

APPENDIX A

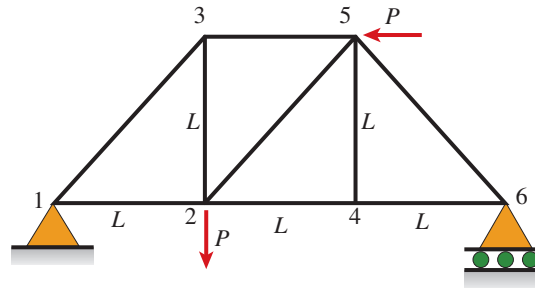
FE Exam Review Problems

The Fundamentals of Engineering (FE) examination [see <http://www.ncees.org/Exams.php>] is the first step on the path to registration as a Professional Engineer (P.E.). In its current form, the FE exam is an 8-hour exam consisting of 120 multiple choice questions in the 4-hour morning session, followed by 60 multiple choice questions in the 4-hour afternoon session. The exam is usually taken by recent graduates of accredited college engineering programs and covers a broad range of topics presented in their undergraduate courses. The afternoon portion is usually focused on questions related to the student's specific engineering subdiscipline (chemical, civil, electrical, environmental, industrial, mechanical, and "other").

In the past, approximately 10 to 15% of the questions have been based on principles presented in undergraduate courses in engineering mechanics. This appendix presents 106 FE-type review problems in *Mechanics of Materials*, many of which are based upon modifications of problems presented at the end of each chapter throughout this text. The problems cover all of the major topics presented in the text and are thought to be representative of those likely to appear on an FE exam. Most of these problems are in SI units, which is the system of units used on the FE Exam itself, and require use of an engineering calculator to carry out the solution. Each of the 106 problems is presented in the FE Exam format. The student must select from four available answers (A, B, C, or D), only one of which is the correct answer. The correct answer choices are listed in the Answers section at the back of this text, and the detailed solution for each problem is available for download on the student website. It is expected that careful review of these problems will serve as a useful guide to the student in preparing for this important examination.

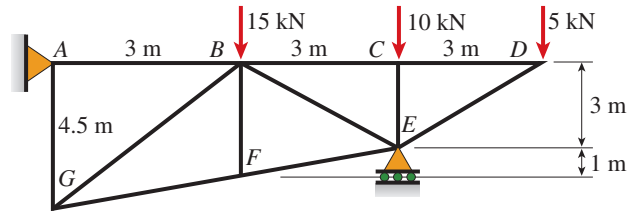
A-1.1: A plane truss has downward applied load P at joint 2 and another load P applied leftward at joint 5. The force in member 3–5 is:

- (A) 0
- (B) $-P/2$
- (C) $-P$
- (D) $+1.5 P$



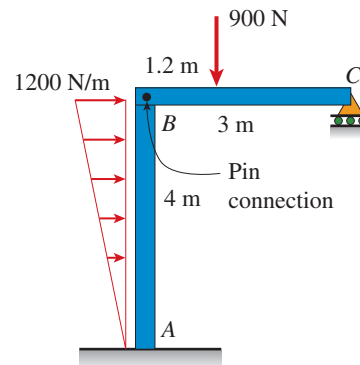
A-1.2: The force in member FE of the plane truss below is approximately:

- (A) -1.5 kN
- (B) -2.2 kN
- (C) 3.9 kN
- (D) 4.7 kN



A-1.3: The moment reaction at A in the plane frame below is approximately:

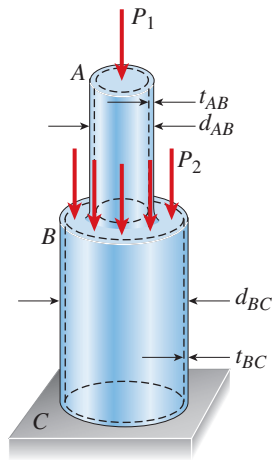
- (A) $+1400$ N·m
- (B) -2280 N·m
- (C) -3600 N·m
- (D) $+6400$ N·m



A-1.4: A hollow circular post ABC (see figure) supports a load $P_1 = 16$ kN acting at the top. A second load P_2 is uniformly distributed around the cap plate at B . The diameters and thicknesses of the upper and lower parts of the post are $d_{AB} = 30$ mm, $t_{AB} = 12$ mm, $d_{BC} = 60$ mm,

