



1933

Applied Mechanics (4th Year): Technical School Examinations 1933

Department of Education: Technical Instruction Branch

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COURSE IN BUILDING.

AN ROINN OIDEACHAIS.
(Department of Education.)

(37)

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

TECHNICAL SCHOOL EXAMINATIONS.
1933.

APPLIED MECHANICS.
(Fourth Year.)

Monday, May 15th—7 p.m. to 10 p.m.

Examiner—P. CORMACK, ESQ., F.R.C.S.C.I., M.R.I.A.

Co-Examiner—PEADAR A. MACCIONNAITH, M.S.C., A.C.S.C.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.

1. A roof, 28 ft. span, height 7 ft., rests on king-post trusses, Fig. 1. The load at each joint is as shown. Find the stress in each part.

2. The beam, Fig. 2, carries a concentrated load at each end and a distributed load between the supports. The bending moment diagrams for the concentrated loads and for the distributed load are drawn separately to the scale of 1 inch to 10 tons ft. Draw the combined bending moment diagram. What is the nature of the stress in the beam where the bending moment is zero?

3. Fig. 3 shows one of the three beams which support an overline bridge. Each beam is trussed by two 1" diameter iron rods, and is of 12" x 12" pitch pine, effective span 34 ft. Find the stress in the rods with a load of 3 tons at middle of beam, and the stress in the timber with the same load at the point $\frac{1}{4}$ span from one end. You may assume a free joint at the middle of the beam, i.e., assume the beam cut at the centre and supported by the truss there, the lowest point of the truss being 24" below the top of the beam.

4. A plate girder supporting a railway bridge is 41 ft. long over all and 38 ft. clear span. The section of the girder is shown in Fig. 4. Find the moment of resistance of the section and the safe load for the bridge. Thickness of plates $\frac{3}{8}$ ". Angle irons 4" x 4" x $\frac{1}{2}$ ". The maximum stress is not to exceed 7 tons per sq. inch.

5. In the shoring of the wall, of which Fig. 5 is a scale drawing, each needle DE takes a vertical load of 4,000 lbs. Find the thrust on the top raker, the middle

raker, and the bottom shore. What is the resultant load on the footing block? Obtain the vertical component of this load.

6. A hinged pair of step ladders are held from opening by a rope, AB, Fig. 6, tied to each leg one-third the way up. A load of 200 lbs. rests at C two-thirds the way up. Find the pull in AB.

7. In erecting a pole the end is to be placed in the hold D. As shown (Fig. 7) the end of the pole presses against a board AB and the pole is being raised by a man pushing it at C. Explain why the pole must be pushed in a direction lying between KC and GC in order that it may slip down the board AB. RN is the normal to the board at R and the angle NRK is the angle of friction.

8. The end section of a braced girder is shown in Fig. 8. The loads on the section considered are given. Find the stresses H_1 , H_2 and S which are necessary to keep the section in equilibrium.

9. A cast iron water pipe (Fig. 9) 12" external diameter, $\frac{11}{16}$ " thick and 9 ft. long, weighs 700 lbs. Calculate its deflection under its own weight when supported at the ends. Young's Modulus = 15×10^6 lbs. per sq. inch.

10. Give any well-known pillar formula connecting the safe load with the properties of the cross-section and the length of the pillar. The H sections used for the columns of a steel building are shown in Fig. 10. The smaller section carries a load of 4,530,000 lbs. Find the corresponding load for the larger section. Length of column 20 ft. Area of smaller section 302 sq. inches. Area of larger section 381 sq. inches. Radius of gyration of smaller section 8 inches. Radius of gyration of larger section 10 inches.