Chapter 17
STRUCTURAL DRAWINGS AND DESIGN

SECTION 1701 - CONTENTS

1701.1 Definition: All structural materials shall be defined with dimensions, sizes, and locations. The drawings shall indicate complete design. Prior written acceptance from the Project Manager is required for any design-build component. Structural drawings shall be coordinated with other disciplines and shall include penetrations and other accommodations required for installation of other systems.

1701.2 Load Data: Live load and dead load design data shall be placed on the structural drawings for all areas of the building.

1701.3 Sequence: Structural Drawings are divided into specific groups. Drawings within a group are numbered consecutively, ie S3.01, S3.02, etc. The group designation shall always remain the same, regardless of the size or scope of the individual project. If specific projects do not include work related to a group, that group shall be eliminated from the drawings. When appropriate, the Consultant shall obtain written permission from the Project Manager to vary the sequence.

| S0.xx  | Index, Symbols, Abbreviations, Key Plan, Notes |
| S1.xx  | Demolition, Site Work                           |
| S2.xx  | Foundation Plans & Details                      |
| S3.xx  | Framing Plans                                    |
| S4.xx  | Elevations                                      |
| S5.xx  | Details                                         |
| S6.xx  | Schedules                                       |
| S7.xx  | Special Design                                   |


SECTION 1702 - FOUNDATION PLANS

1702.1 Foundation plans show location, size and type of foundations supporting the building. Plan views locate supported columns, grade beams, basement walls (if any), location and size of caissons and piles, equipment pedestals and any other items that are part of the foundation. Cross sections and details shall be provided to show dimensions and shapes of all concrete items not completely defined in plan. Show number and location of caissons and piles (if any) along with type, size, and length. Show reinforcing bars, anchor bolts and other embedded items, joints and penetrations. Give material properties for concrete, reinforcing steel and all other parts of foundations. Foundation Plans shall indicate all required penetrations and references for any modifications to reinforcing or structure required for penetrations.

SECTION 1703 - FLOOR PLANS

1703.1 Structural Steel Framing: Show framing for each floor level, and elevations (top of steel) for all members. Locate all beams with respect to column lines and give sizes. Locate all support points for equipment, posts, hangars, stairs, etc. Cut sections referring to structural steel details are required. Design-build connections are not allowed without prior written approval by the University Representative; in such instances, provide loads for any connections to be designed by contractor.

Define by notes all grades of steel used, types and sizes of connections (with details as required) designed by Engineer and refer to all standard drawings, charts, tables, notes, etc. for information required to construct a safe and complete floor system.

1703.2 Floor Plans: Show all plan dimensions of floor. Give outer limits, location and size of openings, elevations for all areas, floor types (concrete, grating, floor plate, etc.) and thickness, equipment supports, and any other items to be incorporated in the floor construction. Cut sections and indicate details shown...
on same or other sheets to show edge details, equipment pedestals, reinforcement, anchor bolts and all miscellaneous embedments.

Define reinforcement grades and sizes, bar grating or floor plate sizes and details, locate and dimension all floor construction joints, reinforcement lap, splices as required. Define and locate all penetrations. Define all steel decking, whether used as concrete form or otherwise. Give material properties required for all concrete, steel, floor topping, or other materials used.

Note: Each member must be drawn. Notations such as “18 joist @ 4’0” o.c.” are not acceptable due to the requirement to provide composite drawings.

1703.3 Roof Plans: Define all plan dimensions and openings as for floors. Give top of steel elevations, sizes and locations of all beams, purlins, and joists. Define roof type (concrete, steel deck, etc.) Provide framing as required around openings. Give loading requirements for steel deck roofs, such as live load, wind uplift, and attachment to framing for diaphragm action. Define roof slope and locate drains. Locate support points for all roof-mounted equipment such as HVAC equipment, tanks, etc.

Note: Each member must be drawn. Notations such as “18 joist @ 4’0” o.c.” are not acceptable due to the requirement to provide composite drawings.

SECTION 1704 ELEVATIONS AND WALL SECTIONS

1704.1 Show all columns, beams, bracing on column lines. Size columns and bracing. Give size for all struts and beams not shown on floor plans. Show framing at doors, windows, etc. Provide details for any non-standard connections. Design-build connections are not allowed without prior written approval by the University Representative; in such instances, provide loads for any connections to be designed by contractor.

On exterior walls, show girt system. Show sizes, spacing, and locate sag rods. Detail special girts, parapet construction, framing around openings, etc. Coordinate types and sizes of siding with architectural drawings.

