36000^{\#'}$
$V_x = 6000^{\#}$

$5\frac{1}{8} \times 18$ GLB
$f_b = 1561^{PSI}$
$f_v = 86^{PSI}$
$\delta_{TL} = 0.83''$ L/346

— OKAY

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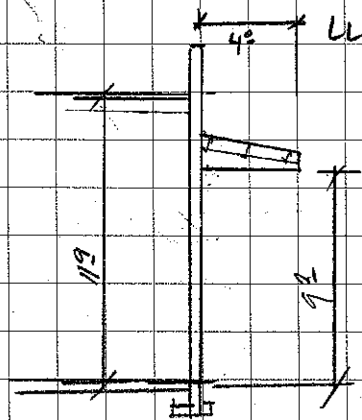
JOB: UPS BFI SEATTLE
DATE: 7/30/2019 BY: R. CRUZ
SUBJECT: SECURITY BLDG

- BUILDING CANOPY -

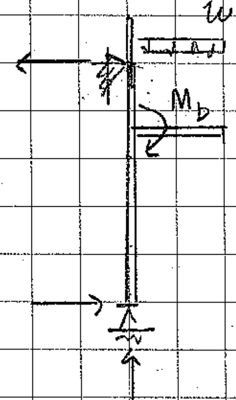
CANOPY LOADING DL = 10 PSF
LL = 25 PSF > 35 PSF



TYPICAL JOISTS
L = 19'
w = 2'(35) = 70 PLF ⟹ 600T 300-68 CAPACITY = 74 PLF
M_x = 3160#'
V_x = 665#

— FRAME SUPPORT —

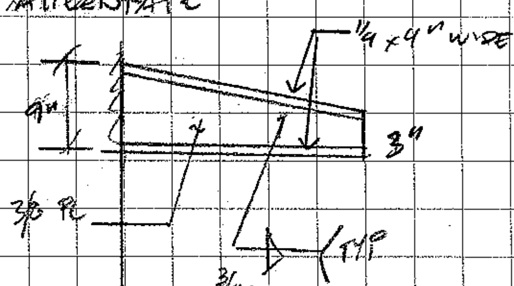
w = 19'(35) = 665 PLF



$M_b = 0.67 \times 4^2/2 = 5.36^{k'}$
$V_b = 0.67 \times 4 = 2.68^k$

W8×10 (min)
f_b = 8.36 ksi
S_x = 0.04"
} OKAY

ALTERNATE



NOTE: WELDING OKAY
BY INSPECTION OF
LOW LEVEL FORCES

STRONGBACK
M = 5.36 k
HSS 4×4×1/4 → f_b = 15.7 ksi < 30 ksi

OKAY

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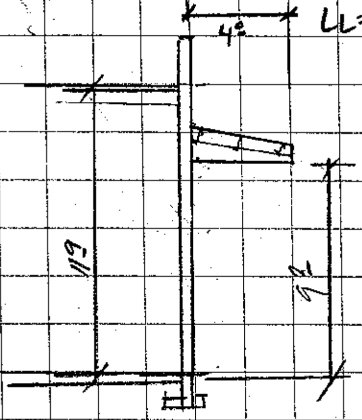
JOB: UPS BFI SEATTLE
DATE: 7/30/2019 BY: R. CRUZ
SUBJECT: SECURITY BLDG

- BUILDING CANOPY -

ALTERNATE - MAX TRIB = 26'-0"

CANOPY LOADING DL = 10 PSF, LL = 25 PSF > 35 PSF



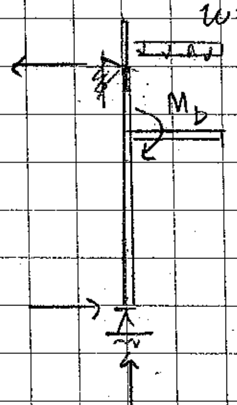
TYPICAL JOISTS

$L = 26'$
$w = 1.33(35) = 47$ PLF
$M_x = 3971$ #'
$V_x = 1099$ #

⟹ 1000 S 250-54
$f_b = 25^{KSI}$
$S_{TL} = 1.32"$ $L/237$

— FRAME SUPPORT —

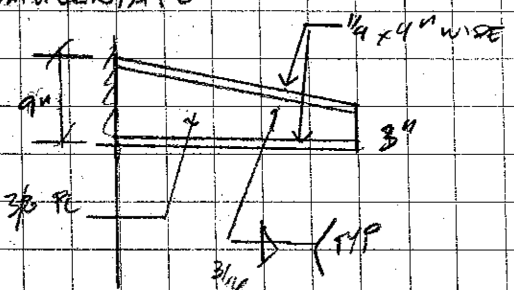
$w = 26'(35^{PSF}) = 910^{PLF}$



$M_b = 0.91 \times 4^2/2 = 7.3^{K'}$
$V_b = 0.91 \times 4 = 3.6^K$

W8×10 (min)
$f_b = 11.2^{KSI}$
$S_{TL} = 0.056"$
} OKAY

ALTERNATE



NOTE: WELDING OKAY BY INSPECTION OF LOW LEVEL FORCES

STRONGBACK (ALT TO WITH BLDG COL)
$M = 7.3^K$
HSS 4×4×3/8 → 12.8^{KSI} $< 30^{KSI}$

OKAY

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LATERAL ANALYSIS

o SEISMIC ANALYSIS $[S_{DS} = 1.004, S_{D1} = 0.577]$

$C_S = \dfrac{S_{DS}}{R/I} = \dfrac{1.004}{6.5/1.0} = 0.154$ ⟵ CONTROLS

$C_S|_{MAX} = \dfrac{S_{D1}}{T_a \times R/I} = \dfrac{0.577}{0.33 \times 6.5/1.0} = 0.269$

$C_S|_{MIN} = 0.044\, S_{DS} I = 0.044(1.004)(1.0) = 0.044$

$V_{AS} = \rho C_S W_T / 1.4$
$= 1.3(0.154) W_T / 1.4$
$= 0.143\, W_T$

ROOF: $1250^{\square'} \times 15^{PSF} = 18\,750$
WALLS: $160' \times 10' \times 16^{PSF} = 10\,000$
$W_T = 28\,750^{\#}$

$\therefore V_{AS} = 0.143(28.75^K) = 4.11^K$

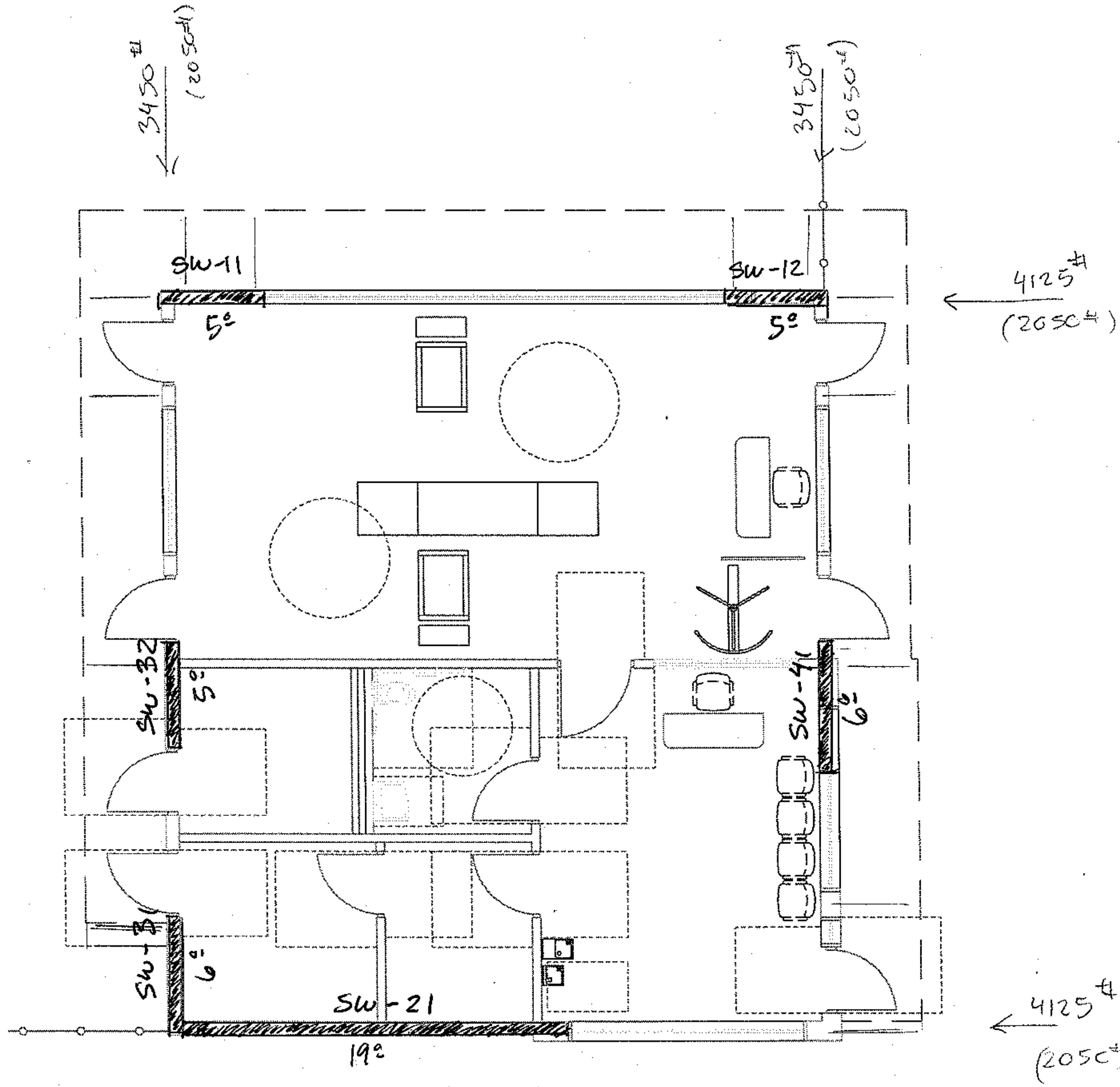
o WIND ANALYSIS
115 MPH, EXP "B" $\Longrightarrow$ $P_{AW} = 15$ PSF

EW DIRECTION $V_{AW}|_{NS} = 460^{\square'} \times 15^{PSF} = 6900^{\#} > V_{AS}$
NS DIRECTION $V_{AW}|_{EW} = 550^{\square'} \times 15^{PSF} = 8250^{\#} > V_{AS}$

∴ WIND CONTROLS LATERAL ANALYSIS

o DIAPHRAGM ANALYSIS
- DIAPHRAGM SHEAR
EW DIRECTION $v_{AD} = 6900^{\#}/(2 \times 37) = 93^{PLF}$
NS DIRECTION $v_{AD} = 8250^{\#}/(2 \times 33) = 125^{PLF}$
} OKAY FOR 5/8" PLYWD - UNBLOCKED -

- CHORD FORCES
EW DIRECTION $CF_1 = 6900 \times 33'/(8 \times 37) = 770^{\#}$
NS DIRECTION $CF_2 = 8250 \times 37'/(8 \times 33) = 1156^{\#}$
} OKAY FOR NAILED DBL TOP PL SPLICE



SHEARWALL PLAN

1/8" = 1'-0"

Shearwall Calculations - Wind

Wall Mark	Dimensions L - ft	H - ft	H/L Ratio	SW Cap. Coeff.	Unit shear - plf	Shear / Coeff. -plf	OTM k-ft.	DL on wall wall (k)	Uplift (k)	Comp at ends - k	Holdown	Shearwall Type
11	5	12	2.4	0.83	413	495	24.8	1.3	5.1	5.6	HDU5	W3
12	5	12	2.4	0.83	413	495	24.8	1.3	5.1	5.6	HDU5	W3
21	19	12	0.6	1.00	217	217	49.5	4.8	1.1	5.0	HDU2	W6
31	6	12	2.0	1.00	314	314	22.6	0.9	3.8	4.2	HDU4	W6
32	5	12	2.4	0.83	314	376	18.8	0.8	3.9	4.1	HDU4	W6
41	6	12	2.0	1.00	575	575	41.4	0.9	7.2	7.4	HDU8	W3

Wind Shearwall Capacities

W6 1/2" plywood (1-side) 10d com at 6" oc at panel edges — Doug-Fir Capacity = 434 plf

W3 1/2" plywood (1-side) 10d com at 3" oc at panel edges — Doug-Fir Capacity = 840 plf

Shearwall Calculations - Seismic

Wall Mark	Dimensions L - ft	H - ft	H/L Ratio	SW Cap. Coeff.	Unit shear - plf	Shear / Coeff. -plf	OTM k-ft.	DL on wall wall (k)	Uplift (k)	Comp at ends - k	Holdown	Shearwall Type
11	5	12	2.4	0.83	205	246	12.3	1.3	2.3	3.1	HDU5	W3
12	5	12	2.4	0.83	205	246	12.3	1.3	2.3	3.1	HDU5	W3
21	19	12	0.6	1.00	108	108	24.6	4.8	-	3.7	HDU2	W6
31	6	12	2.0	1.00	186	186	13.4	0.9	2.1	2.7	HDU4	W6
32	5	12	2.4	0.83	186	224	11.2	0.8	2.2	2.6	HDU4	W6
41	6	12	2.0	1.00	342	342	24.6	0.9	4.2	4.6	HDU8	W3

Seismic Shearwall Capacities

W6 1/2" plywood (1-side) 10d com at 6" oc at panel edges — Doug-Fir Capacity = 310 plf

W3 1/2" plywood (1-side) 10d com at 3" oc at panel edges — Doug-Fir Capacity = 600 plf

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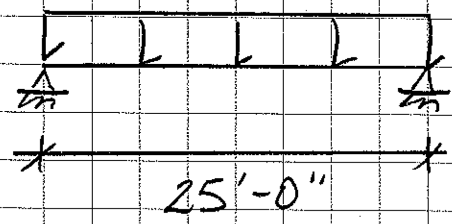
FLOOR
GL CA (GIRDER)

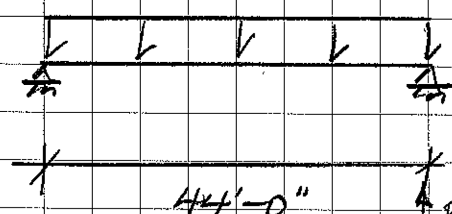


DL = 10 psf × 14/2 + 75 psf × 44/2 = 1720 plf
LL = 50 × " = 1100 plf
W_{PRTN} = 15 × " = 330 plf } 1430 plf

$\boxed{\text{USE W27×94}}$

$\boxed{\text{NO CAMBER}}$

JOIST GL CA/CB



W_{DL} = 75 psf × 7'-0" = 520 plf
W_{LL} = 50 × " = 350 plf
W_{PRTN} = 15 × " = 110 plf } 460 plf

R_{DL} = 3.6k
R_{LL} = 11.5k

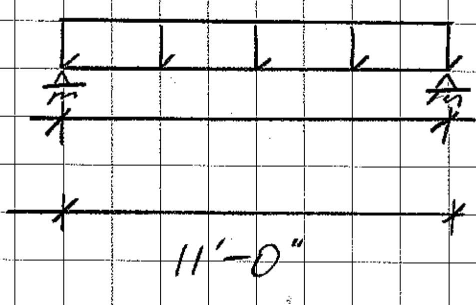
$\boxed{\text{USE W21×68}}$

$\boxed{\text{EDGE BEAM W21×55 CAMBER = 5/8"}}$

FL = 8 1/4" WIDE

CAMBER = 0.8 × (2.2 − 1.0)
= 1.0"

GL CB (GIRDER)



DL = 75 psf × (44' + 10')/2 = 2025 plf
LL = 50 × " = 1350 plf
W_{PRTN} = 15 × " = 405 plf } 1755 plf

$\boxed{\text{USE W16×26}}$

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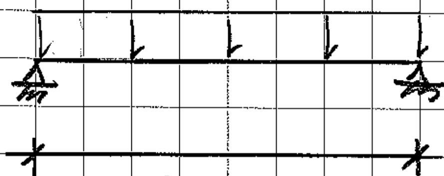
JOB: UPS BFI
DATE: 9/11/19 BY: PCB
SUBJECT: FLIGHT CONTROL

FLOOR CON'T

GL 1.5 (GIRDER)

10psf × 14'/2 +
DL = 75psf × 10'/2 = 445 plf
LL = 50psf × " = 250plf
W_{PRTN} = 15psf × " = 75plf } 225 plf

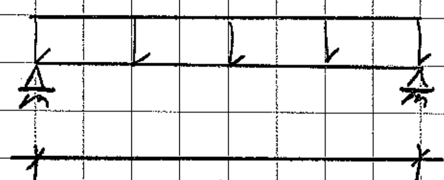


20'-0"

$\boxed{\text{USE W14x22}}$

GL CB-1.5 (JOIST)

DL = 75psf × 11' = 825plf
LL = 50 × " = 550plf
W_{PRTN} = 15 × " = 165plf } 715plf



10'-0"

$\boxed{\text{USE W10x12}}$

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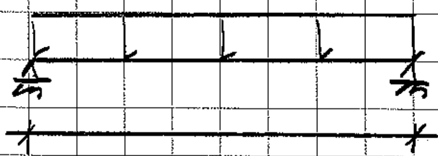
DATE: 9/11/2019 BY: PCB
SUBJECT: FLIGHT CONTROL

ROOF

GL CA (GIRDER)

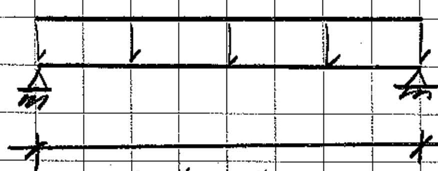


$W_{DL} = 20psf \times 44'/2 = 440plf$
$W_{SL} = 25 \times " = 550plf$

25'-0"

$\boxed{\text{USE W27x84}}$

GL C7-C8 (JOIST)



