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ProtaStructure Design Guide

Local Ductility Condition Check (EC8)

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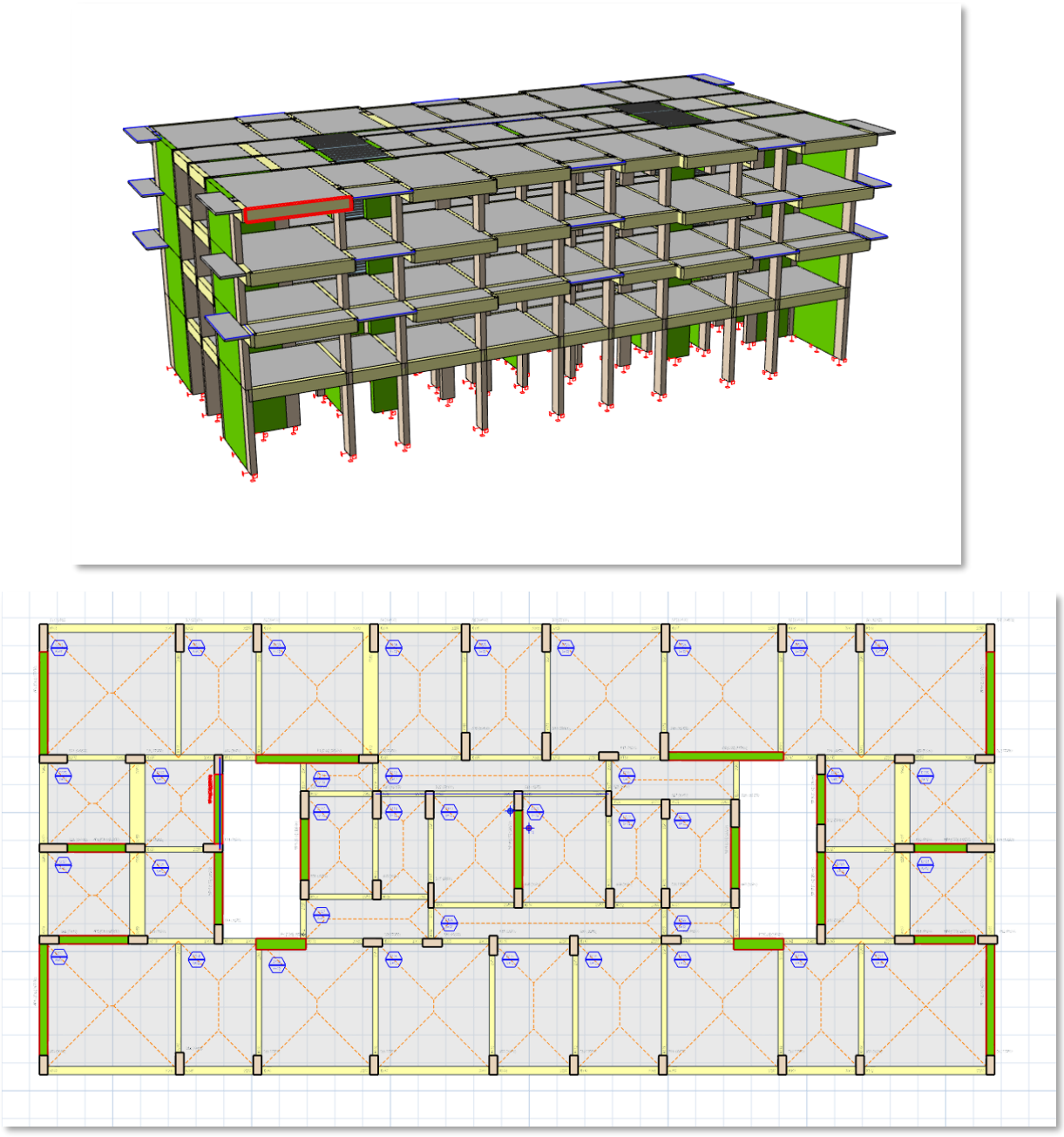
Introduction

ProtaStructure checks global and local ductility conditions according to EC8 Chapter 4.4.2.3.

This document explains calculations for strong column weak beam condition checks.

