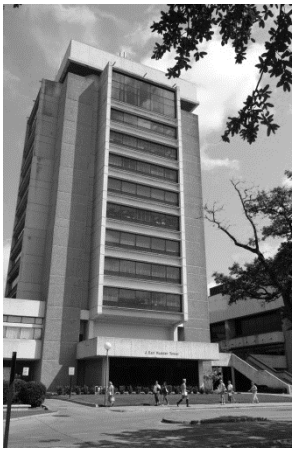
ARCH 631. Essay Questions for Final Exam

This is the list of possible essay questions* for Final Exam.

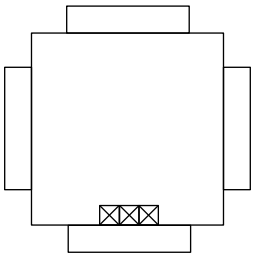
*Only one question will be asked on the exam.

1. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria to evaluate the design. Using either reinforced concrete, wood, or steel construction as your example (*choose only one*), and identify a typical multi-story structural system for that material and describe the members, organization, and connections for it. Choose one of the following soils – very moist sandy-silt (bearing capacity: 4 ksf or 190 kPa) or hard clay (bearing capacity: 8 ksf or 380 kPa) – in order to identify all appropriate foundation types for your soil choice with your structural system. Provide a sketch that clearly identifies the system (stories and column placement) and components you describe with annotations (notes and arrows). Identify the limitations for the building size, member sizes, and foundation size(s) and the reasons for the limitations. Also discuss the lateral resisting elements or mechanisms you would use for your structure and foundation for wind loading. Provide a load tracing diagram with relative sizes of lateral loads due to wind and live occupancy load complete with the resisting forces by the foundation, and illustrate all possible deformations with dashed lines.

2. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria to evaluate the design. Discuss the serviceability criteria for both the superstructure (above ground) and for the foundation of a building. Identify the differences in requirements, if any, for low-rise, mid-rise, and high-rise structures with respect to loads, materials, spans, structural elements, soil, and foundation type and construction. Knowing that Rudder Tower is 11 stories, with the top story being double height and a penthouse for the mechanical systems, discuss and sketch the likely structural system (including material, member types and connections) and identify members with annotations (notes and arrows). The typical floor plan has meeting rooms on the perimeter and large meeting rooms in the interior with the elevators on one side (see drawing). Also discuss the likely foundation system and justify your reasoning based on the anticipated soil type in College Station (which you must state). Include the lateral load tracing on your sketch by indicating the relative size of the wind load per story knowing that the surrounding terrain is Exposure B (urban and suburban), and point out the lateral resisting system or elements (with notes and arrows).

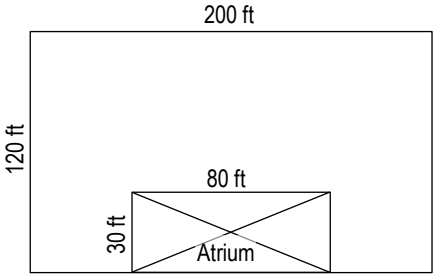


Q2. Rudder Tower



Q2. Typical Floor Plan

3. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. Using a 5-story steel frame having a rectangular plan (as shown), with a full building-height atrium on one side, pinned connections, floors with non-composite concrete cast on steel decking, and concrete masonry shear walls as your example, address the following: Discuss the implication of the structural planning in both the vertical and horizontal direction on the grid, the material choice, the lateral resistance, and the foundation. Provide an example of another system and material that could also be appropriate and describe why. Draw the system in an axonometric (3D) view and show the load path for the gravity and lateral loads. Sketch where you would place the masonry shear walls in the building view and the plan (with notes and arrows), and provide your reasoning for their location and size. Choose a foundation system for this structure when the soil at the site is a highly-expansive clay with bedrock 500 ft (150 m) below grade, and provide the reason for your choice with respect to the structural system and loads of your example **and** in comparison to other possible choices. Be certain to list any disadvantages of your choice, and include the foundation (with notes and arrows) and load tracing in your building view.



