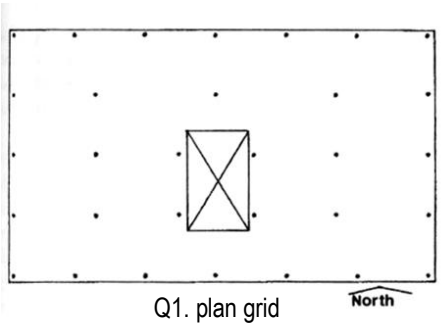
ARCH 631. Essay Questions for Exam 3

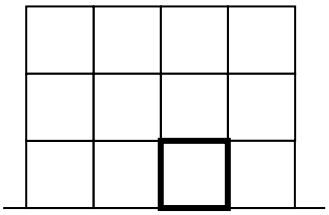
This is the list of possible essay questions* for Exam 3.

*Only one question will be asked on the exam.

1. Effective design for seismically resistant structures requires an understanding of the nature of the hazards, basic lateral resistance strategies for and behavior of low, medium and high-rise buildings, the design choices resulting in poor seismic resistance, and the design choices resulting in good seismic resistance. Discuss the inherent lateral-resisting problems with non-symmetrical stiffness for any building plan and for the vertical direction of the building with respect to the most important ground motion for structural design. Identify the common reasons for non-symmetrical stiffness horizontally and vertically. Then describe a better design solution for the column layout (dots) of the plan shown having a non-symmetrical opening by incorporating rigid frames. Sketch your solution and identify all components and connection types with notes and arrows. If the profile of the 3 story structure on the east side of the building is as shown in the figure below and there must be no obstruction in the bay indicated by bold lines (for a very large window, perhaps), propose a bracing system if the frame has all pinned joints and sketch the placement and identify the bracing on the figure.



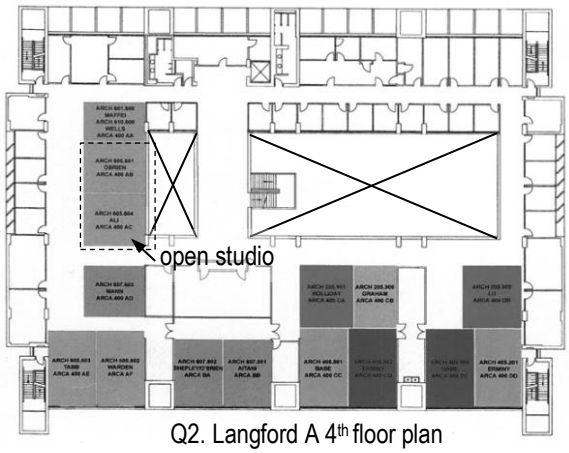
Q1. plan grid



Q1. east-west elevation

2. Effective design for seismically resistant structures requires an understanding of the nature of the hazards, basic lateral resistance strategies for and behavior of low, medium and high-rise buildings, the design choices resulting in poor seismic resistance, and the design choices resulting in good seismic resistance. Describe the general requirements for seismic design of structures, and identify the specific design principles with respect to materials and systems, connections, massing, isolation strategies, horizontal and vertical stiffness, load tracing, and building period. Use Building A of the Langford Architectural Center as a case and identify good or poor planning strategies if it were to experience a seismic event with a magnitude of 5. Include a sketch of the expected response with annotations (notes and arrows) identifying the resistance mechanisms and motion. If you were in the studio indicated on the 4th floor when the earthquake struck, how likely would it be that you would get under a desk next to a tall locker on wheels knowing that the top shelf of the locker is full of textbooks and that the wheels are not locked? Justify your answer.

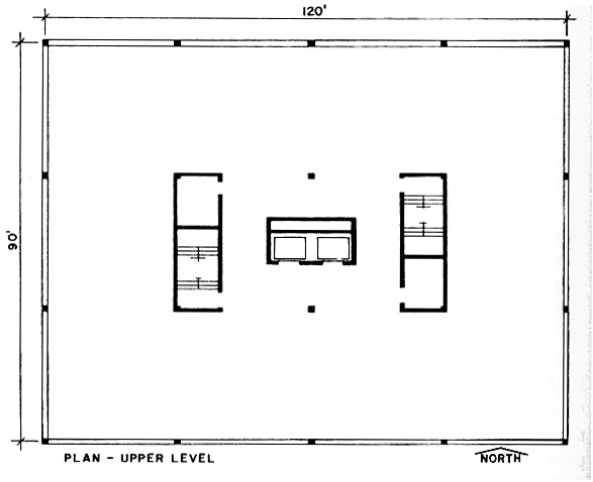
elevation (from quad)



Q2. Langford A 4th floor plan

4. Effective design for seismically resistant structures requires an understanding of the nature of the hazards, basic lateral resistance strategies for and behavior of low, medium and high-rise buildings, the design choices resulting in poor seismic resistance, and the design choices resulting in good seismic resistance. Describe the specific hazards, and characteristics and measurement of ground motions. Identify the structural effect on building forms with respect to overall shapes and heights, and the lateral loads that must be resisted and designed for. List all major examples of bad planning and design, along with the reasons for the poor behavior and provide the corrective or effective strategy and reasons for the good behavior. Choose one example from your discussion to draw and annotate (with notes and arrows). Also be sure to identify and annotate (with notes and arrows) the lateral resistance mechanisms involved with respect to member assemblies, orientations, and construction materials.

