3.0 DFCM REQUIREMENTS

3.4 STRUCTURAL

DFCM DESIGN MANUAL
UNIVERSITY OF UTAH SUPPLEMENT

January 15, 2016
**PREFACE**

**University of Utah Supplement**

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### GENERAL INTRODUCTION TO THE UNIVERSITY OF UTAH SUPPLEMENT:

The DFCM Design Manual “Design Requirements” (State of Utah, Department of Administrative Services, Division of Facilities Construction and Management, referred to herein as “DFCM Manual” or “Manual”) dated June 11, 2009 including highlighted updates is the basis for A/E design services provided for all University of Utah projects.

This document accepts the DFCM Manual as the University of Utah standard, and supplements the Manual with requirements which are needed to satisfy University organization and mission objectives.

The reader is directed first to the DFCM Manual, then to this supplement where added requirements are preceded by “**ADDED**” and paragraph alterations required to accommodate University processes are preceded by “**REVISED**.”

To remain consistent with the DFCM Manual, this supplement is organized in a format matching that of the parent Manual. Only portions of the parent Manual are reproduced in this supplement, either as navigation guides or as altered paragraphs. DFCM text is presented in a gray font. University additions and insertions are presented in normal font.

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### ADDED:

This supplement provides structural design standards for construction of new and remodeled facilities at the University of Utah.

### ADDED:

#### REVISIONS SUMMARY

for the University of Utah Supplement:

<table>
<thead>
<tr>
<th>REVISION DATE</th>
<th>LOCATION</th>
<th>SUMMARY OF CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 January 2016</td>
<td>3.4 B. 1)</td>
<td>Removed areas that repeat code.</td>
</tr>
<tr>
<td>1 November 2013</td>
<td>3.4 / B. / (2) / f. / 1</td>
<td>High Temp Water Equipment Rooms. Updated HTW Equipment room requirements.</td>
</tr>
<tr>
<td>1 November 2013</td>
<td>3.4 / B. / (2) / f. / 1</td>
<td>High Temp Water Equipment Rooms. Added HTW Equipment room requirements.</td>
</tr>
<tr>
<td>21 September 2012</td>
<td>3.4 / B. / (3) / a. / 1) / h)</td>
<td>Sidewalk Requirements. Added reference to campus sidewalk requirements in 3.2 Civil</td>
</tr>
<tr>
<td>06 January 2012</td>
<td>- - -</td>
<td>University Design Standards. The former University Design Standards Chapters 1 through 12 were reformatted and re-issued as the U of U Supplement to the DFCM Design Manual.</td>
</tr>
<tr>
<td>06 January 2012</td>
<td>- - -</td>
<td>General. Entire Chapter Updated</td>
</tr>
<tr>
<td>10 December 2009</td>
<td>- - -</td>
<td>General. All references to UBC changed to “State adopted codes”</td>
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</tbody>
</table>
3.0 DFCM REQUIREMENTS

3.4 Structural

ADDED:

B. University of Utah Requirements

(1) Design Loads

a. Design load requirements shall be as required by State adopted codes and shall include the following minimum requirements:

1) Roof Loads

a) Rain on Snow

An additional 5 psf rain on snow surcharge; this surcharge may be disregarded where roof slopes exceed 1/2 inch in 12 inches. Rain on snow does not need to be included in seismic calculations.

b) Office Areas

Due to the nature of offices where there is a need for many filing cabinets, open office landscaping, etc., all office floors shall be designed for 80 psf minimum uniform load plus 15 psf for removable partitions. This requirement is in lieu of the 50 psf currently required in State adopted codes. Alternative floor load requirements may be approved by the University when deemed appropriate for the expected use of the building over its lifetime.

(2) Design Criteria

a. Special Inspection

The structural engineer shall include in the drawings the structural items which require special inspection according to State adopted codes.

b. Geotechnical Information

A soil investigation report is required for all new buildings unless specifically waived in writing by Facilities Management through the University Project Manager. No part of the soils investigation report or borings should be included in the plans or specification. The specifications should be modified to include the geotechnical
c. Excavation and Compacted Fill

1) This is an area of great concern to the University and should be given special attention in the preparation of bidding documents. The University is interested in using on-site materials to the greatest degree possible, but at the same time, change orders for imported fill must be held at a minimum.

2) The A/E shall thoroughly investigate existing conditions and prepare bidding documents to achieve these goals. Each site needs to be considered on its own merits on a case by case basis. This precludes any kind of standard strategy, as each case will have differing conditions. Strategies should be considered that will minimize total project costs while protecting the University against excessive change orders. Strategies are to be coordinated with Facilities Management through the University Project Manager.

d. Footings and Foundations

1) Design of footings and foundations shall be based on the recommendations of the soils investigation report and the specifications shall be modified to reflect said recommendations. The following requirements shall also be used in design:

   a) Footing shall be designed to resist frost heave, water infiltration, settlement and overturning.

   b) Footings shall bear atop undisturbed earth or compacted backfill.

   c) Elevation of top of footing and finished grade lines shall be noted on building elevation views.

e. Parking Structures

1) Minimum Concrete Strength

   5,000 psi for post-tensioned members

2) Air Entrainment

   6-1/2% ± 1-1/2%

3) Rebar

   Adequate life cycle / corrosion resistant design is required to protect rebar.

