NUST Institute of Civil Engineering (NUST)
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CE 809: Structural Dynamics 3 (3-0) **Semester: August 2021**

Assignment 2: Response of SDF systems to harmonic forces

Question 1:

Consider the same simple structure described in Question 2 of Assignment 1 (damped case).

Task 1: Construct a computer model of this simple structure using ETABS or SAP 2000. Subject the model to a harmonic force defined as $p(t) = p_o \sin \bar{\omega} t$ where $p_o = 1000\ N$ and $\bar{\omega} = 2\pi \bar{f}$ (see Figure 1 below). Analyze the model and determine the forced vibration response of system under this harmonic force.

Consider the following cases.

a) $\bar{f} = 0.25\ f$
b) $\bar{f} = 0.5\ f$
c) $\bar{f} = 0.9\ f$
d) $\bar{f} = f$
e) $\bar{f} = 1.1\ f$
f) $\bar{f} = 2\ f$
g) $\bar{f} = 3f$

Where f is the natural cyclic frequency of the SDF system. Use at-rest initial conditions (i.e. $u(0) = 0$, $\dot{u}(0) = 0$). Plot the displacement-vs-time response for each case.

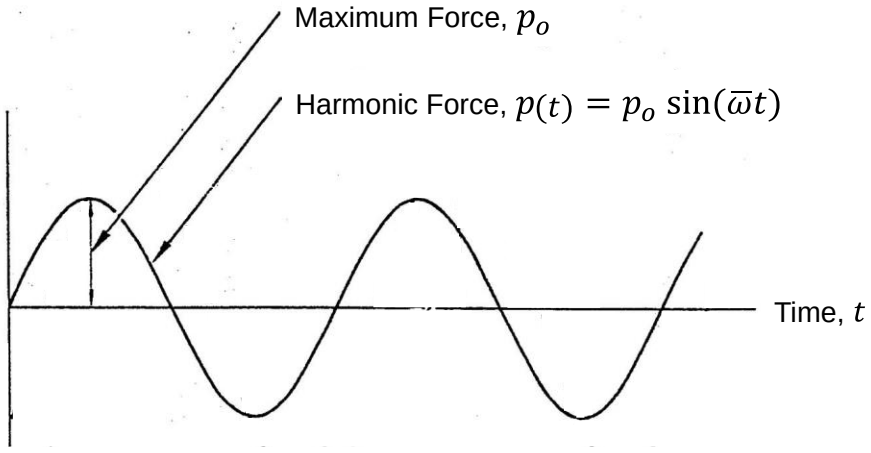

Figure 1: The harmonic force

Task 2: For each case, determine the forced vibration response of the system (under the same harmonic force) using the analytical expressions derived in class. Plot the response in each case and find

maximum displacement, base shear and base moment. Compare the analytical results with those obtained from the computer program.

Task 3: Plot the frequency-response curve for the given structure.

Note: The frequency-response curve is a plot of the maximum amplitude of a response quantity (i.e. displacement in this question) against the excitation frequency.