Assignment 3: Problem Statement

26 January 2022 18:16

CE 629A: Earthquake Analysis and Design of Structures
Assignment #3: Response of Inelastic SDF Systems and Inelastic Design Spectra
Due Wednesday, February 09, 2022

Note: For Problems 1-3, you can use any suitable time integration algorithm of your choice.

Problem 1 [65+25=90]
In Problem 4 of Assignment 2, you have generated the constant-R_y ductility and residual deformation spectra for the El Centro ground motion for EPP, BP and BE systems. Now, do the same for the 44 ground motion records (FEMAP695 Far-field ground motion set) available here and present your results as noted below.

Download ground motion files

Part-A

For each of EPP, BP and BE systems and for each of $R_y = 4$ and 6, determine and plot the following:

(i) constant-R_y ductility spectra for each ground motion and the median spectrum and,

(ii) constant-R_y residual deformation spectra and the median spectrum.

Consider $\zeta = 5\%$, $R_y = 4$ and 6. Use a range of 0.02 sec to 5 sec for T_n. Plot the data in normal scale. Comment on your results. You will get a total of 6 plots of ductility spectra and 6 plots of residual drift spectra, in which each will contain 44 curves and the median spectrum.

Part-B

Now, for $R_y = 4$ and 6, compare the constant-R_y median ductility spectra and constant-R_y median residual deformation spectra for the EPP, BP and BE force-deformation behaviour. Comment on your results. You will get a total of 4 plots and each plot will have 3 curves.

Problem 2 [35]
Determine and plot the following constant-ductility response spectra for elastic perfectly plastic systems with $\zeta = 5\%$ subjected to the El Centro ground motions for $\mu = 1, 2, 4, 6$, and 8:

(i) pseudo-acceleration response spectra, (make the time axis 3 sec long), and

(ii) pseudo-acceleration, pseudo-velocity, and yield deformation response spectra in a tripartite plot (make the natural period axis 50 sec long). You may use the "TripartitePlot.m" script attached with this assignment or develop your own.


Tripartite...

Comment on your results.

Problem 3 [35]
Determine and plot the time variation of energy dissipated by viscous damping and yielding, and of kinetic plus strain energy for the following systems:

(i) linear elastic system with $T_n = 0.5$ sec and $\zeta = 5\%$ and

(ii) elastic perfectly plastic system with the same initial period and damping ratio.

Write a discussion on your results and observations.

Problem 4 [30]
Construct the 84th percentile Newmark-Hall inelastic design spectra for $\mu = 1$, 4, and 6, and for a maximum design ground acceleration of 0.4g on rock site. Assume 5% damping. You may either use the logarithmic chart appended to this assignment or use the given MATLAB script. Write a short note on the application of the inelastic design spectrum.

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Semester 2021-22-II
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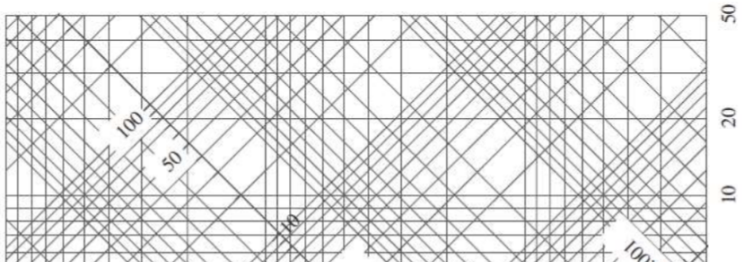

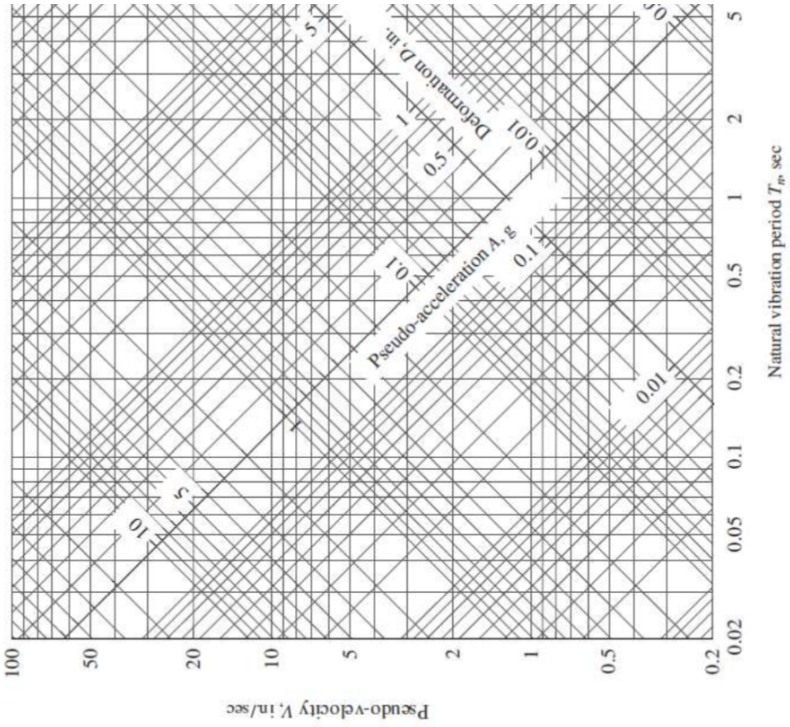
Pseudo-velocity V, in/sec
100
50
20
10
5
2
1
0.5
0.2
Natural vibration period T_n, sec
5
2
1
0.5
0.2
0.1
0.05
0.02
Deformation D, in.
Pseudo-acceleration A, g
0.01