4) Cover on Reinforcing

   1" min, 1-1/2" at top of slab
5) Top Deck (if no roof)

Combine snow load with vehicles. Review with Facilities Management through the University Project Manager those areas of higher loading due to snow removal.

f. High Temperature Water Equipment Rooms

1) Design high temperature water equipment rooms accommodate the forces associated with a possible rupture of a HTW pipe operating at 400 + psi and 400 degrees F. Wall and floor construction shall be designed, and doors and hardware shall be selected and specified with sufficient resistive strength to withstand the pressures of a maximum HTW release event.

a) High Temperature Water Equipment Rooms shall be entirely designed by an engineer. Calculations shall be provided to support the design solution and justify all materials being specified in the construction of the room.

b) Exhaust vents shall be sufficiently sized to dissipate the pressures that might occur in a maximum HTW event in a given HTW room.

c) Doors and hardware shall be selected specifically to withstand maximum explosive HTW release pressures. Latching of these doors should be designed using flush bolts or other suitable means by which to safely maintain enclosure integrity and security during a HTW breach. The design should allow for normal operation of the doors after an explosive breach.

d) Note that the HTW equipment room will require an exhaust system and conduit for an emergency HTW shut-off switch outside the room near the door.

2) Note that the HTW equipment room will require an exhaust system and conduit for an emergency HTW shut-off switch outside the room near the door.

(3) Material Strengths and Construction Requirements

a. Concrete

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>INTERIOR (not exposed to freeze-thaw)</th>
<th>EXTERIOR (exposed to freeze-thaw)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings</td>
<td>3,000 psi</td>
<td>4,500 psi</td>
</tr>
<tr>
<td>Slabs on Grade</td>
<td>4,000 psi</td>
<td>4,500 psi</td>
</tr>
<tr>
<td>Walls</td>
<td>4,000 psi</td>
<td>4,500 psi</td>
</tr>
</tbody>
</table>
1) Materials shall comply with the standards specified in the latest addition of ACI 318. Minimum compressive strengths of concrete (28 day strengths) shall be:

   a) Normal weight concrete mixes shall comply with the concrete durability requirements of Chapter 4 of ACI 318 for all concretes exposed to freezing and thawing, sulfates soils or water, or for corrosion protection of reinforcement. Air entrainment shall be as recommended by ACI 318, Chapter 4.

   b) The concrete design should have a water to cement ratio such that the mix not exceed a 4” slump. The water cement ratio shall be as recommended by ACI 318, Chapter 4. For interior concrete not requiring special exposure conditions, the water-cement ratio may be increased; however, the slump shall not be more than 4” before a water reducer or HRWR (super plasticizer) admixture is used to increase the slump.

   c) Reinforcing steel shall be grade 60; fy=60 ksi.

   d) Lightweight concrete shall not exceed recommended unit weight for applicable UL-listed assemblies and shall be made of lightweight course aggregates and lightweight and/or normal weight fines.

   e) Provide a surface intentionally roughened to ¼” amplitude in all wall footings, and all horizontal and vertical construction joints. A continuous 2 x 4 keyway may be used in walls and elements other than shear walls.

   f) Provide reinforcing dowels to match the member reinforcing at the joint.

   g) Construction joints shall be made at the center of spans.

   h) Slabs-on-grade shall have construction or control joints placed in lengths not to exceed 30 times the slab thickness in any direction. Construction joints will not exceed a distance of 12'-0” o.c. in any direction. For walking surfaces along the accessible paths of travel, expansion/construction/control joints shall be no wider than 3/8" with tooled edges of not more than a 1/4” radius. The intent is to provide a joint which does not exceed 1/2" in width for ADA requirements. Other areas not requiring ADA compliance could use the 1/2" wide expansion joint material. Special requirements for campus sidewalks are found at: 3.2 CIVIL / A. PAVING / (3) / a.

<table>
<thead>
<tr>
<th>Materials</th>
<th>4,000 psi</th>
<th>4,500 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columns</td>
<td>4,000 psi</td>
<td>4,500 psi</td>
</tr>
<tr>
<td>Beams and Suspended Slabs</td>
<td>4,000 psi</td>
<td>4,500 psi</td>
</tr>
<tr>
<td>Post-tensioned Concrete</td>
<td>5,000 psi</td>
<td>5,000 psi</td>
</tr>
<tr>
<td>All Other Site Cast Concrete</td>
<td>4,000 psi</td>
<td>4,500 psi</td>
</tr>
</tbody>
</table>
b. Masonry

1) Concrete masonry unit assemblies shall be lightweight grade N1 or better (minimum unit strength 1,900 psi average for \( f'm = 1,500 \) psi).