SECTION 1705 DETAILS, SCHEDULES AND TABLES

1705.1 Typical Details: In lieu of detailing repeated identical items on all views where they occur, design typical details on detail sheets and refer to them by letter or number designations. The drawings include, but are not limited to, the following:

1705.2 General Notes and Details: Include references to pertinent codes and standards. Give design criteria and loads as required. Show details to be used for treatment of concrete edges, joints, penetrations, and anchor bolts. Detail handrails and ladders and their anchorage to structure.

1705.3 Column Schedules: Show location and size of columns used. Detail splices and base plates, showing shear bars, anchor bolts, grout and any other required features.

1705.4 Bracing Connections: Show typical details for diagonal bracing. List all combinations of vertical, horizontal and diagonal connections between braces, beams and columns and reference by letter or number designations to plans and elevations.

1705.5 Beam and Joist End Connections: Detail typical connections, showing required tolerances, edge distances, pitch, gage, etc. Show manner of designating connections on plans. Provide list of connections to be used for given beam sizes when typical.

1705.6 Non-standard Connections: Detail all non-standard (atypical) connections on the detail sheets except where shown on plan or elevation drawings.
1705.7 **Stair Details:** Show plan and elevations for all stairs, with riser and tread dimensions. Show reinforcing for concrete stairs. For steel stairs, show all member sizes, connections, bracing and supports.

1705.8 **Girt Details:** Show all girt bracket types, sag rods and joints between girt sections and all connections. Detail special built-up girt sections.

1705.9 **Miscellaneous Details:** Show details for all welded girders, trusses, built-up members, and assemblies used. Show all necessary views of crane girders, crane columns, and brackets and attachment to building, crane stops, clearance requirements, and dimensions relative to building column lines and elevations. Provide details for fabrication of floor plates, floor bracing and all other miscellaneous items to be installed by the contractor.

### 1706 - WELDING, BOLTING AND OTHER CONNECTIONS

1706.1 **General:** Design-build connections are not allowed without prior written approval by the University Representative. The Consultant shall design all connections, including welded connections.

1706.2 **Welding:** ALL welds shall be defined using standard ANSI / AWS symbols, designating location, type, dimensions (size, root, length, pitch), preparation, backing, penetration, finish, etc. Simply copying a few joint configurations in a drawing will not suffice. The Consultant shall assured that the weld symbols are appropriate to the joint and that welding and inspection of the assembly will be feasible.

1706.3 **Bolting:** All bolted connections shall be annotated with the type of joint and the ASTM designation, type and size of bolt to be used. The Consultant shall assure that the bolting and inspection of the assembly will be feasible.

1706.4 **Special Connectors:** Special connectors and anchors shall be defined by type and size on the drawings. Complete specification and installation data shall be written in the Specifications.

### 1707 - STRUCTURAL DESIGN

1707.1 **General:** Prior to commencing design, the Consultant shall study and be familiar with all parts of the CSU Construction Standards (Administrative, Design and Construction Standards), current edition, as posted on the Facilities Management website.

1707.2 **Vibration Standards**

**Vibration Requirement Table for Floor Systems**

<table>
<thead>
<tr>
<th>Space Type</th>
<th>vibration structural dynamic criteria, micro-inches, peak to peak maximum total motion (vertical)</th>
<th>Typical center bay minimum static stiffness that will meet vibration structural dynamic criteria pounds / inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser / nanotech Labs</td>
<td>100</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Research Labs</td>
<td>300</td>
<td>400,000</td>
</tr>
<tr>
<td>Classrooms, Offices</td>
<td>1000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Structural engineering calculations may be required to validate that proposed floor systems provide the required static stiffness. Dynamic analysis should use a time-history of total floor vibratory motion, not just the components of that motion. Some responses such as footfall impulses, cart excitation, etc. cannot be accurately represented by motion components. Vibration due to such impulses and excitations are often 5 to 10 times greater than those due to ambient excitations from rotating machinery imbalance.
1707.3 **Vibration Design:** Structural and vibration design should consider the influence of all relevant sources of vibration, including but not limited to:

1. Human activity: footfall, cart excitations, door operation, amplified audio
2. Mechanical systems and machinery imbalance
3. Mass movement of air and water in building systems
4. Wind and traffic

Performance to the more stringent criteria may require designs to control, isolate and transfer vibration forces from mechanical systems or mass fluid movements independent of the building structure.

END OF CHAPTER 17