edcetera engineering

Final Exam

Continuing Education Course #261
What Every Engineer Should Know About Structures Part C - Axial Strength of Materials

1. Strength of Materials is a part of the division of physics known as engineering mechanics.
- a. True
- b. False

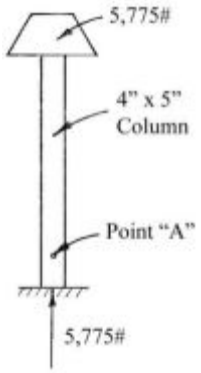
2. Strength of Materials considers the internal forces in structural elements to determine:
- a. the stress and deformation within a member (stress analysis).
- b. the required size of the member to support the applied loads (design analysis).
- c. the load carrying capacity of a structural system or member (load analysis).
- d. all of the above.

3. Strength of Materials is based on equilibrium of forces on a body at rest.
- a. True
- b. False

4. An axial load is a load that has a line of action along the long axis of a member.
- a. True
- b. False

5. In the equation for stress ($\sigma = \frac{F}{A}$), there is <u>one</u> answer and <u>two</u> variables.
- a. True
- b. False

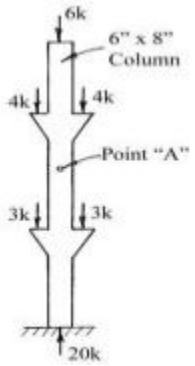
6. What is the stress in the 4" by 5" rectangular column at point "A"? <u>Note</u>: Ignore the weight of the column AND answer to 3 significant figures.



- a. 290.00 psi
- b. 288.75 psi

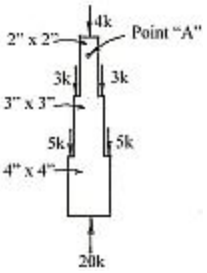
○ c. 288.8 psi
○ d. 289 psi

7. What is the stress at Point "A" in the 6" by 8" rectangular column shown below? Note: Ignore the weight of the column AND answer to three significant figures.



○ a. 0.125 ksi
○ b. 0.167 ksi
○ c. 0.292 ksi
○ d. 0.417 ksi

8. What is the stress at Point "A" in the column shown below? Note: Ignore the weight of the column.

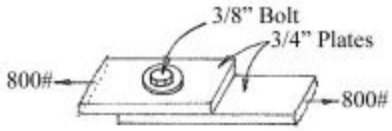


○ a. 1 ksi
○ b. 1.11 ksi
○ c. 1.25 ksi
○ d. 4 ksi

9. Axial loads on a member are assumed to act uniformly over the entire cross section of the member.
○ a. True
○ b. False

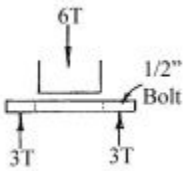
10. Shear is:
○ a. a tensile stress
○ b. a compressive stress
○ c. an axial load
○ d. none of the above

11. Two plates are bolted together as shown in the drawing below. What is the shear stress in the bolt? The plates are 3/4 inch thick. The force pulling on each plate is 800 pounds. And the bolt is 3/8 inch in diameter.



- a. 1,810 psi = 1.81 ksi
- b. 3,620 psi = 3.62 ksi
- c. 7,240 psi = 7.24 ksi
- d. 14,500 psi = 14.5 ksi

12. A hydraulic log splitter was exerting a force of 6 tons when the connecting bolt failed in double shear. The bolt was 1/2 inch in diameter. What was the shear stress in the bolt at failure? (1 ton = 2,000 pounds)

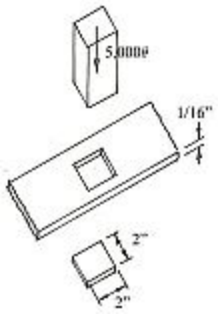


- a. 3.82 ksi
- b. 7.64 ksi
- c. 15.3 ksi
- d. 30.6 ksi

13. Cutting shear and punching shear are two examples of when it is desirable for the cut or punched material to fail in shear.

- a. True
- b. False

14. A 2" by 2" square hole is to be punched through a piece of 1/16th inch thick material. If the force required to punch out the slug is 5,000 pounds, what is the shear stress in the material at failure?

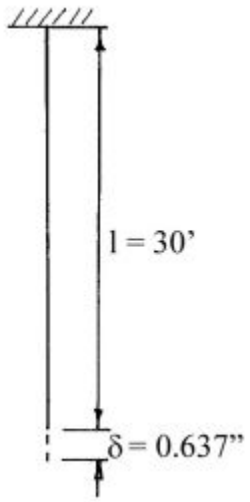


- a. 20,000 psi = 20 ksi
- b. 10,000 psi = 10 ksi
- c. 2,500 psi = 2.5 ksi
- d. 1,590 psi = 1.59 ksi

15. A horizontal shear stress (which is caused by horizontal forces) creates a vertical shear stress.

○ a. True
○ b. False

16. A 30 foot long cable is stretched 0.637 inches after a load is applied. What is the strain in the cable in inches per inch?