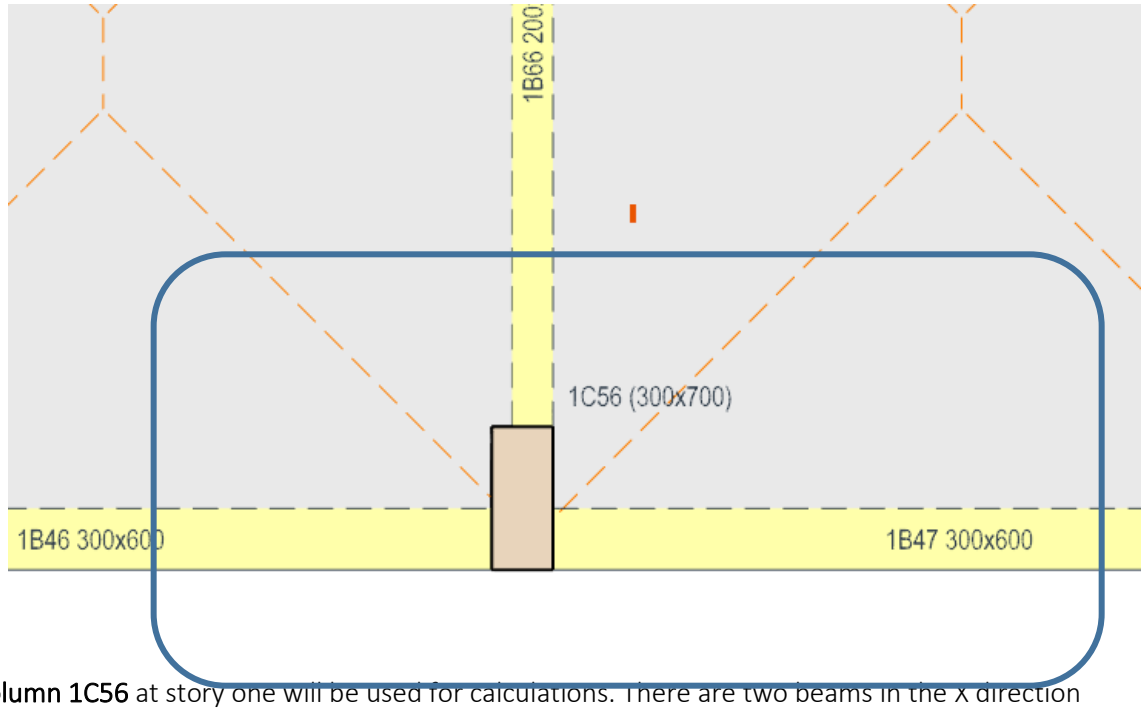
Building Model

The building model consists of 4 floors. 3D and typical story plan views are shown below.



