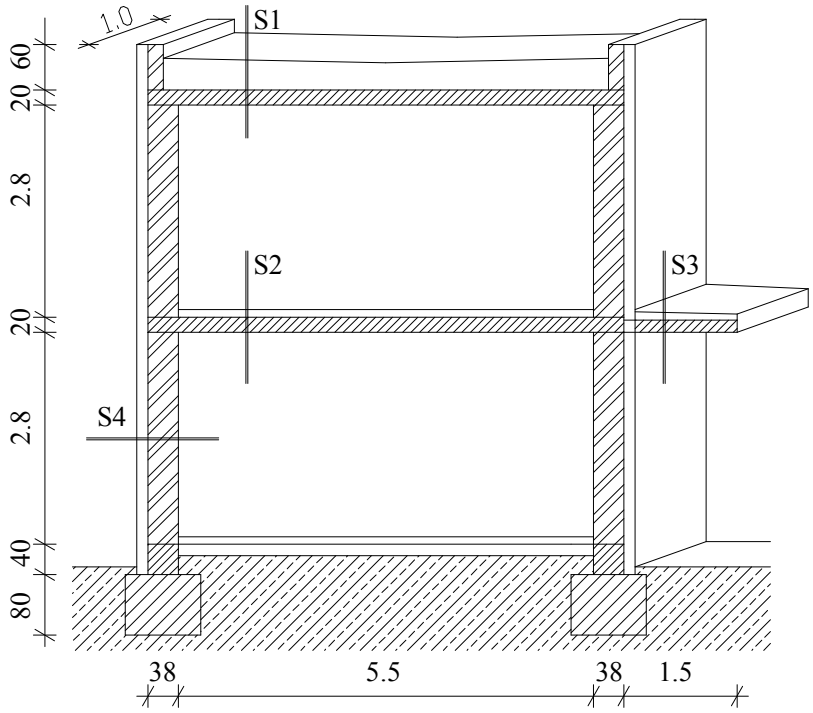
Fundamentals of Structures Blackboard exercise No9 06.05.2014

# Summary

A section of a building is given. Calculate the forces that are transmitted to the foundations!
(Biggest simplification of the solution: self weight is not multiplied by safety factor)




S1 (roof structure):

| | | |
|---|---|---|
| 10 cm | gravel | $\gamma$=16kN/m$^3$ |
| 20 cm | thermal insulation | $\gamma$=0.5kN/m$^3$ |
| 1 cm | waterproof insulation | ~ 0 |
| 5-11 cm | concrete bolster | $\gamma$=22kN/m$^3$ |
| 20 cm | RC slab | $\gamma$=25kN/m$^3$ |
| 1 cm | plaster | $\gamma$=17kN/m$^3$ |

Snow load 2kN/m$^2$

S2 (floor structure):

| | | |
|---|---|---|
| 2 cm | tiles | $\gamma$=22kN/m$^3$ |
| 6 cm | concrete bolster | $\gamma$=22kN/m$^3$ |
| 2 cm | rockwool | $\gamma$=0.5kN/m$^3$ |
| 20 cm | RC slab | $\gamma$=25kN/m$^3$ |
| 1 cm | plaster | $\gamma$=17kN/m$^3$ |

Furniture and people 3kN/m$^2$

S3 (balcony structure):

| | | |
|---|---|---|
| 2 cm | tiles | $\gamma$=22kN/m$^3$ |
| 1cm | waterproof insulation | ~ 0 |
| 5-8 cm | concrete bolster | $\gamma$=22kN/m$^3$ |
| 16 cm | RC slab | $\gamma$=25kN/m$^3$ |

Weight of crowd 4.5kN/$^2$

S4 (wall structure):

| | | |
|---|---|---|
| 1 cm | plaster | $\gamma$=17kN/m$^3$ |
| 38 cm | brick block | g=3.84kN/m$^2$ |
| 15 cm | thermal insulation | $\gamma$=0.5kN/m$^3$ |
| 1 cm | plaster | $\gamma$=17kN/m$^3$ |

Foundation:

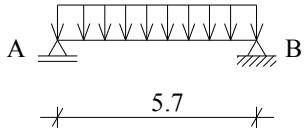
| | | |
|---|---|---|
| 40/40 | reinforced concrete | $\gamma$=25kN/m$^3$ |
| 100/80 | armed concrete | $\gamma$=24kN/m$^3$ |

## 1. Roof structure

Distributed load: $0.1 \cdot 16 + 0.2 \cdot 0.5 + 0.08 \cdot 22 + 0.2 \cdot 25 + 0.01 \cdot 17 + 2 = 10.63 kN/m^2$

×1m: $10.63 kN/m$

Simple supported beam: A = 30.3kN B = 30.3kN




## 2. First floor

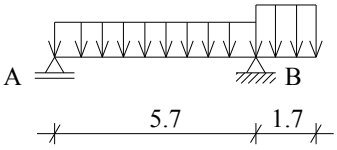
Distrubuted load floor: $0.02 \cdot 22 + 0.06 \cdot 22 + 0.02 \cdot 0.5 + 0.2 \cdot 20 + 0.01 \cdot 17 + 3 = 8.94 kN/m^2$

×1m: $8.94 kN/m$

Distrubuted load balcony: $0.02 \cdot 22 + 0.065 \cdot 22 + 0.16 \cdot 25 + 4.5 = 10.37 kN/m^2$

×1m: $10.37 kN/m$

Simple supported beam with cantilever: A = 22.9kN B = 45.7kN




## 3. Wall

Distributed load: $0.01 \cdot 17 + 3.84 + 0.15 \cdot 0.5 + 0.01 \cdot 17 = 4.255 kN/m^2$

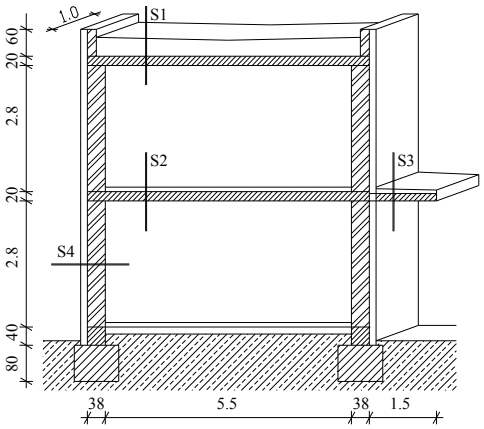
Attic: ×1m×0.6m: 2.6 kN

Wall: ×1m×2.8m: 11.9 kN

## 4. Foundations

Concentrated load: $0.4 \cdot 0.4 \cdot 1 \cdot 25 + 0.8 \cdot 1 \cdot 1 \cdot 24 = 23.2 kN$

## 5. Summarization of forces:




| | | |
|---|---|---|
| Attic: | 2.6kN | 2.6kN |
| Roof: | 30.3kN | 30.3kN |
| Wall: | 11.9kN | 11.9kN |
| Floor: | 22.9kN | 45.7kN |
| Wall: | 11.9kN | 11.9kN |
| Foundation: | 23.2kN | 23.2kN |
| Sum: | 102.8kN | 125.6kN |

The soil bears: $300 kN/m^2$: $300 \cdot 1 \cdot 1 = 300 kN$ > 125.6kN > 102.8kN Safe!