

**TABLE OF CONTENTS**

**STRUCTURAL**

Table of Contents  
Page Verification Sheet

---

3A	General Requirements
3B	Seismic Analysis & Upgrades
3C	Modifications to Existing Structures
3D	Shoring
3E	Foundations and Piles
3F	Slab on Grade
3G	Sub-Grade Walls
3H	Structured Floors
3I	Roofs
3J	Concrete
3K	Reinforced Masonry
3L	Structural Steel – Steel Joists and Decking
3M	Timber
3N	Cold Formed Metal Framing
3P	Nonstructural Component Seismic Design

---

<b>TITLE</b>	<b>Pages</b>	<b>Revision date</b>
Table of Contents	1	REV:05 – JUN2008
Page Verification Sheet	1	REV:06 – JUL2008

---

3A	General Requirements	1-3	REV:04 – JUN2008
3B	Seismic Analysis & Upgrades	1-3	REV:04 – JUN2008
3C	Modifications to Existing Structures	1-2	REV:03 – JUN2008
3D	Shoring	1-2	REV:03 – JUN2008
3E	Foundations and Piles	1-3	REV:04 – JUN2008
3F	Slab on Grade	1-2	REV:06 – JUL2008
3G	Sub-Grade Walls	1-2	REV:04 – JUN2008
3H	Structured Floors	1-3	REV:05 – JUL2008
3I	Roofs	1-2	REV:05 – JUL2008
3J	Concrete	1-6	REV:05 – JUL2008
3K	Reinforced Masonry	1-2	REV:03 – JUN2008
3L	Structural Steel – Steel Joists and Decking	1-3	REV:03 – JUN2008
3M	Timber	1-2	REV:03 – JUN2008
3N	Cold Formed Metal Framing	1-2	REV:03 – JUN2008
3P	Nonstructural Component Seismic Design	1	REV:03 – JUN2008

## **Basis of Design**

This section applies to the general structural requirements.

### **Background**

- This section is intended to assist the Structural Engineer and other design team members during the design process. The University's intent is to build high-quality structures. If there are questions about this information or proposed alternative ideas, discuss them with the Project Manager and Campus Engineering. We encourage an open dialog between the University and the design team. The structural engineer should also familiarize themselves with the other applicable sections of the Facilities Services Design Guide.

### **Design Criteria**

- Typically for the structural design, utilize the most recent version of the International Building Code (IBC) with whatever local municipality amendments that exist. The IBC is considered a minimum requirement. Structural engineer needs to consider other factors in their design such as temperature effects, shrinkage, long-term maintenance, and serviceability items. Note that some Facilities Services Design Guide sections require use of a Seattle Department of Planning And Development (DPD) Director's Rule. Note that this applies to all UW property locations including Tacoma, Bothell, Friday Harbor and all others.
- The structural engineer is encouraged to provide a cost-effective economical design that gets the University the most "bang for the buck". Incorporate repetition wherever practical in the design.
- The structural engineer is required to design all the structural details for the building. Fabricator/contractor designed details are not allowed with the exception of fabricator designed items as described below. The use of "Similar" details is discouraged. Provide sufficient detailing so that the contractor can accurately price and construct the building. If "Similar" details are used where appropriate, then specifically indicate on the detail just what is "similar" about it.
- Deferred submittals are allowable for such items including steel stairs and curtainwalls. These submittals must be stamped and signed by a PE. The structural engineer of record needs to closely review the submittals. The structural engineer of record needs to design and detail any connections/embedments in the main structure for the deferred submittal item to connect to.
- Provide key plans of each building level that clearly indicates the design live load used for each different area including the roof. Indicate if live load reduction was utilized in the design. This information will assist the University during future tenant improvements etc.
- Specify that the contractor is to use concrete placement and finishing techniques which produce the specified or higher F-Numbers. Require that each day's work be measured as soon as possible so, if there is a problem, it will be identified and corrected before it is repeated.

### **Inter-discipline Coordination**

- Coordinate the structural work with all other disciplines. The structural engineer needs to be "proactive" in this coordination by reviewing all the other consultant's drawings and asking the

appropriate questions. Consistently look for revisions in the other consultant's designs in order to stay up to date with an accurate structural design.

- Be aware of all the loads and requirements of the other consultants. For example; be sure to note housekeeping pads, inertia pads, operating (not shipping) weights and location of equipment, window washing equipment etc.
- Verify that there are no conflicts of "space" in the design. Verify that the structural framing does not conflict with any other components of the building. Review and indicate all structural penetrations required on the drawings. Submit study sections through the building in critical areas that indicate the location of the structure and how it relates to the other building components.
- Request information from the other consultants early in the design. Passively waiting until another consultant passes on information often leads to problems in the design and coordination.

### **Plans**

- Drawings and reports of existing buildings are available from Facilities Records. Structural Engineer is responsible to attain whatever existing drawings and reports are necessary.
- The attachment B requirements at each phase of design are considered a bare minimum. Include whatever information is necessary at the various phases in order to achieve an accurate cost estimate and proper coordination.
- Structural Engineer is responsible to review whatever "secondary" structures that are detailed on the other consultant's drawings. For example; stairs shown on architectural drawings, retaining walls shown on landscape drawings, mechanical platforms shown on mechanical drawings.

### **Calculations**

- Submit structural calculations with construction document submittal. Submit additional calculations as requested by Campus Engineering.
- Format and number structural calculations in an easy-to-follow format. Divide calculations into categories such as foundations, first floor framing, roof framing, lateral design, etc.
- Include clear explanation/summary sheet before all computer output that explains analysis used, assumptions made, and conclusions. Include sketch of computer model nodes and member numbers.
- Indicate at the start of each calculation a description of what is being calculated. Indicate in the calculation what the conclusion is. For example; For a typical floor beam at 10 feet on center (oc), include "Calculate typical floor beam at 10'-0" oc" and indicate what beam is selected for use in the project. Include calculation for how the loads for the member being designed are determined.

### **Design Evaluation**

**The following information is required to evaluate the design:**

- Programming Phase: Identify structural system requirements and any exceptions to the Facilities Services Design Guides.
- Schematic Design Phase: Refer to requirements specified in the individual Structural sections.
- Design Development Phase: Refer to requirements specified in the individual Structural sections.
- Construction Document Phase: Refer to requirements specified in the individual Structural sections.

### **Construction Submittals**

- Refer to requirements specified in the individual Structural sections.

### **Related Sections**

- Facilities Services Design Guide - Seismic Analysis & Upgrade of Existing Buildings
- Facilities Services Design Guide - Modifications of Existing Buildings
- Facilities Services Design Guide - Shoring
- Facilities Services Design Guide - Foundations
- Facilities Services Design Guide - Slab on Grade
- Facilities Services Design Guide - Structured Floors
- Facilities Services Design Guide - Roofs
- Facilities Services Design Guide - Concrete
- Facilities Services Design Guide - Reinforced Masonry
- Facilities Services Design Guide - Structural Steel
- Facilities Services Design Guide - Timber
- Facilities Services Design Guide - Cold Formed Steel Framing

### **Products, Materials and Equipment**

- Refer to requirements specified in the individual Structural sections.

### **Installation, Fabrication and Construction**

- Refer to requirements specified in the individual Structural sections.

END OF DESIGN GUIDE SECTION

## **Basis of Design**

This section applies to the seismic evaluation, analysis, and upgrade of existing buildings.