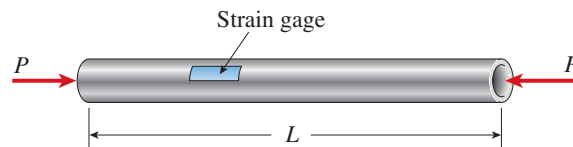
and $t_{BC} = 9$ mm, respectively. The lower part of the post must have the same compressive stress as the upper part. The required magnitude of the load P_2 is approximately:

- (A) 18 kN
- (B) 22 kN
- (C) 28 kN
- (D) 46 kN



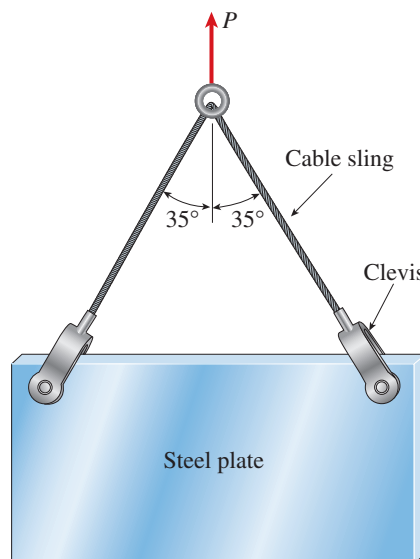
A-1.5: A circular aluminum tube of length $L = 650$ mm is loaded in compression by forces P . The outside and inside diameters are 80 mm and 68 mm, respectively. A strain gage on the outside of the bar records a normal strain in the longitudinal direction of 400×10^{-6} . The shortening of the bar is approximately:

- (A) 0.12 mm
- (B) 0.26 mm
- (C) 0.36 mm
- (D) 0.52 mm



A-1.6: A steel plate weighing 27 kN is hoisted by a cable sling that has a clevis at each end. The pins through the clevises are 22 mm in diameter. Each half of the cable is at an angle of 35° to the vertical. The average shear stress in each pin is approximately:

- (A) 22 MPa
- (B) 28 MPa
- (C) 40 MPa
- (D) 48 MPa



A-1.7: A steel wire hangs from a high-altitude balloon. The steel has unit weight 77 kN/m^3 and yield stress of 280 MPa . The required factor of safety against yield is 2.0 . The maximum permissible length of the wire is approximately:

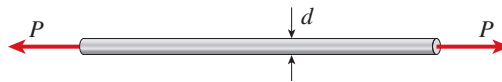
- (A) 1800 m
- (B) 2200 m
- (C) 2600 m
- (D) 3000 m

A-1.8: An aluminum bar ($E = 72 \text{ GPa}$, $\nu = 0.33$) of diameter 50 mm cannot exceed a diameter of 50.1 mm when compressed by axial force P . The maximum acceptable compressive load P is approximately:

- (A) 190 kN
- (B) 200 kN
- (C) 470 kN
- (D) 860 kN

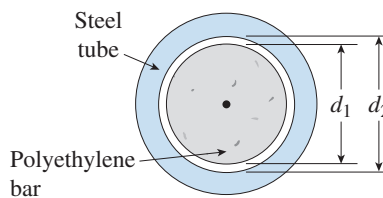
A-1.9: An aluminum bar ($E = 70 \text{ GPa}$, $\nu = 0.33$) of diameter 20 mm is stretched by axial forces P , causing its diameter to decrease by 0.022 mm . The load P is approximately:

- (A) 73 kN
- (B) 100 kN
- (C) 140 kN
- (D) 339 kN



A-1.10: A polyethylene bar ($E = 1.4 \text{ GPa}$, $\nu = 0.4$) of diameter 80 mm is inserted in a steel tube of inside diameter 80.2 mm and then compressed by axial force P . The gap between steel tube and polyethylene bar will close when compressive load P is approximately:

- (A) 18 kN
- (B) 25 kN
- (C) 44 kN
- (D) 60 kN



A-1.11: A pipe ($E = 110 \text{ GPa}$) carries a load $P_1 = 120 \text{ kN}$ at A and a uniformly distributed load $P_2 = 100 \text{ kN}$ on the cap plate at B . Initial pipe diameters and thicknesses are $d_{AB} = 38 \text{ mm}$, $t_{AB} = 12 \text{ mm}$, $d_{BC} = 70 \text{ mm}$, and $t_{BC} = 10 \text{ mm}$. Under loads P_1 and P_2 , wall thickness t_{BC} increases by 0.0036 mm . Poisson's ratio ν for the pipe material is approximately:

- (A) 0.27
- (B) 0.30
- (C) 0.31
- (D) 0.34