



## Structural Design Guidelines

### I. Structural Engineering Submissions

The designer shall submit all information required by the State Construction Office (SCO) as described in the State Construction Manual Chapter 300 - Project Design Phases. These requirements are outlined below for reference; the designer shall refer to the SCO Manual for detailed descriptions of each SCO item.

The designer shall also submit additional information required by the University as described and underlined below.

*For informal projects, all items below are required with the **exception** of italicized items. (Narratives and calculations are not required for informal projects.) For informal projects without SD or DD submissions, the 95% CD submission shall incorporate all phase requirements.*

#### a. Schematic Design

- i. Building code analysis
- ii. Written narrative and general description of the project including a description of the structural conditions, if the structure is existing
- iii. Scaled site plan showing existing utilities (refer to UNC GIS maps)
- iv. Initiate soil investigation to be provided in the Design Development submittal
- v. Identify individual sustainable design and construction measures and goals which may be applicable to the project

#### b. Design Development

- i. Written response to Schematic Design review comments
- ii. Building code analysis
- iii. Scaled site plan showing any civil work
- iv. Soil investigation report and boring logs
- v. Narrative
  1. Provide a written description of the gravity systems to be used on the project (including foundations, substructure, superstructure, exterior cladding support, etc.).
  2. Provide a written description of the lateral force resisting system to be used on the project. Include a brief description of the load path and load transfer mechanisms.
  3. Provide sufficient technical detail and information to fully describe these systems for engineering review purposes.
  4. Describe any deviations from the structural systems as approved in the Schematic Phase.
- vi. Outline technical specifications, coordinated with the geotechnical report and specifications of other disciplines, including the following information at a minimum
  1. Concrete



- a. Provide basic material properties for concrete to be used, including compressive strength, entrained air content, maximum aggregate size, allowable water/cement ratios, unit weight or aggregate type, and anticipated admixtures.
- b. For reinforcing steel, provide the ASTM material designation for the type of rebar to be used.
2. Steel
  - a. Provide the ASTM material designation for the steel to be used.
  - b. For historic shapes, provide the assumed or tested material strength used for analysis.
3. Masonry
  - a. Provide ASTM designation for the types of masonry units and mortar to be used (brick, CMU, etc).
4. Steel Deck
  - a. Provide basic information for the type of deck to be used including profile and depth, ASTM material designation, span conditions, coating, method of attachment.
  - b. Indicate any areas where shoring of the metal deck will be required.
- vii. Drawings showing principal members and lateral system including at a minimum:
  1. Structural Loading Information
    - a. Design soil bearing pressure and/or pile type and capacity.
    - b. Dead and live loads for all floors and roof.
      - i. Provide floor plan diagrams indicating live load basis of design.
    - c. Snow load including: flat roof snow load (Pf), snow exposure factor (Ce), snow load importance factor (I), and thermal factor (Ct).
    - d. Wind loads: basic wind speed, wind importance factor (I), wind exposure (C), internal pressure coefficient (GC<sub>pi</sub>), and wind pressures for components and cladding.
      - i. Provide building elevations with component and cladding loads indicated.
    - e. Earthquake loads: seismic importance factor, occupancy category, mapped spectral response accelerations (S<sub>s</sub> and S<sub>1</sub>), site class, spectral response coefficients (S<sub>ds</sub>, S<sub>d1</sub>), seismic design category, basic seismic force resisting system, response modification factor (R), system overstrength factor ( $\Omega$ ), deflection amplification factor (C<sub>d</sub>) redundancy coefficient ( $\rho$ ), and analysis procedure used for design.
    - f. Building Performance Basis of Design
      - i. Maximum allowable drift criteria.
      - ii. Maximum floor and roof live load deflections.
      - iii. Floor flatness and levelness numbers.
      - iv. Maximum allowable horizontal and vertical deflection for members supporting exterior cladding and materials.
      - v. Floor vibration criteria.