### **Background**

- In addition to the “As Built” construction drawings maintained in Facilities Records, the University has completed structural analysis studies of many of the buildings on campus. Also, in October 1991, the Earthquake Readiness Advisory Committee (ERAC) at the University of Washington issued a report detailing its findings of its campus-wide seismic hazards survey. The purpose of the ERAC report was to establish a consistent set of rules to prioritize which existing buildings needed further seismic analysis. The ERAC report also prioritized existing buildings according to Damage Index numbers and Life Safety Index numbers and recommended a number of facilities that should have further detailed seismic analysis performed by a licensed structural engineer. A microfiche copy of the ERAC report is available from Record Services under Engineering Reports

### **Design Criteria**

#### **Evaluate and analyze in accordance with the following:**

- 1) Perform a seismic study and evaluation per the latest edition of the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 31, “Seismic Evaluation of Existing Buildings”.
- 2) Design the upgrade per the latest edition of the Federal Emergency Management Agency (FEMA) 356, “Prestandard and Commentary for the Seismic Rehabilitation of Buildings”. Utilize ASCE 41 when it is published (publication estimated in Spring, 2007).

#### **ASCE/SEI 31 Study**

- Use “High” Level of Seismicity in the evaluation.
- Use “Life Safety” Performance Level except for Hospital and other essential facilities use “Immediate Occupancy” Performance Level.
- Determine “Site Class” from information contained in an existing geotechnical report for a particular building or neighboring building. Obtain new geotechnical information if no existing information is found.
- Conduct Tier 1 evaluation for all buildings. Conduct Tier 2 and 3 evaluations where required by ASCE/SEI 31 based on the building type, number of stories, and level of seismicity.
- Design proposed concepts for seismic strengthening in accordance with the applicable material chapters of the International Building Code (IBC), latest edition.

#### **The ASCE/SEI 31 study shall include the following:**

- Document review (existing drawings, specifications, and soils reports)
- General and structural building description. Nonstructural systems descriptions that affect seismic performance.
- Field survey including areas of structural distress or damage. Material test results as necessary.

- Statement of design criteria.
- Seismic analysis, including copy of evaluation checklists and structural calculations.
- Prioritized list of deficiencies.
- Concept designs (to allow cost estimate accuracy of  $\pm 20\%$ )
- Conceptual cost estimates
- Consultant to present the findings of the study along with the other requirements noted for the Programming Phase under the DESIGN EVALUATION section below at a meeting scheduled with CPO and Campus Engineering prior to issuing final copy.

#### **FEMA 356 (ASCE 41) Upgrade**

- Design all upgrades to meet the Life Safety Building Performance Level (3-C) for the BSE-1 Earthquake Hazard Level.
- Submit list of proposed upgrades that would likely be needed to upgrade the building to the Collapse Prevention Building Performance Level (5-E) for the BSE-2 Earthquake Hazard Level. The intent is to provide this list based on the Structural Engineering firm's experience on similar buildings and based upon engineering judgment. This list is to be discussed at a meeting scheduled with CPO and Campus Engineering to determine what items should be included with the upgrade design.
- Design is to include all of the mitigation work necessary to clear all the non-conformances identified in the ASCE/SEI 31 study.
- In Unreinforced Masonry (URM) Buildings, where the roof and floor structure is supported by a URM wall, provide secondary structure to support the vertical loads of the roof and floor members. This includes support of all the floor and roof structure including joists, beams, girders, rafters etc.
- For hospital and other essential facilities utilize the following Enhanced Rehabilitation Objective: Immediate Occupancy Performance Level (1-B) at BSE-1 Earthquake Hazard Level, and Collapse Prevention Performance Level (5-E) at BSE-2 Earthquake Hazard Level.
- Perform the design of seismic strengthening elements in accordance with the applicable material chapters of the IBC, latest edition.
- All existing structural defects discovered during design, demolition, and construction shall be repaired. This includes patching of spalls at exposed rebar in slabs, beams, and columns.

#### **Design Evaluation**

- Programming Phase: Provide the findings of the ASCE/SEI 31 study in a bound report. Along with the ASCE/SEI 31 study, submit a list of potential upgrades that would likely be needed to satisfy a FEMA 356 (ASCE 41) Collapse Prevention Building Performance Level (5-E) for the BSE-2 Earthquake Hazard Level. The project budget should consider the cost of both the ASCE/SEI 31 and FEMA 356(ASCE 41) upgrade requirements. In URM buildings, the project budget should also include the secondary structure to support the vertical loads of the roof and floor members. Include an executive summary which describes the existing building, evaluates the condition of the building, identifies and comments on the relative significance of any deficiencies, and makes alternative recommendations for correcting those deficiencies. Divide the recommended seismic improvements into those

which can be completed with minimal impact on the occupants of the building and those that will require vacating all or part of the building.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the modifications and review of existing buildings for items which include, but are not limited to, the following: floor or roof penetrations, wall penetrations, support of equipment.

### Design Criteria

- Obtain and review existing drawings maintained in Facilities Records. Conduct site visit during design phase to verify conditions especially if existing drawings are not available.
- The resulting structure shall be at least as strong or stronger than before the modifications. In no case shall the structure be weakened by the modifications. This applies to both gravity loads as well as lateral (seismic and wind) loads.
- Be sure to use the actual operating weight when reviewing new equipment loads. Consider housekeeping pad, inertia pad and curb weights also.
- Include miscellaneous equipment when reviewing new medical equipment. These items include: shielding, ceiling suspended units, and wall mounted units.
- Evaluate the final equipment location as well as the route that the equipment needs to take to travel to the final location.
- Re-establish lateral load strength of the building if wall penetrations are cut into shear walls.
- Analyze lateral load diaphragm effects if floor or roof penetrations are significant.
- Consider and specify any temporary shoring or jacking required to support existing members prior to modification. A possible example would be for supporting or relieving load from existing steel members prior to adding steel plates for strengthening.
- All existing structural defects discovered during design, demolition, and construction shall be repaired. This includes patching of spalls at exposed rebar in slabs, beams, and columns.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Provide schematic plan indicating proposed revisions. Outline specifications.
- Design Development Phase: Provide framing plans, typical details. Draft specifications.
- Construction Document Phase: Complete design and specifications.

## Construction Submittals

- Shop drawings and submittals for new structural members as required by other Facilities Services Design Guide sections.

## Related Sections

- Facilities Services Design Guide - General Requirements – Structural
- Facilities Services Design Guide - Seismic Analysis & Upgrade of Existing Buildings

- All of the structural material sections of the Facilities Services Design Guide.

### **Products, Material and Equipment**

- As required by other Facilities Services Design Guides sections for the specific structural materials utilized.

### **Installation, Fabrication and Construction**

- As required by other Facilities Services Design Guide sections for the specific structural materials utilized.
- Specify that the contractor is to field verify actual field conditions prior to construction.

END OF DESIGN GUIDE SECTION

## **Basis of Design**

This section applies to the design and installation of excavation shoring. This includes soldier piles, tiebacks, and soil nails etc.