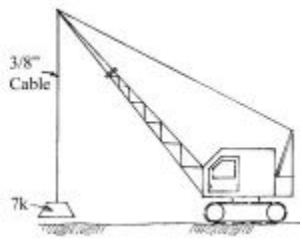
○ a. 0.00177 in/in
○ b. 0.0212 in/in
○ c. 0.191 in/in
○ d. 0.255 in/in

17. A structural member can fail in the following way(s):
○ a. It may fracture (tear in tension - crush in compression).
○ b. It may stretch, or deform, excessively and no longer be able to perform properly.
○ c. It may buckle becoming unstable and no longer able to carry its load.
○ d. All of the above.

18. When a material is stressed within its elastic range, the strain produced is proportional to the stress.
○ a. True
○ b. False

19. Different species of wood all have the same value for its modulus of elasticity (E).
○ a. True
○ b. False

20. A crane has a hanging, unloaded steel cable that is exactly 50.000 feet long. If the crane picks up a 7 kip load, how much will the cable stretch? The cable is 3/8 inch diameter. The modulus of elasticity (E) for the steel cable is 30 x 10^6 psi.

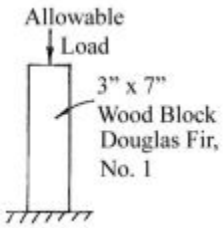


○ a. 0.00127 in
○ b. 0.106 in

○ c. 0.317 in
○ d. 1.27 in

21. The maximum allowed stress for design and analysis is determined by applying a factor of safety to either the yield strength of the material or the ultimate strength of the material.
○ a. True
○ b. False

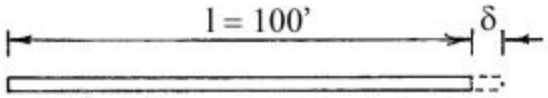
22. Using the table of properties and the diagram below, what is the allowable load in compression parallel to the grain for the short block of wood? The actual dimensions of the block are 3 inches and 7 inches.



Properties of Wood Allowable Stress					
Type & grade	Bending (psi)	Tension parallel to grain (psi)	Compression parallel to grain (psi)	Compression perpendicular to grain (psi)	Modulus of elasticity (psi)
Douglas Fir - 2 to 4 in. thick, 6 inches and wider No. 1	1,750	1,050	1,250	385	1,800,000

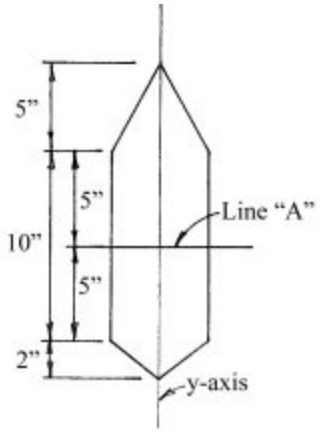
○ a. 8,090 #
○ b. 22,100 #
○ c. 22,700 #
○ d. 26,200 #

23. A continuous section of concrete slab pavement is 100 feet long at zero degrees Fahrenheit (it's winter here in Michigan :)). How much longer will the section of pavement be when it is 100 °F in the summer? The coefficient of thermal expansion (α) for concrete is 6.0×10^{-6} °F^{-1}.



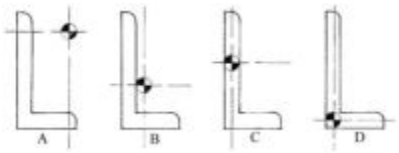
○ a. 0.06' = 0.72"
○ b. 0.12' = 1.44"
○ c. 0.6' = 7.2"
○ d. 1.2' = 14.4"

24. In the drawing of a beam cross section shown below, select the answer that best describes the location of the centroid of the cross section.



- a. The centroid of the cross section lies above the line "A"
- b. The centroid of the cross section lies on the line "A"
- c. The centroid of the cross section lies below the line "A"

25. Look at the four drawings below. Each steel angle is identical in size and shape. Which drawing most nearly shows where the centroid of the cross section is located?



- a. Drawing A most nearly shows the correct location of the centroid of the cross section.
- b. Drawing B most nearly shows the correct location of the centroid of the cross section.
- c. Drawing C most nearly shows the correct location of the centroid of the cross section.
- d. Drawing D most nearly shows the correct location of the centroid of the cross section.