

NAME: \_\_\_\_\_

2011 Perspectives on the Evolution of Structures Quiz 1 (Total = 75 points)

Dear Student

From the Undergraduate Academic Ethics Board

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I attest that I will not violate the academic integrity of the University:

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date

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Name: \_\_\_\_\_

**I. Identify the following structures (25 points – 1 point each)**



Name: \_\_\_\_\_  
Designer: \_\_\_\_\_  
Location: \_\_\_\_\_  
Date: \_\_\_\_\_  
Form: \_\_\_\_\_  
Material: Iron



Name: \_\_\_\_\_  
Designer: \_\_\_\_\_  
Location: \_\_\_\_\_  
Date: 1905  
Form: \_\_\_\_\_  
Material: \_\_\_\_\_



Name: \_\_\_\_\_  
Designer: Lindenthal  
Location: \_\_\_\_\_  
Date: \_\_\_\_\_  
Form: \_\_\_\_\_  
Material: \_\_\_\_\_



Name: \_\_\_\_\_  
Designer: \_\_\_\_\_  
Location: \_\_\_\_\_  
Date: \_\_\_\_\_  
Form: \_\_\_\_\_  
Material: Iron wire, wood deck



Name: \_\_\_\_\_  
Designer: \_\_\_\_\_  
Location: Chicago  
Date: \_\_\_\_\_  
Form: \_\_\_\_\_  
Material: \_\_\_\_\_

Put your name on every page.....

Name: \_\_\_\_\_

**II. Matching, Fill in the blank, Multiple Choice (50 points – 2 points each)**

1. Darby's Iron Bridge is the first major structure built of iron. Which fact given below about the Iron Bridge is NOT true:

- (a) shape is semi-circular
- (b) used 50 ksi yield strength material for the first time
- (c) survived the 1795 Severn river flood
- (d) two of the major arches are incomplete

Answer: \_\_\_\_\_

2. The age of the railroad challenged many engineers to develop novel solutions. Which one of the following engineers did NOT practice during the industrial revolution/dawn of the railroad

- (a) Khan
- (b) Brunel
- (c) Stephenson
- (d) Eiffel

Answer: \_\_\_\_\_

3.-5. Consider a comparison of Brunel's Saltash Bridge (lenticular truss) with Stephenson's Britannia Bridge (tubular). For each of the following statements answer either Saltash or Britannia

I am the lighter of the two bridges: \_\_\_\_\_

I am the first of my kind: \_\_\_\_\_

I am the costlier of the two bridges: \_\_\_\_\_

6. The Rouzat Viaduct is often listed as a predecessor to the Eiffel Tower because

- (a) it is the first bridge made from wrought iron,
- (b) the shape of its piers flare out like the Tower,
- (c) it was the tallest structure Eiffel built before La Tour,
- (d) it is in the wilderness of the Central Massif of France

Answer: \_\_\_\_\_

7. In discussing this bridge Billington states "when a designer builds nonfunctional stone towers to visually contain arch forces, which in fact do not exist where they appear to exist, then the design is not an indissoluble union of structure and form but rather a massive frill" Which bridge is he writing about?

- (a) Amman's Bayonne Bridge
- (b) Eiffel's Garabit Viaduct
- (c) Baker's Firth of Forth
- (d) Lindenthal's Hell Gate Bridge

Answer: \_\_\_\_\_

8. The massive Firth of Forth bridge exists for many reasons, except this one:

- (a) strong economic forces of the railways
- (b) the collapse of a bridge nearby in the Firth of Tay
- (c) the introduction of pre-stressed concrete in bridge building
- (d) the necessity of caring heavy rail traffic

Answer: \_\_\_\_\_

9. At Zuoz, what did Robert Maillart observe that significantly influenced his future design?

- (a) 3 hinged arches are more suitable for uncertain foundation conditions
- (b) cantilever construction costs less
- (c) making the deck stiffer than the arch reduces deflections

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(d) vertical cracks in the walls near the abutments.

Answer: \_\_\_\_\_

10.-12. Roof vaults and national styles: fill in the letter indicating the matching word or phrase on the right, to that on the left.