### **Design Criteria**

- Shoring shall be designed by the engineer of record. Contractor designed shoring is not acceptable.
- Base shoring design on the recommendations in the Geotechnical Engineering Report.
- Neither Owner nor Consultant shall be responsible for the interpretation drawn by the Contractor from any subsurface information received from the Owner or Consultant.
- It shall be the Contractor's responsibility to satisfy themselves regarding subsurface conditions.
- At shoring for structures located below the water table, locate the shoring walls a sufficient distance outside the face of the permanent basement walls to allow for proper installation and inspection of positive-side waterproofing.
- In regard to pile, tieback, and soil nail installation; an "Obstruction" shall be defined as rocks or logs over 24 inches in diameter. Owner will only be responsible for additional costs if obstruction is greater than 24" in any direction.
- Shotcrete utilized with a soil nail system shall meet the requirements found in the most current applicable Seattle DPD Director's Rule. This requirement applies to all UW properties.
- Shotcrete utilized with a soil nail system shall not be used for permanent perimeter below grade walls where adjacent to occupied spaces.
- Soldier piles used as underpinning shall be jacked as specified by the engineer of record to preload the piles to prevent settlement of the existing building.

## **Design Evaluation**

- Schematic Design Phase: Indicate type of shoring and locations proposed.
- Design Development Phase: Plan showing shoring locations, typical sizes and sections. Draft specifications.
- Contract Document Phase: All notes, plans, wall elevations and details required for the installation of shoring. Final specifications.

## **Construction Submittals**

- Product data: For each type of material indicated
- Provide a detailed sequence and procedure for shoring construction for review 21 days prior to any shoring installation

### **Quality Assurance**

- Testing and inspection services will be provided by the Owner. The Contractor shall cooperate and provide access and samples when requested by the Owner.
- See Concrete and Structural Steel sections for material inspection.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Foundations
- Facilities Services Design Guide - Sub-Grade Walls
- Facilities Services Design Guide - Concrete
- Facilities Services Design Guide - Structural Steel
- Facilities Services Design Guide - Thermal and Moisture Protection

### **Products, Material and Equipment**

- See Concrete.
- See Structural Steel
- Minimum structural concrete strength for drilled shafts is 3000 psi.
- Minimum concrete strength for lean mix concrete is 1000 psi.
- Lagging shall be pressure treated.

### **Installation, Fabrication and Construction**

- In general, comply with industry standard practice.
- Provide unit price section in specifications for temporary casing of drilled shafts where casing may be needed due to field conditions including groundwater and caving.
- Concrete placed into drilled shafts around soldier piles shall be conveyed in a manner to prevent separation or loss of materials. In no case shall the concrete be allowed to freefall more than 5 feet. Tremie concrete where required.
- All voids behind lagging shall be filled prior to excavating subsequent lifts. Use material and method that will not interfere with the free drainage system.
- Remove top of shoring system a minimum of 3 feet below finished grade. Also remove additional depth as required by the local municipality or adjacent property owner.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of foundations including piling.

### Design Criteria

- Base foundation design on the recommendations in the Geotechnical Engineering Report.
- Neither Owner nor Consultant shall be responsible for the interpretation drawn by the Contractor from any subsurface information received from the Owner or Consultant.
- Structures located on the Montlake Landfill that are supported on piling need to have the piling extend down to the underlying firm clay layer in order to avoid additional loading on the refuse and peat.
- It shall be the Contractor's responsibility to satisfy themselves regarding subsurface conditions and to install piles into the bearing stratum.
- Driven piles are not recommended because of noise and vibration issues.
- In regards to pile installation; an "Obstruction" shall be defined as rocks or logs over 24 inches in diameter. Owner will only be responsible for additional costs if obstruction is greater than 24" in any direction.
- Augercast and pin piles shall meet the requirements found in the most current applicable Seattle Department of Planning and Development (DPD) Director's Rule. This requirement applies to all UW properties.
- Controlled Density Fill is acceptable for backfilling over-excavation with the approval of the Geotechnical Engineer.

## Design Evaluation

- Schematic Design Phase: Plan showing type of foundation.
- Design Development Phase: Plan showing foundations, piling and typical sections. Draft specifications.
- Contract Document Phase: All information required for the installation of foundations and piling. Final specifications.

## Construction Submittals

- Product data: For each type of material indicated
- Require that a detailed sequence and procedure for construction of piling be submitted to the Engineer of Record for review 21 days prior to any pile installation.

## Quality Assurance

- Testing and inspection services will be provided by the Owner. The Contractor shall cooperate and provide access and samples when requested by the Owner.
- See Concrete section for material inspection.

### **Related Sections**

- Facilities Services Design Guide - General Requirements
- Facilities Services Design Guide - Shoring
- Facilities Services Design Guide - Slab on Grade
- Facilities Services Design Guide - Sub-Grade Walls
- Facilities Services Design Guide - Concrete

### **Products, Material and Equipment**

- See Facilities Services Design Guide - Concrete.
- Minimum concrete strength for augercast piles and drilled piers is 5000 psi.
- Timber piles shall be Douglas Fir treated with Creosote to a minimum net retention of 17 PCF.

### **Installation, Fabrication and Construction**

- In general, comply with industry standard practice.
- Provide suitable spacers at least one set every 6 feet in concrete piles or piers.
- Place augercast piling by rotating a continuous flight-hollow-shaft auger into the ground to a predetermined depth. Place reinforcing while mortar is still fluid.
- Locate pile centers to an accuracy of  $\pm 3$  inches and plumb within 2%. Place augercast piles no closer than 4 feet center-to-center until the grout in the previously poured pile has set for 12 hours.
- Place augercast pile high strength grout during auger withdrawal under sufficient pressure to fill the hole and prevent hole collapse, and to cause the lateral penetration of the grout into soft or porous zones of the surrounding soil. Provide a head of at least several feet of grout above the injection point around the perimeter of the auger flighting at all times during the raising of the auger so that the grout has a displacing action, removing any loose materials from the hole.
- Provide a calibrated pressure gage on the augercast pile grout pump, in clear view of the operator, and maintain at all times, a positive pressure (approximately 2.5 times the ground water pressure). The minimum volume of grout placed in the hole shall be at least 10% greater than the net volume of the augered hole. The amount of grout placed shall be determined by attaching a counter to a displacement-type pump to record the number of strokes.
- Submit drilling logs for each augercast pile. Include identification mark, shaft diameter, bottom elevation, top elevation, nature and location of obstructions, water conditions during drilling, and grout placement.
- Contractor shall provide temporary casing for drilled piers where required due to field conditions including groundwater and caving.

- Concrete placed into drilled piers shall be conveyed in a manner to prevent separation or loss of materials. In no case shall the concrete be allowed to freefall more than 5 feet. Tremie concrete where required.
- Temporary foundations, such as for tower cranes, that are outside the footprint of the building need to be removed.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of concrete slabs on grade in buildings.

