NUST Institute of Civil Engineering (NUST)
School of Civil and Environmental Engineering (SCEE)
National University of Sciences and Technology (NUST), H-12, Islamabad

CE 809: Structural Dynamics 3 (3-0) **Semester: August 2021**

Assignment 6: Seismic Response of MDF systems using Step-by-step Direct Integration Method

Question 1:

Consider the multiple-degree-of-freedom system shown in Figure 1 below. It is a 2-dimensional frame structure idealized as lumped mass and lumped stiffness model with floors and beams assumed to be rigid. The mass of each floor is lumped at floor level and is shown in figure. Similarly, the story stiffness for each story is also given. The story height in this structure is 3 m. The structure is idealized with fixed support condition at the base.

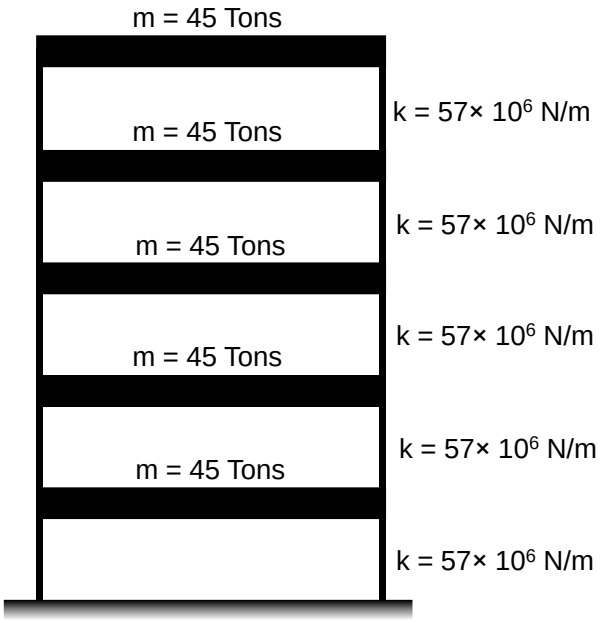


Figure 1: A multiple-degree-of-freedom (MDF) system

Task 1 (Compulsory): Formulate the K and M matrices of this structure.

Task 2 (Compulsory): Formulate the C matrix of this structure.

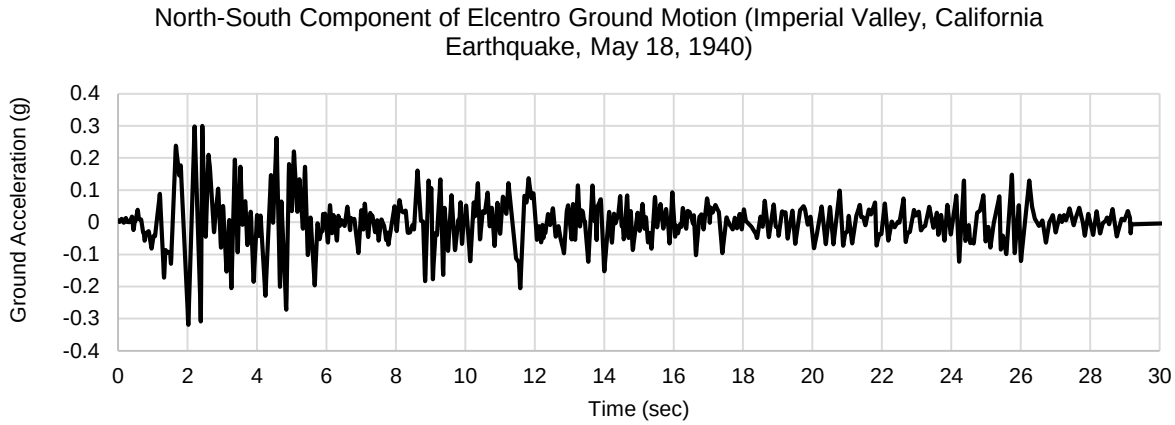
Task 3 Compulsory): Suppose this structure is subjected to a ground motion. Using the Direct Integration Method (Time History Analysis Procedure), calculate the histories of seismic demands of this building against a given $\ddot{u}_g(t)$. Assume missing data if any. Neglect gravity load. Use modal damping ratios of all five modes = 5%.

$\ddot{u}_g(t)$ = North-South Component of El-Centro Ground Motion.

Governing Equation of Motion: $\boldsymbol{M}\ddot{\boldsymbol{U}}(t) + \boldsymbol{C}\dot{\boldsymbol{U}}(\boldsymbol{t}) + \boldsymbol{K}\boldsymbol{U}(t) = -\boldsymbol{M}\boldsymbol{1}\ddot{u}_g(t)$

Global Seismic Demands: Story displacements, Inter-story drift ratios, Story shears, Story Overturning Moments.

Given $\ddot{u}_g(t)$: The data is available in onedrive folder.



Task 4 Compulsory): Repeat the Task 3 using Linear Modal Superposition Method (Modal Time History Analysis Procedure). Determine the histories of seismic demands of this building against the given $\ddot{u}_g(t)$. Assume missing data if any. Neglect gravity load. Use modal damping ratios of all five modes = 5%.