German \_\_\_\_\_

(a) two-way ribbed vaulting

Italian \_\_\_\_\_

(b) design satisfies mathematical conditions

Spanish \_\_\_\_\_

(c) surfaces with double curvature

13. The force in the main span of a suspension bridge cable:  $F_{cable} = (1/8)wLR$ , where  $w$  is the weight/unit length of the bridge,  $L$  is the length of the bridge, and  $R=L/d$  where  $L$  is the length of the bridge and  $d$  is the tower height. To decrease  $F_{cable}$ , do you want tall or short towers?

(a) tall towers decrease the cable force

(b) short towers decrease the cable force

Answer: \_\_\_\_\_

14. We have described three ideals for structural engineering, which one in the following list is not one of these ideals

(a) Permanence

(b) Safety

(c) Balance

(d) Efficiency

Answer: \_\_\_\_\_

15. In class and in your homework we showed that the Eiffel Tower is the same shape as the moment diagram under wind load, this implies that

(a) wider is better and more stable

(b) the forces in the legs of the tower are nearly equal throughout the height of the tower

(c) the tower must be elegant

Answer: \_\_\_\_\_

16. Roman arch bridges and Darby's Iron Bridge were semi-circular in shape, but Telford's bridges such as at Craigellachie are much flatter, How can this be?

(a) Telford understood structures better and could design more daringly

(b) Iron could take tension so arches could now allow for bending without collapse

(c) Loads were not as heavy on Telford's bridges

(d) Telford designed more stable foundations

Answer: \_\_\_\_\_

17. At the Brooklyn Bridge who insured the final construction was completed as needed

(a) John Roebling

(b) Emily Roebling

(c) Washington Roebling

Answer: \_\_\_\_\_

18. Which one of the following engineers did not work for Gustave Lindenthal in New York:

(a) Robert Maillart

(b) David Steinman

(c) Othmar Amman

Answer: \_\_\_\_\_

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19. Which building was not designed by John Wellborn Root?

- (a) Monandock
- (b) First Equitable
- (c) Rookery

Answer: \_\_\_\_\_

20. Any arch will be predicted to have greatest deflection when the load is

- (a) at the center
- (b) at the  $\frac{1}{4}$  point of the arch
- (c) over the entire arch

Answer: \_\_\_\_\_

21. Maillart's Zuoz, Tavanasa, and Salginatobel are all examples of what bridge form?

- (a) crescent shaped arches
- (b) hollow-box 3 hinged arches
- (c) deck stiffened arches
- (d) Burr truss-arch

Answer: \_\_\_\_\_

22. The deck in cable-stayed bridges must carry compressive loads (in suspension bridges this is not the case) why must the deck carry compressive loads?

- (a) so that the load is shared more equally and the structure more efficient
- (b) to resolve the horizontal component of force from the diagonal cable stays
- (c) because the deck is pre-stressed in cable-stayed bridges

Answer: \_\_\_\_\_

23. All of the factors below, except for one, lead to the develop of cable-stayed bridges in Germany approximately 1955-1979

- (a) low wind loads leading to reduced demands on the bridges
- (b) innovations in structural analysis and construction
- (c) pressing societal need (15,000 bridges destroyed in the war)
- (d) societal desire for a new bridge form

Answer: \_\_\_\_\_

24. Maillart's Aarburg bridge was a conventional fixed ended arch bridge that was overly flexible and had a short service life – how did Maillart improve his design based on the experience at Aarburg?

- (a) he removed material anywhere he observed cracks
- (b) he used better concrete in his future designs
- (c) he introduced pre-stressing to remove any cracking
- (d) he made the arch thinner and the deck stiffer

Answer: \_\_\_\_\_

25. Roebling's Niagra River Bridge was a technical tour de force. Which fact given below is not true

- (a) the bridge was the world's longest upon completion,
- (b) the bridge used suspension cables, diagonal cables, and ground stay cables,
- (c) the bridge carried railroad and carriage/horse traffic,
- (d) the bridge was used for 42 years before railroad loading increased too much

Answer: \_\_\_\_\_