### Design Criteria

- Provide joints in all concrete slabs on grade.
- Provide control or construction joints on all column lines and at 20'-0" maximum spacing each way in between. Structural engineer to determine closer spacing requirements.
- Show the location of control and construction joints on the plan.
- Reinforce with conventional reinforcing steel each way. Welded wire fabric is not allowed.
- Design and specify floors that are engineered and constructed to achieve the following minimum degree of flatness when measured in accordance with ASTM E 1155: Overall  $F_F = 35$ , Localized  $F_F = 25$ . Garage floors may be Overall  $F_F = 25$ , Localized  $F_F = 20$ .
- Design and specify floors that are engineered and constructed to achieve the following minimum degree of levelness when measured in accordance with ASTM E 1155: Overall  $F_L = 25$ , Localized  $F_L = 17$ . Garage floors may be Overall  $F_L = 17$ , Localized  $F_L = 13$ .
- The Localized F-Numbers indicated are the minimum quality acceptable in any one floor section. This allows the contractor sufficient margin for the normal variations that occur within a pour.
- Specify the top of concrete elevation at each column or wall to be within  $\frac{1}{4}$  inch of the elevations shown on the drawings.
- Provide below slab capillary break at all slabs on grade. Provide additional details and groundwater collection and drainage systems as required for slabs on grade located below the ground water table. If gravel is used for a capillary break material, it shall be uniformly well graded and compacted.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Indicate Slab on Grade thickness and proposed type of reinforcing.
- Design Development Phase: Plans showing location, thickness, reinforcing of slab on grade. Slab joint locations. Draft specifications.
- Construction Document Phase: All information required for the installation of slabs on grade including slab thickness, location of construction and construction joints and details of joints. Final specifications.

## Construction Submittals

- Submit a jointing plan to the Architect for approval a minimum of 21 days prior to first slab pour.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Concrete

### **Products, Material and Equipment**

- See Facilities Services Design Guide - Concrete

### **Installation, Fabrication and Construction**

- Saw joints as soon as the joint can be cut without edges raveling and within 24 hours of slab placement. Fill sawed joints with sealant.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of sub-grade and site retaining walls that support lateral earth pressure.

### Design Criteria

- Use only concrete construction. Masonry is not allowable.
- Design sub-grade and site retaining walls for the equivalent fluid pressure recommended in the Geotechnical Engineering Report for the project.
- Design sub-grade walls that will permanently extend below the water table for the hydrostatic pressure due to the seasonal high-water table. Indicate on the drawings the minimum extent of the structure that is necessary to be built to provide sufficient dead load to resist hydrostatic uplift prior to discontinuing temporary dewatering.
- Place below-grade building walls in lengths limited to 40 feet.
- Space vertical expansion joints in site concrete retaining walls no more than 20 feet on center. Show specific location of joints on the drawings.
- Provide 3-inch round weep holes at 10'-0" on center maximum spacing in site concrete retaining walls.
- Show joint details on the drawings.
- Provide waterstops at all construction joints below grade.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Plan showing sub-grade and site retaining wall locations.
- Design Development Phase: Thickness of walls, location of vertical expansion joints in site concrete retaining walls. Typical wall section for each type of wall. Draft specifications.
- Construction Document Phase: All information required for the installation of structural sub-grade and site retaining walls. Final specifications.

## Construction Submittals

- See Facilities Services Design Guide - Concrete

## Related Sections

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Foundations
- Facilities Services Design Guide - Concrete
- Facilities Services Design Guide - Earthwork
- Facilities Services Design Guide - Thermal and Moisture Protection

**Products, Materials and Equipment**

- See Facilities Services Design Guide - Concrete

**Installation, Fabrication and Construction**

- See Facilities Services Design Guide - Concrete

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of structured floors.

### Design Criteria

#### Laboratory Buildings

- Design all floors in new laboratory buildings to support a live load of 100 PSF. In addition, use 30 PSF for equipment load plus 20 PSF uniformly distributed partition load. Do not reduce the live load in the design of the floor slabs, floor beams and floor girders. Consider the equipment load as a live load.
- Design the columns and footings to carry the 100 PSF floor live load reduced in accordance with the current building code. Do not reduce the equipment or partition loads.
- Limit the shrinkage to 0.00030 inches per inch (including all admixtures) in the concrete in the floor framing. The contractor shall submit shrinkage test results of mix, conducted per ASTM C-157, a minimum of 4 weeks prior to use.

#### Vibration

- Some buildings on campus contain research instrumentation that is extremely sensitive to vibration. Stiff floors with high resonance frequencies vibrate less than more flexible floors with low resonance frequencies. Short-span floors vibrate less than long-span floors. The structural engineer shall select a framing scheme as well as the size and spacing of columns to keep the floor vibrations within the criteria established in the Technical Programming Phase.
- Basic design is 2000 micro-inches/sec. maximum for lab areas. Refer to building program for more restrictive vibration criteria. Areas of some buildings may require 1000 micro-inches/sec. maximum.

#### All Buildings

- Design penthouse floors to support a live load of 75 PSF or the actual equipment weights, whichever is greater.
- Design platforms for equipment to provide adequate access for maintenance personnel. This may include the design of catwalks and ladders at or above the main platform level.
- Design and specify floors that are engineered and constructed to achieve the following minimum degree of flatness when measured in accordance with ASTM E 1155: Overall  $F_F = 35$ , Localized  $F_F = 25$ .
- Design and specify floors that are engineered and constructed to achieve the following minimum degree of levelness when measured in accordance with ASTM E 1155: Overall  $F_L = 25$ , Localized  $F_L = 17$ . Note that the use of  $F_L$  on structured floors is limited to when the slab is still supported in its original as-cast position (still shored) and when the slab has no camber.
- The Localized F-Numbers indicated are the minimum quality acceptable in any one floor section. This allows the contractor sufficient margin for the normal variations that occur within a pour.

- Specify the top of concrete elevation at each column or wall to be within  $\frac{1}{4}$  inch of the elevations shown on the drawings.
- Design camber of formwork and steel framing with the goal of keeping the final (after shore removal) deflected slab or beam at, or just below a horizontal position. Engineer of Record shall specify the required cambers on the drawings in order to achieve the tolerances stated above.
- Provide sleeve and/or curb at all floor slab penetrations.
- If a floor is designed for a future load, indicate clearly on the plan (or a key plan) the location, footprint, operating weight and move-in pathway as applicable. This may typically apply to future medical or lab equipment.

#### **Garage Structures**

- Limit the shrinkage to 0.00030 inches per inch (including all admixtures) in the concrete in garage floor framing. The contractor shall submit shrinkage test results of mix, conducted per ASTM C-157, a minimum of 4 weeks prior to use.
- Garage floors may be Overall  $F_F = 25$ , Localized  $F_F = 20$ , and Overall  $F_L = 17$ , Localized  $F_L = 13$ .

#### **Pedestrian Bridges**

- Design pedestrian bridges to support a minimum live load of 100 PSF. Also coordinate with Project Manager for any equipment loads that may be used on the bridge.

#### **Slabs over Electrical Rooms**

- Design slabs over electrical rooms with micro silica concrete mix or limit shrinkage to 0.00030 inches per inch and add polypropylene fibers. Treat all cracks with Methylmethacrylate.

#### **Post-Tensioned Slabs**

- Use of post-tensioned slabs is discouraged because of inflexibility of the structure for remodeling. The tendons are difficult to locate in the field for future remodeling and penetrations are restricted. Post-tensioned slabs are acceptable for parking garages. All other proposed uses shall be discussed with Project Manager and Campus Engineering.
- All post-tensioning shall be a grouted duct type system.
- Provide for a method of permanently identifying each tendon's location on the soffit of the structure for future remodels. Identification shall be a maximum of 10 feet oc. Possible method is by use of  $\frac{3}{4}$ " chamfer strips on soffit of forms. Discuss with Project Manager and Campus Engineering.

