EXAM 2
Exam Date: October 7th, 2009,
2pm
Room 327
50 Minute Time Limit

EXAM FORMAT
Students are allowed one 8 ½” x 11” handwritten sheet of their own notes. Students must also have the AISC steel manual for the potential use of beam formulae.

Bonus Questions (0.1 points each)
Famous Addresses: What significant landmark is found at each of the following addresses

10 Downing St. ______________________

124 Conch Street______________________

1060 West Addison ______________________

221B Baker Street, London ______________________

34th St. & 5th Avenue, NY ______________________
Problems 1 through 4 are based on the following frame structure and given information.

The frame shown has a horizontal frame stiffness \( k = 16000 \text{ lb/inch} \), a weight of 10 kips at the floor level and is subjected to harmonic horizontal shaking at the ground with a frequency of 5 hertz, reaching a peak base acceleration of 0.5g. Damping is 5%.

1. (15 points). Compute the amplitude of the maximum ground displacement, in inches.

2. (15 points). Compute the maximum horizontal displacement of the floor, relative to the ground, due to the ground-shaking (units: inches).

3. (15 points). Compute the maximum total horizontal base shear force \( P \), in units of kips.
4. (15 points). Compute the maximum floor acceleration in units of g’s.

5. (10 points). The laboratory shaketable that you have used can operate at a maximum frequency of about 10 hertz. If the crank-arm is mounted on the outermost hole of the flywheel at a distance of 1.5 inches from the center of the wheel, while operating at the maximum frequency, the shaketable undergoes its most severe loading condition. For this condition, determine the maximum force in the crank arm, if the table weighs 20 lbs and friction is ignored.
6. (25 points). At a high-precision manufacturing facility, it is necessary to reduce vertical accelerations on the 1000-lb machine as much as possible. If the ground is subjected to vertical displacement of 0.01 inches, at 30 hertz, determine the vertical acceleration of the machine.

\[ W = 1000 \text{ lbs.} \]
\[ \zeta = 5\% \]
\[ k = 500 \text{ lb/in.} \]

Plan A

7. (5 points). For an application in which base isolation is needed to reduce vibrations on sensitive equipment (such as the previous problem), characterized by natural frequency \( \omega \) and subjected to driving harmonic frequency \( \omega_d \), which is true (circle the correct answer):

a. It is desirable to use a stiff spring so that \( \omega/\omega_n > 1 \)
b. It is desirable to use a soft spring so that \( \omega/\omega_n > 1 \)
c. It is desirable to use a stiff spring so that \( \omega/\omega_n < 1 \)
d. It is desirable to use a soft spring so that \( \omega/\omega_n < 1 \)