# Bullet Constraints Builder

## Building description of a Multi- Family House

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## General description of structure

The building that we are going to simulate is a Multi Family House with four storeys. The dimensions of its footprint are 18.50 x 17.00 m, the building has a height of 14.00 m over ground. The standard floor height is 3.5 m. All loadbearing structural members are made of reinforced concrete. Wall and columns stabilise the structure against horizontal forces and transfer the loads between the storeys. Non-structural components, like windows or light separating walls are not taken into consideration in the 3D model. A special feature of this building is its cantilever extension supported by girders in the first floor.

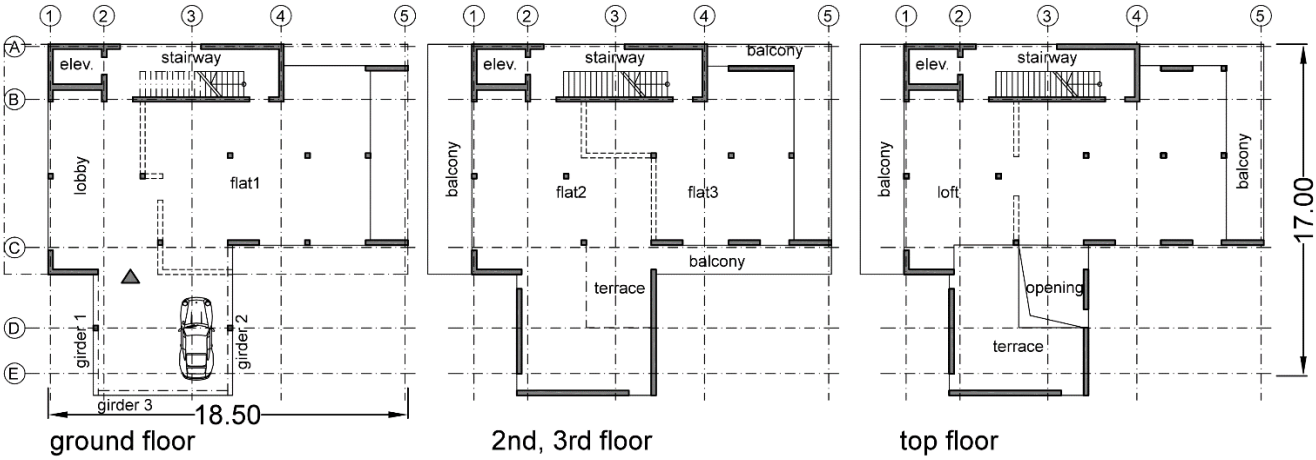


*Figure 1- floor plans*

## Compound Ceilings

The ceiling slabs of the Multi Family House are 0.22 m thick with the exception of the basement ceiling which is 0.28 m thick. They consist of concrete C30/37 and have S 500 as steel reinforcements, Figure 2 and Figure 3 show their cross sections and their position in the building. Table 1 contains the ceiling element information that is read out from the sections and that needs to be inserted in the BCB Formula Assistant.