#### **"Floating" slabs for mechanical equipment**

- Avoid using "Floating Slabs" i.e., slabs that are acoustically isolated from the structural slab with insulation between the two slabs. These slabs are usually constructed before the building is "closed in" or protected from rain. Consequentially they are exposed to rain which saturates the insulation, making the acoustical performance ineffective and providing a breeding place for mold and mildew. Consult with Campus Engineering if floating slabs are considered.

## **Design Evaluation**

The following information is required to evaluate the design:

- Schematic Design Phase: Plans showing structural scheme.
- Design Development Phase: Typical floor framing plan and typical sections. Draft specifications.
- Contract Document Phase: All information required for the installation of the structured floors. Final specifications.

## **Construction Submittals**

- Product data for each type of material utilized

## **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Concrete
- Facilities Services Design Guide - Structural Steel
- Facilities Services Design Guide - Timber
- Facilities Services Design Guide - Finishes

## **Products, Material and Equipment**

- See Related Sections

## **Installation, Fabrication and Construction**

- See Related Sections

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of roof framing and rooftop elevated platform framing.

### Design Criteria

- Slope the structural roof system to accomplish the roof slopes shown on the drawings. This applies to plaza decks and walkways also.
- Design for a minimum Live Load of 25 PSF.
- Design and specify roofs that are engineered and constructed to achieve the following minimum degree of flatness when measured in accordance with ASTM E 1155: Overall  $F_F = 25$ , Localized  $F_F = 20$ .
- Design and specify roofs that are engineered and constructed to achieve the following minimum degree of levelness when measured in accordance with ASTM E 1155: Overall  $F_L = 17$ , Localized  $F_L = 13$ . Note that the use of  $F_L$  on roofs is limited to when the slab is still supported in its original as-cast position (still shored) and when the slab has no camber.
- The Localized F-Numbers indicated are the minimum quality acceptable in any one roof section. This allows the contractor sufficient margin for the normal variations that occur within a pour.
- In addition to the F-Numbers, specify the top of structure elevation at each column and wall to be within  $\frac{1}{4}$  inch of the elevation shown on the drawings.
- Camber structural system as needed to assure positive flow of rainwater. Check for progressive deflection due to ponding.
- Design for International Building Code (IBC) Rain Loads due to rainwater that will accumulate if the primary drainage system for any portion of the roof is blocked.
- Design with additional dead load to allow for reroofing once.
- If the roof is to be designed as a future floor, detail tops of columns and walls above the roof level for ease of future vertical extensions and to minimize the disturbance to the existing roofing. Clearly indicate on the drawings the extent of future addition that is designed for.
- Be aware of possible increased roof loads due to “garden” or “vegetated” roofs that may be used for sustainability.
- Design for all present and future rooftop mechanical and electrical equipment. Be sure to use “operating” weights of heaviest possible equipment that may be selected. Design for weight of all curbs, housekeeping pads, and inertia pads. Coordinate pad thicknesses with acoustical consultant.
- Design rooftop elevated platforms for equipment to provide adequate access for maintenance personnel. This may include the design of catwalks and ladders at or above the main platform level.
- Design for bracing of fume hood exhausts and other items that project above the roof including towers, antennas etc. Arrange guy wires and supports in a manner to minimize aesthetic disturbance.
- Design for all window washing equipment support.

## **Design Evaluation**

- Schematic Design Phase: Plan showing structural scheme.
- Design Development Phase: Roof framing plan and typical sections. Draft specifications
- Contract Document Phase: All information required for the installation of structural roofs and rooftop platforms. Final specifications.

## **Construction Submittals**

- Product data for type of material utilized.

## **Related Sections**

- Facilities Services Design Guide - Concrete
- Facilities Services Design Guide - Structural Steel
- Facilities Services Design Guide - Timber
- Facilities Services Design Guide - Roofing
- Facilities Services Design Guide - Thermal and Moisture Protection
- Facilities Services Design Guide - Fume Hood Exhaust Systems

## **Products, Material and Equipment**

- See Related Sections.

## **Installation, Fabrication and Construction**

- See Related Sections.

END OF DESIGN GUIDE SECTION

## **Basis of Design**

This section applies to the design and installation of cast-in-place concrete, shotcrete, precast concrete, and post-tensioned concrete.

### **Design Criteria**

- Use most recent version of the International Building Code (IBC) with local municipality amendments. Referenced standards include American Concrete Institute (ACI) standards.
- Concrete mix designs shall be approved by the local municipality in addition to complying with all the requirements of this section.
- Concrete strength shall be not less than 3,000 psi at 28 days.
- Shotcrete shall meet the requirements found in the most current applicable Seattle Department of Planning And Development (DPD) Director's Rule. This requirement applies to all UW properties. (This Director's rule contains beneficial information that the UW wishes to apply to all sites.)
- Structural precast members shall be designed by the engineer of record. Precast stairs may be fabricator designed.
- Key construction joints for shear transfer and extend reinforcing through joint.
- Provide keyways at all construction joints and provide continuous waterstops at all joints exposed to weather or below grade. Take special care in design and specifying waterstops for conditions below the water table.
- Dowels shall be provided at each construction joint to lap with all reinforcing in the adjoining member. This includes: each curtain of wall reinforcing, top and bottom slab and beam reinforcing, and all column reinforcing.
- Slab temperature steel shall be provided each way throughout all slabs. Provide each way top and bottom for slabs greater than or equal to 8" thick.
- Provide corner bars to match all horizontal wall and longitudinal footing reinforcing.
- Where main slab bars are parallel to a support, specify a minimum of #4 @ 12" oc top bars extending a minimum of 2'-0" beyond the face of support into the slab. Specify a 90° standard hook into support where the slab is on one side only.
- In structural steel construction with steel deck and concrete fill, specify a minimum of #4 @ 12" oc top over steel members that are parallel to the steel deck. Extend bars a minimum of 2'-0" beyond the edge of the member flange. This will mainly occur over steel girders.
- Beams and girders shall be uniform in size and spacing.
- Provide the maximum reuse of forms for all cast-in-place concrete work. This requires repetition of design features throughout the project.
- Column cross section shall be constant for two stories, minimum. Change column cross section with an inside face setback. Circular free standing columns shall be of a constant diameter at each story. Reinforce with spiral hoops. Isolated column ties are unacceptable for circular columns.
- Dimensions of columns and beam sides shall be in multiples of 2 inches.

- Slope the top of all exposed concrete surfaces and provide cast-in drips at cantilevered leading edges.
- Special design attention shall be given to the long term effects of member shortening and creep cambering of pre or post-tensioned members.
- Provide chart on the structural drawings that clearly indicates each type of concrete used on the project. Include the following minimum information: strength, minimum cement content, maximum Water/Cement (W/C) ratio, air-entraining requirements and where each type of concrete is to be used.
- Specify low water/cement ratio for concrete to reduce potential shrinkage cracks.
- Provide chart on the structural drawings that clearly lists the minimum required lap lengths for each bar size and for each concrete strength.
- Chloride containing admixtures are not allowed.
- Admixtures either accelerating or retarding set times without water reduction are discouraged.
- Water reducing admixtures can be used to increase slump and workability without increasing mix water.
- The use of superplasticizers shall be considered to temporarily increase mix fluidity whenever strength dictated low water/cement ratios interfere with successful placement and consolidation. Applications include pumped concrete placement and in thin section construction where shrinkage must be minimized.
- Specify air entrainment admixtures for all slabs exposed to weather. Do not use with high-early strength type III cement.
- Consider specifying fly ash as a Portland cement replacement of up to 30% of the weight of the concrete.
- Sealers: The purpose of sealers is to protect exterior concrete from damage by water and to protect the window glazing from chemical leeching of the concrete.
- Use silica fume in concrete for all ramps greater than or equal to 5% grade.
- Epoxy and powder driven type fasteners are not allowed for tension applications.
- See Mechanical – Piping, Valves and Accessories for pipe sleeves and Link Seals or approved substitution.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Provide schematic plan indicating typical concrete framing. Outline specifications.
- Design Development Phase: Provide framing plans, schedules, and typical concrete details. Draft specifications.
- Construction Document Phase: Complete design and specifications.