3D and Typical Plan View of Building Model

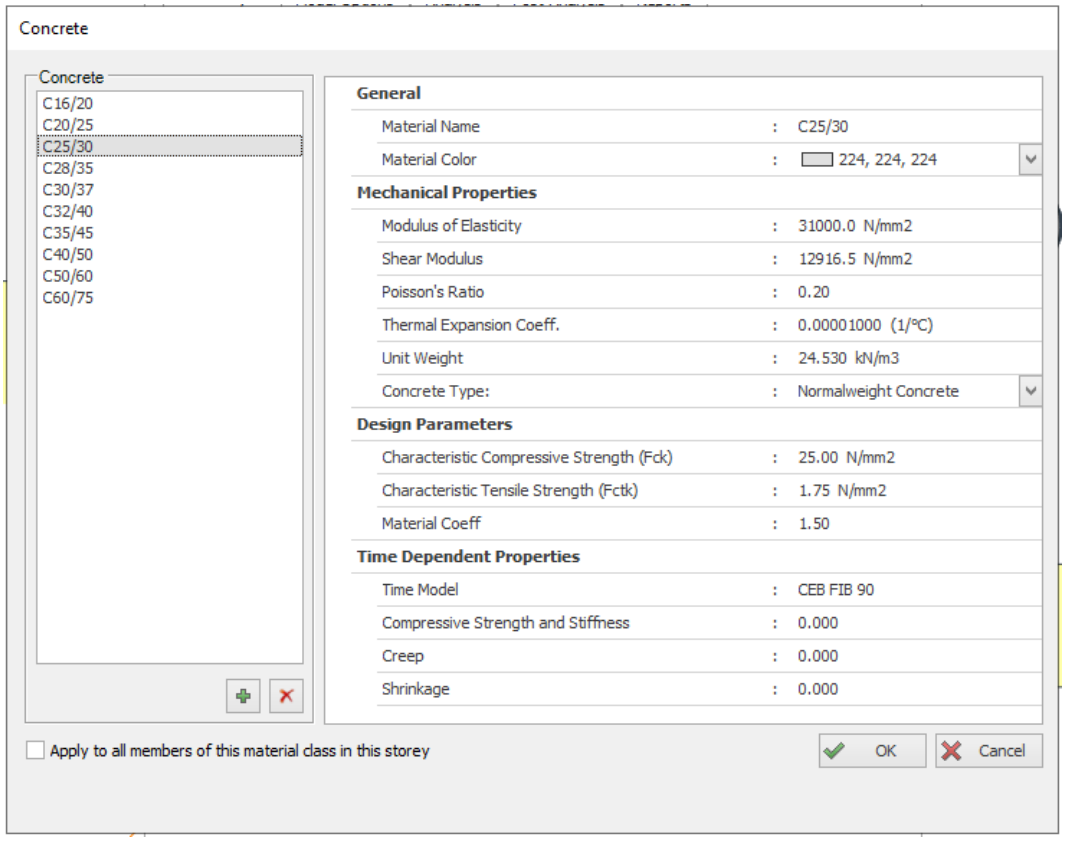
Member Details



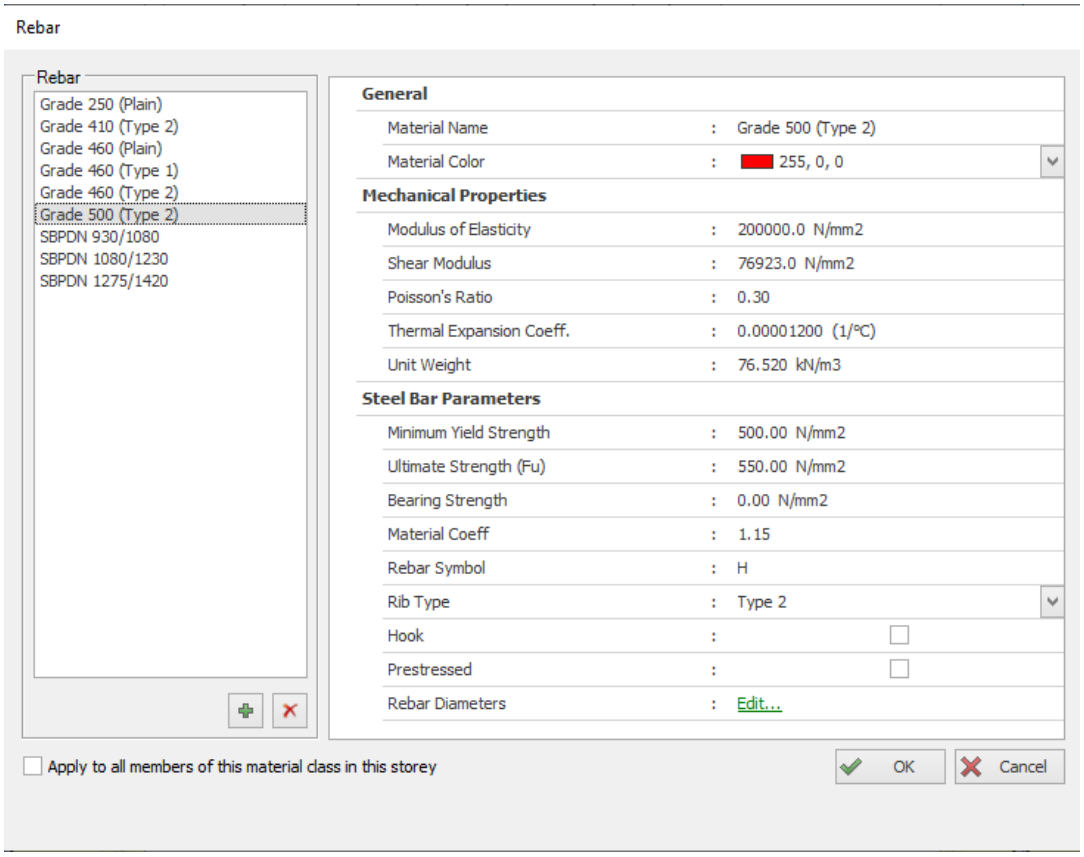
Column 1C56 at story one will be used for calculations. There are two beams in the X direction connected to columns **1C56** and one in the Y direction.