$W_{DL} = 20psf \times 8'-0" = 160plf$
$W_{SL} = 25 \times " = 200plf$

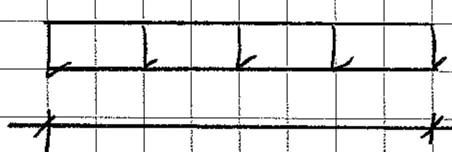
44'-0"

GL 7&8 USE W21x44

BTWN GL7/8 USE

GL CB (GIRDER)

$W_{DL} = 20psf \times \frac{44+10}{2} = 540plf$
$W_{SL} = 25 \times " = 675plf$



11'-0"

USE W14x22

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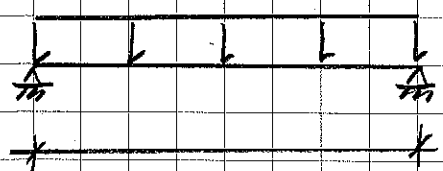
DATE: 9/11/19 BY: PCB
SUBJECT: FLIGHT CONTROL

ROOF CONT

GL 1.5 (GIRDER)

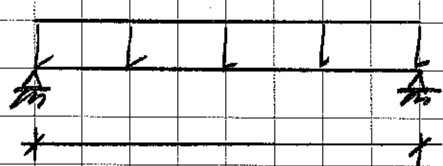


$W_{DL} = 20psf \times 10'/2 = 100plf$
$W_{SL} = 25psf \times$ " $= 125plf$

20'-0"

USE W10 x 15

GL CB/1.5 (JOIST)



$W_{DL} = 20psf \times 11'-0" = 220plf$
$W_{SL} = 25 \times$ " $= 275plf$

10'-0"

USE W5 x 16
OR/ HSS 5x2x1/4

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Steel Beam

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Lic. # : KW-06001622 Licensee : PETERSON-STREHLE-MARTINSON, INC

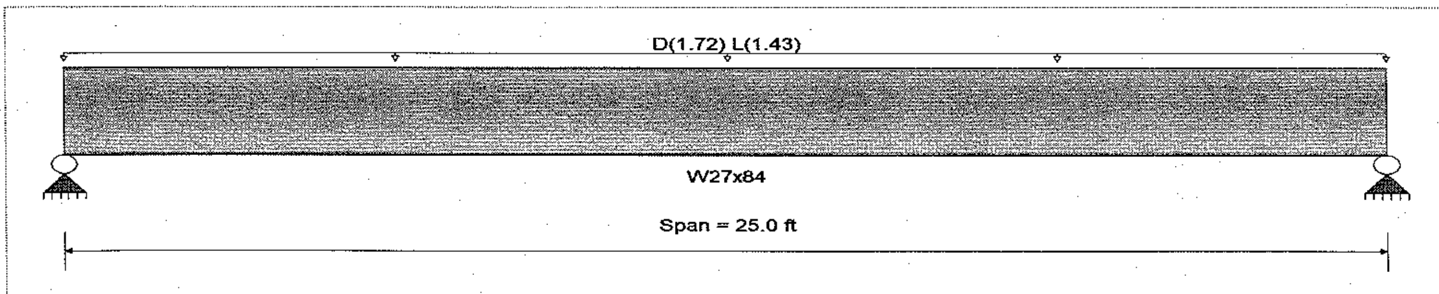
Description : FC - GL CA (Floor Girder)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 1.720, L = 1.430 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.404 : 1**	Maximum Shear Stress Ratio =	**0.160 : 1**
Section used for this span	**W27x84**	Section used for this span	**W27x84**
Ma : Applied	246.094 k-ft	Va : Applied	39.375 k
Mn / Omega : Allowable	608.782 k-ft	Vn/Omega : Allowable	245.640 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	12.500ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.153 in	Ratio =	1,963 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.337 in	Ratio =	892 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 25.00 ft	1	0.221	0.088	134.38		134.38	1,016.67	608.78	1.00	1.00	21.50	368.46	245.64
+D+L													
Dsgn. L = 25.00 ft	1	0.404	0.160	246.09		246.09	1,016.67	608.78	1.00	1.00	39.38	368.46	245.64
+D+0.750L													
Dsgn. L = 25.00 ft	1	0.358	0.142	218.16		218.16	1,016.67	608.78	1.00	1.00	34.91	368.46	245.64
+0.60D													
Dsgn. L = 25.00 ft	1	0.132	0.053	80.63		80.63	1,016.67	608.78	1.00	1.00	12.90	368.46	245.64

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.3365	12.571		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	39.375	39.375
Overall MINimum	12.900	12.900
D Only	21.500	21.500
+D+L	39.375	39.375
+D+0.750L	34.906	34.906
+0.60D	12.900	12.900
L Only	17.875	17.875

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Lic. # : KW-06001622 | Licensee : PETERSON-STREHLE-MARTINSON, INC

Description : FC - CA/CB (Floor Joist)

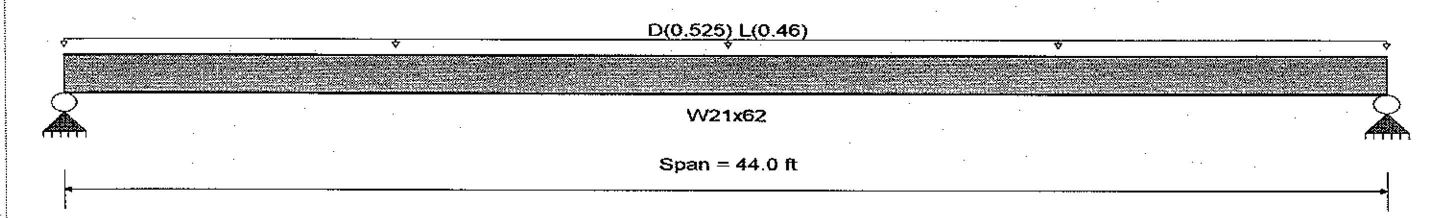
CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.5250, L = 0.460 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.663 : 1**	Maximum Shear Stress Ratio =	**0.129 : 1**
Section used for this span	**W21x62**	Section used for this span	**W21x62**
Ma : Applied	238.370 k-ft	Va : Applied	21.670 k
Mn / Omega : Allowable	359.281 k-ft	Vn/Omega : Allowable	168.0 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	22.000ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	1.010 in	Ratio =	522 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	2.164 in	Ratio =	244 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 44.00 ft	1	0.354	0.069	127.05		127.05	600.00	359.28	1.00	1.00	11.55	252.00	168.00
+D+L													
Dsgn. L = 44.00 ft	1	0.663	0.129	238.37		238.37	600.00	359.28	1.00	1.00	21.67	252.00	168.00
+D+0.750L													
Dsgn. L = 44.00 ft	1	0.586	0.114	210.54		210.54	600.00	359.28	1.00	1.00	19.14	252.00	168.00
+0.60D													
Dsgn. L = 44.00 ft	1	0.212	0.041	76.23		76.23	600.00	359.28	1.00	1.00	6.93	252.00	168.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	2.1635	22.126		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 — Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	21.670	21.670
Overall MINimum	6.930	6.930
D Only	11.550	11.550
+D+L	21.670	21.670
+D+0.750L	19.140	19.140
+0.60D	6.930	6.930
L Only	10.120	10.120

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Project ID:
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Steel Beam

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Lic. # : KW-06001622 Licensee : PETERSON-STREHLE-MARTINSON, INC

Description : FC - CA/CB (Floor Joist - edge)

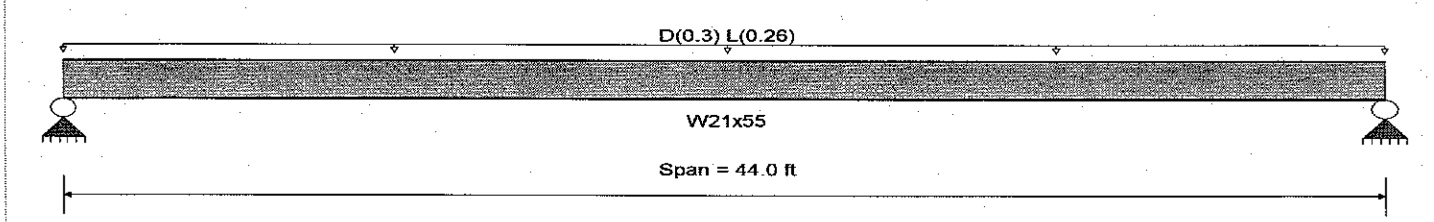
CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.30, L = 0.260 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.431** : 1	Maximum Shear Stress Ratio =	**0.079** : 1
Section used for this span	**W21x55**	Section used for this span	**W21x55**
Ma : Applied	135.520 k-ft	Va : Applied	12.320 k
Mn / Omega : Allowable	314.371 k-ft	Vn/Omega : Allowable	156.0 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	22.000ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.666 in	Ratio =	792 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	1.435 in	Ratio =	368 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 44.00 ft	1	0.231	0.042	72.60		72.60	525.00	314.37	1.00	1.00	6.60	234.00	156.00
+D+L													
Dsgn. L = 44.00 ft	1	0.431	0.079	135.52		135.52	525.00	314.37	1.00	1.00	12.32	234.00	156.00
+D+0.750L													
Dsgn. L = 44.00 ft	1	0.381	0.070	119.79		119.79	525.00	314.37	1.00	1.00	10.89	234.00	156.00
+0.60D													
Dsgn. L = 44.00 ft	1	0.139	0.025	43.56		43.56	525.00	314.37	1.00	1.00	3.96	234.00	156.00

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	1.4350	22.126		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	12.320	12.320
Overall MINimum	3.960	3.960
D Only	6.600	6.600
+D+L	12.320	12.320
+D+0.750L	10.890	10.890
+0.60D	3.960	3.960
L Only	5.720	5.720

Steel Beam

Description : FC -GL CB (Floor Girder)

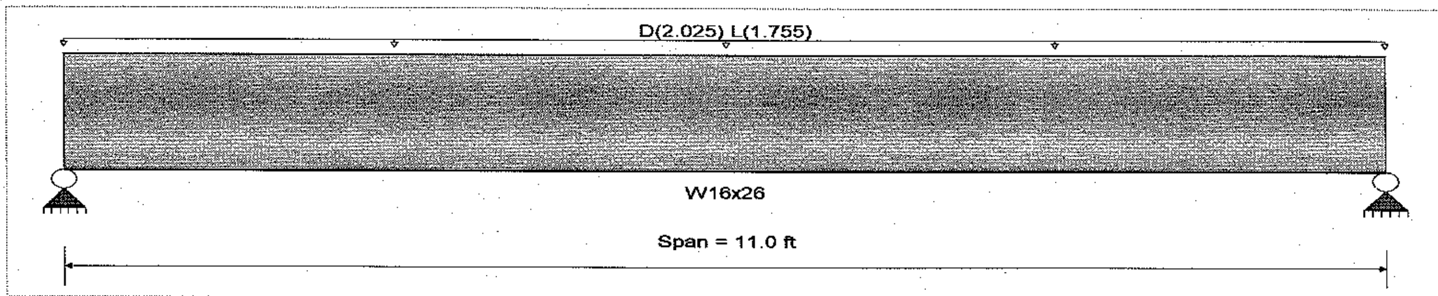
CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 2.025, L = 1.755 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.518 : 1**	Maximum Shear Stress Ratio =	**0.295 : 1**
Section used for this span	**W16x26**	Section used for this span	**W16x26**
Ma : Applied	57.173 k-ft	Va : Applied	20.790 k
Mn / Omega : Allowable	110.279 k-ft	Vn/Omega : Allowable	70.509 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	5.500 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.067 in	Ratio =	1,983 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.143 in	Ratio =	921 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 11.00 ft	1	0.278	0.158	30.63		30.63	184.17	110.28	1.00	1.00	11.14	117.75	70.51
+D+L													
Dsgn. L = 11.00 ft	1	0.518	0.295	57.17		57.17	184.17	110.28	1.00	1.00	20.79	117.75	70.51
+D+0.750L													
Dsgn. L = 11.00 ft	1	0.458	0.261	50.54		50.54	184.17	110.28	1.00	1.00	18.38	117.75	70.51
+0.60D													
Dsgn. L = 11.00 ft	1	0.167	0.095	18.38		18.38	184.17	110.28	1.00	1.00	6.68	117.75	70.51

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1433	5.531		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	20.790	20.790
Overall MINimum	6.683	6.683
D Only	11.138	11.138
+D+L	20.790	20.790
+D+0.750L	18.377	18.377
+0.60D	6.683	6.683
L Only	9.653	9.653

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Steel Beam

Description : FC - GL 1.5 (Floor Girder)

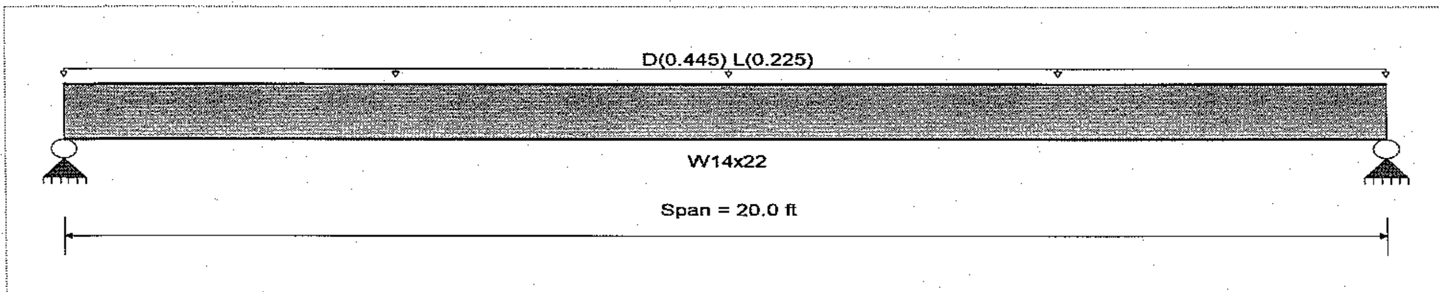
CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method : Allowable Strength Design
Beam Bracing : Beam is Fully Braced against lateral-torsional buckling
Bending Axis : Major Axis Bending

Fy : Steel Yield : 50.0 ksi
E: Modulus : 29,000.0 ksi



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.4450, L = 0.2250 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.404** : 1	Maximum Shear Stress Ratio =	**0.106** : 1
Section used for this span	**W14x22**	Section used for this span	**W14x22**
Ma : Applied	33.500 k-ft	Va : Applied	6.70 k
Mn / Omega : Allowable	82.834 k-ft	Vn/Omega : Allowable	63.020 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	10.000 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.141 in	Ratio =	1,702 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.420 in	Ratio =	572 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 20.00 ft	1	0.269	0.071	22.25		22.25	138.33	82.83	1.00	1.00	4.45	94.53	63.02
+D+L													
Dsgn. L = 20.00 ft	1	0.404	0.106	33.50		33.50	138.33	82.83	1.00	1.00	6.70	94.53	63.02
+D+0.750L													
Dsgn. L = 20.00 ft	1	0.370	0.097	30.69		30.69	138.33	82.83	1.00	1.00	6.14	94.53	63.02
+0.60D													
Dsgn. L = 20.00 ft	1	0.161	0.042	13.35		13.35	138.33	82.83	1.00	1.00	2.67	94.53	63.02

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.4199	10.057		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.700	6.700
Overall MINimum	2.250	2.250
D Only	4.450	4.450
+D+L	6.700	6.700
+D+0.750L	6.138	6.138
+0.60D	2.670	2.670
L Only	2.250	2.250

Steel Beam

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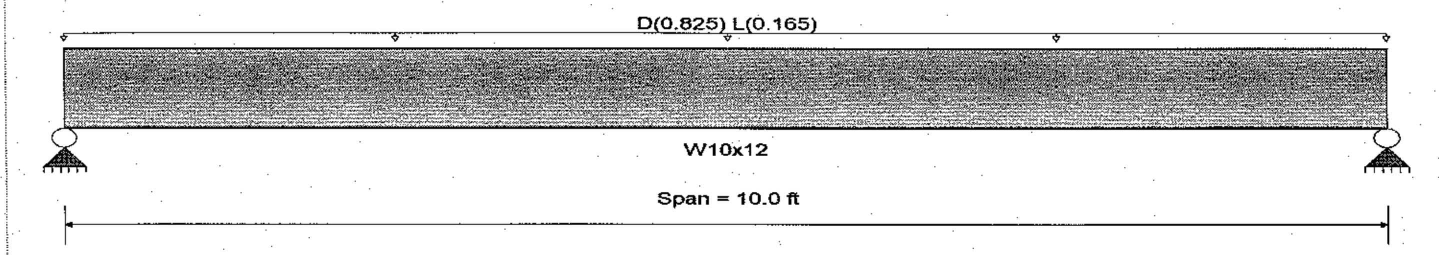
Description : FC - GL CB/1.5 (Floor Joist)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.8250, L = 0.1650 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.397** : 1	Maximum Shear Stress Ratio =	**0.132** : 1
Section used for this span	**W10x12**	Section used for this span	**W10x12**
Ma : Applied	12.375 k-ft	Va : Applied	4.950 k
Mn / Omega : Allowable	31.207 k-ft	Vn/Omega : Allowable	37.506 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	5.000 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.024 in	Ratio =	5,020 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.143 in	Ratio =	837 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 10.00 ft	1	0.330	0.110	10.31		10.31	52.12	31.21	1.00	1.00	4.13	56.26	37.51
+D+L													
Dsgn. L = 10.00 ft	1	0.397	0.132	12.38		12.38	52.12	31.21	1.00	1.00	4.95	56.26	37.51
+D+0.750L													
Dsgn. L = 10.00 ft	1	0.380	0.126	11.86		11.86	52.12	31.21	1.00	1.00	4.74	56.26	37.51
+0.60D													
Dsgn. L = 10.00 ft	1	0.198	0.066	6.19		6.19	52.12	31.21	1.00	1.00	2.48	56.26	37.51

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1434	5.029		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	4.950	4.950
Overall MINimum	0.825	0.825
D Only	4.125	4.125
+D+L	4.950	4.950
+D+0.750L	4.744	4.744
+0.60D	2.475	2.475
L Only	0.825	0.825

