

## DIVISION 05 – METALS

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### 05 12 00 STRUCTURAL STEEL FRAMING

#### A. Design Considerations

1. **Steel framed structures** shall be designed in accordance with the latest addition of the AISC Specification for Structural Steel Buildings. The COMMENTARY to the AISC Specification for Structural Steel Buildings shall be included by reference.
2. “Two categories of limit states must be considered in the design of structures: strength and serviceability. Strength limit states control the safety of the structure and are well defined in building codes and specifications. Serviceability limit states define the functional performance of a structure. **Serviceability limit states have few codified standards yet often control the successful design of a structure...**” (emphasis added), 2014 NASCC Steel Conference brochure.
3. “Strength Limit States – The majority of what the AISC *Specification* addresses.
  1. Yielding
  2. Buckling
  3. Rupture
  4. Others
4. **“Serviceability Limit States” is what usually controls structural design in steel.**
  1. Deflection
  2. Drift
  - 3. Vibration**
  4. Wind induced motion
  5. Expansion and contraction
  6. Connection slipAddressed in Chapter L of the AISC *Specification*.” (emphasis added) Louis F. Geschwinder, PhD, P.E. Introduction to Basic Steel Design.
5. Consideration shall be given to stability and serviceability (both static and dynamic loading) design requirements for both framing and stairs.
6. Design of decorative metal stairs (monumental stairs) shall be by the structural engineer of record and shown on the contract drawings. The design shall not be delegated to the contractor as a “performance

specification”.

7. Testing and inspection will be required for structural steel work. For Class I buildings, as defined by the New Jersey Uniform Construction Code, some or all of the testing and inspection is required by the "Structural Tests and Special Inspections" provisions of the Building Code. All testing and inspection of structural steel work will be contracted for and paid for by the University, regardless of building class. The A/E must specify all testing and inspection of structural steel in the structural steel section in accordance with requirements in Division 1. Testing shall be in accordance with applicable ASTM standards.

References:

1. AISC Design Guide 11, Vibration of Steel Framed Structural Systems Due to Human Activity, Second Edition 2016, Thomas M. Murray, PhD, P.E. et al. FloorVibe © software is recommended for use with Design Guide 11.
2. *Slender Monumental Stair Vibration Serviceability*, Brad Davis, PhD, S.E. and Thomas M. Murray, PhD, P.E. Journal of Architectural Engineering December 2009.
3. Steel Joist Institute TECHNICAL DIGEST 5 VIBRATION OF STEEL JOIST – CONCRETE SLAB FLOORS, Second edition January 2015
4. *Presentation to Project AEs on Composite Steel-Deck-Concrete Floors and Monumental Stair Vibration Serviceability Considerations - an Owner's Perspective* © by Alexander Andrews, Rutgers University. For information only.

**B. Special Documentation Requirements**

1. AE to consult with owner early in the project on all vibration design considerations, criteria (quiet spaces, laboratories, monumental stairs, other). Provide copy of design criteria including vibration calculations to the owner. Use finite element analysis / design (for example SAP2000) where analysis /design is beyond methods provided by Design Guide 11 and/or in SJI Technical Digest 5, 2015. Use latest edition of Design Guide 11.

**C. Materials and Methods of Construction**

1. Coordinate the selection of structural steel primers with the types of fireproofing proposed. Some fireproofing designs prohibit primed steel, or require additional steps be taken to ensure adhesion of the fireproofing. Unprimed steel is appropriate for fireproofed steel in many ordinary applications.
2. Lintels and shelf angles in exterior walls shall be hot dip galvanized after fabrication.

**05 31 00 STEEL DECKING**

**A. Design Considerations**

1. Design and installation of metal deck shall comply with Steel Deck Institute (SDI) Publication No. 30, *Design Manual for Composite Decks, Form Decks, and Roof Decks*, except where FM Global has more stringent requirements (for example, the concentrated midspan load required to meet live load deflection criteria for roof deck). Specified metal roof deck must conform to FM 4451, *Approval Standard for Steel Roof Decking*.
2. The roof deck manufacturer's FM listings state the requirements for securing the deck to the structural substrate as needed for a given uplift rating, evaluated for exposure to wind loads in the field (interior) of the roof. The wind uplift loads are generally higher at the roof corners and at the roof perimeter. These higher loads must be taken into account when designing the securement of the roof deck (and all other components in the roof assembly), in accordance with FM requirements.

**B. Special Documentation Requirements**

1. Provide details of supplemental steel framing at openings in deck; include fastening requirements. Indicate maximum dimensions of openings without supplemental framing.
2. The A/E must provide separate plan/diagram drawing(s) illustrating fastener and/or weld patterns for securing metal roof deck in the "field", and any required increases for corner and perimeter attachment, (including written dimensions to define corner/perimeter widths) determined according to FM design guidelines for the appropriate wind uplift rating. The separate plan/diagram shall be at a scale not less than 1/16" = 1'-0".

3. In an area adjacent to the plan/diagram, the A/E shall provide a written summary of FM wind uplift design criteria and a summary of minimum and specified FM wind uplift ratings for fields, perimeters and corners.