2) Hollow clay unit assemblies shall be hollow brick, grade 1 or better (minimum unit strength 6,600 psi average for \( f'm = 2,500 \) psi).

3) Solid clay unit assemblies shall be SW or better (minimum unit strength 3,350 psi average for \( f'm = 1,500 \) psi).

4) Grout shall be proportioned, tested, mechanically consolidated, and reconsolidated in accordance with State adopted codes. Grout shall attain a minimum compressive strength of 2,000 psi.

5) Mortar shall be type "S", and tested in accordance with State adopted codes. Mortar shall attain a minimum strength of 1,800 psi.

6) Reinforcing steel shall be grade 60; \( f_y = 60 \) ksi.

7) Joint reinforcement may be included in the wall design, but this reinforcement shall not replace the requirement for reinforced bond beams.

8) Reinforcement that requires welding shall be of the deformed bar anchor type and conform to ASTM A496 or ASTM A706.

9) Footing stem walls to finish grade or floor shall not be constructed of masonry.

10) Dowels from the foundation into the supported masonry wall above shall be spaced an increment of the vertical masonry reinforcement.

11) Veneer shall have attached seismic anchorage in accordance with State adopted codes.

12) All anchors and lintels supporting veneer shall be galvanized.

c. Steel

1) W-Shapes

   ASTM A992, (\( F_y = 50 \) ksi).

   All Other Shapes and Plates: ASTM A36 (\( F_y = 36 \) ksi).

2) Tubes

   ASTM A500, Grade B (\( F_y = 46 \) ksi)
3) Pipe and Columns
   ASTM A53, Types E or S, Grade B (Fy=35 ksi).
   Round ASS: ASTM A500, Grade B (Fy=42 ksi).

4) Deformed Bar Anchors
   ASTM A496

5) Headed Stud Anchors
   ASTM A108, with dimensions complying with AISC specifications.

6) Bolts
   ASTM A325 or A490

7) Anchor Rods
   ASTM F1554, Grade 36, minimum, with ASTM A563 heavy hex nuts and
   ASTM F436 hardened washers.

(4) Design Submissions
   a. Schematic Design
      1) Code and Loadings
         State the governing code used for design. State the criteria for live, wind, snow
         and seismic loads, together with data to justify any difference from established
         criteria. Seismic design shall be in accordance with State adopted codes.
      2) Structural System
         Provide a comparative description of at least three structural systems for the
         building, i.e., consider wood, steel, concrete, masonry. Give a description of
         the type of construction proposed and reasons therefor, including the structural
         framing system. The structural design should be carried only to the point
         where the total framing systems are determined and a realistic cost estimate can
         be made.
      3) Foundation Design
         Describe the type of foundation proposed and define the basis for selection.
         Include bearing capacity, anticipated settlement, alternatives considered, and
         other pertinent design factors. Also include the depth of excavation,
         disposition of excavated material, whether in-place foundation material will be
compacted, whether imported fill is required, whether compacted backfill will be utilized as foundation, and the frost penetration. State ground water level and method of waterproofing. State needs for drainage or vapor barrier. Describe pertinent corrosion control methods. Refer to the Soils Report included in the supplements.

4) Structural drawings should include:

   a) Foundation plan
   b) Floor and roof framing plan
   c) Details are not required

b. Design Development

1) The following plans shall be submitted:

   a) Foundation plan
   b) Floor(s) and roof framing plans
   c) Some typical foundation details
   d) Some typical roof framing details

2) Foundation plan shall show type of foundation proposed, depths, sizes and reinforcing of footings, relationship of walls and floor slab to foundation system, overall dimensions, column spacing, joint pattern in slab-on-grade, tie beams, grade beams, etc.

3) Floor(s) and roof framing plans shall show framing members including columns. The majority of the framing members shall have sizes indicated.

c. Contract Documents

1) Computations

   a) Present complete structural calculations covering all parts of the structure and miscellaneous facilities. Calculations shall be bound and indexed. When a computer is utilized to perform design calculations, the analysis will include, but not be limited to, the following information.

      (i) Design methods will be described, including assumptions, theories, and technical formulas employed in design solutions.

      (ii) Present copies of computer input data and output summaries in user friendly language, accompanied by diagrams which identify joints, members, areas, etc., according to the notations used in the data listings, will form integral parts of the design analysis in lieu of manual computations otherwise required. Complete listing of all computer output will be provided in a separate binding when it is too voluminous for including in the design analysis. These listings will be augmented with intermediate results where
applicable, so that sufficient information is available to permit manual checks of final results.

b) Live loads shall be placed to produce maximum stresses and minimum stresses where there is a possibility of stress reversal.

c) If special methods of solution, tables, etc., are employed, references shall be made in the calculations to the sources of such material.

d) Adequacy of existing structure, where applicable, to account for new functional loads or new criteria.

2) Drawings

All drawings shall be complete and represent coordination by the A/E with all disciplines. Evidence of this coordination shall be provided by the A/E at the final design review.

End of 3.4 Structural