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Steel Beam

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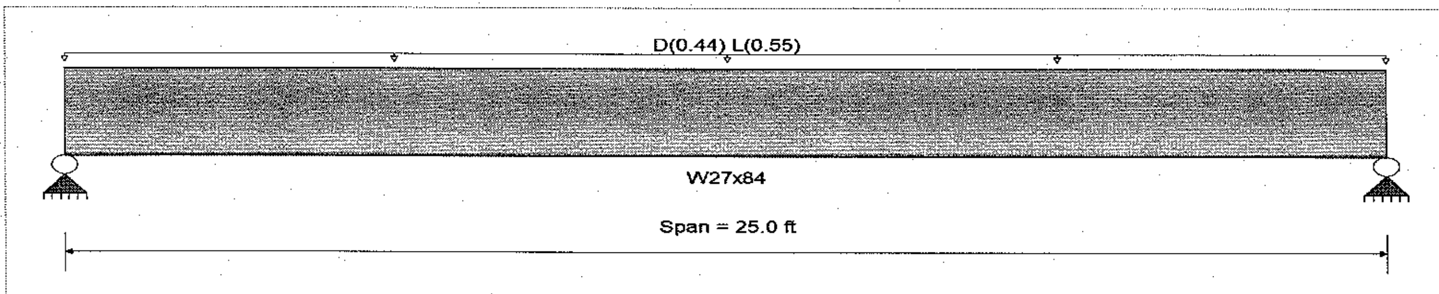
Description : FC - GL CA (roof girder)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.440, L = 0.550 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.127 : 1**	Maximum Shear Stress Ratio =	**0.050 : 1**
Section used for this span	**W27x84**	Section used for this span	**W27x84**
Ma : Applied	77.344 k-ft	Va : Applied	12.375 k
Mn / Omega : Allowable	608.782 k-ft	Vn/Omega : Allowable	245.640 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	12.500ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.059 in	Ratio =	5,105 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.106 in	Ratio =	2837 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 25.00 ft	1	0.056	0.022	34.38		34.38	1,016.67	608.78	1.00	1.00	5.50	368.46	245.64
+D+L													
Dsgn. L = 25.00 ft	1	0.127	0.050	77.34		77.34	1,016.67	608.78	1.00	1.00	12.38	368.46	245.64
+D+0.750L													
Dsgn. L = 25.00 ft	1	0.109	0.043	66.60		66.60	1,016.67	608.78	1.00	1.00	10.66	368.46	245.64
+0.60D													
Dsgn. L = 25.00 ft	1	0.034	0.013	20.63		20.63	1,016.67	608.78	1.00	1.00	3.30	368.46	245.64

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1058	12.571		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	12.375	12.375
Overall MINimum	3.300	3.300
D Only	5.500	5.500
+D+L	12.375	12.375
+D+0.750L	10.656	10.656
+0.60D	3.300	3.300
L Only	6.875	6.875

Steel Beam

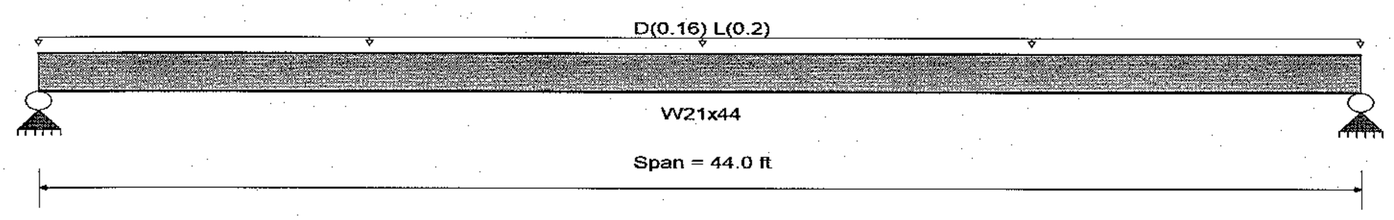
Description : FC - GL C7/C8 (roof joist)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.160, L = 0.20 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.366 : 1**	Maximum Shear Stress Ratio =	**0.055 : 1**
Section used for this span	**W21x44**	Section used for this span	**W21x44**
Ma : Applied	87.120 k-ft	Va : Applied	7.920 k
Mn / Omega : Allowable	238.024 k-ft	Vn/Omega : Allowable	144.90 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	22.000ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.693 in	Ratio =	761 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	1.248 in	Ratio =	423 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 44.00 ft	1	0.163	0.024	38.72		38.72	397.50	238.02	1.00	1.00	3.52	217.35	144.90
+D+L													
Dsgn. L = 44.00 ft	1	0.366	0.055	87.12		87.12	397.50	238.02	1.00	1.00	7.92	217.35	144.90
+D+0.750L													
Dsgn. L = 44.00 ft	1	0.315	0.047	75.02		75.02	397.50	238.02	1.00	1.00	6.82	217.35	144.90
+0.60D													
Dsgn. L = 44.00 ft	1	0.098	0.015	23.23		23.23	397.50	238.02	1.00	1.00	2.11	217.35	144.90

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	1.2475	22.126		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	7.920	7.920
Overall MINimum	2.112	2.112
D Only	3.520	3.520
+D+L	7.920	7.920
+D+0.750L	6.820	6.820
+0.60D	2.112	2.112
L Only	4.400	4.400

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Engineer:
Project ID:
Project Descr:

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Steel Beam

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Lic. # : KW-06001622 Licensee : PETERSON-STREHLE-MARTINSON, INC

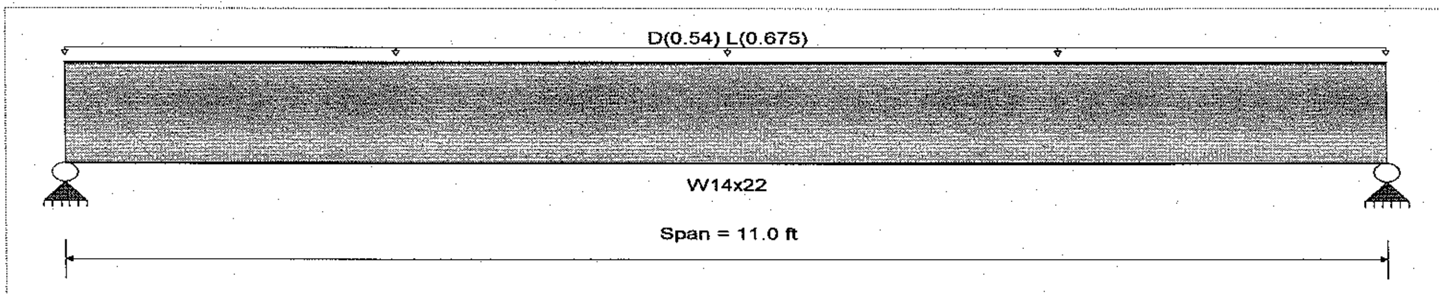
Description : FC - GL CB (roof girder)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.540, L = 0.6750 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.222 : 1**	Maximum Shear Stress Ratio =	**0.106 : 1**
Section used for this span	**W14x22**	Section used for this span	**W14x22**
Ma : Applied	18.377 k-ft	Va : Applied	6.683 k
Mn / Omega : Allowable	82.834 k-ft	Vn/Omega : Allowable	63.020 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	5.500ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.039 in	Ratio =	3,410 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.070 in	Ratio =	1895 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 11.00 ft	1	0.099	0.047	8.17		8.17	138.33	82.83	1.00	1.00	2.97	94.53	63.02
+D+L													
Dsgn. L = 11.00 ft	1	0.222	0.106	18.38		18.38	138.33	82.83	1.00	1.00	6.68	94.53	63.02
+D+0.750L													
Dsgn. L = 11.00 ft	1	0.191	0.091	15.82		15.82	138.33	82.83	1.00	1.00	5.75	94.53	63.02
+0.60D													
Dsgn. L = 11.00 ft	1	0.059	0.028	4.90		4.90	138.33	82.83	1.00	1.00	1.78	94.53	63.02

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.0697	5.531		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	6.683	6.683
Overall MINimum	1.782	1.782
D Only	2.970	2.970
+D+L	6.683	6.683
+D+0.750L	5.754	5.754
+0.60D	1.782	1.782
L Only	3.713	3.713

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Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

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Printed: 11 SEP 2019, 5:25PM

Steel Beam

File = L:\Jobs\2018\18188 - UPS BFI Seattle\Engineering\Enercalc\18188.ec6

Lic. # : KW-06001622 — Licensee : PETERSON-STREHLE-MARTINSON, INC

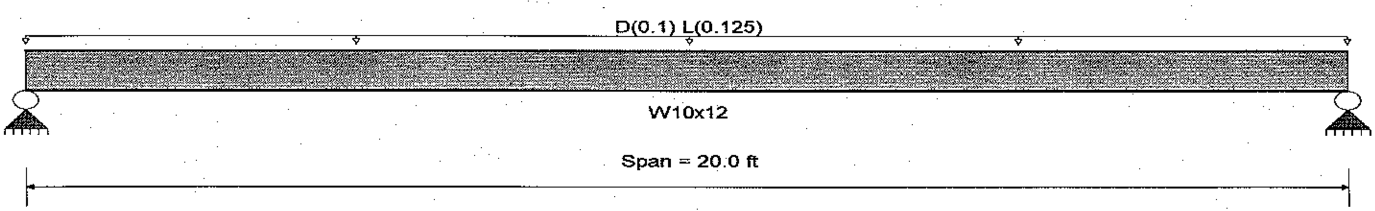
Description : FC - GL 1.5 (roof girder)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.10, L = 0.1250 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.360** : 1	Maximum Shear Stress Ratio =	**0.060** : 1
Section used for this span	**W10x12**	Section used for this span	**W10x12**
Ma : Applied	11.250 k-ft	Va : Applied	2.250 k
Mn / Omega : Allowable	31.207 k-ft	Vn/Omega : Allowable	37.506 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	10.000 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.290 in	Ratio =	828 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.522 in	Ratio =	460 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 20.00 ft	1	0.160	0.027	5.00		5.00	52.12	31.21	1.00	1.00	1.00	56.26	37.51
+D+L													
Dsgn. L = 20.00 ft	1	0.360	0.060	11.25		11.25	52.12	31.21	1.00	1.00	2.25	56.26	37.51
+D+0.750L													
Dsgn. L = 20.00 ft	1	0.310	0.052	9.69		9.69	52.12	31.21	1.00	1.00	1.94	56.26	37.51
+0.60D													
Dsgn. L = 20.00 ft	1	0.096	0.016	3.00		3.00	52.12	31.21	1.00	1.00	0.60	56.26	37.51

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.5215	10.057		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 — Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.250	2.250
Overall MINimum	0.600	0.600
D Only	1.000	1.000
+D+L	2.250	2.250
+D+0.750L	1.938	1.938
+0.60D	0.600	0.600
L Only	1.250	1.250

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Project Title:
Engineer:
Project ID:
Project Descr:

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Steel Beam

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Lic. # : KW-06001622 Licensee : PETERSON-STREHLE-MARTINSON, INC

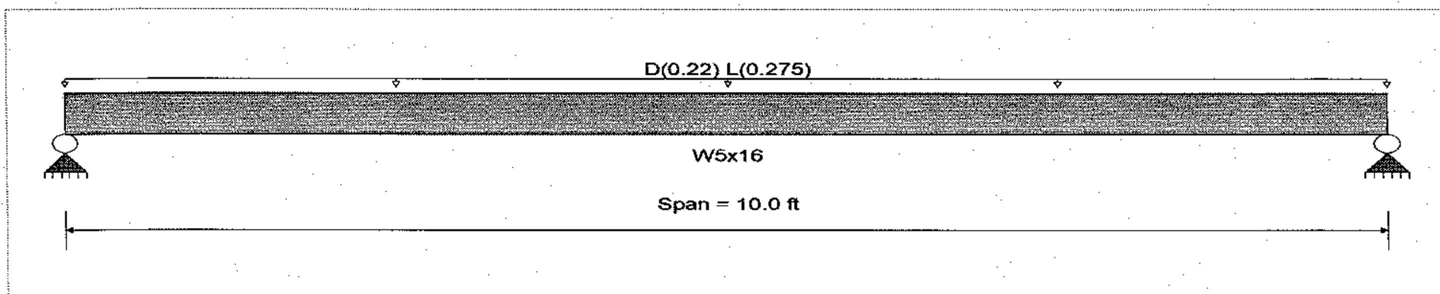
Description : FC - GL CB/1.5 (roof joist)

CODE REFERENCES

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combination Set : ASCE 7-10

Material Properties

Analysis Method :	Allowable Strength Design	Fy : Steel Yield :	50.0 ksi
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling	E: Modulus :	29,000.0 ksi
Bending Axis :	Major Axis Bending		



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight NOT internally calculated and added
Uniform Load : D = 0.220, L = 0.2750 k/ft, Tributary Width = 1.0 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio =	**0.258** : 1	Maximum Shear Stress Ratio =	**0.103** : 1
Section used for this span	**W5x16**	Section used for this span	**W5x16**
Ma : Applied	6.188 k-ft	Va : Applied	2.475 k
Mn / Omega : Allowable	24.027 k-ft	Vn/Omega : Allowable	24.048 k
Load Combination	+D+L	Load Combination	+D+L
Location of maximum on span	5.000 ft	Location of maximum on span	0.000 ft
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.100 in	Ratio =	1,198 >=360
Max Upward Transient Deflection	0.000 in	Ratio =	0 <360
Max Downward Total Deflection	0.180 in	Ratio =	666 >=240
Max Upward Total Deflection	0.000 in	Ratio =	0 <240

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios		Summary of Moment Values							Summary of Shear Values		
Segment Length	Span #	M	V	Mmax +	Mmax -	Ma Max	Mnx	Mnx/Omega	Cb	Rm	Va Max	Vnx	Vnx/Omega
D Only													
Dsgn. L = 10.00 ft	1	0.114	0.046	2.75		2.75	40.13	24.03	1.00	1.00	1.10	36.07	24.05
+D+L													
Dsgn. L = 10.00 ft	1	0.258	0.103	6.19		6.19	40.13	24.03	1.00	1.00	2.48	36.07	24.05
+D+0.750L													
Dsgn. L = 10.00 ft	1	0.222	0.089	5.33		5.33	40.13	24.03	1.00	1.00	2.13	36.07	24.05
+0.60D													
Dsgn. L = 10.00 ft	1	0.069	0.027	1.65		1.65	40.13	24.03	1.00	1.00	0.66	36.07	24.05

Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1803	5.029		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	2.475	2.475
Overall MINimum	0.660	0.660
D Only	1.100	1.100
+D+L	2.475	2.475
+D+0.750L	2.131	2.131
+0.60D	0.660	0.660
L Only	1.375	1.375

/18188

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JOB: UPS BFI
DATE: 9/23/2019 BY: PCR
SUBJECT: FLIGHT CONTROL

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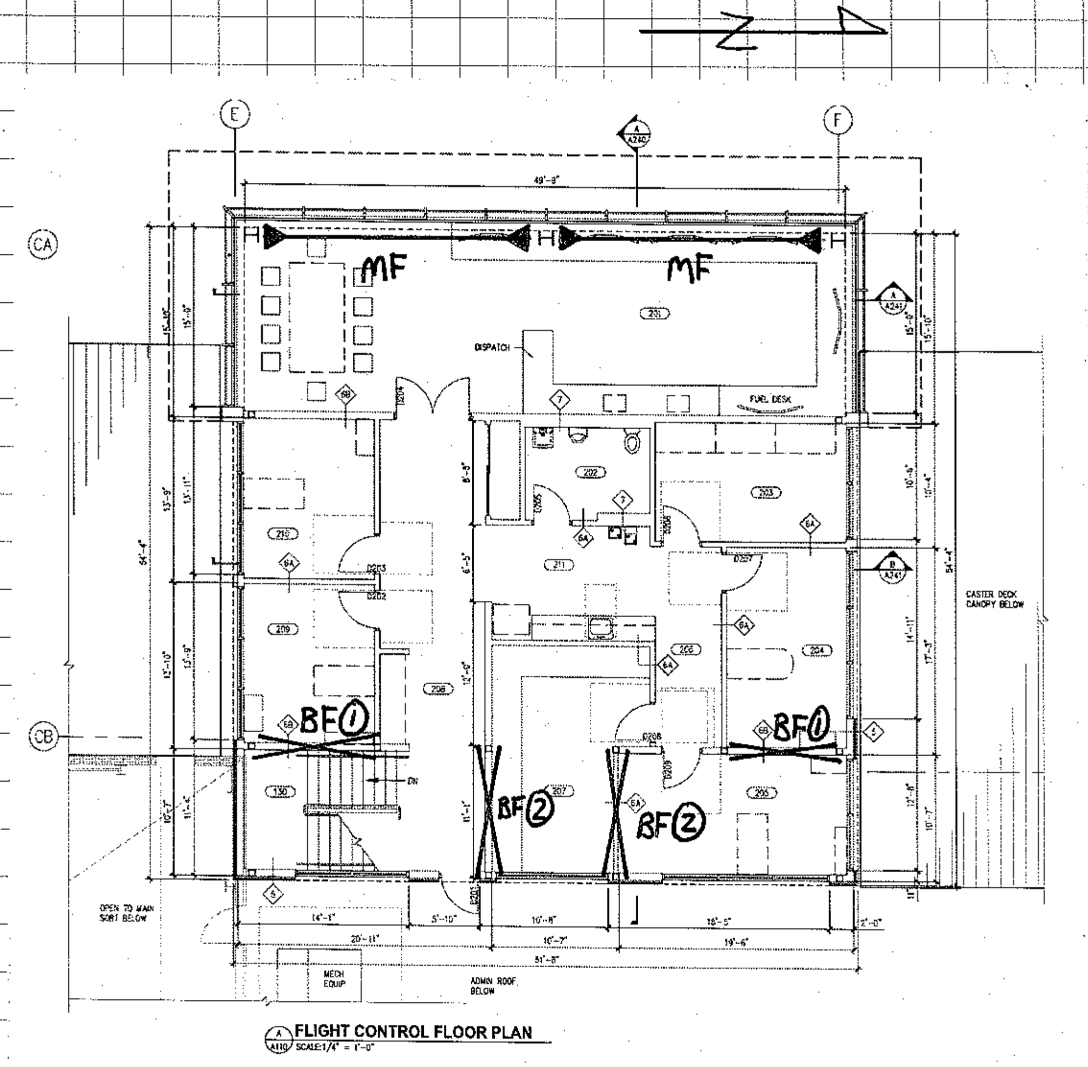