**C. Materials and Methods of Construction**

1. Galvanized metal decks conforming to ASTM A653, G60, minimum, are the only material to be used for metal decks for floor and roof decks. Where metal deck will be used in especially harsh or corrosive environments, protection greater than G60 may be required. Designer shall consult with deck manufacturer to choose appropriate protection. Prime painted, ungalvanized decks are not acceptable.
2. Specialty decks, such as dove-tail type decks intended to function as both structural deck and finished ceiling, shall not be used unless in conjunction with a concrete floor slab or as part of an FM approved roof assembly incorporating lightweight insulating concrete topping. These decks may not be used as part of a roof assembly without concrete topping.
3. Metal roof deck shall be listed by FM as a component of the intended FM approved roof assembly.

## **05 40 00 COLD-FORMED METAL FRAMING**

**A. Design Considerations**

1. Cold-formed metal framing includes load-bearing interior and exterior metal wall studs, floor and ceiling joists, roof trusses and rafters, and exterior non-loadbearing wall studs. Interior non-loadbearing metal framing belongs in Division 9 and should not be specified under this section heading.
2. Design of cold-formed metal framing must take into account all axial and lateral loading imposed on the system, and, when used in non-loadbearing applications, details must accommodate movement in the primary structural system, avoiding unintended load transfer to non-loadbearing studs. Lateral deflection must be within limits appropriate for the proposed cladding materials. For example, the Brick Industry Association recommends maximum deflection of L/600 (and minimum 18 gage) for steel studs used as backup for brick veneer, although a more stringent L/720 is

preferred. Industry sources and manufacturers are to be consulted for requirements for other cladding materials.

**B. Special Documentation Requirements**

1. Drawings shall include all design loads, including live load, dead load, and lateral loads, as well as maximum deflection criteria, whether final structural design of the cold-formed metal framing system is by the A/E or, by permission of the University, assigned to the Contractor.
2. Details shall indicate methods of accommodating deflection of the primary structural system without loading non-loadbearing cold-formed metal framing members.
3. Wall sections shall indicate depth and spacing of cold-formed metal framing members. Spacing shall be appropriate for proposed sheathing and interior finish materials.

**C. Materials and Methods of Construction**

1. All cold-formed metal framing shall be galvanized to inhibit corrosion. A minimum G60 coating is required; BIA calls for a heavier G90 for brick veneer/steel stud backup applications.

## **05 50 00 METAL FABRICATIONS**

**A. Design Considerations**

1. The Metal Fabrications section is concerned with items of iron and steel (and some fabricated of aluminum) not attached to the structural steel frame. When specifying metal fabrications, careful coordination is required with the Structural Steel section to ensure that all required items are specified, and in the appropriate section.

**B. Special Documentation Requirements**

1. Drawings shall show extent and locations of each item of Metal Fabrications work, as well as locations and extent of metal finishes, if there is more than one type of finish for any type of metal fabrication.

**C. Materials and Methods of Construction**

1. Loose steel lintels and shelf angles in exterior walls shall be hot dip galvanized after fabrication. All exterior metal fabrications shall be hot dip galvanized and prime painted, after fabrication, ready for field finishing. Holes and other modifications shall be completed prior to hot-dip galvanizing. Vent holes shall be plugged and filed flushed after galvanizing.
2. Steel lintels which will be fully or partially exposed in the final construction are to be galvanized and painted. Specifying prime painting by the galvanizer will help to avoid difficulties encountered when attempting to field paint over galvanizing.

**05 52 00 METAL RAILINGS**

**A. Design Considerations**

1. This section is concerned with the safety, maintainability and historical appropriateness of handrails and guardrails in all University projects. Railings and guards must be designed to comply with all applicable codes and accessibility standards, for loading, height, spacing of intermediate rails and graspability.

**B. Special Documentation Requirements**

1. Drawings must indicate locations, configurations and details of all railings, including heights, profiles, bends, terminations, brackets, and anchorage to building structure, including blocking as applicable. Note railing materials and finishes.
2. Responsibility for engineering of railing systems shall not be left entirely to the manufacturer. The A/E must design a railing that can be built to comply with all requirements, without major changes in appearance.

**C. Materials and Methods of Construction**

1. Clear anodized aluminum is the University's preferred material for both interior and exterior railings, for ease of maintenance and durability. For renovation projects and historic buildings, alternative materials may be proposed, subject to the approval of the University Architect.

2. Aluminum shall be protected from the corrosive effects of cement and lime mortar and shall be isolated from dissimilar metals by the use of a heavy bodied asphaltic paint or other suitable coating.
3. Railing supports or posts shall be set using non-shrink, non-metallic grout that is premixed, factory-packaged, non-staining, non-corrosive, and non-gaseous. Special care shall be taken to avoid the use of setting materials which will deteriorate or fail in the presence of moisture, or which are incompatible with the railing or surrounding materials.
4. When railings are proposed at the roof, the designer shall explore methods of mounting the railings that do not require penetration of roof membranes, copings and other roof components.