

Homework 3 Solution

H _{1/3}	T _{peak} (=T _{modal})										
	4	6	8	10	12	14	16	18	20	22	sum
2.0	10	24	31	33	45	45	30	22	11	2	253
4.0	4	38	42	48	43	50	33	21	13	4	296
6.0	0	23	28	35	33	49	29	16	10	3	226
8.0	0	1	19	22	23	23	19	12	6	2	127
10.0	0	0	2	12	16	12	13	9	2	0	66
12.0	0	0	0	2	6	5	7	5	1	0	26
14.0	0	0	0	0	0	2	2	1	1	0	6
sum	14	86	122	152	166	186	133	86	44	11	1000

$$\bar{T}_{mean} \approx \sum T_{mean,i} \times \frac{N_{T,i}}{N_{Total}} = \left(4 \times \frac{14}{1000} + 6 \times \frac{86}{1000} + \dots + 22 \times \frac{11}{1000} \right) = 12.462 \text{ sec}$$

$$Q = \frac{\bar{T}_{mean}}{M_{year} \times 3.1536 \times 10^7} = \sum_i \exp \left[-2 \left(\frac{H_{design}}{H_{1/3,i}} \right)^2 \right] \frac{N_{H,i}}{N_{Total}}$$

(1) 100 years return period

$$\begin{aligned} \frac{12.462}{100 \times 3.1536 \times 10^7} &= \sum_i \frac{N_{H,i}}{N_{Total}} \exp \left[-2 \left(\frac{H_{design}}{H_{1/3,i}} \right)^2 \right] \\ &= \frac{253}{1000} \exp \left[-2 \left(\frac{H_{design}}{2} \right)^2 \right] + \frac{296}{1000} \exp \left[-2 \left(\frac{H_{design}}{4} \right)^2 \right] + \dots + \frac{6}{1000} \exp \left[-2 \left(\frac{H_{design}}{14} \right)^2 \right] \\ \Rightarrow &\boxed{H_{design}^{100} \approx 37.4(m)} \end{aligned}$$

(2) 1000 years return period

$$\begin{aligned} \frac{12.462}{1000 \times 3.1536 \times 10^7} &= \sum_i \frac{N_{H,i}}{N_{Total}} \exp \left[-2 \left(\frac{H_{design}}{H_{1/3,i}} \right)^2 \right] \\ &= \frac{253}{1000} \exp \left[-2 \left(\frac{H_{design}}{2} \right)^2 \right] + \frac{296}{1000} \exp \left[-2 \left(\frac{H_{design}}{4} \right)^2 \right] + \dots + \frac{6}{1000} \exp \left[-2 \left(\frac{H_{design}}{14} \right)^2 \right] \\ \Rightarrow &\boxed{H_{design}^{1000} \approx 40.3(m)} \end{aligned}$$