Lecture 10 罗生贵 24S154097

Solve:

the slope ratio $= (8.71-5.72)/2/100 \approx 0.015$

Use the diameter at $2/3H$ to caculate the critical wind speed.
So $D = 6.33m$

For the first period

$$\bar{u}_{cr1} = \frac{D}{S_t \cdot T_1} = \frac{6.33}{0.2 \times 2.102} = 15.06\,(m/s)$$

For the second period

$$\bar{u}_{cr2} = \frac{D}{S_t \cdot T_2} = \frac{6.33}{0.2 \times 0.508} = 62.303\,(m/s)$$

The design reference wind speed at the top of the structure is

$$\bar{u}_H = \sqrt{\frac{2000\mu_H w_0}{\rho}} = \sqrt{\frac{2000 \times 2 \times 0.55}{1.25}} = 41.95\,(m/s)$$

for terrain B, $\mu_H = 2$

$\bar{u}_H < \bar{u}_{cr2}$, So, only check for the first period

Checking for the critical range

$$Re = 69000\,\bar{u}_{cr} \cdot D = 69000 \times 15.06 \times 6.33 = 6.58 \times 10^6 > 3.5 \times 10^6$$

it checking for the equivalent cross-wind resonance force

The starting height of critical wind speed

$$H_1 = H \times \left(\frac{\bar{u}_{cr}}{1.2u_H}\right)^{1/a} = 100 \times \left(\frac{15.06}{1.2 \times 41.95}\right)^{1/0.15} = 0.032$$

because $H_1 \ll H$, approximatively $H_1 = 0$

according to GB 50009-2012 chart H.1.1

$\lambda_1 = 1.56$

So the equivalent cross-wind resonance force

$$P_{d1}(z) = \lambda_1 \frac{\phi_1(z_i)\,\bar{u}_{cr1}^2 \cdot D \cdot h_i}{12800\zeta_i} = 1.56 \times \frac{\phi_1(z_i) \times 15.06^2 \times 6.33 \times h_i}{12800 \times 0.05} = 3.499\,\phi_1(z_i)\,h_i$$

point	1	2	3	4	5	6	7	8	9	10
$P_{d1}(z_i)$	0.42	1.26	2.97	5.53	8.92	13.09	17.95	23.34	29.15	17.50

(kN)

$h_1 = 15 - H_1 = 15\ m$, $h_{10} = 5\ m$

base bending moment $M_{d1}(0) = \sum_{i=1}^{10} P_{d1}(z_i) \cdot h_i = 9067.3\ (kN \cdot m)$