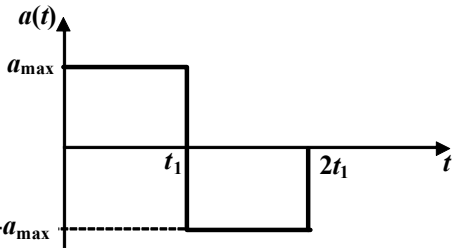
Answers of Questions (per Chapter)

Chapter 2



Question 2.1

Consider the pulse-like excitation depicted in Fig. 2.35, with amax =0.1g and t_1 = 0.15 s. Calculate the Cumulative Absolute Velocity (*CAV*) and the Arias Intensity I_A.

Answer of Question 2.1

CAV is given by Eq. (2.3); is simply equal to area under the acceleration time history:

$CAV = 2a_{max}t_1 = 2\times 9.81\times 0.15 = 2.943$ m/s

The Arias intensity is given by Eq. (2.4) and is equal to /2g times the area under the acceleration time history squared

$$I_A = \frac{\pi}{2g} 2a_{max}^2 t_1 = 4.71 \text{m/s}$$

Question 2.2

Fig. 2.8 gives the annual probability of exceedance of peak ground acceleration (PGA) at a given site, from several individual seismic sources. Calculate the annual probability that a PGA of 0.1g will be exceeded for a building located at that site. For a building structure designed for a lifetime of 50 years, what is the probability that a PGA of 0.1g will be exceeded during the lifetime of the structure?

Answer of Question 2.2

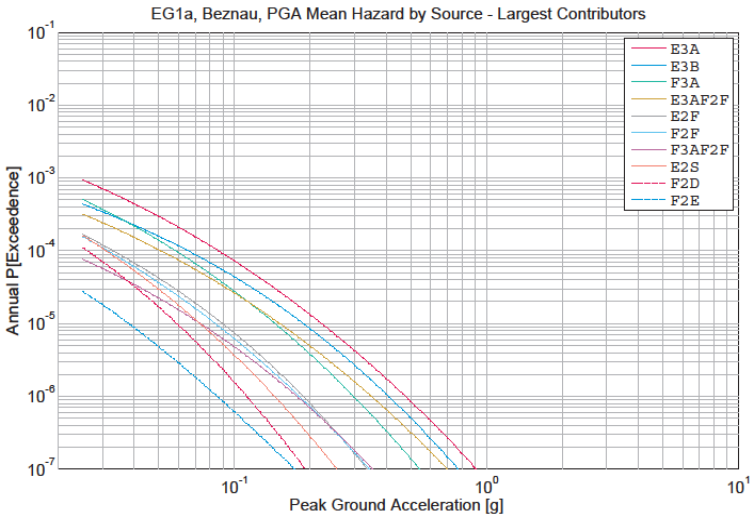
For a PGA of 0.1g, all seismic sources contribute to the hazard: the annual probability of exceedance of each source is respectively: 6.0×10^{-7}, 1.5×10^{-6}, 3.6×10^{-6}, 4.7×10^{-6}, 6.1×10^{-6},

7.1×10^{-6}, 2.5×10^{-5}, 2.7×10^{-5}, 4.4×10^{-5}, 7.2×10^{-5}. According to Eq. (2.9), summing the contribution of all sources gives an annual rate of exceedance of a PGA of 0.1g:

$6.0\times10^{-7}+1.5\times10^{-6}+3.6\times10^{-6}+4.7\times10^{-6}+6.1\times10^{-6}+7.1\times10^{-6}+2.5\times10^{-5}+2.7\times10^{-5}+4.4\times10^{-5}$

$+7.2\times10^{-5} = 1.92\times10^{-4}$.

For the lifetime of the structure, this PGA will be exceeded with a probability of (see Eq. (2.10)): $1-\exp\left(-1.92\,10^{-4}\,\mathrm{x}\,50\right)=9.7510^{-3}\approx 1\%$



(a)  (b)  (c) 

Fig. 2.36 Question 2.3

Question 2.3

What is the mode of failure or damage of the beams in Fig. 2.36? Would you characterise this case as damage or as failure?

Answer of Question 2.3

All three: Flexural damage (not failure).

Question 2.4

What is the mode of failure or damage of the columns in Fig. 2.37? Would you characterise this case as damage or as failure?

(a)  (b)  (c) 

(d)  (e)  (f) 

(g)  (h)  (i) 

(j)  (k)  (l) 

Fig. 2.37 Question 2.4

Answer of Question 2.4

(f), (g), (i), (j): Flexure; all others: shear;

(b), (k): damage; all others: failure (possible exception: (j), (i)).

Question 2.5

What is the mode of failure or damage of the concrete walls in Fig. 2.38? Would you characterise this case as damage or as failure?

(a)  (b)  (cz 

(d)  (e)  (f) 

Answer of Question 2.5

All: Shear.

All, except (f): Failure; (f): damage.