### **Construction Submittals**

- Shop drawings for reinforcing steel and post-tensioning
- Concrete mix designs
- Grout mix design for bonded post-tensioning
- Formwork shop drawings
- Stamped engineering calculations and shop drawings for fabricator designed non-structural (or stair) precast.
- Product data: For each type material indicated.
- Submit a jointing plan to the Architect for approval.

### **Quality Assurance**

- Provide inspection of all concrete, reinforcing steel and PT placement, PT stressing, and curing procedures by an independent testing lab.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Shoring
- Facilities Services Design Guide - Foundations
- Facilities Services Design Guide - Slab on Grade
- Facilities Services Design Guide - Sub-Grade Walls
- Facilities Services Design Guide - Structured Floors
- Facilities Services Design Guide - Roofs
- Facilities Services Design Guide - Thermal and Moisture Protection
- Facilities Services Design Guide - Finishes
- Facilities Services Design Guide - Piping, Valves and Accessories
- Facilities Services Design Guide - Hangers and Supports - Mechanical

### **Products, Materials and Equipment**

- Cement: ASTM Designation C-150.
- Aggregates: Clean and natural crushed Steilacoom gravels complying with ASTM Designation C-33. Maximum size: not to exceed 1/5 of the minimum concrete section or 3/4 of the clear distance between reinforcing bars.
- Reinforcing: Deformed bars shall be ASTM 615 or A 706 as required. Welded wire fabric shall be ASTM 185 furnished in flat sheets only.
- Water: Potable quality, free from oils, acids and injurious amounts of organics or salts.

- Air Entrainment Admixture: Vinsol-resin type.
- Waterstops: Flexible or self-expanding type.
- Extruded polystyrene that will remain in place permanently as a filler under concrete shall be specified as 40 psi minimum.
- Concrete mix batch weights and bulk specific gravity determinations shall be required for all selected aggregates based on saturated surface dry (SSD) conditions. This mix information must be sufficient to verify through absolute volume calculations the concrete's yield, cement factor, water/cement ratio and mortar to voids ratio as a primary basis for mix acceptance.
- Mix ingredients and proportions shall be such as to work readily into corners and around reinforcing without segregation and undue shrinkage while achieving the specified strength. Final mix shall be based on either laboratory test batches or field experience with standardized mixes.

### **Installation, Fabrication and Construction**

- Forms may be of wood, steel or fiberglass. Exposed surfaces shall be equal in appearance to that of plywood. Forms shall be mortar-tight and sufficiently strong and rigid to resist deformation.
- Form ties shall be steel rods of adequate strength, providing a minimum 1-inch break back from the surface.
- Form all vertical footing surfaces. Remove all water from form work - by pump from an outside sump, if necessary. Forms shall be true, rigid, tight and clean.
- Job site application of a superplasticizer shall be monitored by the testing lab.
- Ready-mix concrete shall be utilized whenever locally available. Fully executed and signed trip tickets shall accompany each load and shall be recorded by the inspector at the job site at the time of entry. Re-tempering of concrete or adding water without authorization is unacceptable.
- All reinforcement and embedded items shall be securely fastened, inspected, and approved by the inspector before pouring operations may be started.
- Discharge of concrete shall be within 1 ½ hours, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. (This is an excerpt from the American Society for Testing and Materials (ASTM) C 94)
- Vibrate concrete in its final location to a uniform and homogeneous mass. Vibration by means of approved portable vibrators shall be done only to the degree necessary to produce a dense well-compacted concrete free from honeycomb and voids. The contractor must have available at all times at least one spare vibrator equal in performance to that in service.
- Existing concrete surfaces to receive new concrete shall be cleaned, roughened and coated with bonding agent prior to new concrete placement.
- Maintain the temperature of the concrete at 50° F or above for the entire curing period.
- Cure all concrete for a minimum period of 7 days after placing the concrete.

- The Contractor may leave the formwork in place for the curing period and provide moisture-retaining covers over any exposed concrete. Moisture-retaining covers: Waterproof paper, polyethylene film or polyethylene-coated burlap meeting the requirements of ASTM C 171.
- If the formwork is removed before the 7-day curing period has elapsed, the concrete must be thoroughly wetted and a moisture-retaining cover provided. Place the cover in the widest practical width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive
- If the temperature is expected to exceed 75° F for the two days following placement of the concrete, loosen the forms as soon as it can be done without damage to the concrete. Apply water continuously using soil-soaker hoses and allow to run down the inside of the forms.
- Cure building concrete slabs using liquid membrane-forming curing compound complying with ASTM C 309, Type 1-D, Class B, with fugitive dye. The curing compound shall be water-based acrylic. Solvent-based curing compounds shall not be used. The curing compound shall be applied to the surface of the concrete as soon as the bleed water evaporates from the surface of the concrete, and finishing procedures are complete. The total amount of material applied on the surface shall be at the rate recommended by the manufacturer. Two applications at right angles to each other shall be provided.
- Cure shotcrete walls using liquid membrane-forming curing compound as specified for building concrete slabs.
- Do not use curing compounds on surfaces that are to receive additional concrete, paint or tile, unless it has been demonstrated that the membrane-curing compound can serve as a base for the later application. Verify that the curing compound is compatible with finish materials. If the curing compound hinders positive bond, remove it (by sandblasting, etc.) after a 7-day curing period, or cure the concrete using water curing or by sealing with moisture retaining cover.
- Curing compounds are not allowed on slabs in laboratories and mechanical rooms and slabs over electrical rooms. Provide water curing only.
- Forms shall be removed at such time and manner to guarantee the safety of the structure. Primary supports for elevated slabs shall not be removed before 28 days in the case of regular concrete usage. Other mix ingredients may affect this time and any primary shoring removal shall be verified by break strength tests of at least two job cured cylinders. Equivalent strength of fly ash concrete may require up to 58 days to cure properly.
- Where post-tensioned construction is allowed per Section 3H, the structural engineer shall determine the minimum length of time needed for the post-tensioned slabs to cure, after the post-tensioning forces are applied, prior to casting any adjacent pour strips. The absolute minimum length of time shall be 28 days. The structural engineer shall determine what length of time over and above 28 days is needed in order to minimize cracking and assure proper performance of the post-tensioning system. It is crucial that the contractor or CMGC schedule this time into the construction schedule.
- Finishing shall follow immediately upon form removal and patching. Finish all exposed concrete walls as follows and note on drawings:
  - 1) Class A: Provide a dry surface honed to a uniformed and even color and texture. Follow by a wet bagged (burlap) rub with 1 part Portland cement and 1 ½ parts fine sand. When dry, remove excess grout with a second sacking.
  - 2) Class B: Remove irregularities by chipping and grinding. After wetting, sack as describe for Class A finish above.