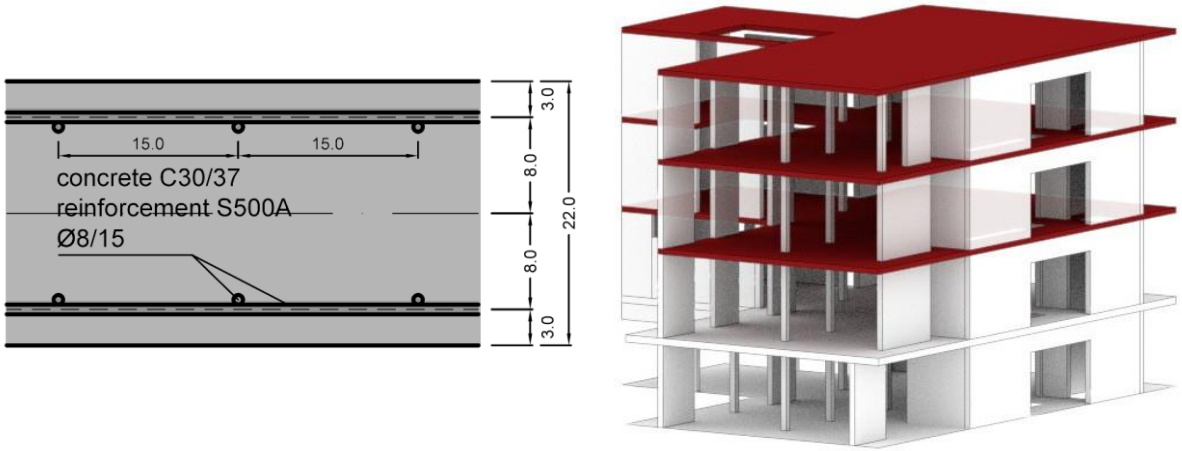


*Figure 2- Slabs 22cm, section with reinforcement and location of these slabs in the building*

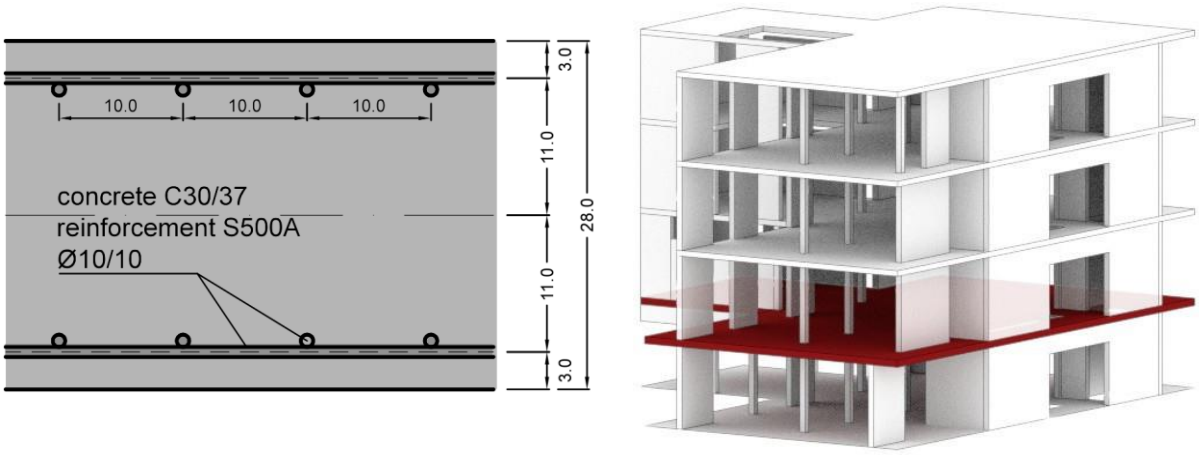


*Figure 3- Slab 28cm, section with reinforcement and location of this slab in the building*

| Level | Member Thickness | Member Width(part) | Bars ø | Bar Distance | Bar Amount 2*(width/Dist) | Concrete Cover | Strengths Fs/Fc |
|---|---|---|---|---|---|---|---|
| [-] | [mm] | [mm] | [mm] | [mm] | [-] | [mm] | N/mm$^2$ |
| 2,3,4 | 220 | 1500 | 8 | 150 | 20 | 30 | 500/30 |
| 1 | 280 | 1500 | 10 | 100 | 30 | 30 | 500/30 |

*Table 1- Slabs specifications to be inserted in the BCB Formula Assistant*

## Precast - Rectangular Beam

The building´s cantilever extension is supported by girders at the ground level which absorb the forces from above and transfer them to columns and walls in the ground floor. The girder consist of concrete C40/50 and have S 500 as steel reinforcements, Figure 4 shows the girders cross section and their position in the building. Table 2 contains the girder element information that is read out from the cross section and that needs to be inserted in the BCB Formula Assistant.