- a. Deflection under dead, live, and total loads
  - b. Thermal loading
  - c. Vibration propagation and method of analysis
  4. For computer-generated results, submit the input data and the results together with all pertinent program materials required to understand the output. Include a short narrative of the input and results for computer-generated calculations.
- iii. Full technical specifications for all materials used on the project, coordinated with geotechnical report and specifications of other disciplines.
  - iv. Drawings. Drawings shall include all elements listed as required for Design Development as well as the following:
    1. Full set of structural construction drawings fully dimensioned, noted, and detailed for bidding and construction, including, but not limited to, the following:
      - a. All structural loading information listed for Design Development in I.b.vii.1.
        - i. Include live load basis of design diagrams.
        - ii. Include mechanical unit basis of design weights. (Refer to II.c.)
      - b. Foundation (including site walls and under-slab drainage), Floor, and Roof (including fall protection) framing plans.
      - c. Structural sections, details, and elevations.
      - d. Type and strength of all structural materials.
      - e. Top elevation of all footings, grade elevations, estimated pile lengths, and any underpinning requirements. Include elevations of piping or ductbanks penetrating and within five feet (in plan) of foundation elements.
      - f. Joints. Provide a plan clearly indicating and dimensioning all construction, expansion, and contraction joints coordinated with architectural finishes.
      - g. Special shoring or bracing requirements.
    2. Schedules for foundation, columns (with loads), walls, beams, slabs, and decks as applicable.
    3. Structural Details: All details must be shown on the drawings.
      - a. All major slab edges, openings, and penetrations shall be located and dimensioned.
      - b. Weights and location of major mechanical equipment and their supporting systems.
      - c. All necessary supports for cladding (such as brick shelf, embedded plates, anchors, etc.), as applicable. Provide a support strategy that is standardized.
      - d. Sizes, locations, and details of major structural elements and their connection, including equipment supports and site structure, base plates, and anchor bolts, camber, shear stud types, and lengths.



- e. Details for anchorage of building system equipment and non-structural building elements (may be shown on mechanical, electrical, or architectural drawings, as applicable).
- d. 100% Construction Documents
  - i. Technical specifications as outlined in the 95% CD phase shall be developed to a 100% level of completion. The specifications shall reflect any changes, revisions, clarification, or additional information as a result of UNC-Facilities Services review comments and recommendations, and all regulatory agency approvals.
  - ii. Drawings as submitted in the 95% CD phase shall be developed to a 100% level of completion. The drawings shall reflect any changes, revisions, clarification, or additional information as a result of UNC-Facilities Services review comments and recommendations, and all regulatory agency approvals.
- II. UNC-FOPD Specific Design Requirements. The following are specific design and drawing requirements prescribed by UNC-Facilities Services.
  - a. Foundation Drains and Under-slab Drains. Under-slab drains are often required on our campus due to proximity of water table to the ground surface. If under-slab drains are required, then information about the drainage system shall be shown on the structural drawings and coordinated with the civil, architectural, and plumbing consultant. The foundation perimeter drain diameter, high point elevation, and flow direction shall be indicated Refer to foundation drawings for Koury Dental Sciences for examples of how to show the system.
  - b. Site walls. Construction information for site walls shall be shown on the structural drawings. Top of wall elevations, wall reinforcing, and behind-wall drainage (if required) shall be indicated.
  - c. Mechanical Unit Basis of Design. The basis of design weight for mechanical equipment shall be indicated on the structural drawings. A note on the plans shall include the basis of design make and model. This note shall indicate that if a different model is purchased, the Engineer of Record shall be notified.
  - d. Fall Protection Required at New Buildings and Roof Replacements. New construction shall include scope for fall protection to safely maintain the building, including, but not limited to, servicing PME equipment on roof or elevated platforms, maintaining rooftop gardens, etc. Designs shall also provide for fall protection lanyard attachment points for safely exiting manlifts onto platforms. Fall restraint systems are strongly preferred over fall arrest systems. (Refer to UNC-Chapel Hill Fall Protection Design Guideline for more information.)
  - e. Structural slab over backfill. Slabs-on-grade over backfill that are adjacent to basement walls shall be doweled into foundation wall and shall be design as structural slabs to span over the backfill to avoid settlement at less compacted soil.
  - f. Existing reinforcing and conduits shall be located with GPR or other non-destructive means prior to cutting existing concrete including slab on grade. Indicate in construction documents that the contractor shall not damage existing steel reinforcement. Contractor shall determine the location of concrete reinforcing by non-destructive means prior to installation of fall protection anchorage.



- g. Mechanical pipe, top of pipe and top of footing elevations. Indicate on foundation plan the location of all pipes, duct banks or utility tunnels or other infrastructure penetrating foundation wall as well as all pipes, duct banks, or utility tunnels or other infrastructure parallel and within five feet of wall. Include the top and bottom elevation of these items on plan.
- h. Masonry veneer detailing. Advise architect on detailing recommendations of the Brick Industry Association <http://www.gobrick.com/>
- i. Historic Preservation Engineering requirements. All work at historic structures shall utilize the National Park Service recommendations: <http://www.nps.gov/tps/standards.htm>
- j. Project Close-Out
  - i. In addition to design drawings (CAD and PDF per UNC Design Guidelines), provide Shop Drawings (PDF only) for the following items.
    1. Precast concrete
    2. PT concrete
    3. Structural cold formed steel framing
    4. Open-web steel roof or floor joists
    5. Glulams
    6. Stair framing
    7. Pre-engineered metal buildings