Chapter 32

Case Study III: MAGAZINI GENERALI

`Adapted from (Billington and Mark 1983)`

32.1 Geometry

1 This sotrage house, built by Maillart in Chiasso in 1924, provides a good example of the mariage between aesthetic and engineering.

2 The most strking feature of the Magazini Generali is not the structure itself, but rather the shape of its internal supporting frames, Fig. 32.1.

3 The frame can be idealized as a simply supported beam hung from two cantilever column supports. Whereas the beam itself is a simple structural idealization, the overhang is designed in such a way as to minimize the net moment to be transmitted to the supports (foundations), Fig. 32.2.

32.2 Loads

4 The load applied on the frame is from the weights of the roof slab, and the frame itself. Given the space between adjacent frames is 14.7 ft, and that the roof load is 98 psf, and that the total frame weight is 13.6 kips, the total uniform load becomes, Fig. 32.3:

$$q_{roof} = (98)\text{ psf}(14.7)\text{ ft} = 1.4\text{ k/ft} \tag{32.1-a}$$

$$q_{frame} = \frac{(13.6)\text{ k}}{(63.6)\text{ ft}} = 0.2\text{ k/ft} \tag{32.1-b}$$

$$q_{total} = 1.4 + 0.2 = \boxed{1.6\ \text{k/ft}} \tag{32.1-c}$$

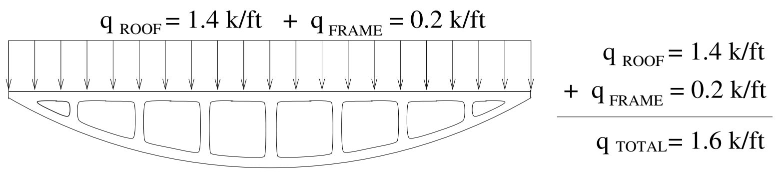

Figure 32.3: Magazzini Generali; Loads (Billington and Mark 1983)

32.3 Reactions

5 Reactions for the beam are determined first taking advantage of symmetry, Fig. 32.4:

$$W = (1.6)\text{ k/ft}(63.6)\text{ ft} = 102\text{ k} \tag{32.2-a}$$

$$R = \frac{W}{2} = \frac{102}{2} = \boxed{51\text{ k}} \tag{32.2-b}$$

We note that these reactions are provided by the internal shear forces.

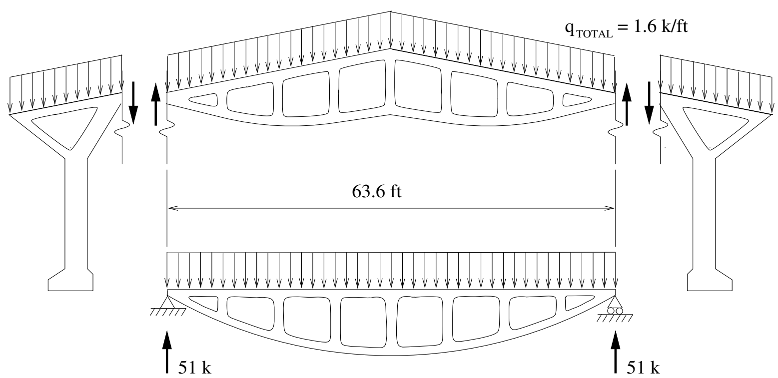

Figure 32.4: Magazzini Generali; Beam Reactions, (Billington and Mark 1983)

32.4 Forces

6 The internal forces are pimarily the shear and moments. Those can be easily determined for a simply supported uniformly loaded beam. The shear varies linearly from 51 kip to -51 kip with zero at the center, and the moment diagram is parabolic with the maximum moment at the center, Fig. 32.5, equal to:

$$M_{max} = \frac{qL^2}{8} = \frac{(1.6)\text{ k/ft}(63.6)\text{ ft}^2}{8} = \boxed{808\text{ k.ft}} \tag{32.3}$$

7 The externally induced moment at midspan must be resisted by an equal and opposite internal moment. This can be achieved through a combination of compressive force on the upper fibers, and tensile ones on the lower. Thus the net axial force is zero, however there is a net internal couple, Fig. 32.6.