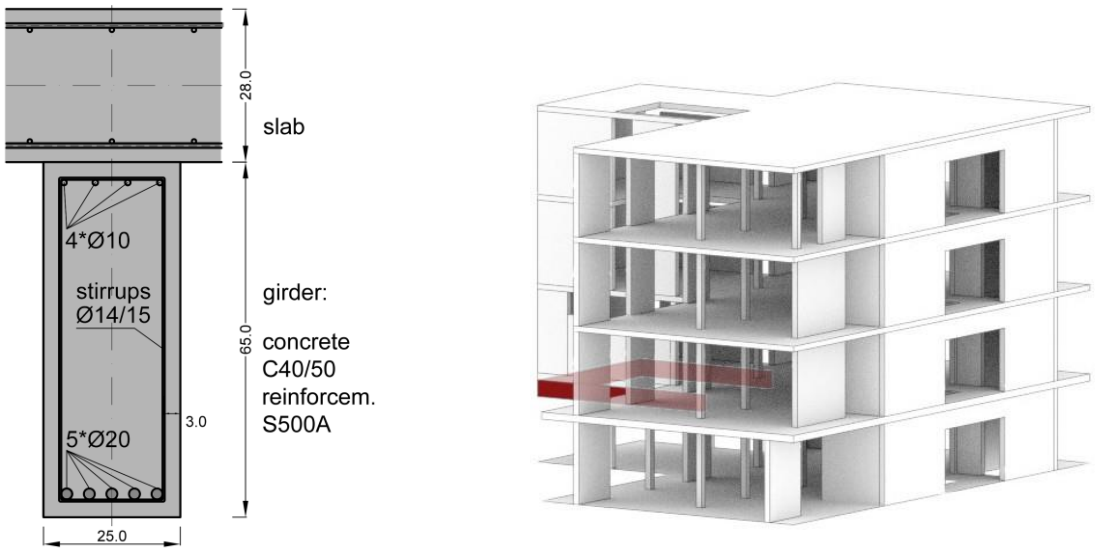


Figure 4- Girders, section with reinforcement and their location in the building

| Member Width | Member Height | Lower longitu-dinal Bars, ø | Lower longitudi-nal Bars, Amount | Stirrup ø | Stirrup Distance | Concrete Cover | Strengths Fs/Fc |
|---|---|---|---|---|---|---|---|
| [mm] | [mm] | [mm] | [-] | [mm] | [mm] | [mm] | N/mm$^2$ |
| 250 | 650 | 200 | 5 | 14 | 150 | 30 | 500/40 |

*Table 2- Beam specifications to be inserted in the BCB Formula Assistant*

## Basic Walls

The main supporting structure of this Multi Family House are the façades and some inner walls that have also the task to stabilise the building against horizontal forces. All walls are 25 cm thick. The reinforced concrete walls consist of concrete C30/37, Figure 5 shows the walls cross section and their position in the building. Table 3 contains the wall element information that is read out from the cross section and that needs to be inserted in the BCB Formula Assistant.


*Figure 5- Walls, section with reinforcement and their location in the building*

| Member Thickness | Member Width(part) | Bars ø | Bar Distance | Bar Amount (width/Dist) | Concrete Cover | Strengths Fs/Fc |
|---|---|---|---|---|---|---|
| [mm] | [mm] | [mm] | [mm] | [-] | [mm] | N/mm$^2$ |
| 250 | 1500 | 10 | 150 | 10 | 125 | 500/30 |

*Table 3- Wall specifications to be inserted in the BCB Formula Assistant*

## Columns

Beside the walls there are columns to carry the vertical loads, the columns allow more open spaces in the apartments. They consist of concrete C30/37 and have S 500 as steel reinforcement, Figure 6 shows the column cross section and their position in the building. Table 4 contains the column element information that is read out from the cross section and that needs to be inserted in the BCB Formula Assistant.

