

## ARCH 631. Essay Questions for Exam 2

### **This is the list of possible essay questions\* for Exam 2.**

\*Only one question will be asked on the exam.

1. Structural planning requires the designer to be familiar with the choice of materials, the shapes and sizes of the members making up a structural system, and the appropriateness or efficiency of a system for spans, loads, and building forms. Using the category of rigid frames for an example of planning, describe the choice of materials, the choices for shape or building form and the reason for the appropriateness or efficiency of those shapes with respect to spans and loads, the choice of sizes (heights and spans) of members and the effect of member cross sections on the behavior of the entire system. Choose one material for a multistory rigid frame and address one one-way and one two-way horizontal spanning system option. Illustrate your two-way system option in a 3D sketch with load tracing for gravity and lateral loads including reactions developed at the base and possible deformations. Put notes with arrows on the support, loads, members, and deflected shape.
2. Structural planning requires the designer to be familiar with the choice of materials, the shapes and sizes of the members making up a structural system, and the appropriateness or efficiency of a system for spans, loads, and building forms. Reinforced concrete is a material that has a large variety of structural members and arrangements with applications for low-span, intermediate span, and long-span systems. Discuss the one-way and two-way systems for low-span, intermediate span, and long-span systems of reinforced concrete. Identify which systems are appropriate for floors and for roofs. Describe the limitations of one of the two-way low or intermediate span systems you have identified that restricts its use for long-spans, and illustrate and annotate (with notes and arrows) the behavior with a sketch. Also identify how the system you chose could be changed for use as a longer spanning system with similar features and illustrate those changes to the horizontal and/or vertical system with annotations on the sketch.
3. Structural planning requires the designer to be familiar with the choice of materials, the shapes and sizes of the members making up a structural system, and the appropriateness or efficiency of a system for spans, loads, and building forms. Two structural system types that have distinctly different materials, but similar forms are shells and membranes. Describe the materials, shapes, and sizes of members and supports – particularly with respect to span and depth, typical loads for efficient use, and the nature of the vertical support systems (as concentrated or distributed) for shells and for membranes. Choose an example of a shell structure other than a spherical shell and its material, and a membrane structure and its material which could take on the same shape or form with the same load. Provide an illustration of each with annotations and identify your material choices. Describe the forces or stresses or serviceability issues that are similar. Also identify the forces or stresses, and serviceability issues that are different, and document the specific design requirements for the structural materials that you have selected with your form. Also comment on the spatial characteristic of your shell and of your membrane structure.
4. Span length and grid organization are key determinates to the selection of an appropriate structural system. Floor systems must be horizontal, while roof systems do not. Discuss the appropriate loading, materials, span length, support conditions, and key design concerns for a two way floor system of your choice. Also discuss the appropriate loading, materials, span length, support conditions, and key design concerns for one of the following roof systems: membrane, shell, space truss OR folded plate. Provide a sketch of each of your system choices with the material, loading, support conditions, and span length with annotations (notes with arrows). Identify the disadvantages of your horizontal system choice in relation to the advantages of your roof system choice. Also identify the disadvantages of your roof system choice in relation to the advantages of your floor system choice. Which of these systems would be easiest to manipulate the support locations? Justify your decision.

5. Structural planning includes adopting a pattern of organization and identifying the structural hierarchy for the vertical support and horizontal spanning system. Discuss how the pattern influences the span lengths, and how the span lengths influence the choice of one-way or two-way system and appropriate vertical support for each system. Describe the alternative design strategies of a “concentrated” structure versus a “distributed” structure for the specific loading condition of a light uniform load on a floor, and illustrate each strategy for an intermediate span length with annotations (notes and arrows). Graphically trace the floor loads through the horizontal arrangement to the vertical supports on your sketches. If your two systems are to be placed next to each other in a single structure, identify and justify one solution for the intersection of the structural grids you have illustrated.
6. Structural planning includes adopting a pattern of organization and identifying the structural hierarchy for the vertical support and horizontal spanning system. One long span roof shape for which a variety of structural systems can be used is a spherical surface. Choose one system other than a reinforced concrete shell that is appropriate for this shape and describe the types of external loading, structural design and geometric considerations, analysis methods, and any material or other considerations specific to the chosen system. Sketch it. Compare the requirements for performance and design to those for an equivalently shaped reinforced concrete shell. Specifically discuss the opening and foundation requirements, and sketch an illustration of a problem or potential problem with annotations (notes and arrows) of what the problem is and discuss why it is a problem.
7. Structural planning includes adopting a pattern of organization and identifying the structural hierarchy for the vertical support and horizontal spanning system. Reinforced concrete is commonly used to construct plate systems, grid systems, folded plates, and shells. Describe the primary stresses each system must be designed for and how the steel and the concrete act together to resist the stresses. Describe all the design or planning variables that can influence the size or location of the critical stresses and the possible deflection issues. Choosing one of the systems listed above, describe, illustrate, and annotate (with notes and arrows) one example of an intermediate-span system and discuss and illustrate with annotations what changes would be required for that system to be a long-span system.
8. Air-inflated membranes, air-supported membranes, nets, and shell structures are structural types which resist forces and stresses primarily in the surface or thickness of the shape. Choose two from these four structural types and identify your choices with annotated sketches identifying the material and system of each. Identify and describe the similarities and the differences in design requirements for strength (*stress type and direction*) and serviceability with respect to the overall shaping, material selection, and usual loads supported by the types you chose. Identify the problems with large concentrated forces and with lateral loads for each structural type chosen, and make a sketch with the anticipated response of the concentrated force on one system and the anticipated response of the lateral load for the other system with annotations (notes and arrows).
9. Many two-way structural systems, and some one-way systems are very appropriate for light, uniformly distributed loads, such as those carried by roofs and floors. Select a roof shape that is of interest to you other than a flat system. Suggest two structural systems that could be used to fill or support the shape and sketches each systems in the shape chosen, and annotate the material and components that make up the system. For each system chosen, discuss the effect of the light uniformly distributed load on system parameters such as depth, span, bay size or plan shape, stresses that be designed for, and serviceability issues. Discuss the appropriate support conditions to any of the parameters mentioned. Which system would you construct based on these planning issues for what reasons? Also describe a problem that would result from a loading *which is not light and uniformly distributed* for one of the systems you discussed. Sketch the problem and annotate it (with notes and arrows.)