Eciv 303 Final Exam

Fundamentals...Things you must know

1. Most materials can be represented by Elastic constants to represent behavior. Typically we use two constants. What are those constants and what behavior do they represent?
2. When analyzing strength data, we may use an offset method, what is an offset method?
3. We may classify materials as brittle or ductile. Name one of each. How do they behave differently?
4. At the atom level, material behavior is often governed by imperfections. What are those imperfections?
5. What are the basic ingredients of steel?
6. What are the basic ingredients of concrete?
7. Wood is anisotropic. What does anisotropic mean? How is wood anisotropic?
8. What does flux do during the welding process?
9. What happens during corrosion?

Behavior of Materials

1. Elastic behavior means a material returns to its original position after loading. What does this mean about work/energy in the material?

2. Given the Kelvin Body below, sketch the deformation vs. time behavior if I hung a weight at the lower end of the body and fixed the upper end so it did not move

3. If we are given an equation for non-linear behavior such as

$$\sigma = A\varepsilon^2 + B\varepsilon + C$$

a. Can we compute a secant modulus? How would we do it?
b. Can we compute a secant modulus? How would we do it?

4. Indicate the secant modulus for 5% strain on the diagram below

5. Using a 0.5% offset, what is the yield stress of the aluminum in the diagram?

6. A pavement slab rests on the ground just after sunset when the air is rapidly cooling. What would be the stresses in the slab due to cooling effect of the air on the top of the slab? What would the shape of the slab look like if the ground below was still warm (exaggerate your sketch for clarity)

7. Given the test data below, if I wanted the bridge beam to never fail, what would be the maximum loading I should allow?

Basic Material Structure

8. What determines a material's crystal structure?
9. Given the binary phase diagram below:
    a. at 500°, how much liquid α and how much liquid β is present.
    b. what is the eutectoid temperature?

Measurement of Properties

10. What electrical property in a strain gage changes when a strain gage is doing what it is supposed to do?

11. Given the two load cell graphs, which one is more sensitive, which one is more linear

12. Which is more accurate if you want to measure the 0 to 1.00-volt output of a pressure transducer? a: a 12-bit system that measures input from -10volts to +10 volts
    b. a 10 bit system that measures from -1.0 volts to +1.0 volts

note: 10 bits = 2^{10} =1024 and 12 bits = 2^{12}=4096

Steel

14. Name three raw materials that go into iron making.

15. We saw how continuous casting works. It starts as molten but how can they handle the stuff to manipulate it and produce steel continuously?

18. What does the Charpy V-notch test measure? How does it measure that property?

Application of statistics to material properties (Including handouts)

19. You have been testing some steel coupons from Buddys Alloys' plant. He gave you their numbers for this production run as mean=40,000 psi, std. dev = 1,500 psi. They want to know with a 99% confidence if our data matches theirs. You tested your coupons your batches and found that the Z-statistic was -2.197 and P Z>z =0.017 for one-tail and 0.034 for two tail

a. What was your Null Hypothesis
b. Did you reject the Null Hypothesis
c. What can you tell Buddy about your tests and their production?
d. Can you tell him something different if he wanted 95% confidence?

Aluminum

20. What, chemically, is bauxite?
21. What is so energy intensive in producing aluminum?
22. How does recycling aluminum compare to producing it from ore from an energy standpoint

23. We saw how easily Aluminum is alloyed with other metals. How does alloying change aluminum's properties, give me some examples.
24. Does Aluminum corrode? What happens to it?

Corrosion

25. Corrosion requires two materials, how are they represented ?
26. While the process of corrosion is occurring, what is happening electrically?
27. Name three ways to prevent corrosion
28. Why doesn't normal steel "heal" itself when it corrodes

Aggregates

29. We saw a lot of cool videos on blasting. Why didn't the blasts occur simultaneously?
30. How does one blast bench of stone for aggregate processing
31. What is the objective of a good aggregate blast?
32. Why do we test aggregate for Saturated Surface Dry Conditions?
33. What kind of reactivity to we worry about with aggregates in concrete

Brick

34. How does mortar work with brick?
35. Do we test brick for strength? What is the most common way to test for strength

CMU

36. We saw CMU with symmetrical break facing. What is that?
37. Why do we soak CMU's in a test?
38. How do we use reinforcing steel with CMU construction?

Portland Cement Concrete

39. What raw ingredients go into Portland Cement production
40. Why do we heat it so much
41. How do we characterize the strength properties of the cement
42. What is the difference between cement paste, mortar and concrete
43. What are the four predominant chemicals in Portland Cement (your best guess at the full name, not formula)

Concrete Proportioning and Mixing

44. What ingredients go in to a concrete mix
45. Why would I use Type III over Type I cement in my mix?
46. If I did a volumetric mix design, do I consider the moisture in the aggregate. How do I account for it?
47. What does a retarder do
48. When placing concrete, why should I use a tremie?
49. Is steam-cured concrete stronger or weaker than air cured concrete

50. Why use air entrainment
51. Why do we require minimum space between reinforcing steel and the concrete forms
52. How does water cement ratio affect workability
53. How does duration of curing affect compressive strength
54. What is the relationship between average compressive strength and design compressive strength for a batch plant mix

Wood

55. Why are we concerned about how lumber is cut from the tree?
56. How is wood anisotropic
57. Why do we treat wood with preservatives
58. Plywood laminates make wood sheeting stronger, how does it accomplish this
59. How does lumber grade affect design values for beams and rafters
60. What is the benefit of machine testing versus visual grading for structural design

Presentations

1.How does pervious concrete help maintain stormwater quality?
2. What is the typical unit weight of brick?
3. What are the two classes of fly ash?
4. How does dry application of shotcrete differ from wet application?
5. With respect to market share, how does OSB compare to plywood?
6. What is chopped strand vs. woven cloth in glass-reinforced plastic
7. High speed rail will require new rails, what about the ties (sleepers)?
8. How does the method of weave and strand size affect steel cable?
9. What kind of specialized construction techniques are necessary for paving a racetrack?
10. What are the three types of prestressed concrete?
11. Name two types of specialized steel casting
12 How can one orient the wood grain in glulam fabrication?
13. How can glass be recycled as aggregate?
14. Is a pole-vault pole perfectly straight? why?
15. What is the major benefit in fiber reinforced concrete?
16. Why would we want a metamaterial to be able to bend electromagnetic radiation?
17. What is the function of the top layer of inert material in an explosion weld
18. Carbon nanotubes are fabricated from a family of molecules called fullerenes, where does this name come from?