FLIGHT CONTROL FLOOR PLAN
SCALE:1/4" = 1'-0"

MOMENT FRAME (MF) $R = 8.0$

BRACED FRAME (BF) $R = 6.0$

$A_{FLOOR} = 55'\text{-}0'' \times 50'\text{-}0'' = 2750\ sf$

$A_{ROOF} = 2750\ sf + 6'\text{-}0'' \times [\cancel{50'\text{-}0''} + (2 \times 22'\text{-}0'')]$ 565

$= 3315\ sf$

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JOB: UPS BFI
DATE: 9/23/2019 BY: PCB
SUBJECT: FLIGHT CONTROL

$S_{DS} = 1.0$

FLOOR — EXT WALL — 12,600#

$DL_{FLR} = 75\,psf \times 2750\,sf + [2 \times \frac{12'-0"}{2} \times (55'-0" + 50'-0")] \times 10\,psf$
$= 218.9^K$

$DL_{ROOF} = 20\,psf \times 3315\,sf + 12{,}600^{\#}$
$= 78.9^K$

		ULT	ASD
N/S	$V_{MF\_RF} = 1 \times 78.9^K / 2\,SIDES / 2\,MF / 8$	$= 2.5^K$	1.8^K
	$V_{MF\_FLR} = 1 \times 218.9 / 2 / 2 / 8 + 2.5^K$	$= 9.4^K$	6.7^K
N/S	$V_{BF\_RF①} = 1 \times 78.9^K / 2 / 2 / 6$	$= 3.3^K$	2.4^K
	$V_{BF\_FLR①} = 1 \times 218.9 / 2 / 2 / 6 + 3.3^K$	$= 12.4^K$	8.9^K
E/W	$V_{BF\_RF②} = 1 \times 78.9 / 2\,BFs / 6$	$= 6.6^K$	4.7^K
	$V_{BF\_FLR②} = 1 \times 218.9 / 2 / 6 + 6.6^K$	$= 24.5^K$	17.5^K

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Peterson Strehle Martinson, Inc. **Consulting Engineers** 2200 Sixth Avenue Suite 601, Seattle, WA 98121-1849 ph: 206 622 4580 | fx: 206 622 0422	PSM	Job: UPS BFI (18188) Date: By: Re: E/W top floor

Braced Frame on grid line at floor

Input

Geometry		Load		Material Properties	
H_{STR}[1]	11.3 ft	P_U[3]	8.6 k	F_{y_BM}	50 ksi
W_{BAY}[2]	10.8 ft	ρ	1.29	F_{y_COL}	50 ksi
W_{COL_LT}	6 in	Ω_0	2.0	F_{y_BRC}	46 ksi
W_{COL_RT}	6 in	R_y	1.4	F_{y_GP}	36 ksi
D_{BM_TOP}	16 in				
D_{BM_BOT}	16 in				

assumed thicknesses

t_{BR}	0.23 in	OK
t_{BM_FL}	0.35 in	OK
t_C	0.25 in	OK
t_{GP}	1/2 in	OK

Brace Configuration

Working Column & Beam Point centerline

Type[4]	X	
L		7.15 ft
θ		46.43 deg

Output

HSS[5]	4 X 4 X 1/4		P_{CONN}[6]	205 k
$\phi_c P_n$	104 k	OK	P_{ut}	217 k

l_{B_MIN}	7 in	4	sixteenths weld
l_{H_MIN}	16 in	4	sixteenths weld
l_{V_MIN}	12 in	4	sixteenths weld

t_{GP}	1/2 in	NO	stiffener

Note 1. H_{STR} refers to story height from top of beam to top of beam.
Note 2. W_{BAY} refers to distance from centerline of column to centerline of column.
Note 3. $P_U = \rho\, Q_E$ perASCE 7-02. This is the force in brace member under design.
Note 4. "X" for cross-bracing and "V" for chevron bracing.
Note 5. Most efficient member automatically picked. Engineer may overwrite. Beware of syntax.
Note 6. Maximum of $P_U R_y \Omega_0 / \rho$ and $1.1\, P_n R_y$ (P_n function of actual unbraced length)

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Consulting Engineers
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PSM

Job:	UPS BFI (18188)
Date:	
By:	
Re:	E/W

Braced Frame on grid line at floor

Input

Geometry

H_{STR}[1]	17.7 ft
W_{BAY}[2]	10.8 ft
W_{COL_LT}	6 in
W_{COL_RT}	6 in
D_{BM_TOP}	16 in
D_{BM_BOT}	16 in

Load

P_U[3]	31.9 k
ρ	1.29
Ω_0	2.0
R_y	1.4

Material Properties

F_{y_BM}	50 ksi
F_{y_COL}	50 ksi
F_{y_BRC}	46 ksi
F_{y_GP}	36 ksi

assumed thicknesses

t_{BR}	0.23 in	OK
t_{BM_FL}	0.35 in	OK
t_C	0.25 in	OK
t_{GP}	1/2 in	OK

Brace Configuration
Working Column & Beam
Point centerline

Type[4]	X
L	9.64 ft
θ	58.69 deg

Output

HSS[5]	4 X 4 X 1/4		
$\phi_c P_n$	87 k	OK	

P_{CONN}[6]	176 k
P_{ut}	217 k

l_{B_MIN}	6 in	4	sixteenths weld
l_{H_MIN}	13 in	4	sixteenths weld
l_{V_MIN}	12 in	4	sixteenths weld

t_{GP}	1/2 in	NO	stiffener

Note 1. H_{STR} refers to story height from top of beam to top of beam.
Note 2. W_{BAY} refers to distance from centerline of column to centerline of column.
Note 3. $P_U = \rho Q_E$ perASCE 7-02. This is the force in brace member under design.
Note 4. "X" for cross-bracing and "V" for chevron bracing.
Note 5. Most efficient member automatically picked. Engineer may overwrite. Beware of syntax.
Note 6. Maximum of $P_U R_y \Omega_0 / \rho$ and 1.1 $P_n R_y$ (P_n function of actual unbraced length)

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Consulting Engineers
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PSM

Job:	UPS BFI (18188)
Date:	
By:	
Re:	N/S TOP FLOOR

Braced Frame on grid line A at floor ROOF

Input

Geometry		Load		Material Properties	
H_{STR}[1]	11.3 ft	P_U[3]	4.3 k	F_{y_BM}	50 ksi
W_{BAY}[2]	9.7 ft	ρ	1.29	F_{y_COL}	46 ksi
W_{COL_LT}	6 in	Ω_0	2.0	F_{y_BRC}	46 ksi
W_{COL_RT}	6 in	R_y	1.4	F_{y_GP}	36 ksi
D_{BM_TOP}	16 in				
D_{BM_BOT}	16 in				

assumed thicknesses

t_{BR}	0.23 in	OK
t_{BM_FL}	0.35 in	OK
t_C	0.25 in	OK
t_{GP}	1/2 in	OK

Brace Configuration
Working Column & Beam
Point centerline

Type[4]	X	
L		6.76 ft
θ		49.23 deg

Output

HSS[5]	4 X 4 X 1/4	P_{CONN}[6]	210 k
$\phi_c P_n$	107 k OK	P_{ut}	217 k

l_{B_MIN}	8 in	4	sixteenths weld
l_{H_MIN}	16 in	4	sixteenths weld
l_{V_MIN}	13 in	4	sixteenths weld

t_{GP}	1/2 in	NO	stiffener

Note 1. H_{STR} refers to story height from top of beam to top of beam.
Note 2. W_{BAY} refers to distance from centerline of column to centerline of column.
Note 3. $P_U = \rho\, Q_E$ perASCE 7-02. This is the force in brace member under design.
Note 4. "X" for cross-bracing and "V" for chevron bracing.
Note 5. Most efficient member automatically picked. Engineer may overwrite. Beware of syntax.
Note 6. Maximum of $P_U R_y \Omega_0 / \rho$ and $1.1\, P_n R_y$ (P_n function of actual unbraced length)

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Peterson Strehle Martinson, Inc.		
Consulting Engineers	Job:	UPS BFI (18188)
2200 Sixth Avenue Suite 601, Seattle, WA 98121-1849	Date:	
ph: 206 622 4580 | fx: 206 622 0422	By:	
	Re:	N/S

PSM

Braced Frame on grid line A at floor ROOF

Input

Geometry			Load		Material Properties	
H_{STR}[1]	17.7 ft		P_U[3]	16.2 k	F_{y_BM}	50 ksi
W_{BAY}[2]	9.7 ft		ρ	1.29	F_{y_COL}	46 ksi
W_{COL_LT}	6 in		Ω_0	2.0	F_{y_BRC}	46 ksi
W_{COL_RT}	6 in		R_y	1.4	F_{y_GP}	36 ksi
D_{BM_TOP}	16 in					
D_{BM_BOT}	16 in					

assumed thicknesses

t_{BR}	0.23 in	OK
t_{BM_FL}	0.35 in	OK
t_C	0.25 in	OK
t_{GP}	3/4 in	OK

Brace Configuration

Working Column & Beam
Point centerline

Type[4]	X
L	9.38 ft
θ	61.24 deg

Output

HSS[5]	4 X 4 X 1/4		P_{CONN}[6]	183 k
$\phi_c P_n$	90 k	OK	P_{ut}	217 k

l_{B_MIN}	7 in	4	sixteenths weld
l_{H_MIN}	12 in	4	sixteenths weld
l_{V_MIN}	13 in	4	sixteenths weld

t_{GP}	3/4 in	NO	stiffener

Note 1. H_{STR} refers to story height from top of beam to top of beam.
Note 2. W_{BAY} refers to distance from centerline of column to centerline of column.
Note 3. $P_U = \rho\, Q_E$ perASCE 7-02. This is the force in brace member under design.
Note 4. "X" for cross-bracing and "V" for chevron bracing.
Note 5. Most efficient member automatically picked. Engineer may overwrite. Beware of syntax.
Note 6. Maximum of $P_U R_y \Omega_0 / \rho$ and $1.1 P_n R_y$ (P_n function of actual unbraced length)

PETERSON STREHLE MARTINSON, INC.
Consulting Engineers
2200 Sixth Avenue, Suite 601
Seattle, Washington 98121
Office (206) 622-4580 / Fax (206) 622-0422

JOB: **UPS BFI**
DATE: Oct 29,19 BY: PCB
SUBJECT: Reduced Beam Section Design
SHEET NO. OF

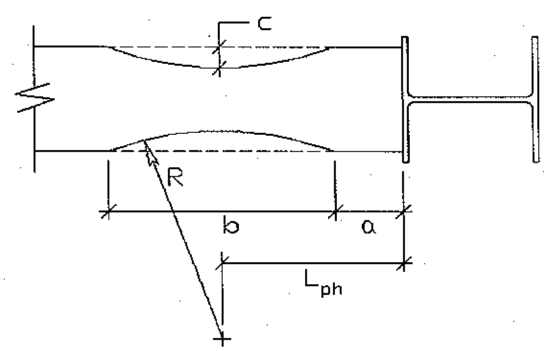
Description
This speadsheet calculates and checks the plastic moment capacity for a "reduced beam section" (RBS). This speadsheet assumes a non-composite steel beam section.

Beam Input Data

Section	**W27X94**	
L_{clr} =	**25**	ft.: Clear span of beam member
d =	**27**	in.: Depth of beam
t_w =	**0.49**	in.: Web thickness
b_f =	**10**	in.: Flange width
t_f =	**0.745**	in.: Flange thickess
Z_x =	**278**	in.^{3}: Plastic section modulus
$V_{u,g}$	**20**	kips: Factored gravity shear load at RBS
F_y =	**50**	ksi: Yield strength of steel
R_y =	**1.1**	Ration of expected yield stength to minimum steel strength
C_{pr} =	**1.15**	Coefficient used to account for peak strenght of connection

Reduced Beam Section Data

a =	**6**	in.
b =	**18**	in.
c =	**1.75**	in.
$R = (4c^2 + b^2)/(8c)$ =	24.0	in
$L_{ph} = a + (b/2)$ =	15	in.



Calculations
Check moment resistance of flanges

$Z_{xf} = (b_f t_f) \times (d - t_f)$ = 197.4995 in.^{3}

Z_{xf}/Z_p = 0.71 **> 0.7 - Okay**

Check RBS local flange stability

$b_{f,eff} = 2(R-c) + b_f - (2\sqrt{[R^2 - (b_f/3)^2]}$ = 6.96 In.

$b_{f,eff}/(2t_f)$ = 4.67

$52/\sqrt{(F_y)}$ = 7.35 **Local Flange Stability at RBS is okay.**

Calculate Z_{RBS}

$Z_{RBS} = Z_x - 2ct_f(d - t_f)$ = 209.54 In.^{3}

Calculate M_{RBS} and V_{RBS}

$M_{RBS} = C_{pr} \times R_y \times Z_{RBS} \times F_y$ = 1104.45 k-ft. <---------To be used with ϕ

$V_{RBS} = [2M_{RBS} / (L_{clr} - 2L_{ph})] + V_{u,g}$ = 118.17 kips <---------To be used with ϕ

$V'_{RBS} = [-2M_{RBS} / (L_{clr} - 2L_{ph})] + V_{u,g}$ = 9.50 kips <---------To be used with ϕ

Calculate and check M_F

$M_F = M_{RBS} + V_{RBS}L_{ph}$ = 1252.17 k-ft.

$R_y \times Z_x \times F_y$ = 1274.17 k-ft. **RBS is okay.**

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JOB: UPS BFI
DATE: 10/15/2019 BY: PCB
SUBJECT:

$OTM_{MF} = 2\times\left(1.8^K \times 32'\text{-}0'' + (6.7-1.8)^K \times 16'\text{-}0''\right) = 272.0 \text{ k-ft}$

$RM = 0.6 \times \left[15_{psf} \times \left(\overset{ROOF}{\frac{42'\text{-}0''}{2}} + 5'\text{-}0''\right) \times 50'\text{-}0'' + 10_{psf}\ \overset{WALL}{(42'\text{-}0'' + 50'\text{-}0'')} \times 16'\text{-}0'' + 75_{psf} \times \frac{42'\text{-}0''}{2} \times 50'\text{-}0''\right] \times \frac{50'\text{-}0''}{2}$

$= 1695 \text{ ft-k} < 272 \text{ k-ft}$ $\boxed{\text{NO UPLIFT}}$

$OTM_{BF\text{-}N/S} = 2.4^K \times 32'\text{-}0'' + 8.9^K \times 16'\text{-}0'' = 219.2 \text{ ft-k}$

$RM = 0.6 \times \left[15_{psf} \times \frac{\cancel{42'+10'}\ 26}{\cancel{2}} \times 10'\text{-}0'' + 10_{psf} \times \overset{WALL}{16'\text{-}0'' \times 26'\text{-}0''} + 75_{psf} \times 26'\text{-}0'' \times 10'\text{-}0''\right] \times 10'\text{-}0''/2$

$= 82.7 \text{ ft-k}$

$T = C = (219.2 - 82.7) \text{ ft-k} / 10'\text{-}0''$
$= 13.7^K$

$DL_{FTG} = 10'\text{-}0'' \times (\overset{FTG}{4'\text{-}0'' \times 2'\text{-}0''} + \overset{STEM}{2'\text{-}0'' \times 1'\text{-}0''}) \times 0.15 \text{ kcf}$
$= 15.0^K > 13.7^K$ OK

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$$OTM_{BF\_E/W} = 4.7 \times 32'\text{-}0" + (17.5 - 4.7) \times 16'\text{-}0"$$
$$= 355.2 \text{ ft-K}$$

$$RM = 0.6 \times \left(15\text{psf} \times \tfrac{10'}{2} \times 15'\text{-}0" + 10\text{psf} \times 16'\text{-}0" \times 15'\text{-}0" + 75\text{psf} \times 5'\text{-}0" \times 15'\text{-}0"\right) \times \tfrac{10'}{2}$$
$$= 27.5 \text{ ft-K}$$

$$C = T = (355.2 - 27.5)/10'$$
$$= 32.8^K$$

$$DL = 0.15\text{kcf} \times 7'\text{-}0" \times 7'\text{-}0" \times 2'\text{-}0" = 14.7^K$$
$$\text{"} \quad \times 2'\text{-}0" \times 2'\text{-}0" \times 2'\text{-}0" = 1.2^K$$
$$\text{"} \quad \times \tfrac{5"}{12} \times 10'\text{-}0" \times 10'\text{-}0" = 6.2^K$$
$$0.11\text{kcf} \times 7'\text{-}0" \times 7'\text{-}0" \times 1'\text{-}6" = 8.1^K$$

$$\Sigma = 30.2^K$$

NG - CONN BF FΔNS & USE 18'-0" x 7'-0" x 2'-0"

PSM Engineers
2200 6th Avenue., #601, Seattle, WA 98121

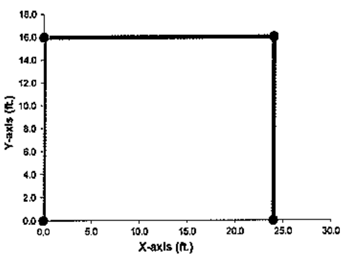
Job Name:		Subject:			
Job Number:		Date:		By:	

PORTAL RIGID PLANE FRAME ANALYSIS
For Fixed or Pinned Bases

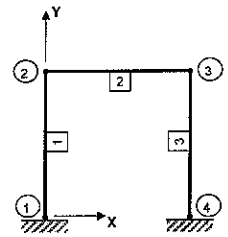
Input Data:

Joint Coordinates:

Joint No.	x (ft.)	y (ft.)
1	0.0000	0.0000
2	0.0000	16.0000
3	24.0000	16.0000
4	24.0000	0.0000



