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COURSE IN BUILDING.

AN ROINN OIDEACHAIS.
(Department of Education.)

BRAINSE AN CHEARD-OIDEACHAIS.
(Technical Instruction Branch.)

TECHNICAL SCHOOL EXAMINATIONS.
1934.

APPLIED MECHANICS.
(Fourth Year.)

Monday, May 14th—7 p.m. to 10 p.m.

Examiner—P. CORMACK, ESQ., F.R.C.SC.I., M.R.I.A.
Co-Examiner—PEADAR A. MACCIONNAITH, M.SC., A.C.SC.I.

GENERAL INSTRUCTIONS.

You are carefully to enter on the Answer Book and Envelope supplied your Examination Number and the subject of examination, but you are not to write your name on either. No credit will be given for any Answer Book upon which your name is written, or upon which your Examination Number is not written.

You must not have with you any books, notes or scribbling-paper.

You are not allowed to write or make any marks upon your paper of questions.

You must not, under any circumstances whatever, speak to or communicate with another candidate ; and no explanation of the subject of the examination may be asked for or given.

You must remain seated until your answer-book has been taken up, and then leave the examination-room quietly. You will not be permitted to leave before the expiration of twenty minutes from the beginning of the examination, and will not be re-admitted after having once left the room.

If you break any of these rules, or use any unfair means, you are liable to be dismissed from the examination, and your examination may be cancelled by the Department.

Three hours are allowed for this paper. Answer-books, unless previously given up, will be collected at 10 *p.m.*

Read the General Instructions on page 1.

(*a*) *Six* questions only may be attempted.

(*b*) Equal values are attached to the questions.

(*c*) Answers must be written in *ink*; diagrams may be drawn in *pencil*.

(*d*) Write the number of the question distinctly in the margin of your paper before the answer.

(*e*) Slide-rules and drawing instruments may be used.

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1. A cylindrical water tank 22 ft. long, 3 ft. 7 in. in diameter (Fig. 1) is supported on two pitch pine crossbearers 13 feet apart. You may assume that the load on the tank due to its own weight and the contained water is 600 lbs. per foot run for the entire 22 feet. Sketch the Bending Moment curve for the tank, and find the maximum stress in the material which is of steel plate $\frac{3}{16}$ inch thick.

2. Four cast iron pillars, each 10′ 6″ high and 9″ outside diameter support the water tank (Question 1). Find a suitable thickness for the metal. Take the load on each pillar as 1·5 tons vertically and 2 tons horizontally at the top (due to wind pressure on tank).

3. A roof 48 feet span, 12 feet high rests on queen trusses 8 feet high (Fig. 3). Find the stress in each member of the truss under the loads shown on the diagram.

4. Find the ratio of depth to span for a beam loaded in the middle and supported at the ends, assuming a stress of 1,000 lbs. per square inch, Young's Modulus 10,000,000 lbs. per square inch and a deflection one-fortieth the span.

5. The footbridge shown in plan (Fig. 5) is constructed of two 10″×5″ I beams on which rest 4″×1¾″ I section cross beams spaced 3 feet apart. The load is 2½ cwt. per square foot. Find the flange thickness of the large and small I beams allowing a stress of 7 tons per square inch.

6. The Bending Moment curve for a plate girder 36 feet span, 3 feet deep is shown in Fig. 6. The bending moment

scale is one inch to 200 tons feet. The flange plates are $18'' \times \frac{1}{2}''$ and the angle irons are each $4'' \times 4'' \times \frac{1}{2}''$. Find the number and the length of the plates required.

7. The weight of the buttress (Fig. 7) is 14 tons acting along the line shown. The buttress takes an inclined load of 5·5 tons as shown in the diagram. Determine the stress on the inner and outer edges of the T section (the cross section at AB) which takes the above loads.

8. Describe fully the nature of the stresses in the loaded beam (Fig. 8). Discuss the effect on the strength of this beam of

(*a*) a longitudinal crack *xy* existing between A and B ;

(*b*) a longitudinal crack *uv* existing between A and C.

9. Show generally that the strength of a pillar depends on its length, on the area and shape of the cross section, and also on the manner of fixing or guiding its ends. The formula recommended by the Am. Inst. Steel Construction regarding the allowable stress in columns is—

$$f = \frac{18{,}000}{1 + \frac{l^2}{18{,}000\, k^2}}$$

Explain the significance of the terms in this formula.

10. A lorry load of sand is run on to the platform of a weighbridge, but the platform is too short to take all four wheels on it. With the front wheels only on the platform, the weight recorded is 5 tons, and with the back wheels only on the platform, the weight recorded is 6 tons. Discuss what precautions should be taken so that the sum of these two weighings should give the weight of the loaded lorry correctly.