Structural 01.83.13

Description:

The purpose of the section is to highlight the current applicable UMD Design Standards for the design of main structural elements related to building construction.

Related Sections:

- TBD

Effective Date:

January 1, 2023

Applicable Standards:

- American Concrete Institute: Building Code Requirements for Reinforced Concrete and Commentary (ACI 318 and ACT 318R).
- American Concrete Institute: ACI Manual on Concrete Practice.
- American Concrete Institute: Building code Requirements for Masonry Structures (ACI 530) and Appendix A: Special Provisions for Seismic Design and Specifications for Masonry Structures (ACI 530.1).
- American Institute of Steel Construction: Manual of Steel Construction.
- American Iron & Steel Institute: Cold-formed Steel Design Manual.
- American Welding Society: Structural Welding Code AWS D1.1.
- American Welding Society: Structural Welding Code, Reinforcing Steel, AWS D1.4.
- American Aluminum Manufacturers' Association: Aluminum Handbook.
- Steel Deck Institute, Inc.: Design Manual for Composite Decks, Form Decks, and Roof Decks.
- Steel Joist Institute: Specifications.
- Seismology Committee, Structural Engineers' Association of California: Recommended Lateral Force Requirements and Commentary.
- American Institute of Timber Construction: Timber Construction Manual.
- National Forest Products Association: National Design Specifications for Stress Grade Lumber and Its Fastenings.
- American Society of Civil Engineers: Minimum Design Loads for Buildings and Other Structures, ASCE 7.

The codes and standards listed here are intended as guidelines only. The list is not meant to restrict the design consultant from using additional guides or standards as required.

General Requirements:

During the life span of a typical campus building many minor and major alterations are necessary as the requirements of the University change. The capability to accommodate alterations must be incorporated into the building from the outset. Structural systems should be designed to provide some leeway for increase in load concentrations in the future. They should also be designed to facilitate future alterations, e.g., the cutting of openings for new vertical elements, such as piping, conduit, and ductwork.

Structural Loads

- **Floor and Roof Loading**
  - The designers shall provide, as a minimum, a uniformly distributed live load of 100 pound per square foot in all areas of the building, unless otherwise noted in the Facility Program.
  - Roofs shall be constructed for a minimum of 30 pounds per square foot.
  - In areas requiring special attention to floor loading, e.g., library stacks, heavy equipment and machinery, etc., the Consultant shall investigate the specific support requirements of these areas and design for these spaces accordingly.
  - In no event shall the design live load be less than what is required by the applicable codes.
  - Do not use live load reductions for horizontal framing members and columns, or load-bearing walls supporting the top floor or roof.

- **Wind and Snow Load**
  - For the purpose of code, wind, and snow load determination, UMCP buildings are designated as "standard occupancy" structures to corresponding to ASCE 7-10.

Structural Systems

- Steel Framing Systems
  - Unshored composite steel beams deflect under the weight of concrete slabs at the time of placement. In order to achieve a level floor, additional concrete may need to be poured. Where unshored construction is used, the additional dead load caused by the increased concrete thickness should be accounted for in the structural design and specification.
  - Shored composite steel beams do not deflect under concrete placement, resulting in less cost of material for concrete and steel. These savings may offset the costs of shoring. Once the shoring is removed, the floor deflects. This type of construction results in a floor that is less level than an unshored system.
  - Cambered composite beams and girders may produce the most level floors. A camber should be considered for beams longer than 25 feet. The camber should equal the deflection calculated for the combined dead load of wet concrete, steel deck and steel beams. Superimposed dead and live loads should be excluded from the calculation.
- Concrete Framing Systems
  - Cast-In-Place Systems that have fewer limitations in cutting openings during future alterations are preferred over other systems.
  - Precast floor framing systems should not be used for office buildings unless the design can be demonstrated to adapt well to future changes in locations of heavy partitions or equipment. Precast systems may be considered for low-rise structures such as parking garages, industrial buildings, and storage and maintenance facilities.
  - Pre-tensioning and Post-tensioning as with precast floor framing should not be used unless the design can be demonstrated to not impede future flexibility. Post-tensioned beams may be used where code allows in beams.