- Specify that the design and camber of the formwork to maintain levelness (or camber if a cambered system) after the weight of the wet concrete is introduced is the contractor's responsibility. Contractor shall adjust formwork as required prior to subsequent pours if necessary to meet floor tolerances specified.
- A Special Formwork Survey shall be performed by the contractor for all areas of structured floors where the center to center of supports is greater than or equal to 35 feet. At a minimum, survey at the mid-span of each member. Conduct and document the survey at the following stages of construction at a minimum:
  - 1) Immediately prior to pouring concrete, survey bottom of soffit form.
  - 2) One day after concrete pour, survey top of concrete and bottom of soffit form.
  - 3) One day after removal of all shores and reshores, survey top of concrete.

These survey values will enable the contractor and structural engineer to determine what movement is due to the formwork system settling (crushing) and what movement is due to structural deflection after the temporary vertical supports are removed. Contractor is to review each survey immediately to verify the assumptions made for their formwork design and make adjustments if necessary. Require, prior to subsequent pour, that the contractor submit in writing that they have reviewed the survey and describe what modifications, if any, they are incorporating to improve the results for subsequent pours.

- Submit results of Special Formwork Survey within 3 days of shore and reshore removal. Submit results in the form of a plan with the elevations clearly noted for each survey point. Submit copies to owner, architect and structural engineer.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of reinforced CMU and reinforced multi-wythe brick walls.

### Design Criteria

- Use most recent version of the International Building Code (IBC) with local municipality amendments. Referenced standards include American Society of Civil Engineers (ASCE) 5 and ASCE 6.
- Refer to the following industry guidelines; Brick Institute of America (BIA), National Concrete Masonry Association (NCMA).
- Do not use masonry below grade.
- Detail non-bearing walls to allow for vertical deflection of members above. Provide positive connection at top of wall at 4'-0" on center maximum spacing.
- Detail non-bearing/shear walls to allow for seismic inter-story drift at both top and each end of walls where adjacent to structural members.
- Provide footing under all masonry walls. Interior non-bearing walls may utilize a thickened slab which is a minimum of 12" thick by 1'-6" wide.
- Specify the use of low lift masonry practices. Grout vertically reinforced cells in no more than four foot high lifts. Grout pours over 12" in height shall be mechanically vibrated.
- Provide control joints in CMU walls and expansion joints in multi-wythe brick walls at a spacing not to exceed  $1 \frac{1}{2}$  x the wall height or 25'-0" whichever is less. Follow recommendations in NCMA TEK Manual 10-2B.
- Provide vertical and horizontal reinforcing in CMU walls. Wall reinforcing shall not be less than #5 at 32" oc vertical and 2 #4 in horizontal bond beam at 4'-0" oc.
- Use of stack bond is discouraged. If used, for architectural reasons, provide a minimum of one vertical reinforcing bar in each piece of block.
- Extend vertical reinforcing up to top of parapet walls. Provide horizontal reinforcing at the top of the wall.
- Provide a table on the drawings that indicates required lap lengths of the various bars used.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Provide schematic plan indicating location and type of reinforced masonry. Outline specifications.
- Design Development Phase: Provide framing plans, typical masonry details, control joint locations. Draft specifications.
- Construction Document Phase: Complete design and specifications.

### **Construction Submittals**

- Shop drawings for reinforcing steel.
- Material certificates for masonry units.
- Mix design for mortar and grout.

### **Quality Assurance**

- Provide inspection of all masonry by independent testing lab.
- Mock-up is required for large projects; shall not be part of the work. Work must be approved prior to working on the building.

### **Related Sections**

- General Requirements
- Below Grade Walls
- Architectural – Masonry Walls
- Architectural – Thermal and Moisture Protection

### **Products, Material and Equipment**

- Concrete masonry units (CMU) minimum net compressive strength 1900 psi, normal or medium weight block.
- Brick minimum net compressive strength 3000 psi.
- Grout minimum compressive strength 2500 psi.
- Type-S mortar.
- No calcium chloride allowed in mortar or grout.
- At exterior walls, all metal accessories shall be stainless steel.
- Consider specifying reinforcing steel with a high recycled content.

### **Installation, Fabrication and Construction**

- Store masonry units in dry location. If units are not stored in an enclosed location, cover top and sides of stacks with waterproof sheeting, securely tied.
- Follow cold and hot weather construction practices per ASCE 6.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of structural steel, steel joists (open-web steel joists) and steel decking.

### Design Criteria

- Use most recent version of the International Building Code (IBC) with local municipality amendments. Referenced standards include American Institute of Steel Construction (AISC), American Welding Society (AWS), American Iron and Steel Institute (AISI), and the Steel Joist Institute (SJI) specifications and standards.
- Clearly identify which welds in the project are seismic critical welds. Identify special materials, procedures, and inspection required for seismic critical welds.
- All connections are to be designed by the engineer of record. No fabricator designed connections are allowed.
- Specify that only WABO certified welders are acceptable.
- Use composite design whenever possible in order to provide a cost effective design. Specify a regular spacing of welded studs such that the contractor can easily install the correct number of studs on each member. In other words, do not specify multiple numbers of studs for beams of the same length.
- Use of steel joists is acceptable only for roofs in areas that are not supporting rooftop or suspended units greater than 1000 pounds operating weight. Do not utilize steel joists for floor construction.
- Clearly indicate any special loading that occurs for the design of the steel joists. These loads include snow drift, duct and piping weights, and equipment weights.
- Indicate the locations of steel joist bridging on the framing plans so that it can be coordinated with the other consultants. Take special care to coordinate with the architect where the framing will be left exposed.
- Indicate locations where shoring of steel decking is required to support the weight of wet concrete.
- Steel decking may be used for garage construction as a form only. Provide reinforcing bars (not WWF) in slab to support 100% of the design loads. Take note of minimum concrete cover indicated for garages in Structured Floors section.
- Take special care if underfloor ducts (such as Walker Ducts) are to be installed in a topping slab over steel decking. Check gravity and diaphragm loads on the decking.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Provide schematic plan indicating typical steel framing. Outline specifications.
- Design Development Phase: Provide framing plans, typical steel details. Draft specifications.
- Construction Document Phase: Complete design and specifications.

### **Construction Submittals**

- Shop drawings for structural steel, and steel decking.
- Mill Test Reports for Structural steel, bolts nuts and washers, and shear stud connectors.
- Manufacturer Certificate for steel joists.
- Shop drawings and calculations for steel joists.
- Product Certificates for each type of steel deck.

### **Quality Assurance**

- Provide inspection of all steel fabrication and erection by an independent testing lab.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Structured Floors
- Facilities Services Design Guide - Roofs

### **Products, Material and Equipment**

- All steel exposed to the weather shall be hot dipped galvanized unless an acceptable alternate coating is specified.
- Provide a G60 minimum coating on all steel decking.
- Consider specifying structural steel with a high recycled content.