Material Properties

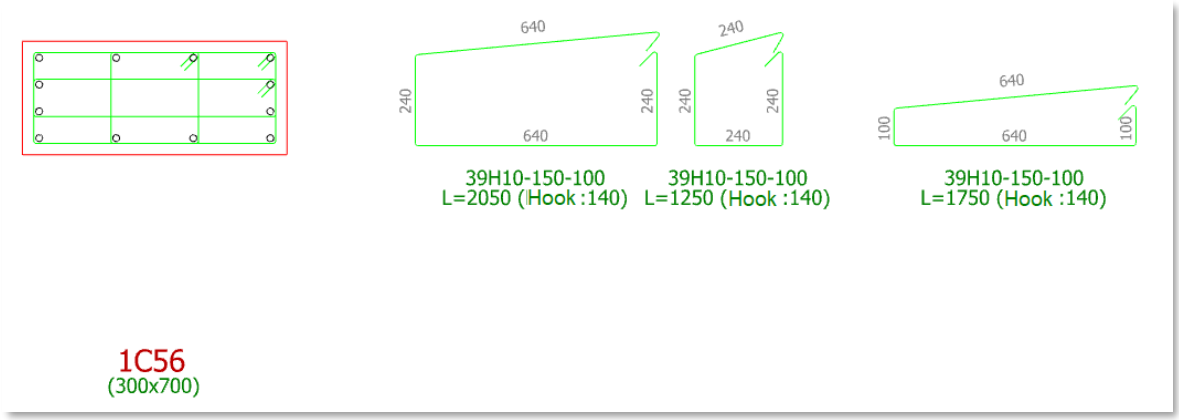
Concrete



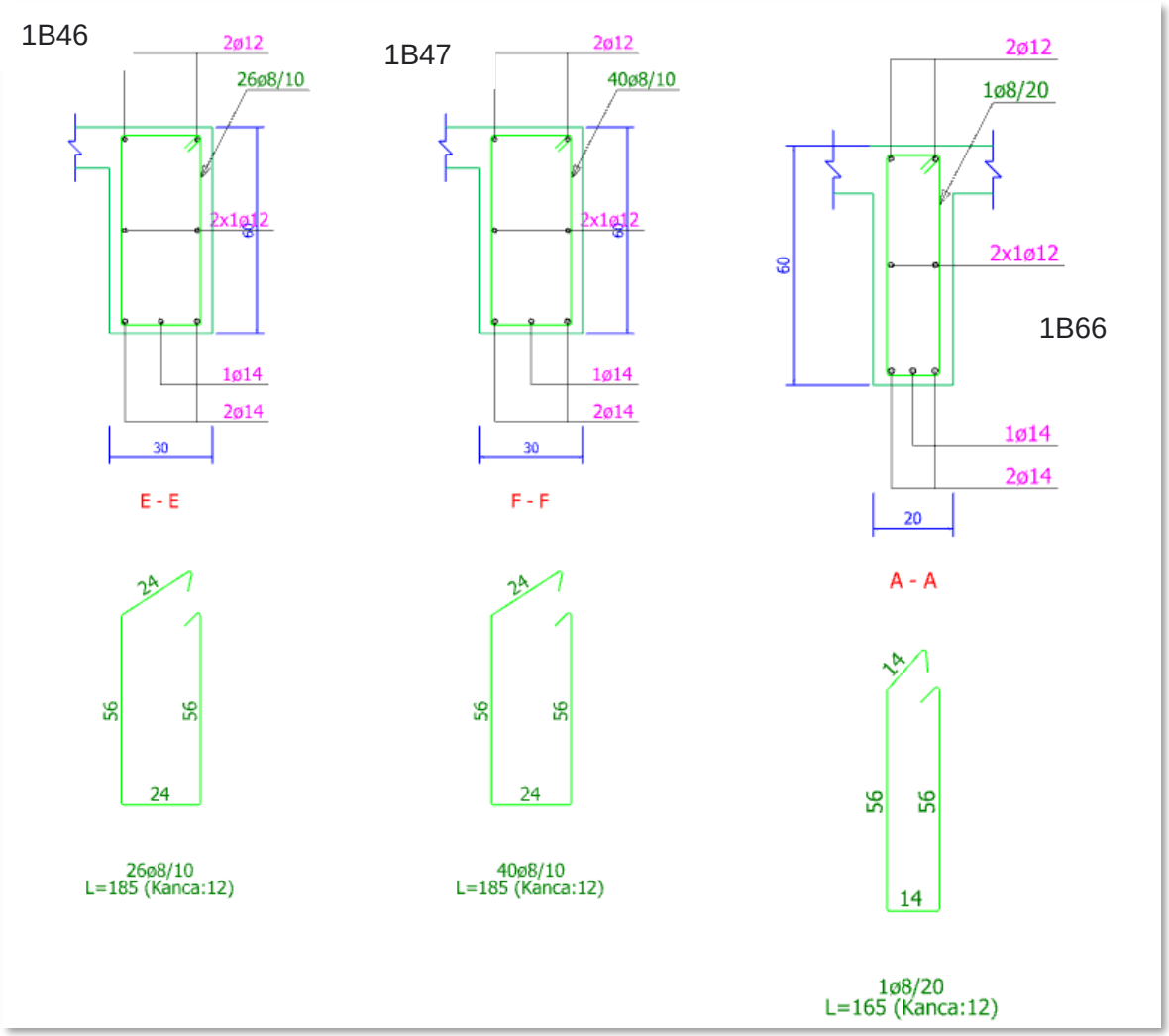
Steel



Column Section and Reinforcement



Beam Section and Reinforcement



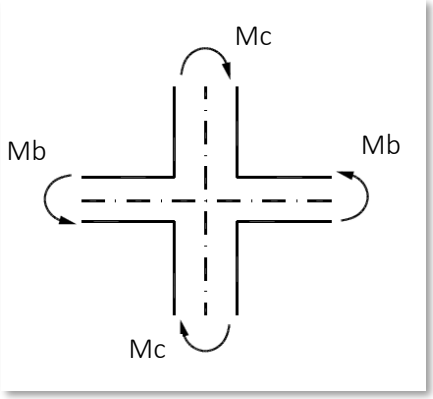
Details of Calculation

According to **EC8 4.4.2.4 (4)**, "Unless otherwise specified in Sections 5 to 8, to satisfy the requirement (3)P, in frame buildings, including frame-equivalent ones as defined in 5.1.2(1), with two or more stories, the following condition should be satisfied at all joints of primary or secondary seismic beams with primary seismic columns:

$$\sum M_{Rc} \geq 1.3 \sum M_{Rb} \quad (4.29)$$

$\sum M_{Rc}$: The sum of the design values of the moments of resistance of the columns framing the joint. The minimum value of column moments of resistance within the range of axial column forces produced by the seismic design situation should be used in the expression (4.29)

$\sum M_{Rc}$: the sum of the design values of the moments of resistance of the beams framing the joint. When partial strength connections are used, the moment resistance of these connections is taken into account in the calculation of $\sum M_{Rb}$



Checks according to **EC8 4.4.2.4 (5)** and **(6)** are performed by ProtaStructure automatically.

X-Direction

In the X direction, 1B46 and 1B47 are connected to column 1C56. Strong column check calculations are given as follows;

Left Beam (1B46) Moment Capacity : 158.5 kN.m

