The equation of motion for a damped SDoF (Single Degree of Freedom) system under given force is:

(1)

It can be shown that when we have no external force and system is subjected to ground excitation , \ddot{x}\_{g} then the equation of motion turns to this form:

(2)

Let’s say we have SDoF systems with mass of , damping coefficient of and stiffness of for ’th system. Equation of motion for each system when subjected to ground excitation is:

(3)

This differential equation can numerically solve by methods like Newmark-Beta or central difference or … then ()will be obtained. Same approach can be use to obtain the (ground motion) and (ground displacement). After solving the eq. 3 for all systems, we will have , and and also which is period of ’th system. Defining these parameters:

The spectrum for ’th system is obtained by

Then we will have , , and for every system and now can draw them into three charts of against , against and against . Here is the example charts for this record:

*“The Imperial Valley (USA) earthquake of October 15, 1979.*

*Source: PEER Strong Motion Database*

*Recording station: USGS STATION 5115”*

The top most chart is which vertical axis is denoted by , second one is and third one is .