Plot of Portal Frame



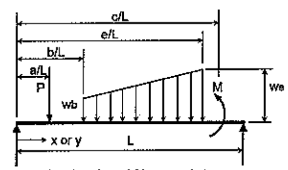
Portal Frame Nomenclature

Support Constraints:

Joint No.	Condition
1	Fixed
4	Fixed

Member Properties and Data:

Member No.	E (ksi)	A (in.^2)	I (in.^4)	L (ft.)	λx	λy
1	29000	26.5	999.0	16.0000	0.0000	1.0000
2	29000	24.8	2850.0	24.0000	1.0000	0.0000
3	29000	26.5	999.0	16.0000	0.0000	1.0000



Member Load Nomenclature

Note: *Point loads or moments at member ends must be input as joint loads.*

Joint Loads:

ASD

Joint No.	Px (kips)	Py (kips)	Mz (ft-k)
1			
2	17.00		
3			
4			

Member Loads:

Distributed Loads:

Member		Distributed Load #1				Distributed Load #2				Distributed Load #3				Distributed Load #4				Distributed Load #5			
No.	Load Direct.	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)
1	X-Global																				
2	Y-Global	0.0000	3.1500	1.0000	3.1500																
2	X-Projected																				
3	X-Global																				

Point Loads:

Member		Point Load #1		Point Load #2		Point Load #3		Point Load #4		Point Load #5		Point Load #6		Point Load #7		Point Load #8		Point Load #9		Point Load #10	
No.	Load Direct.	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)
1	X-Global																				
2	Y-Global																				
2	X-Global																				
3	X-Global																				

Applied Moments:

Member No.	Moment #1		Moment #2		Moment #3		Moment #4	
	c/L	M (ft-kips)	c/L	M (ft-kips)	c/L	M (ft-kips)	c/L	M (ft-kips)
1								
2								
3								

Results:

Support Reactions:

Joint No.	Rx (kips)	Ry (kips)	Mz (ft-k)
1	-15.77	-43.00	112.41
4	-1.23	-32.60	34.76

Member End Forces:

Member No.	Joint No.	Axial (k)	Shear (k)	Moment (ft-k)
1	1	-43.00	15.77	112.41
	2	43.00	-15.77	139.96
2	2	1.23	-43.00	-139.96
	3	-1.23	-32.60	15.13
3	4	-32.60	1.23	34.76
	3	32.60	-1.23	-15.13

Member Maximum Moments:

Member No.	+M or -M	M (ft-k)	x or y (ft.)
1	+M(max)	139.96	16.00
	-M(max)	-112.41	0.00
2	+M(max)	139.96	0.00
	-M(max)	-153.55	13.65
3	+M(max)	0.00	0.00
	-M(max)	-34.76	0.00

Joint Displacements:

Joint No.	Δx (in.)	Δy (in.)	θz (rad.)
1	0.0000	0.0000	0.0000
2	0.2159	0.0107	0.0011
3	0.2154	0.0081	-0.0020
4	0.0000	0.0000	0.0000

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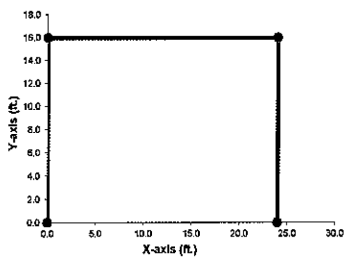
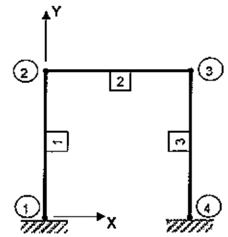
Input Data:

Joint Coordinates:

Joint No.	x (ft.)	y (ft.)
1	0.0000	0.0000
2	0.0000	16.0000
3	24.0000	16.0000
4	24.0000	0.0000



Plot of Portal Frame



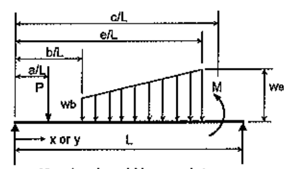
Portal Frame Nomenclature

Support Constraints:

Joint No.	Condition
1	Fixed
4	Fixed

Member Properties and Data:

Member No.	E (ksi)	A (in.^2)	I (in.^4)	L (ft.)	λx	λy
1	29000	26.5	999.0	16.0000	0.0000	1.0000
2	29000	24.8	2850.0	24.0000	1.0000	0.0000
3	29000	26.5	999.0	16.0000	0.0000	1.0000



Member Load Nomenclature

Note: *Point loads or moments at member ends must be input as joint loads.*

Joint Loads:

ASD

Joint No.	Px (kips)	Py (kips)	Mz (ft-k)
1			
2	8.50		
3			
4			

Member Loads:

Distributed Loads:

Member		Distributed Load #1				Distributed Load #2				Distributed Load #3				Distributed Load #4				Distributed Load #5			
No.	Load Direct.	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)	b/L	wb (k/ft.)	e/L	we (k/ft.)
1	X-Global																				
2	Y-Global	0.0000	3.1500	1.0000	3.1500																
2	X-Projected																				
3	X-Global																				

Point Loads:

Member		Point Load #1		Point Load #2		Point Load #3		Point Load #4		Point Load #5		Point Load #6		Point Load #7		Point Load #8		Point Load #9		Point Load #10	
No.	Load Direct.	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)	a/L	P (kips)
1	X-Global																				
2	Y-Global																				
2	X-Global																				
3	X-Global																				

Applied Moments:

Member No.	Moment #1		Moment #2		Moment #3		Moment #4	
	c/L	M (ft-kips)	c/L	M (ft-kips)	c/L	M (ft-kips)	c/L	M (ft-kips)
1								
2								
3								

Results:

Support Reactions:

Joint No.	Rx (kips)	Ry (kips)	Mz (ft-k)
1	-11.50	-40.40	75.37
4	3.00	-35.20	-1.78

Member End Forces:

Member No.	Joint No.	Axial (k)	Shear (k)	Moment (ft-k)
1	1	-40.40	11.50	75.37
	2	40.40	-11.50	108.59
2	2	-3.00	-40.40	-108.59
	3	3.00	-35.20	46.18
3	4	-35.20	-3.00	-1.78
	3	35.20	3.00	-46.18

Member Maximum Moments:

Member No.	+M or -M	M (ft-k)	x or y (ft.)
1	+M(max)	108.59	16.00
	-M(max)	-75.37	0.00
2	+M(max)	108.59	0.00
	-M(max)	-150.49	12.83
3	+M(max)	1.78	0.00
	-M(max)	-46.18	16.00

Joint Displacements:

Joint No.	Δx (in.)	Δy (in.)	θz (rad.)
1	0.0000	0.0000	0.0000
2	0.1072	0.0101	0.0013
3	0.1084	0.0088	-0.0018
4	0.0000	0.0000	0.0000

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GL CA/C7.5

DL = 2 x 19.7^K = 39.4^K (FLOOR)
= 10psf x 16'-0" x 25'-0" = 4.0^K (EXT WALL)
= 2 x 4.9^K = 9.8^K (ROOF)
= 150pcf x 4'-0" x 2'-0" x 2'-4" = 3.0^K (PLINTH)
= 5.9^K (CASTER DECK)
= 19.4^K (SOIL)

81.5^K

M = 112.4 ft-k

T = C = 112.4 / 12'-0" + 43^K = 53.4^K

DL = 0.6 x (81.5^K + 0.15 kcf x 2'-0" x 6'-0" x 12'-0")
= 61.9^K > 53.4^K

$\boxed{\text{USE FTG 12'-0" x 6'-0" x 2'-0"}}$

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GL CA/7 &8

DL	$= 8\,psf \times \frac{33'-0''}{2} \times \frac{42'-0''}{2}$	$= 2.7^K$	(CANOPY ROOF)
	$= 75\,psf \times \frac{25'-0''}{2} \times 21'-0''$	$= 19.7^K$	(FC FLOOR)
	$= 10\,psf \times 16'-0'' \times (12.5' + 21')$	$= 5.4^K$	(EXT WALL-FC)
	$= 15\,psf \times 12.5' \times (21' + 5')$	$= 4.9^K$	(ROOF-FC)
	$= 150\,pcf \times 4'-0'' \times 2'-4'' \times 4'-6''$	$= 6.3^K$	(PLINTH)
	$= 150\,pcf \times 6\tfrac{1}{2}/12 \times 12'-0'' \times 6'-0''$	$= 5.9^K$	(CASTER DECK)
	$= 110\,pcf \times 2'-0'' \times 11'-0'' \times 8'-0''$	$= 19.4^K$	(SOIL)

$\Sigma = 64.3^K$

$M = 75.4\ ft\text{-}k$

$T = C = 75.4\ ft\text{-}k / 12'-0'' + 40.4^K$
$= 46.7^K$

$DL = 0.6 \times (64.3 + 0.15\,pcf \times 2'-0'' \times 6'-0'' \times 12'-0'')$
$= 51.5^K > 46.7^K$

$\boxed{\text{USE FTG } 12'-0'' \times 6'-0'' \times 2'-0''}$

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

CONSTRUCTION — The pole shaft sections shall be high strength low alloy steel conforming to ASTM A572 Grade 55 or ASTM A595 Grade A. Cross section shall be round. Each section is a constant tapered hollow steel section and shall be up to 55 feet in length with a minimum 1-1/2 times diameter slip joint as standard for two section poles. The plate shall be single thickness - no laminations.

Anchor base is fabricated from hot-rolled carbon steel plate that conforms to ASTM A36. Base plate and shaft are circumferentially welded top and bottom or full penetration groove welded.

Oval shaped reinforced handhole having a nominal dimension of 4" x 6.5". Cover with attachment screws included. Handhole is located 18" above the base.

Top cap provided with all drill mount plates.

Fasteners are high-strength galvanized, zinc-plated or stainless steel.

Finish: Must specify finish.

Grounding: Provision located inside handhole rim. Grounding hardware is not included (provided by others).

Anchor bolts: Top portion of anchor blot is galvanized per ASTM A-153. Made of steel rod having a minimum yield strength of 55,000 psi.

WARRANTY — 1-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Actual performance may differ as a result of end-user environment and application.

Note: Specifications subject to change without notice.

Anchor Base Poles

SPRTS

ROUND TAPERED STEEL SPORTSLIGHTING

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: SPRTS 40 HT01 ACR2 DDB

SPRTS					
Series	**Nominal fixture mounting height**[1]	**Nominal shaft base size/wall thickness**	**Mounting**[1]	**Options**	**Finish**[4]
SPRTS	40 – 80 feet	(see back page)	Angle iron crossarms	Shipped installed	Standard colors
	(see back page)		ACR2 2 fixture angle arm	L/AB Less anchor bolts	DDB Dark bronze
			ACR3 3 fixture angle arm	FBC Full base cover	DWH White
			ACR4 4 fixture angle arm	VD Vibration damper	DBL Black
			ACR5 5 fixture angle arm	TP Tamper proof	DMB Medium bronze
			ACR6 6 fixture angle arm	H1-18Sxx Horizontal arm bracket (1 fixture)[2,3]	DNA Natural aluminum
			Tubular crossarms	FDLxx Festoon outlet less electrical[2]	GALV Galvanized finish
			CR2 2 fixture crossarm	CPL12xx 1/2" coupling[2]	Classic colors
			CR3 3 fixture crossarm	CPL34xx 3/4" coupling[2]	DSS Sandstone
			CR4 4 fixture crossarm	CPL1xx 1" coupling[2]	DGC Charcoal gray
			CR5 5 fixture crossarm	NPL12xx 1/2" threaded nipple[2]	DTG Tennis green
			CR6 6 fixture crossarm	NPL34xx 3/4" threaded nipple[2]	DBR Bright red
			CR7 7 fixture crossarm	NPL1xx 1" threaded nipple[2]	DSB Steel blue
			CR8 8 fixture crossarm	EHHxx Extra handhole[2]	Architectural colors
				MAEX Match existing	(powder finish)[4]

IMPORTANT INSTALLATION NOTES:

- **Do not** erect poles without fixtures in place.
- Factory-supplied templates must be used when setting anchor bolts. Lithonia will not accept claim for incorrect anchorage placement due to failure to use Lithonia Lighting factory template.
- If poles are stored outside, all protective wrapping must be removed immediately upon delivery to prevent finish damage.

Notes

1 Mounting height is to lowest fixture when multiple arms are utilized, unless otherwise specified.

2 Specify location and orientation when ordering option.
For 1st "x": Specify the height in feet above base of pole.
Example: 5ft = 5 and 20ft = 20
For 2nd "x": Specify orientation from handhole (A,B,C,D)
Refer to the Handhole Orientation diagram on this page.

3 Horizontal arm is 18" x 2-3/8" O.D. tenon standard.

4 Finish must be specified. Additional colors available; see www.lithonia.com/archcolors or Architectural Colors brochure (Form No. 794.3). Powder finish standard.

SPRTS Round Tapered Steel Poles Sportslighting

For 40' pole, we have used "SPRT40HT02" design number

TECHNICAL INFORMATION

Design Number	Nominal pole height (feet) [1]	BOTTOM SECTION		TOP SECTION		AASHTO 2009 ALLOWABLE LOADING [3]						ANCHOR BOLTS			Approximate ship weight (lbs) [4]
		Base diameter (inch) [2]	Wall thickness (inch)	Base diameter (inch) [2]	Wall thickness (inch)	90 MPH		100 MPH		110 MPH		Bolt circle (inch)	Bolt size (in. x in. x in.)	Number of bolts	
						EPA sq. ft.	Weight (lbs)	EPA sq. ft.	Weight (lbs)	EPA sq. ft.	Weight (lbs)				
SPRTS 40 HT01	38.75	9.00	0.1793	--	--	26.1	654	21.0	525	17.2	430	12.5	1.25 x 42 x 6	4	474
SPRTS 40 HT02	38.75	10.00	0.1793	--	--	41.0	1025	33.5	838	28.0	700	14.00	1.50 x 54 x 6	4	551
SPRTS 50 HT01	50.00	10.00	0.1793	--	--	18.0	450	14.0	350	11.0	275	13.50	1.25 x 42 x 6	4	633
SPRTS 50 HT02	50.00	10.00	0.1793	--	--	22.5	563	18.7	470	15.5	390	14.00	1.50 x 54 x 6	4	633
SPRTS 50 HT03	50.00	11.00	0.1793	--	--	31.5	790	26.0	650	21.5	540	15.00	1.50 x 54 x 6	4	733
SPRTS 50 HT04	50.00	13.00	0.1793	--	--	50.4	1260	40.5	1020	34.0	850	17.50	1.75 x 84 x 6	4	933
SPRTS 50 HT05	50.00	13.00	0.2391	--	--	70.5	1770	58.5	1475	49.0	1225	18.00	2.00 x 84 x 6	4	1223
SPRTS 55 HT01	55.00	10.50	0.1793	4.08	0.1793	15.3	381	11.5	288	8.8	225	14.00	1.25 x 42 x 6	4	728
SPRTS 55 HT02	55.00	11.00	0.1793	4.59	0.1793	24.0	600	20.0	500	16.5	420	15.00	1.50 x 54 x 6	4	785
SPRTS 55 HT03	55.00	13.00	0.1793	6.62	0.1793	43.8	1075	34.8	875	28.5	725	17.50	1.75 x 84 x 6	4	1015
SPRTS 55 HT04	55.00	13.00	0.2391	8.26	0.1793	57.0	1425	47.5	1200	40.5	1025	18.00	2.00 x 84 x 6	4	1275
SPRTS 60 HT01	60.00	13.00	0.2391	10.76	0.1793	15.0	750	15.0	750	15.0	750	17.00	1.25 x 42 x 6	6	1263
SPRTS 60 HT02	60.00	14.44	0.2500	12.00	0.1793	22.0	1100	22.0	1100	21.5	645	18.50	1.25 x 42 x 6	6	1507
SPRTS 60 HT03	60.00	14.44	0.3125	12.00	0.1793	33.0	1650	33.0	1650	33.0	1650	19.50	1.50 x 54 x 6	6	1692
SPRTS 60 HT04	60.00	14.44	0.3750	12.00	0.1793	44.0	2200	44.0	1320	37.0	1110	19.50	1.50 x 54 x 6	6	1876
SPRTS 60 HT05	60.00	15.58	0.3750	13.00	0.1793	52.5	2625	50.5	1515	41.0	1230	21.00	1.50 x 54 x 6	6	[illegible]
SPRTS 60 HT06	60.00	18.50	0.3750	17.00	0.1875	78.0	3900	78.0	2340	64.0	1920	23.50	1.50 x 54 x 6	8	[illegible]
SPRTS 70 HT01	70.00	14.44	0.2500	12.00	0.1793	14.0	700	14.0	700	14.0	700	19.00	1.25 x 42 x 6	6	[illegible]
SPRTS 70 HT02	70.00	14.44	0.3125	12.00	0.1793	23.5	1175	23.5	1175	23.5	1011	21.00	1.50 x 54 x 6	6	[illegible]
SPRTS 70 HT03	70.00	14.44	0.3750	12.00	0.1793	33.0	1452	30.0	900	25.0	750	21.00	1.50 x 54 x 6	6	1987
SPRTS 70 HT04	70.00	15.44	0.3750	13.00	0.1793	38.5	1925	37.0	1110	30.5	915	21.00	1.50 x 54 x 6	6	2102
SPRTS 70 HT05	70.00	17.50	0.3750	13.00	0.1793	52.0	2600	52.0	2600	49.0	1470	23.00	1.50 x 54 x 6	8	2952
SPRTS 70 HT06	70.00	19.50	0.3750	17.08	0.1875	67.0	3350	66.5	1995	53.0	1590	25.00	1.50 x 54 x 6	8	3061
SPRTS 80 HT01	80.00	15.84	0.3125	12.00	0.1793	21.0	1050	21.0	1050	21.0	1050	21.00	1.50 x 54 x 6	6	2311
SPRTS 80 HT02	80.00	15.84	0.3750	12.00	0.1793	30.0	1500	28.5	855	22.5	675	21.00	1.50 x 54 x 6	6	2591
SPRTS 80 HT03	80.00	16.84	0.3750	13.00	0.1793	36.0	1800	35.0	1050	29.0	870	21.50	1.50 x 54 x 6	8	2831
SPRTS 80 HT04	80.00	18.50	0.3750	13.00	0.1793	45.0	2250	45.0	2250	38.0	1140	23.00	1.50 x 54 x 6	8	3511
SPRTS 80 HT05	80.00	20.50	0.3750	16.68	0.1875	58.0	2900	58.0	2900	51.5	1545	25.50	1.75 x 84 x 6	8	3773
SPRTS 80 HT06	80.00	22.50	0.3750	18.68	0.1875	71.0	3550	71.0	3550	64.0	1920	27.50	1.75 x 84 x 6	8	4271

For 60' pole, we have used "SPRT60HT01" design number

Notes

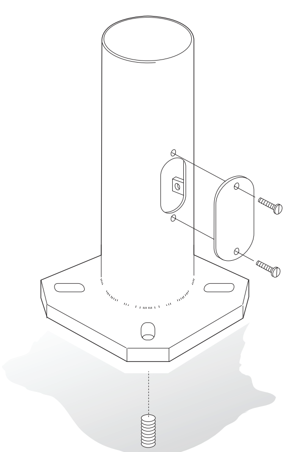
1 Poles that are 55' or less have a socketed base connection. All others have a full penetration groove weld.