5. Lateral resisting mechanisms can behave differently under wind loading than they do with inertial forces resulting from seismic acceleration. The most common choices for the general lateral bracing system are *core shear wall system, braced pinned frame core, perimeter shear walls, mixed exterior and interior shear walls or braced pinned frames, full rigid frame system, and perimeter rigid frame system*. Describe the general requirements of lateral resisting systems, and the specific requirements of systems for earthquake design. Choosing one of the common systems above, identify and justify a choice of material with respect to those requirements that could be used in a six-story building with a general floor plan shown to the right having three bays one way (N-S), and four bays the other. Draw on the plan the location and type of the components of the bracing system with notes and arrows. Also draw a typical elevation through the bracing system and label the components with notes and arrows. Discuss the horizontal and vertical arrangements to avoid, any architectural disadvantages of your choice, and the behavior and impact of your material choice on ductility, stiffness, and building period with respect to earthquake-resistance.



Q5

6. Seismic building codes have the stated goal of maintaining life safety while providing a simple uniform method to determine the seismic forces to ensure a safe and economical design. In an effort to define safety, performance objectives classify the limits of damage which a structure can be expected to sustain, both structurally and non-structurally, when subject to specified earthquake demands. Describe the three major performance levels, specifically identifying the structural and non-structural requirements. Choosing *either* a three story retail structure with an open store front (three sides of solid walls) *or* a single story long span structure, discuss the design strategies specific to the building type, including structural system choices, which should be followed for seismic design and justify any choices made. Sketch the structure and identify the key design element with notes and arrows. Also sketch the anticipated movement under horizontal ground acceleration with notes and arrows.

7. Planning and designing a building to meet building codes and seismic provisions requires knowledge of the seismic risk of the site as well as the response of the structure to ground motions. Describe the anticipated loads on a structure due to ground motion, particularly with respect to the building code expression: $V = ZICW/R_W$ (with reference), and describe the requirements of building performance with respect to stiffness (rather than strength). Choose an appropriate material and system for a structure that is taller than 15 stories and illustrate, annotate (with notes and arrows), and discuss the good planning principals while identifying and annotating how your structure will meet the requirements <u>without</u> using addition mechanisms such as dampers and base isolation. .

$$C = 1.25S / T^{2/3} < 2.75$$

TABLE 5-13 SEISMIC ZONE FACTOR *Z* (*UBC TABLE 23-I*)

Zone	1	2A	2B	3	4
Z	0.075	0.15	0.20	0.30	0.40

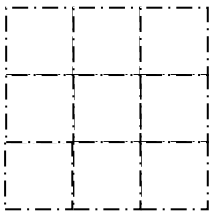
TABLE 5.5 Importance Factor for Seismic Coefficient

Occupancy Category	Importance Factor
I and II	1.0
III	1.25
IV	1.5

Q7. Reference Figures

8. Planning and designing a building to meet building codes and seismic provisions requires knowledge of the seismic risk of the site as well as the response of the structure to ground motions. Describe the critical ground motions that affect building stability, strength or performance, and the relevant measurement systems. Describe the acceptable or desired building response or responses and indicate why it is desirable or required by code. Illustrate, annotate (with notes and arrows), and discuss two common architectural configurations or arrangement that exhibit unacceptable or poor response to seismic motion and theorize on why a practicing architect could possibly want to design them that way by specifically addressing the poor design identified by your annotations.

9. Effective design for laterally resistant structures requires an understanding of the nature of the hazards, basic lateral resistance strategies for and behavior of low, medium and high-rise buildings, the design choices resulting in poor lateral resistance, and the design choices resulting in good lateral resistance. You are designing a six story structure that must resist large wind loads. You plan to use a three-bay square grid (see figure). You have identified framing options of a moment-resisting frame, a pinned frame with knee bracing, a pinned frame with X (cross) bracing, a pinned frame with K bracing, a frame with floor diaphragms and shear walls, an exterior column (framed) tube, or a tube with diagonal bracing (trussed frame). Choose <u>two</u> frame types from the available options listed above and make an elevation *and* plan arrangement sketch of each including bracing, if any, and connection types or rigidities with annotations (notes and arrows). Choose an appropriate material for each and state your reason for the choice with respect to design requirements for strength and serviceability under lateral loads. Make a final design selection from the two options you have chosen and discussed, and justify your decision by evaluating the disadvantages of each system.



Q9. plan grid

10. Effective design for laterally resistant structures requires an understanding of the nature of the hazards, basic lateral resistance strategies for and behavior of low, medium and high-rise buildings, the design choices resulting in poor lateral resistance, and the design choices resulting in good lateral resistance. You are designing a four story structure that must resist large wind loads for your geographic area of the country. You plan to use a three-bay square grid. You have identified framing options of a moment-resisting frame, a pinned frame with knee bracing, a pinned frame with X bracing, a pinned frame with K bracing, a frame with floor diaphragms and shear walls, an exterior column (framed) tube, or a tube with diagonal bracing (trussed frame). Choose two frame types from the available options. Draw the elevation and plan of each including bracing, if any, and modeling of the connections with annotations (notes and arrows). For each system which you have selected and sketched, state what material you would choose for it and why. Also describe the lateral resisting mechanisms and how you would construct or connect the frame members, and identify it on the sketch with annotations. From your system choices, make a selection for the final design, and justify your decision by evaluating the benefits and disadvantages of each system.