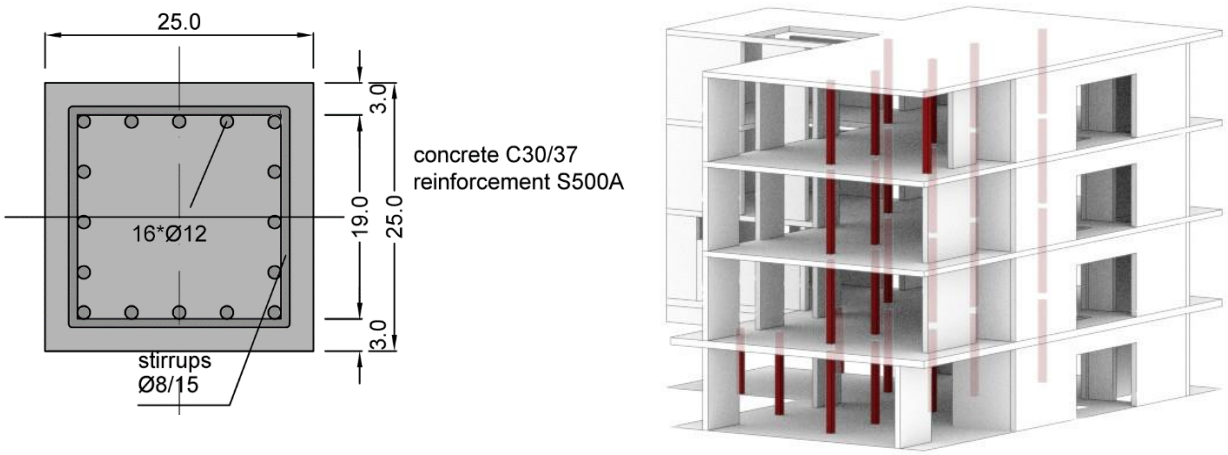


*Figure 6- Columns, section with reinforcement and their location in the building*

| Member Width | Member Length | Longitudinal Bars ø | Longitud. Bar Amount | Stirrup ø | Stirrup Distance | Concrete Cover | Strengths Fs/Fc |
|---|---|---|---|---|---|---|---|
| [mm] | [mm] | [mm] | [-] | [mm] | [mm] | [mm] | N/mm$^2$ |
| 250 | 250 | 12 | 16 | 8 | 150 | 30 | 500/30 |

*Table 4- Column specifications to be inserted in the BCB Formula Assistant*

## Cast-In-Place Stair

The stairs are non-structural elements that don't contribute to the general stability of the building. They most likely don't influence the outcome of the simulation, however, they are still included in the 3D model for sake of completeness. They consist of concrete C30/37 and have S 500 as steel reinforcement, Figure 7 shows the stair cross section and their position in the building. Table 5Table 4 contains the stair element information that is read out from the section and that needs to be inserted in the BCB Formula Assistant.

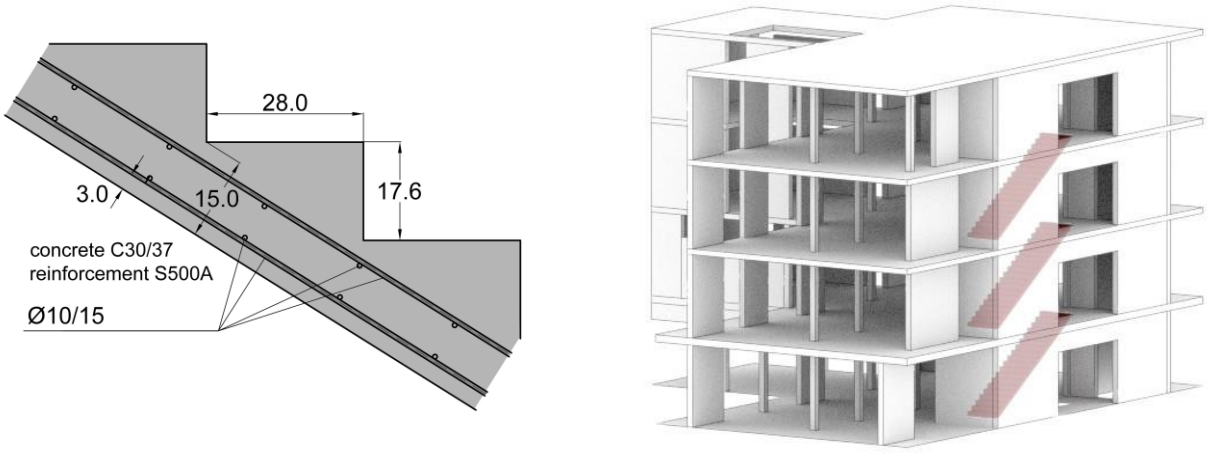


*Figure 7- Stairs, section with reinforcement and their location in the building*

| Member Thickness | Member Width(part) | Bars ø | Bar Distance | Bar Amount 2*(width/Dist) | Concrete Cover | Strengths Fs/Fc |
|---|---|---|---|---|---|---|
| [cm] | [cm] | [mm] | [cm] | [-] | [cm] | N/mm$^2$ |
| 15 | 150 | 10 | 15 | 20 | 3 | 500/30 |

*Table 5- Stair specifications to be inserted in the BCB Formula Assistant*