2 Sections that are 13.0" or less are ASTM A595 Grade 55. All other sections are ASTM A572 Grade 55.

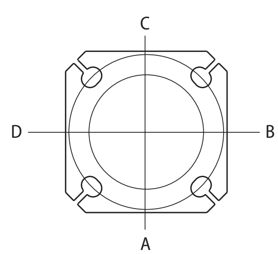
3 Poles higher than 55' will be analyzed to fatigue category 1.

4 Does not include base place, anchor bolts, or cross arms.

BASE DETAIL

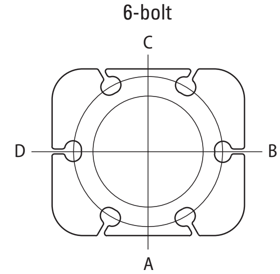


4-bolt



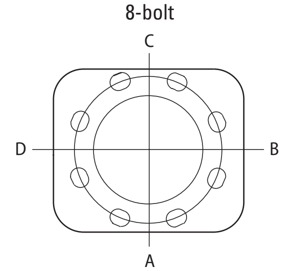
Hand hole

6-bolt



Hand hole

8-bolt



Hand hole

Notes

1 Base plate material: ASTM A36.

2 Hand holes are reinforced.

IMPORTANT:

• These specifications are intended for general purposes only. Lithonia reserves the right to change material or design, without prior notice, in a continuing effort to upgrade its products

LITHONIA LIGHTING® An Acuity Brands Company

OUTDOOR: One Lithonia Way, Conyers, GA 30012 Phone: 800-279-8041 Fax: 770-918-1209 www.lithonia.com

WIND LOAD CALCULATION OF 40' LIGHT POLE

PSM Engineers
2200 6th Ave., #601, Seattle, WA 98121

ASCE7-10 Wind loads Per Chapter 29

Consider 40' height round pole

Base diameter	0.83	ft	assumed
Top diameter	0.50	ft	assumed

Wind parameters

Structure class	II		
Exposure	B		Sect 26.7
Topographic category	1		Sect 26.8
V (3-sec gust) =	110	mph	Fig 26.5-1A
Kd =	0.95		Table 26.6-1
Pole Height	40	ft	
Wind load factor	1		
Zg =	1200		Table 26.9-1
Alpha =	7		Table 29.3-1

Wind on Pole

Height, z (ft)	Kz	Kzt	qz (psf)	Gh	(assumed - consrv.) Cf Pole	Pressure on Pole (psf)	Pole area (sft)	(SD) shear (lb)	(SD) moment (lb-ft) (lb-ft)
5	0.70	1.00	20.6	0.85	1.2	21.03	4.06	85.43	214
10	0.70	1.00	20.6	0.85	1.2	21.03	3.85	81.05	608
15	0.70	1.00	20.6	0.85	1.2	21.03	3.65	76.67	958
20	0.70	1.00	20.6	0.85	1.2	21.03	3.44	72.29	1265
25	0.70	1.00	20.6	0.85	1.2	21.03	3.23	67.91	1528
30	0.70	1.00	20.6	0.85	1.2	21.03	3.02	63.52	1747
35	0.73	1.00	21.5	0.85	1.2	21.98	2.81	61.81	2009
40	0.76	1.00	22.4	0.85	1.2	22.83	2.60	59.45	2230
Reactions at base due wind on pole								568	10558

Additional load at pole top

	Height, z (ft)	Kz	Kzt	qz (psf)	Gh	(assumed - consrv.) Cf	Pressure (psf)	Qty	Area (sqft)	Weight (lbs)	Wind force (lbs)	Moment (kft)
Light	40	0.76	1.00	22.38	0.85	1.2	22.83	4	0.53	12.2	48.40	1.94
Mount	40	0.76	1.00	22.38	0.85	1.2	22.83	4	0.3	5.49	27.40	1.10
Camera (assumed)	16	0.59	1.00	17.23	0.85	1.2	17.57	4	0.2	1.1	14.06	0.22
Reactions at base (additional)												3.26

	Moment (k-ft)	Shear (k)
Reactions at base due wind on pole	10.56	0.57
Reactions at base due to additional load at pole top	3.26	0.09
Total	**13.81**	**0.66**
	(SD)	(SD)

Pole weight	0.6	kips	
Additional weight	0.5	kips	(assumed)
Total	**1.1**	**kips**	

FOOTING DESIGN

PSM Engineers 2200 Sixth Avenue, Suite 601, Seattle, WA 98121 Office (206) 622-4580 / Fax (206) 622-0422	JOB: 18188 - UPS BFI Seattle DATE: Oct. 09, 2017 BY: SMV SITE: Light Pole SUBJECT: Manufacturer Data

Input Data:

Manufacturer base reactions:

	ASD		SD	
Moment:	8.3	k-ft	14	k-ft
Shear:	0.4	k	0.7	k
Axial:	1.1	k		

Deisgn Wind Speed: 110 mph

Increase base wind reactions by 5 mph for foundation design:

Moment:	**9**	k-ft
Shear:	**0.4**	k

Minimum pier diameter:

Bolt circle diameter: 14.00 in

Pier diameter (min): **2.5** ft

Instead of 250 pcf value of passive earth pressure, we have considered allowable passive pressure of 167 pcf (acts over- two pier diameters) for flag pole drilled pier footing (i.e. additional safety factor of 1.5 considered).

PSM Engineers 2200 Sixth Avenue, Suite 601, Seattle, WA 98121 Office (206) 622-4580 / Fax (206) 622-0422	JOB: **18188 - UPS BFI Seattle** DATE: Oct. 09, 2017 BY: **SMV** SITE: **Light Pole** SUBJECT: Drilled Pier Foundation Design

Input Data:

Table 1806.2--FOUNDATION AND LATERAL PRESSURE

Class of Materials	Allowable Foundation Pressure (psf)	Lateral Brg Depth below N.G psf/ft depth	Lateral Sliding Coefficient	Lateral Sliding Resistance (psf)
	"q all"	"p"		
1. Massive Crystalline bedrock	12000	1200	0.7	-
2. Sedimentary and foliated rock	4000	400	0.35	-
3. Sandy Gravel and / or gravel GW & GP	3000	200	0.35	-
4. Sandy, silty, clayey sand, silty gravel and clayey gravel (SW,SP,SM,SC,GM,GC)	2000	150	0.25	-
5. Clay, sandy clay,silty clay and clayey silt (CL,ML,MH and CH)	1500	100	-	130

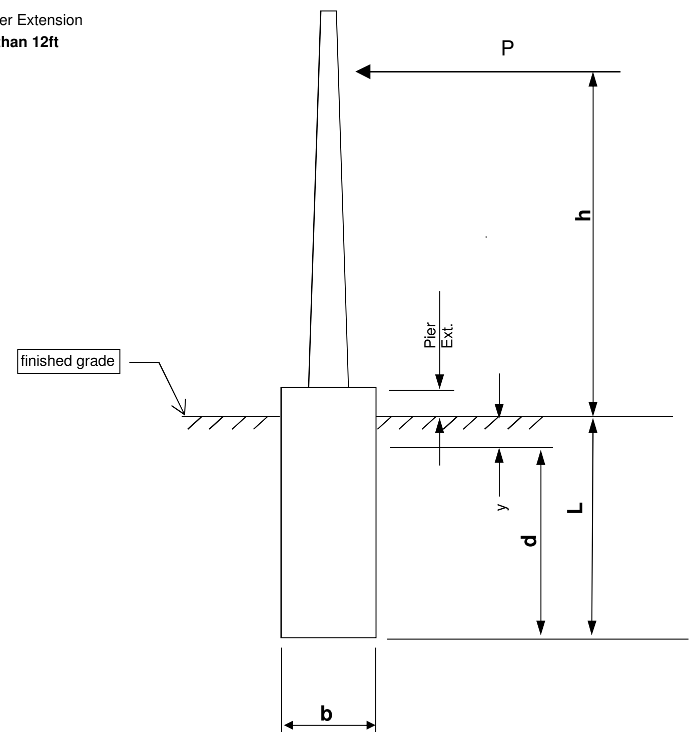
Lateral Passive Pressure Values (assumed)

Depth "L": 6 ft

Strata	begin layer	end layer	Allowable Pass Pres
1	0	2	0
2	2	6	167
3			
4			
5			
6			
7			

Average Allowable P_{ave} = 166.7 psf/ft

Overturning Moment applied at top of	OTM	**9,056**	lb-ft
Applied lateral shear force	V	**433**	lbs
Allowable lateral soil-bearing pressure	p	**333**	psf / ft = 2 x p ave, (acts over two pier diameters)
Diameter of round post	b	**2.50**	ft
Pier extension		**0.50**	ft
Dist from ground surface to point "P"	h	**21.4**	ft = OTM / Shear + Pier Extension
Trial depth, "d"	"d"	**6.0**	ft -- **but not greater than 12ft**
Top soil layer discarded	y	**2.0**	ft



Calculations:

As per IBC 2012 Section 1807.3.2.1 Nonconstrained

a="d"/3		2.00 ft
S_1 = p "d" / 3		666.67 psf
A = (2.34 P) / (S_1 b)		0.608
h' = h + y		23.4 ft
d = (A/2) [1 + (1+ (4.36 x h' / A))^0.5]	IBC (18-1)	4.255 ft
	Minimum L Required =	**6** ft
	Use L =	**6** ft

Maximum Moment in Pier

y"=distance to pivot point	0.52 ft
M=maximum moment in Pier	10288 lb-ft
	10.3 k-ft

Recommended steel reinforcement

Concrete Pier Computations

$A_g = \pi b^2 / 4$				706.86 in²
Try 1/2% of steel reinforcement				0.005
$A_s = 0.005 A_g$				3.53 in²
try #	5	bars	A_s=	0.31 in²
try total of	**12**	bars	A_s=	3.68 in²

Cubic yards of Concrete (including height above grade):

Volume = (1/4)πb^2(Depth+1) / 27 — 1.3 yd^3

Pier Rigidity

E=Modulus of Elasticity=wc^1.5 x(33((f'c)^0.5)	3320561 psi	
w_c=	150 pcf	
f'_c=	3000 psi	
I=Moment of Inertia=PI()xb^4/64	39761 in^4	
n_h=constant of horizontal subgrade reaction	250 pci	(assumed)
T=(EI/n_h)^0.2	55.5 in	
L/T=	**1.36**	

L/T<2, Passive Pressure Method O.K.

assumed (conservative)

PSM Engineers 2200 Sixth Avenue, Suite 601, Seattle, WA 98121 Office (206) 622-4580 / Fax (206) 622-0422	JOB: 18188 - UPS BFI Seattle DATE: Oct. 09, 2017 BY: SMV SITE: Light Pole SUBJECT: Skin Friction

Input Data:

Uplift	0.0	k
Axial vertical downward load	1.1	k
Depth, D	6.0	ft
Diameter, B	2.5	ft
Soil density	100	pcf
Concrete Weight	150	pcf

assumed

Allowable End Bearing Capacity:

End bearing	1.3 D/B	6.0	ksf
Limiting point of resistance	3.0 TSF	6.0	ksf
	D/B equation controls	**6.0**	ksf

Area = PI() x B^2/4	4.9 ft^2		
Vol Pier = Area x (D + 0.5' pier ext.)	31.9 ft^3	=	1.2 yd^3
Allowable net end bearing = Area x Allow. End Bearing	**29.5** kips		
Weight Pier = Concrete Weight x Vol Pier	**4.8** kips		
Soil Weight Removed = Soil Density x Vol Soil Removed	**-2.9** kips		

Skin friction

Strata boundary Upper	Lower	Allowable Skin Friction TSF	Allowable Skin Friction KSF	Vertical distance in Strata (ft)	Surface Area in Strata (ft^2)	Allowable friction (kips)
0	2	0	0	2	15.71	0
2	6	0.05	0.100	4	31.42	3
		0.00	0.000			
		0	0	0	0.00	0
		0	0	0	0.00	0

assumed

Foundation friction resistance **3** kips

Results:

COMPRESSION:

Allowable net end bearing	29.5 kips
Foundation friction resistance	3 kips
Total downward resistance	**33** kips
Axial Vertical Load	1 kips
Pier Weight	5 kips
Removed Soil Weight	-3 kips
SUM: P = Pier Weight - Removed Soil Weight+ Axial Vertical Load	**2.9** kips
S.F. = Total Downward resistance/ (SUM: P)	**11.08** >1.00, OK

UPLIFT: **No Uplift, Therefore OK**

Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

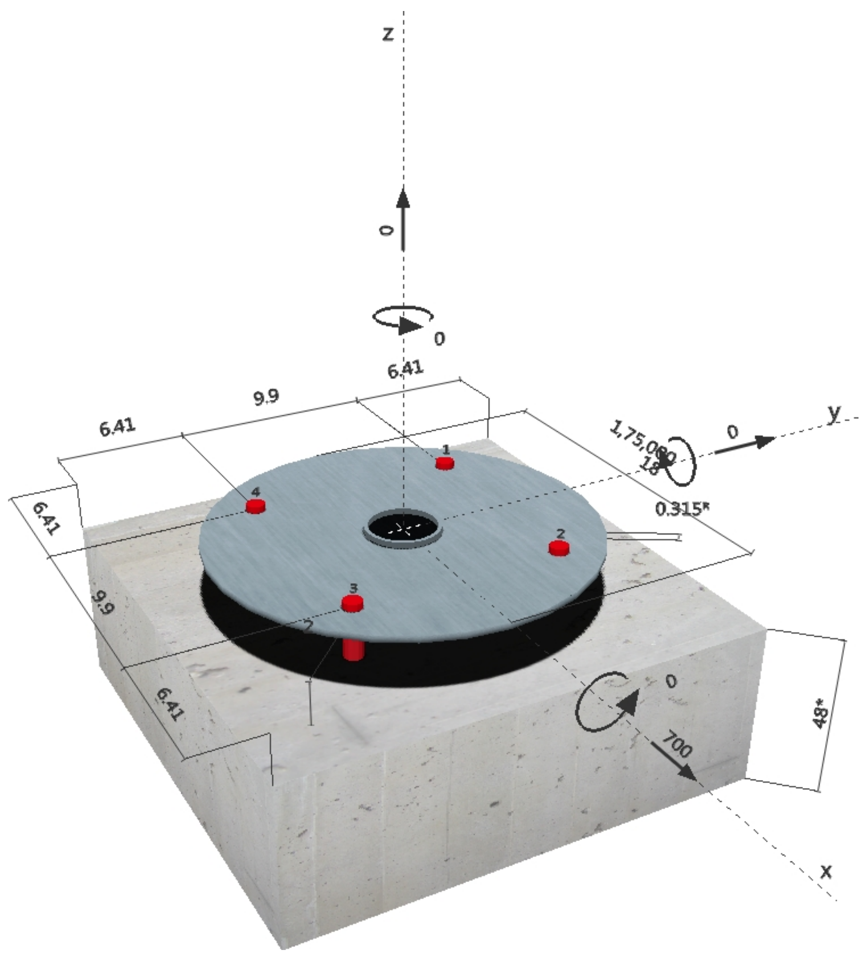
Specifier's comments: Anchorage Design

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 7/8**
Additional plate or washer (17.4.2.8):	d_{plate} = 3.000 in., t_{plate} = 0.500 in.
Effective embedment depth:	h_{ef} = 20.000 in., $h_{ef,17.4.2.8}$ = 0.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-14 / CIP
Stand-off installation:	without clamping (anchor); restraint level (anchor plate): 1.00; e_b = 2.000 in.; t = 0.315 in.
Anchor plate:	l_x x l_y x t = 18.000 in. x 18.000 in. x 0.315 in.; (Recommended plate thickness: not calculated
Profile:	Round HSS (AISC); (L x W x T) = 3.500 in. x 3.500 in. x 0.188 in.
Base material:	uncracked concrete, 3000, f_c' = 3,000 psi; h = 48.000 in.
Reinforcement:	tension: condition A, shear: condition A; anchor reinforcement: tension
	edge reinforcement: none or < No. 4 bar

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



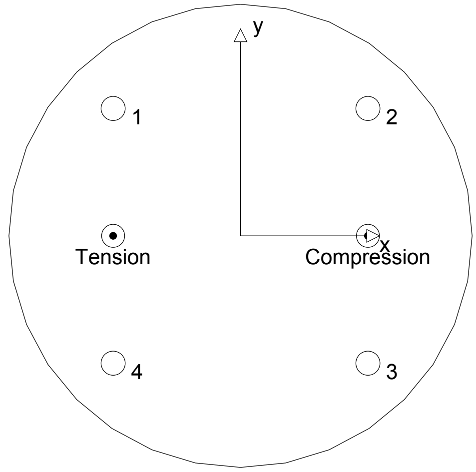
2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	8,838	175	175	0
2	-8,838	175	175	0
3	-8,838	175	175	0
4	8,838	175	175	0

max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-4.950/0.000): 17,677 [lb]
resulting compression force in (x/y)=(4.950/0.000): 17,677 [lb]



Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	8,838	20,097	44	OK
Pullout Strength*	8,838	20,956	43	OK
Concrete Breakout Strength**[1]	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction x-**	17,677	50,005	36	OK

* anchor having the highest loading **anchor group (anchors in tension)
[1] Tension Anchor Reinforcement has been selected!

