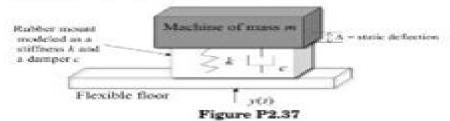
Problems and Solutions Section 2.4 (2.37 through 2.50)

2.37 A machine weighing 2000 N rests on a support as illustrated in Figure P2.37. The support deflects about 5 cm as a result of the weight of the machine. The floor under the support is somewhat flexible and moves, because of the motion of a nearby machine, harmonically near resonance (r =1) with an amplitude of 0.2 cm. Model the floor as base motion, and assume a damping ratio of ζ = 0.01, and calculate the transmitted force and the amplitude of the transmitted displacement.



Solution:

Given: Y = 0.2 cm, $\zeta = 0.01$, r = 1, mg = 2000N. The stiffness is computed from the static deflection and weight:

Deflection of 5 cm implies:
$$k = \frac{mg}{\Delta} = \frac{mg}{5\text{cm}} = \frac{2000}{0.05} = 40,000 \text{ N/m}$$

Transmitted displacement from equation (2.70):
$$X = Y \left[\frac{1 + (2\zeta r)^2}{(1 - r^2)^2 + (2\zeta r)^2} \right]^{1/2} = 10 \text{ cm}$$

Transmitted force from equation (2.77):
$$F_x = kYr^2 \left[\frac{1 + (2\zeta r)^2}{(1 - r^2)^2 + (2\zeta r)^2} \right]^{1/2} = 4001N$$

2.38 Derive Equation (2.70) from (2.68) to see if the author has done it correctly.

Solution:

Equation (2.68) states:

$$x_{p}(t) = \omega_{n} Y \left[\frac{\omega_{n}^{2} + (2\zeta \omega_{n})^{2}}{(\omega_{n}^{2} - \omega_{n}^{2})^{2} + (2\zeta \omega_{n} \omega_{n})^{2}} \right]^{1/2} \cos(\omega_{n} t - \theta_{1} - \theta_{2})$$

The magnitude is:
$$X = \omega_* Y \left[\frac{\omega_*^2 + (2\zeta \omega_s)^2}{(\omega_*^2 - \omega_s^2)^2 + (2\zeta \omega_* \omega_b)^2} \right]^{1/2}$$

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Table of Contents Solutions To Chapter 5 Problems 37 Aerostudents

- 1. Understanding the eBook Solutions To Chapter 5 Problems 37 Aerostudents
 - The Rise of Digital Reading Solutions To Chapter 5 Problems 37 Aerostudents
 - Advantages of eBooks Over Traditional Books
- 2. Identifying Solutions To Chapter 5 Problems 37 Aerostudents
 - Exploring Different Genres
 - o Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Solutions To Chapter 5 Problems 37 Aerostudents
 - User-Friendly Interface
- 4. Exploring eBook Recommendations from Solutions To Chapter 5 Problems 37 Aerostudents
 - Personalized Recommendations
 - Solutions To Chapter 5 Problems 37 Aerostudents User Reviews and Ratings
 - Solutions To Chapter 5 Problems 37 Aerostudents and Bestseller Lists

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 - Solutions To Chapter 5 Problems 37 Aerostudents Enhanced eBook Features
- 7. Enhancing Your Reading Experience
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 - Highlighting and Note-Taking Solutions To Chapter 5 Problems 37 Aerostudents
 - Interactive Elements Solutions To Chapter 5 Problems 37 Aerostudents
- 8. Staying Engaged with Solutions To Chapter 5 Problems 37 Aerostudents
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Solutions To Chapter 5 Problems 37 Aerostudents
- 9. Balancing eBooks and Physical Books Solutions To Chapter 5 Problems 37 Aerostudents
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Solutions To Chapter 5 Problems 37 Aerostudents
- 10. Overcoming Reading Challenges
 - o Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Solutions To Chapter 5 Problems 37 Aerostudents
 - Setting Reading Goals Solutions To Chapter 5 Problems 37 Aerostudents
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Solutions To Chapter 5 Problems 37 Aerostudents
 - Fact-Checking eBook Content of Solutions To Chapter 5 Problems 37 Aerostudents
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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