### **Installation, Fabrication and Construction**

- Structural steel fabricator shall be an AISC-Certified Plant Category Cbd. As an alternate to this requirement, the contractor shall pay for full-time inspection during the fabrication of the project steel. This inspection will be conducted at the fabrication plant by the owner's inspection agency. In addition, the fabrication plant must also be acceptable and approved in writing by the engineer of record and the building official.
- Pretension all high-strength bolts at all steel to steel connections. No snug fit nuts allowed on high-strength bolts.
- Install and cure base plates grout prior to pouring concrete on superstructure above.
- All field modifications shall be approved by the engineer of record and discussed with UW Campus Engineering prior to implementing the modification. All penetrations shall be ground smooth. Engineer of record shall specify any shoring requirements necessary to support steel members prior to cutting or welding.
- Steel joists to be fabricated according to the Steel Joist Institute Specifications.

- Button punching of side lap connections of steel roof deck (where no concrete topping) is not allowed. Provide welded, screwed, or other means to connect side laps.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of timber framing.

### Design Criteria

- Use most recent version of the International Building Code (IBC) with local municipality amendments. Referenced standards include the National Design Specification (NDS) for Wood Construction, the Allowable Stress Design (ASD) Manual for Engineered Wood Construction, and the Load and Resistance Factor Design (LRFD) Manual for Engineered Wood Construction.
- Design timber structures not only to be structurally adequate but also to be durable with a minimum of maintenance required.
- Use only new wood products. An exception to this would be when considering reuse of materials for LEED.
- Specify preservative-treated wood where members are exposed to weather or in contact with concrete or masonry. Specify all fasteners and connection hardware in contact with preservative-treated wood to be stainless steel. Option is to separate the fastener by other means.
- Account for wood shrinkage in design. Use prefabricated wood "I" or open web joists or trusses where necessary to avoid shrinkage problems.
- Check for availability of long members such as studs. Utilize structural composite lumber where necessary.
- Specify camber of floor and roof framing to provide level floors and flat roof planes.
- Engineer of record shall design and document all permanent bridging and bracing necessary for stability of metal plate connected wood trusses.
- Clearly detail shear wall nailing, stud sizes, plate sizes, sheathing orientation, anchor bolts, plate washers, and hold-downs. Provide hold-downs anchors at each end of all shear walls.
- Provide adequate ventilation for all crawl and attic spaces.
- All exposed wood surfaces should be pitched to assure runoff of water. Avoid construction details that trap moisture in end grain.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Provide schematic plan indicating typical framing. Outline specifications.
- Design Development Phase: Provide framing plans, typical details. Draft specifications.
- Construction Document Phase: Complete design and specifications.

## Construction Submittals

- Shop drawings and calculations for prefabricated wood joists and trusses.

- Shop drawings for Glulam members.

### **Quality Assurance**

- Inspection of all wall, floor and roof sheathing nailing is required in addition to current code required inspection. Verify sheathing, nailing and nominal size of framing members at adjoining panel edges.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Foundations (for timber piles)
- Facilities Services Design Guide - Structured Floors
- Facilities Services Design Guide - Roofs

### **Products, Material and Equipment**

- Sawn timber to be Douglas Fir-Larch or better.
- Plywood shall be exterior grade. OSB (oriented strandboard) is not allowed for floors and roof.
- Glulam members shall be 2400 psi minimum. Use architectural grade where exposed to view.
- Gage metal framing connectors shall be Simpson Strong-Tie or equal with ICBO certification.
- Metal plate connected wood trusses shall be designed per TPI (Truss Plate Institute) specifications.

### **Installation, Fabrication and Construction**

- Overdriven nails into sheathing are not allowed. Replace sheathing if nails are overdriven.
- Notching of members not allowed at any time.
- Members shall not be cut, drilled, or altered in any way without written approval by the engineer of record.
- Install all members full length. Splicing of members between supports not allowed.
- Use common nails, staples are not an allowable substitution.
- Glue all floor sheathing with minimum 3/16" diameter continuous bead of construction adhesive. Use two continuous beads at abutting panels.
- Erect and protect timber framing from moisture as quickly as possible to reduce possibility of swelling or distortion.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section applies to the design and installation of Cold-Formed Steel Framing utilized for structural members.

### Design Criteria

- Use most recent version of the International Building Code (IBC) with local municipality amendments. Referenced standards include the American Iron and Steel Institute North American Specification for the Design of Cold-Formed Steel Structural Members (AISI-NASPEC) and The AISC Standard for Cold-Formed Steel Framing.
- Specify members using the latest product identification code per The Steel Stud Manufacturers Association (SSMA). For example, “600S162-54” indicates a 6” deep stud member with a 1 5/8” flange and is 54 mils thick.
- Gypsum board is not allowed to be used as shear wall sheathing.
- Design and detail lateral bracing of members when the members are not adequately held in line with sheathing. Locations where this may occur include: at stud walls above a ceiling line, or on ceiling joists where no sheathing is applied on the top flange.
- Engineer of Record shall design and detail the framing and connections on the construction drawings. An acceptable alternate is to specify as a design-build submittal. If the design-build submittal is utilized, a Washington State PE shall stamp and sign the shop drawings as well as the structural calculations.
- Cold formed metal framing shall not be used as a backup wall to support masonry veneer weight or lateral loads.

## Design Evaluation

The following information is required to evaluate the design:

- Schematic Design Phase: Provide schematic plan indicating typical cold-formed steel framing. Outline specifications.
- Design Development Phase: Provide framing plans, typical connection details. Draft specifications.
- Construction Document Phase: Complete design and specifications.

## Construction Submittals

- Shop drawings and calculations for all members that are part of a design-build submittal
- Product data and certificates for members.

## Quality Assurance

- Inspection of framing and connections to verify compliance with the approved construction documents by an independent testing lab.

### **Related Sections**

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guide - Interior Partitions
- Facilities Services Design Guide - Metal Walls

### **Products, Material and Equipment**

- Provide a G60 minimum coating on all members.
- Manufacture shall be a member of The Steel Stud Manufacturers Association (SSMA).

### **Installation, Fabrication and Construction**

- Studs are to be installed tight-fit into stud wall tracks.
- Locate joists directly above studs below unless a load distribution member is designed to distribute the joist reactions to the studs below.

END OF DESIGN GUIDE SECTION

## Basis of Design

This section establishes minimum seismic design and installation criteria for Architectural and Electrical components that are permanently attached to the structure and for their supports and attachments.

### Design Criteria

- The seismic design shall comply with the “Seismic Design Requirements for Nonstructural Components” of the latest edition of American Society of Civil Engineers Standard ASCE/SEI 7, “Minimum Design Loads for Buildings and Other Structures”.
- The design may be documented on the construction drawings or specified to be contractor designed.

## Design Evaluation

The following information is required to evaluate the design:

- Design Development Phase: Draft specifications.
- Construction Document Phase: Complete design and specifications by project A/E. Structural calculations by a licensed structural engineer in the State of Washington.

## Construction Submittals

- Shop drawings of anchoring and bracing system stamped by a licensed structural engineer in the State of Washington.
- All deferred structural calculation shall be submitted.
- Structural calculations stamped by a licensed structural engineer in the State of Washington.

## Quality Assurance

- Provide inspection of all installation by an independent testing lab.

## Related Sections

- Facilities Services Design Guide - General Requirements - Structural
- Facilities Services Design Guides - Architectural, Mechanical and Electrical

## Products, Material and Equipment

- All steel exposed to the weather shall be hot dipped galvanized unless an acceptable alternate coating is specified.
- Powder driven fasteners are not allowable for use to resist seismic loads.

END OF DESIGN GUIDE SECTION