3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-14 Eq. (17.4.1.2)
$\phi\ N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.46	58,000

Calculations

N_{sa} [lb]
26,796

Results

N_{sa} [lb]	ϕ steel	ϕ N_{sa} [lb]	N_{ua} [lb]
26,796	0.750	20,097	8,838

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3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-14 Eq. (17.4.3.1)
$N_p = 8 A_{brg} f'_c$ ACI 318-14 Eq. (17.4.3.4)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	λ_a	f'_c [psi]
1.400	0.89	1.000	3,000

Calculations

N_p [lb]
21,384

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
29,938	0.700	20,956	8,838

3.3 Concrete Side-Face Blowout, direction x-

$N_{sb} = 160\ c_{a1} \sqrt{A_{brg}}\ \lambda_a \sqrt{f'_c}$ ACI 318-14 Eq. (17.4.4.1)
$N_{sbg} = \alpha_{group} N_{sb}$ ACI 318-14 Eq. (17.4.4.2)
$\phi\ N_{sbg} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1
$\alpha_{group} = \left(1 + \frac{s}{6\ c_{a1}}\right)$ see ACI 318-14, Section 17.4.4.2, Eq. (17.4.4.2)

Variables

c_{a1} [in.]	c_{a2} [in.]	A_{brg} [in.^{2}]	λ_a	f'_c [psi]	s [in.]
6.410	6.410	0.89	1.000	3,000	9.900

Calculations

α_{group}	N_{sb} [lb]
1.257	53,025

Results

N_{sbg} [lb]	$\phi_{concrete}$	$\phi\ N_{sbg}$ [lb]	$N_{ua,edge}$ [lb]
66,674	0.750	50,005	17,677

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4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	175	10,450	2	OK
Steel failure (with lever arm)*	175	412	43	OK
Pryout Strength**	700	63,826	2	OK
Concrete edge failure in direction x+**	700	8,932	8	OK

* anchor having the highest loading   **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa} = 0.6\, A_{se,V}\, f_{uta}$ ACI 318-14 Eq. (17.5.1.2b)
$\phi\ V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.46	58,000

Calculations

V_{sa} [lb]
16,078

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
16,078	0.650	10,450	175

4.2 Steel failure (with lever arm)

$V_s^M = \frac{\alpha_M \cdot M_s}{L_b}$ bending equation for stand-off

$M_s = M_s^0 \left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$ resultant flexural resistance of anchor

$M_s^0 = (1.2)\,(S)\,(f_{u,min})$ characteristic flexural resistance of anchor

$\left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$ reduction for tensile force acting simultaneously with a shear force on the anchor

$S = \frac{\pi (d)^3}{32}$ elastic section modulus of anchor bolt at concrete surface

$L_b = z + (n)(d_0)$ internal lever arm adjusted for spalling of the surface concrete

$\phi\ V_s^M \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

α_M	$f_{u,min}$ [psi]	N_{ua} [lb]	$\phi\ N_{sa}$ [lb]	z [in.]	n	d_0 [in.]
1.00	58,000	8,838	20,097	2.158	0.500	0.875

Calculations

M_s^0 [in.lb]	$\left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$	M_s [in.lb]	L_b [in.]
2,937.209	0.560	1,645.465	2.595

Results

V_s^M [lb]	ϕ_{steel}	$\phi\ V_s^M$ [lb]	V_{ua} [lb]
634	0.650	412	175

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4.3 Pryout Strength

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ec,N}\,\psi_{ed,N}\,\psi_{c,N}\,\psi_{cp,N}\,N_b\right]$ ACI 318-14 Eq. (17.5.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

A_{Nc} see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	4.273	0.000	0.000	6.410

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
1.250	-	24	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
516.20	164.35	1.000	1.000	1.000	1.000	11,612

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
91,181	0.700	63,826	700

4.4 Concrete edge failure in direction x+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\, \psi_{ed,V}\, \psi_{c,V}\, \psi_{h,V}\, \psi_{parallel,V}\, V_b$ ACI 318-14 Eq. (17.5.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

A_{Vc} see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-14 Eq. (17.5.2.1c)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.5)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.6b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-14 Eq. (17.5.2.8)

$V_b = 9\ \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-14 Eq. (17.5.2.2b)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
6.410	6.410	0.000	1.400	48.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
7.000	1.000	0.875	3,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
218.45	184.90	1.000	0.900	1.000	8,000

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
11,909	0.750	8,932	700

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.440	0.425	5/3	50	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- ACI 318 does not specifically address anchor bending when a stand-off condition exists. PROFIS Anchor calculates a shear load corresponding to anchor bending when stand-off exists and includes the results as a shear Design Strength!
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- Attention! In case of compressive anchor forces a buckling check as well as the proof of the local load transfer into and within the base material (incl. punching) has to done separately.
- The design of Anchor Reinforcement is beyond the scope of PROFIS Anchor. Refer to ACI 318-14, Section 17.4.2.9 for information about Anchor Reinforcement.
- Anchor Reinforcement has been selected as a design option, calculations should be compared with PROFIS Anchor calculations.

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Fastening meets the design criteria!

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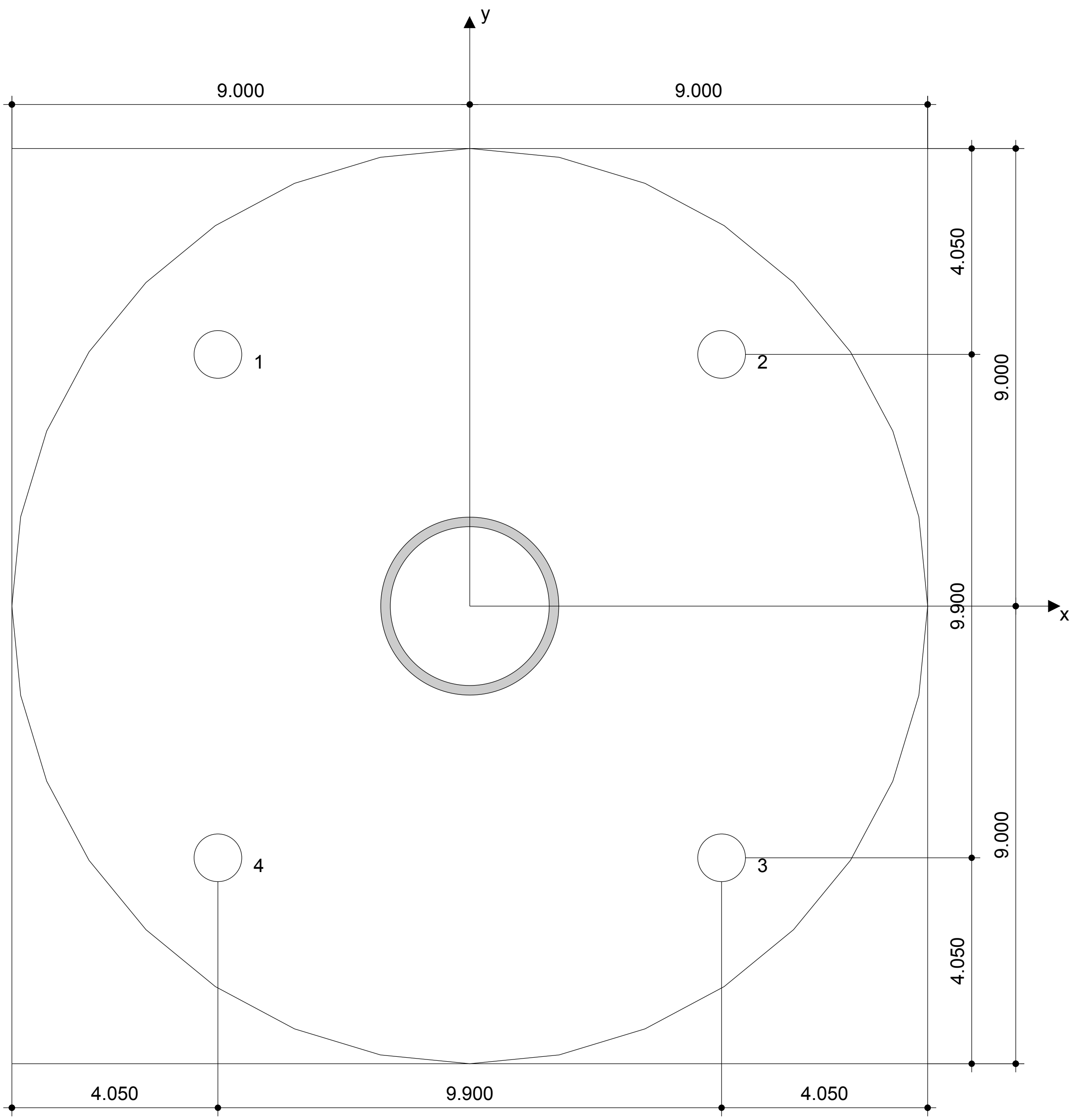
7 Installation data

Anchor plate, steel: -
Profile: Round HSS (AISC); (L x W x T) = 3.500 in. x 3.500 in. x 0.188 in.
Hole diameter in the fixture: d_f = 0.938 in.
Plate thickness (input): 0.315 in.
Recommended plate thickness: not calculated

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 7/8
Installation torque: -
Hole diameter in the base material: - in.
Hole depth in the base material: 20.000 in.
Minimum thickness of the base material: 21.052 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-4.950	4.950	6.410	16.310	16.310	6.410
2	4.950	4.950	16.310	6.410	16.310	6.410
3	4.950	-4.950	16.310	6.410	6.410	16.310
4	-4.950	-4.950	6.410	16.310	6.410	16.310

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8 Remarks; Your Cooperation Duties

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WIND LOAD CALCULATION OF 60' LIGHT POLE

PSM Engineers
2200 6th Ave., #601, Seattle, WA 98121

ASCE7-10 Wind loads Per Chapter 29

Consider 60' height round pole

Base diameter	1.08	ft	
Top diameter	0.50	ft	assumed

Wind parameters

Structure class	II		
Exposure	B		Sect 26.7
Topographic category	1		Sect 26.8
V (3-sec gust) =	110	mph	Fig 26.5-1A
Kd =	0.95		Table 26.6-1
Pole Height	60	ft	
Wind load factor	1		
Zg =	1200		Table 26.9-1
Alpha =	7		Table 29.3-1

Wind on Pole

Height, z (ft)	Kz	Kzt	qz (psf)	Gh	(assumed - consrv.) Cf Pole	Pressure on Pole (psf)	Pole area (sft)	(SD) shear (lb)	(SD) moment (lb-ft) (lb-ft)
5	0.70	1.00	20.6	0.85	1.2	21.03	5.30	111.35	278
10	0.70	1.00	20.6	0.85	1.2	21.03	5.05	106.24	797
15	0.70	1.00	20.6	0.85	1.2	21.03	4.81	101.13	1264
20	0.70	1.00	20.6	0.85	1.2	21.03	4.57	96.02	1680
25	0.70	1.00	20.6	0.85	1.2	21.03	4.32	90.91	2045
30	0.70	1.00	20.6	0.85	1.2	21.03	4.08	85.79	2359
35	0.73	1.00	21.5	0.85	1.2	21.98	3.84	84.32	2740
40	0.76	1.00	22.4	0.85	1.2	22.83	3.59	82.05	3077
45	0.79	1.00	23.1	0.85	1.2	23.61	3.35	79.12	3362
50	0.81	1.00	23.9	0.85	1.2	24.33	3.11	75.62	3592
55	0.83	1.00	24.5	0.85	1.2	25.00	2.86	71.63	3761
60	0.85	1.00	25.1	0.85	1.2	25.63	2.62	67.20	3864
Reactions at base due wind on pole								1051	28820

Additional load at pole top (Light fixures)

	Height, z (ft)	Kz	Kzt	qz (psf)	Gh	(assumed - consrv.) Cf	Pressure (psf)	Qty	Area (sqft)	Weight (lbs)	Wind force (lbs)	Moment (kft)
Light	60	0.85	1.00	25.13	0.85	1.2	25.63	1	9.55	12.2	244.81	14.69
Mount	60	0.85	1.00	25.13	0.85	1.2	25.63	6	0.3	5.49	46.14	2.77
Reactions at base (additional)												17.46

	Moment (k-ft)	Shear (k)
Reactions at base due wind on pole	28.82	1.05
Reactions at base due to additional load at pole top	17.46	0.29
Total	**46.28**	**1.34**
	(SD)	(SD)

Pole weight	1.4	kips	
Additional weight	0.5	kips	(assumed)
Total	**1.9**	**kips**	

FOOTING DESIGN

PSM Engineers 2200 Sixth Avenue, Suite 601, Seattle, WA 98121 **Office (206) 622-4580 / Fax (206) 622-0422**	JOB: **18188 - UPS BFI Seattle** DATE: Oct. 09, 2017 BY: **SMV** SITE: **Light Pole** SUBJECT: Manufacturer Data

Input Data:

Manufacturer base reactions:

	ASD		SD	
Moment:	**27.8**	k-ft	46	k-ft
Shear:	**0.8**	k	1.3	k
Axial:	**1.9**	k		

Deisgn Wind Speed: **110** mph

Increase base wind reactions by 5 mph for foundation design:

Moment:	**30**	k-ft
Shear:	**0.9**	k

Minimum pier diameter:

Bolt circle diameter: **17.00** in

Pier diameter (min): **2.5** ft

Instead of 250 pcf value of passive earth pressure, we have considered allowable passive pressure of 167 pcf (acts over- two pier diameters) for flag pole drilled pier footing (i.e. additional safety factor of 1.5 considered).

PSM Engineers
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JOB: **18188 - UPS BFI Seattle**
DATE: Oct. 09, 2017 BY: **SMV**
SITE: **Light Pole**
SUBJECT: Drilled Pier Foundation Design

Input Data:

Table 1806.2--FOUNDATION AND LATERAL PRESSURE

Class of Materials	Allowable Foundation Pressure (psf)	Lateral Brg Depth below N.G psf/ft depth	Lateral Sliding Coefficient	Lateral Sliding Resistance (psf)
	"q all"	"p"		
1. Massive Crystalline bedrock	12000	1200	0.7	-
2. Sedimentary and foliated rock	4000	400	0.35	-
3. Sandy Gravel and / or gravel GW & GP	3000	200	0.35	-
4. Sandy, silty, clayey sand, silty gravel and clayey gravel (SW,SP,SM,SC,GM,GC)	2000	150	0.25	-
5. Clay, sandy clay,silty clay and clayey silt (CL,ML,MH and CH)	1500	100	-	130

Lateral Passive Pressure Values (assumed)

Depth "L": 9 ft

Strata	begin layer	end layer	Allowable Pass Pres
1	0	2	0
2	2	9	167
3			
4			
5			
6			
7			

Average Allowable P_{ave} = 166.7 psf/ft

Overturning Moment applied at top of p	OTM	**30,350**	lb-ft
Applied lateral shear force	V	**879**	lbs
Allowable lateral soil-bearing pressure	p	**333**	psf / ft = 2 x p ave, (acts over two pier diameters)
Diameter of round post	b	**2.50**	ft
Pier extension		**0.50**	ft
Dist from ground surface to point "P"	h	**35.0**	ft = OTM / Shear + Pier Extension
Trial depth, "d"	"d"	**9.0**	ft -- **but not greater than 12ft**
Top soil layer discarded	y	**2.0**	ft

Calculations:

As per IBC 2012 Section 1807.3.2.1 Nonconstrained

a="d"/3	3.00	ft
S_1 = p "d" / 3	1000.00	psf
A = (2.34 P) / (S_1 b)	0.823	
h' = h + y	37.0	ft
d = (A/2) [1 + (1+ (4.36 x h' / A))^$^{0.5}$] IBC (18-1)	6.188	ft
Minimum L Required =	**8**	ft
Use L =	**9**	ft

Maximum Moment in Pier

y"=distance to pivot point	0.70	ft
M=maximum moment in Pier	32958	lb-ft
	33.0	k-ft

Recommended steel reinforcement

Concrete Pier Computations

$A_g = \pi b^2 / 4$	706.86	in²
Try 1/2% of steel reinforcement	0.005	
$A_s = 0.005\ A_g$	3.53	in²
try # **5** bars A_s=	0.31	in²
try total of **12** bars A_s=	3.68	in²

Cubic yards of Concrete (including height above grade):

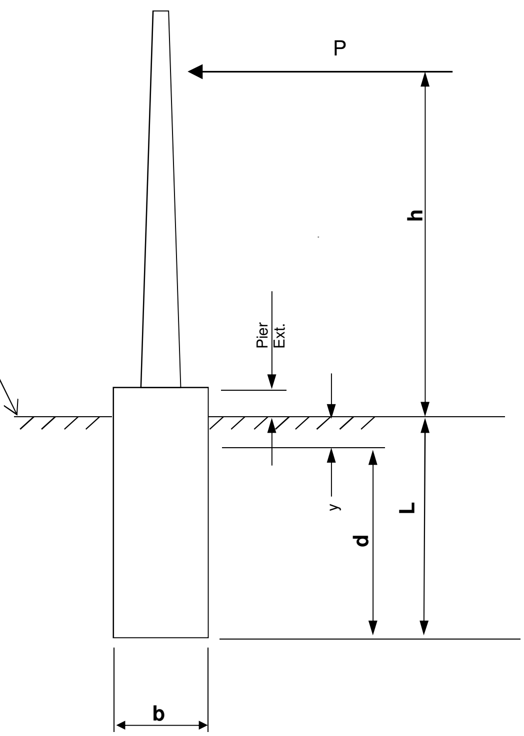
Volume = $(1/4)\pi b^2$(Depth+1) / 27 1.8 yd^3