Stability and Serviceability Criteria

- Progressive Collapse
  - The designed structure must not be subject to progressive collapse, as defined in the IBC International Building Code. The failure of a beam or slab should not result in failure of the structural system below or in adjacent bays. In case of column failure, the damage should be limited to the bays supported by that column.
- Vibration of Floor Systems
  - Transient vibration induced by passing traffic or footfall should be minimized.
- Corrosion Protection
  - Structures in salt environments must have a positive means of corrosion protection. Structures requiring protection include concrete foundations exposed to saline ground-water, parking decks, bridges, and pavements where de-icing salts are used, and structures exposed to salt-laden air.
  - Steel-Structural steel exposed to the elements must have a protective coating on all steel surfaces. Small, isolated structural steel elements may have hot dipped, galvanized zinc coating or coal tar epoxy paint. Larger exposed steel structures, such as parking, should use a two-coat system consisting of an organic zinc rich urethane or epoxy primer, shop applied over blast cleaned surfaces followed by a field applied finish coat.
  - Concrete. Make provisions for crack control and employ the following methods, alone or in combination, according to the severity of the condition:
    - Epoxy coated reinforcing bars.
    - Concrete surface sealers.
    - Corrosion inhibiting concrete additives.
    - Microsilica concrete used in lieu of additives.

    - Concrete Elements in Parking Structures. Protect the concrete in parking structures or below building levels by using corrosion inhibiting additives, epoxy coated reinforcing bars, and a concrete surface sealer. Epoxy coated reinforcing bars should be used for the top bars of the concrete beam and slab construction and the stirrups of beams and spandrel beams. They should not be used for the bottom bars in beams nor for the reinforcement of columns and walls.
- Construction Tolerances
    - Concrete Floor Slab Finish Tolerances should be measured in accordance with ASTM E1155 and should comply with ACI 117: Standard Specification for Tolerances for Concrete Construction and Materials.
- Protection of Adjoining Property
    - Protective measures, including those required by local code, must be taken to avoid the effect of the structure on adjoining buildings both during and after construction.
    - Sheeting, Shoring, and Underpinning, protecting the banks of the excavation or adjoining buildings must be made the full responsibility of the construction contractor.
    - Footings should not project beyond property lines.

Attachment of Nonstructural Elements

All nonstructural elements, components, and equipment located within a building or on the site must be anchored to withstand gravity and wind loads.

- Exterior Cladding
    - Exterior cladding must have connections and joints that permit relative movement between stories. Connections should have sufficient ductility and rotation capacity to preclude the possibility of brittle failure in connection welds or fracture in concrete. Inserts in concrete should be attached to, or hooked around, reinforcing steel.
    - Slotted or oversized holes at cladding connections should be used to permit movement parallel to the plane of the building skin.
    - Window frames should be positively anchored to resist lateral loads. Clearance and flexible mountings should be provided to permit thermal movement and minimize glass breakage in storms and earthquakes.
- Partitions
    - Nonstructural, rigid partitions must be supported by the structure in such a way that they cannot inadvertently become load-carrying elements.
    - Masonry walls should be isolated from the structure of the floor above by a gap and be restrained by continuous or intermittent steel angles at the top of the wall on both sides or by steel straps extending into the grout of the wall. Masonry walls should be isolated from concrete columns by flexible joints.
    - In full height walls, the top of a steel stud should be separated from the track to allow for vertical deflection of the slab.
    - Building expansion joints must be carried through crossing partitions.
- Ceiling Systems
    - Suspended Grid Systems must not support light fixtures that are not supported independently
    - Suspended ceilings, including air diffusers, light fixtures and speakers, must be braced as required
    - Suspended ceilings must be isolated from walls which extend above the ceiling to the building structure.
- Monolithic Ceiling. Gypsum board ceiling should be fastened with large head nails or screws. Building expansion joints must be carried through all monolithic ceilings.

Furnishings and Equipment

- Fixed Casework and Equipment
    - Fixed casework and built-in equipment, such as storage racks and built-in bookcases 5 feet or more in height, should be anchored to floor and walls.
    - Where cabinets or shelving are hung from walls, their weight must be included in the partition design.

Mechanical and Electrical Equipment

- Equipment Anchorage. Mechanical, electrical, and plumbing equipment listed below should be anchored to prevent overturning or sliding due to lateral forces. For lateral loads due to wind, the provisions in the IBC International Building Code should be followed.
  - Air-handling Units
  - Battery Racks
  - Boilers
  - Chillers
  - Control Panels
  - Cooling Towers
  - Emergency Generators
  - Heat Exchangers
  - Motors
  - Panelboards
  - Pumps
  - Switchgear
  - Tanks
  - Transformers
  - Uninterruptible Power Supplies
  - Vessels

Alterations in Existing Buildings and Historic Structures

- Alteration requires ingenuity and imagination.
- It is inherently unsuited to rigid set of rules. Each case is unique. It is recognized that total compliance with standards may not be possible in every case.
- Where serious difficulties arise, creative solutions that achieve the intent of the standard are encouraged and should be presented for the review and approval of UMD Planning and Contraction.