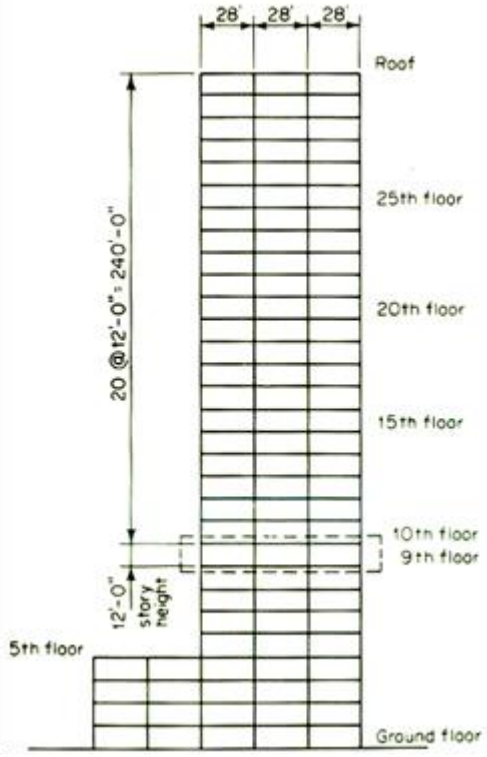
Q3. Plan

4. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. Because foundations must transfer forces due to material weight and live load on the building structure to the ground, the system selection will have a direct influence on the foundation type chosen, while the appropriate foundation type for the site and ground characteristics will have a direct influence on the system selection. Discuss the design factors in your control and out of your control with respect to the foundation. Particularly address structural planning issues that can affect the foundation design, and how materials and connections can impact the foundation design with respect to lateral loading (all types). How do the requirements for building foundations compare to those for retaining walls? Choose *one* of the following to use as an example: an arch, rigid frame, shell structure, or air inflated structure. Illustrate the foundation type(s) and loads to be resisted and discuss the requirements specific to your system selection with annotations (notes and arrows).

5. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. Reinforced concrete is one structural material used in a wide variety of structural systems and long-span applications. Identify why it is versatile with respect to the structural components and their connections for a multistory structure (at least 15 stories). Choose one possible system from you discussion and illustrate it with annotations of the components and foundation (notes and arrows). Identify the advantages and disadvantages of the material for multistory construction with respect to structural planning and design requirements under all possible loading conditions. For the system you have sketched, describe the foundation and structural supervision requirements, and compare those structural supervision requirements to those for *either* steel construction *or* timber construction *or* masonry construction.

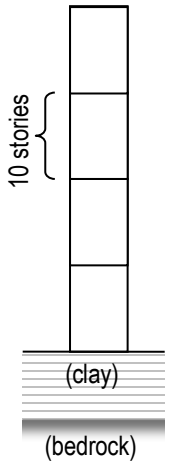
6. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. Selection of the foundation type for a structure is an important issue in structural planning. Identify the important information obtained in a site analysis and relate it to the overall building performance requirements and the foundation requirements. Describe the structural planning issues that affect the selection of the foundation. Choose one example of a shallow foundation and one example of a deep foundation and illustrate the design load and discuss the structural design requirements with respect to the material and critical soil properties. Address the serviceability issues that must be considered.

7. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. In addition to the requirement that gravity loads must be supported and transmitted safely and to the ground, high rise structures required additional planning and analysis. Describe the structural planning considerations that may limit the total height and area, and the attributes of a structure that will ensure its stability and efficiency and explain why for both the imitations and the attributes. Using the figure (shown) for an example, choose a material and structural system for the office building and describe the way in which this building satisfies the criteria you described. Also describe the requirements for any foundation with respect to various soil types and which foundation types and elements would be appropriate for this structure with the system chosen. Show the selection of a foundation by sketching it on the diagram with annotations (notes and arrows).



Question 7

8. Appropriate structural system planning and design requires knowledge of the behavior of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. You are tasked with the design of a forty story office structure with a height about 500 ft (160 m) and a width about 85 ft (30 m) that is situated within a moderate earthquake zone. The soil is a highly compressible clay with bedrock at 100 ft (30 m) below grade. Identify the basic design and structural planning issues with respect to strength, stiffness, serviceability and stability for this building. This should include identification of loads (general sizes, kind and direction), suitability of building type or framing, building behavior under loads, and foundation requirements. Choose a structural system for this building and identify how the vertical layout, horizontal layout, and interconnectedness will address the issues identified. Make a representative sketch of the lower 10 story section identifying components and lateral resistance with annotations (notes and arrows). Also choose a foundation system and identify how it will address the issues identified, and include it in the sketch (with notes and arrows). Appropriate structural system planning and design requires knowledge of the behavior



Q8. elevation at scale

of components and materials, behavior of assemblies, characterization and quantification of gravity and lateral loads, behavior and construction of foundations, analysis of loads in the structure, and use of strength and serviceability criteria used to evaluate the design. The design you are working on for a 12 story tall steel pinned frame with masonry shear walls will be located on the site where the soil has been (reasonably) determined to be stiff clay with an allowable bearing capacity of 1390 kPa (2900 psf). Bedrock exists around 15 m (50 ft) below grade. The site is located in a moderate risk earthquake area and a strong wind zone. Identify two foundation system arrangements that would be possible with respect to economy, and draw each of them with annotations (notes and arrows) supporting the building frame (sketch also) in profile (2 figures). For each system chosen identify how the footing type satisfies the requirement for strength and stability with respect to the loading and soil conditions using proper terms and identifying common construction materials and techniques. Identify the major differences between the systems you have described as your examples.