Pier Rigidity

E=Modulus of Elasticity=wc^1.5 x(33((f'c)^0.5)	3320561	psi
w_c=	150	pcf
f'_c=	3000	psi
I=Moment of Inertia=PI()xb^4/64	39761	in^4
n_h=constant of horizontal subgrade reaction	250	pci (assumed)
T=(EI/n_h)^0.2	55.5	in
L/T=	1.77	

L/T<2, Passive Pressure Method O.K.

assumed (conservative)



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JOB: **18188 - UPS BFI Seattle**
DATE: Oct. 09, 2017 BY: **SMV**
SITE: **Light Pole**
SUBJECT: Skin Friction

Input Data:

Uplift	**0.0**	k
Axial vertical downward load	**1.9**	k
Depth, D	**9.0**	ft
Diameter, B	**2.5**	ft
Soil density	**100**	pcf
Concrete Weight	**150**	pcf

assumed

Allowable End Bearing Capacity:

End bearing	**1.3 D/B**	9.0 ksf
Limiting point of resistance	**3.0 TSF**	6.0 ksf
Limiting point of resistance controls		**6.0** ksf

Area = PI() x B^2/4	4.9 ft^2		
Vol Pier = Area x (D + 0.5' pier ext.)	46.6 ft^3	=	1.7 yd^3
Allowable net end bearing = Area x Allow. End Bearing	**29.5** kips		
Weight Pier = Concrete Weight x Vol Pier	**7.0** kips		
Soil Weight Removed = Soil Density x Vol Soil Removed	**-4.4** kips		

Skin friction

Strata boundary Upper	Lower	Allowable Skin Friction TSF	Allowable Skin Friction KSF	Vertical distance in Strata (ft)	Surface Area in Strata (ft^2)	Allowable friction (kips)
0	2	0	0	2	15.71	0
2	9	0.05	0.100	7	54.98	5
		0.00	0.000			
		0	0	0	0.00	0
		0	0	0	0.00	0

assumed

Foundation friction resistance **5** kips

Results:

COMPRESSION:

Allowable net end bearing	29.5 kips
Foundation friction resistance	5 kips
Total downward resistance	**35** kips
Axial Vertical Load	2 kips
Pier Weight	7 kips
Removed Soil Weight	-4 kips
SUM: P = Pier Weight - Removed Soil Weight+ Axial Vertical Load	**4.5** kips
S.F. = Total Downward resistance/ (SUM: P)	**7.81** **>1.00, OK**

UPLIFT: **No Uplift, Therefore OK**

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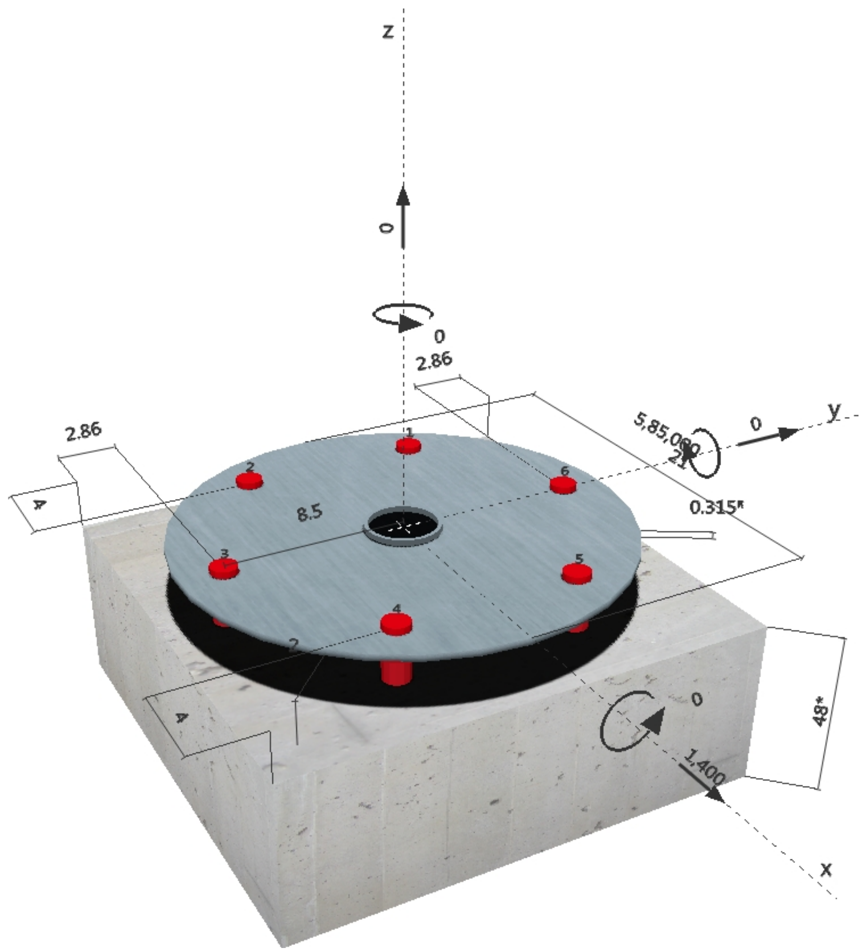
Specifier's comments: Anchorage Design

1 Input data

Anchor type and diameter:	**Hex Head ASTM F 1554 GR. 36 1 1/4**
Additional plate or washer (17.4.2.8):	d_{plate} = 3.000 in., t_{plate} = 0.500 in.
Effective embedment depth:	h_{ef} = 25.000 in., $h_{ef,17.4.2.8}$ = 0.000 in.
Material:	ASTM F 1554
Proof:	Design method ACI 318-14 / CIP
Stand-off installation:	without clamping (anchor); restraint level (anchor plate): 1.00; e_b = 2.000 in.; t = 0.315 in.
Anchor plate:	l_x x l_y x t = 21.000 in. x 21.000 in. x 0.315 in.; (Recommended plate thickness: not calculated
Profile:	Round HSS (AISC); (L x W x T) = 3.500 in. x 3.500 in. x 0.188 in.
Base material:	uncracked concrete, 3000, f_c' = 3,000 psi; h = 48.000 in.
Reinforcement:	tension: condition A, shear: condition A; anchor reinforcement: tension
	edge reinforcement: none or < No. 4 bar

R - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



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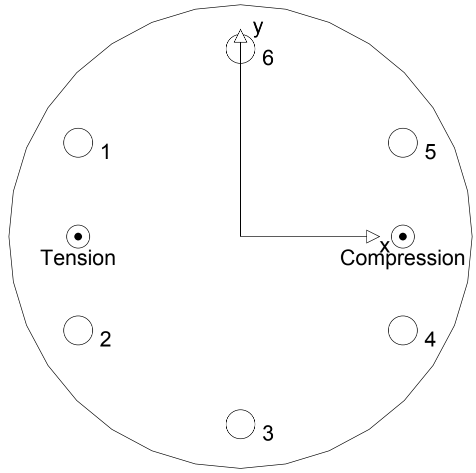
2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	19,871	233	233	0
2	19,871	233	233	0
3	0	233	233	0
4	-19,871	233	233	0
5	-19,871	233	233	0
6	0	233	233	0



max. concrete compressive strain: - [‰]
max. concrete compressive stress: - [psi]
resulting tension force in (x/y)=(-7.360/0.000): 39,742 [lb]
resulting compression force in (x/y)=(7.360/0.000): 39,742 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	19,871	42,151	48	OK
Pullout Strength*	19,871	42,736	47	OK
Concrete Breakout Strength**[1]	N/A	N/A	N/A	N/A
Concrete Side-Face Blowout, direction x-**	39,742	47,990	83	OK

* anchor having the highest loading **anchor group (anchors in tension)
[1] Tension Anchor Reinforcement has been selected!

3.1 Steel Strength

$N_{sa} = A_{se,N}\, f_{uta}$ ACI 318-14 Eq. (17.4.1.2)
$\phi\ N_{sa} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.97	58,000

Calculations

N_{sa} [lb]
56,202

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
56,202	0.750	42,151	19,871

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3.2 Pullout Strength

$N_{pN} = \psi_{c,p} N_p$ ACI 318-14 Eq. (17.4.3.1)
$N_p = 8 A_{brg} f'_c$ ACI 318-14 Eq. (17.4.3.4)
$\phi\ N_{pN} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$\psi_{c,p}$	A_{brg} [in.^{2}]	λ_a	f'_c [psi]
1.400	1.82	1.000	3,000

Calculations

N_p [lb]
43,608

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
61,051	0.700	42,736	19,871

3.3 Concrete Side-Face Blowout, direction x-

$N_{sb} = 160\ c_{a1} \sqrt{A_{brg}}\ \lambda_a \sqrt{f'_c}$ ACI 318-14 Eq. (17.4.4.1)
$N_{sbg} = \alpha_{group} N_{sb}$ ACI 318-14 Eq. (17.4.4.2)
$\phi\ N_{sbg} \geq N_{ua}$ ACI 318-14 Table 17.3.1.1
$\alpha_{group} = \left(1 + \frac{s}{6\ c_{a1}}\right)$ see ACI 318-14, Section 17.4.4.2, Eq. (17.4.4.2)

Variables

c_{a1} [in.]	c_{a2} [in.]	A_{brg} [in.^{2}]	λ_a	f'_c [psi]	s [in.]
4.000	7.110	1.82	1.000	3,000	8.500

Calculations

α_{group}	N_{sb} [lb]
1.354	47,252

Results

N_{sbg} [lb]	$\phi_{concrete}$	$\phi\ N_{sbg}$ [lb]	$N_{ua,edge}$ [lb]
63,987	0.750	47,990	39,742

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4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	233	21,919	2	OK
Steel failure (with lever arm)*	233	1,109	22	OK
Pryout Strength**	1,400	52,314	3	OK
Concrete edge failure in direction y+**	1,400	5,007	28	OK

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength

$V_{sa} = 0.6\, A_{se,V}\, f_{uta}$ ACI 318-14 Eq. (17.5.1.2b)

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.97	58,000

Calculations

V_{sa} [lb]
33,721

Results

V_{sa} [lb]	ϕ steel	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
33,721	0.650	21,919	233

4.2 Steel failure (with lever arm)

V_s^M	$= \frac{\alpha_M \cdot M_s}{L_b}$	bending equation for stand-off
M_s	$= M_s^0 \left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$	resultant flexural resistance of anchor
M_s^0	$= (1.2)\,(S)\,(f_{u,min})$	characteristic flexural resistance of anchor
$\left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$		reduction for tensile force acting simultaneously with a shear force on the anchor
S	$= \frac{\pi(d)^3}{32}$	elastic section modulus of anchor bolt at concrete surface
L_b	$= z + (n)(d_0)$	internal lever arm adjusted for spalling of the surface concrete
$\phi\ V_s^M$	$\geq V_{ua}$	ACI 318-14 Table 17.3.1.1

Variables

α_M	$f_{u,min}$ [psi]	N_{ua} [lb]	$\phi\ N_{sa}$ [lb]	z [in.]	n	d_0 [in.]
1.00	58,000	19,871	42,151	2.158	0.500	1.250

Calculations

M_s^0 [in.lb]	$\left(1 - \frac{N_{ua}}{\phi\, N_{sa}}\right)$	M_s [in.lb]	L_b [in.]
8,981.110	0.529	4,747.263	2.783

Results

V_s^M [lb]	ϕ steel	$\phi\ V_s^M$ [lb]	V_{ua} [lb]
1,706	0.650	1,109	233

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4.3 Pryout Strength

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$ ACI 318-14 Eq. (17.5.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

A_{Nc} see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.4)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c\ \lambda_a \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-14 Eq. (17.4.2.2a)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	2.833	0.000	0.000	2.860

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.250	-	24	1.000	3,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
381.99	72.25	1.000	1.000	0.902	1.000	6,269

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
74,735	0.700	52,314	1,400

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4.4 Concrete edge failure in direction y+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\, \psi_{ed,V}\, \psi_{c,V}\, \psi_{h,V}\, \psi_{parallel,V}\, V_b$ ACI 318-14 Eq. (17.5.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

A_{Vc} see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-14 Eq. (17.5.2.1c)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V'}{3c_{a1}}}\right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.5)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-14 Eq. (17.5.2.6b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-14 Eq. (17.5.2.8)

$V_b = 9\ \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-14 Eq. (17.5.2.2b)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
2.860	11.360	0.000	1.400	48.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
10.000	1.000	1.250	3,000	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
36.81	36.81	1.000	1.000	1.000	2,384

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
6,676	0.750	5,007	1,400

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.828	0.280	5/3	85	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to your local standard.
- ACI 318 does not specifically address anchor bending when a stand-off condition exists. PROFIS Anchor calculates a shear load corresponding to anchor bending when stand-off exists and includes the results as a shear Design Strength!
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI 318 or the relevant standard!
- Attention! In case of compressive anchor forces a buckling check as well as the proof of the local load transfer into and within the base material (incl. punching) has to done separately.
- The design of Anchor Reinforcement is beyond the scope of PROFIS Anchor. Refer to ACI 318-14, Section 17.4.2.9 for information about Anchor Reinforcement.
- Anchor Reinforcement has been selected as a design option, calculations should be compared with PROFIS Anchor calculations.

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Fastening meets the design criteria!

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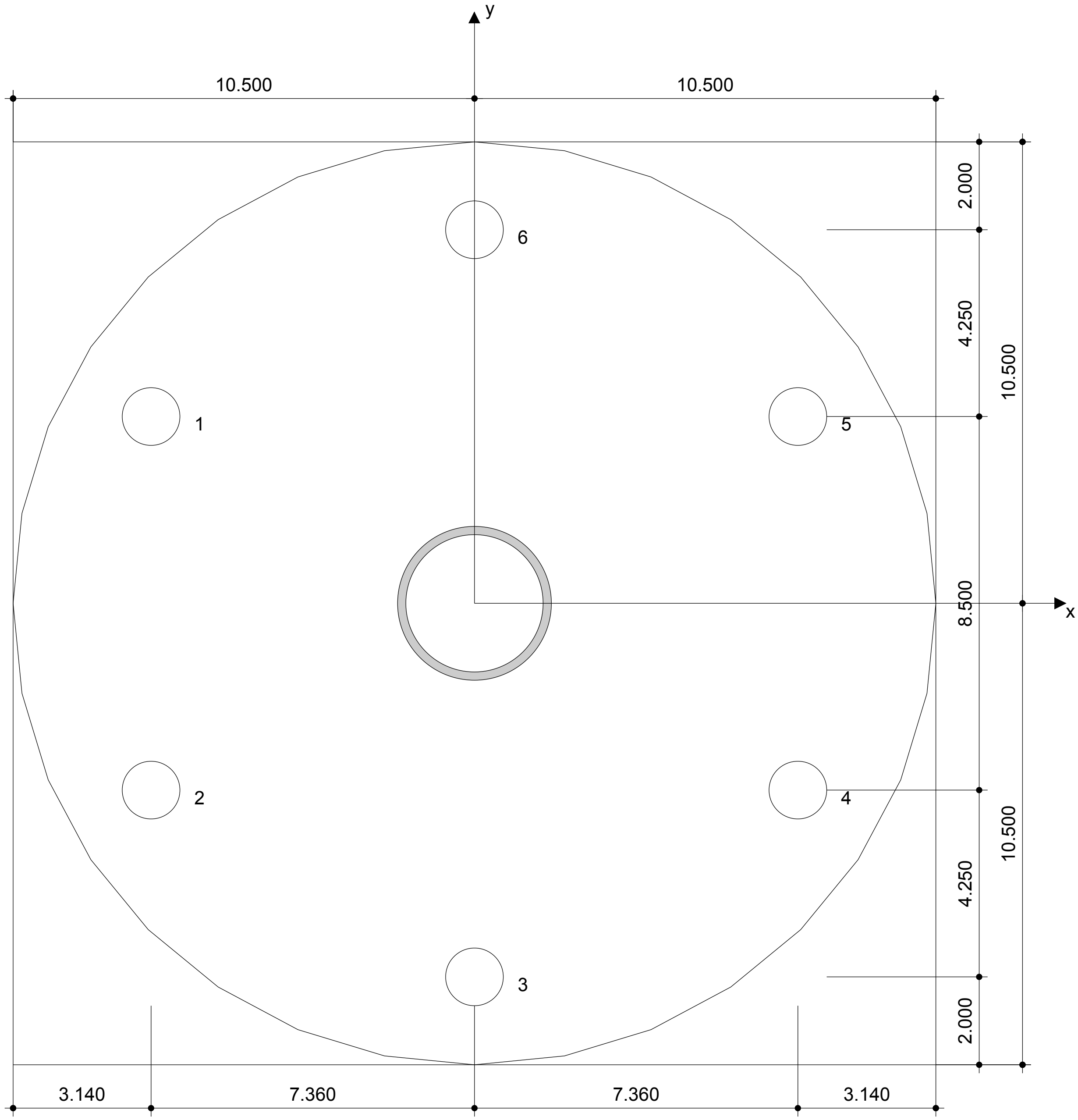
7 Installation data

Anchor plate, steel: -
Profile: Round HSS (AISC); (L x W x T) = 3.500 in. x 3.500 in. x 0.188 in.
Hole diameter in the fixture: d_f = 1.313 in.
Plate thickness (input): 0.315 in.
Recommended plate thickness: not calculated

Anchor type and diameter: Hex Head ASTM F 1554 GR. 36 1 1/4
Installation torque: -
Hole diameter in the base material: - in.
Hole depth in the base material: 25.000 in.
Minimum thickness of the base material: 26.344 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-7.360	4.250	4.000	18.720	15.610	7.110
2	-7.360	-4.250	4.000	18.720	7.110	15.610
3	0.000	-8.500	11.360	11.360	2.860	19.860

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
4	7.360	-4.250	18.720	4.000	7.110	15.610
5	7.360	4.250	18.720	4.000	15.610	7.110
6	0.000	8.500	11.360	11.360	19.860	2.860

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8 Remarks; Your Cooperation Duties

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