Right Beam (1B47) Moment Capacity : 135.1 kN.m

Top Column (2C56-Storey:2) Moment Capacity : 169 kN.m

Bot Column (1C56-Storey:1) Moment Capacity : 172.6 kN.m

$$M_{Rc} = (169 + 172.6) = 341.6\ kN.m$$

$$M_{Rb} = (158.5 + 135.1) = 293.5\ kN.m$$

$$\frac{M_{Rc}}{M_{Rb}} = 1.2 \geq 1.3 \times$$

X-Direction

Joint	Member	Section (mm)	Moment Capacity, M_r(+) (kN.m)	Moment Capacity, M_r(-) (kN.m)
2C56	2C56 - Storey:2	300/700	169.0	169.0
1B46 + 1B47	1C56 - Storey:1	300/700	172.6	172.6
1C56	1B46	300/600	158.5	135.1
	1B47	300/600	135.1	158.5

M_{nc} / M_{nb} = 341.6 kN.m / 293.5 kN.m = 1.2 < 1.3 Insufficient X

Y-Direction

Only 1B66 is connected to column 1C56 at the right side in the Y direction. Strong column check calculations are given as follows;

Right Beam (1B66) Moment Capacity : 120.3 kN.m

Top Column (2C56-Storey:2) Moment Capacity : 453.8 kN.m

Bot Column (1C56-Storey:1) Moment Capacity : 461.7 kN.m

$M_{Rc} = 915.5\ kN.m$

$M_{Rb} = 120.3\ kN.m$

$$\frac{M_{Rc}}{M_{Rb}} = 7.6 \leq 1.3 \times$$

Y-Direction

Joint	Member	Section (mm)	Moment Capacity, M_r(+) (kN.m)	Moment Capacity, M_r(-) (kN.m)
2C56	2C56 - Storey:2	300/700	453.8	453.8
+ 1B66	1C56 - Storey:1	300/700	461.7	461.7
1C56	1B66	200/600	103.2	120.3

M_{nc} / M_{nb} = 915.5 kN.m / 120.3 kN.m = 7.6 > 1.3 Sufficient √

Summary

This document explains global and local ductility conditions according to EC8 Chapter 4.4.2.3 and Eqn (4.29).

Thank You

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