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Course Description

Introduction to design: design process, problem formulation, engineering model, factors of safety and codes, overall design considerations; Stresses: stress concentration factors, residual stresses; Deflection and Stiffness; Stability and Buckling; Theories of failure: failure under static loading, fatigue loading; fracture mechanics.

Course Topics

1. Shaft Design
2. Theory of Failure: Static Loading
3. Deflection of Beams and shafts
4. Stability of Structures: Column Buckling
5. Energy Methods
6. Theory of Failure: Dynamic Loading
7. Introduction to Fracture Mechanics

Assessment Tools

Project (5%)

Quiz Homework Assignments (15%)

Midterms (30%)

Final Examination (40%)
Textbook


3. Mechanical Analysis and Design, By Arthur B. Burr, Elsevier

Course objectives

To develop an understanding of the relationship between factors of safety and codes

To show proficiency in mathematics and basic sciences required to solve structural engineering and mechanics problem.

To develop analytical and graphical problem solving skills.
Exams samples

Student Name:  

The cantilever shown in the figure consists of two structural-steel channels size 3 in, 5.0 lbf/ft. 
Using superposition, find the deflection at A.
A $\frac{1}{4}$-in drill rod was heat-treated and ground. The measured hardness was found to be 490 Brinell. Estimate the endurance strength if the rod is used in rotating bending.
Exam answers

\[ I = 2(1.85) = 3.7 \text{ in}^4 \]

Adding the weight of the channels, \( 2(5)/12 = 0.833 \text{ lbf/in} \),

\[ y_A = \frac{wl^4}{8EI} - \frac{F l^3}{3EI} = -\frac{10.833(48^4)}{8(30)(10^6)(3.7)} - \frac{220(48^3)}{3(30)(10^6)(3.7)} \]

\[ = -0.1378 \text{ in} \]
HB = 490

\[ S_{ut} = 0.495(490) = 242.6 \text{ kpsi} > 212 \text{ kpsi} \]

\[ S_e = 100 \text{ kpsi} \]

\[ a = 1.34, \quad b = -0.085 \]

\[ k = 1.34(242.6) - 0.085 = 0.840 \]

\[ k_b = (1/4/0.3)^{-0.107} \approx 1.02 \]

\[ S_e = k_b S_e = 0.840(1.02)(100) = 85.7 \text{ kpsi} \]
Student results

Will be completed by the end of semester.