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ProtaStructure Design Guide

Seismic Forces on Non-Structural Members (EC8)

Version 1.0   02 February 2021

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Introduction

ProtaStructure calculates non-structural member forces according to **EC8 Chapter 4.3.5**.

In the current document, calculations details about non-structural members earthquake force and parameters such as seismic coefficient are explained.
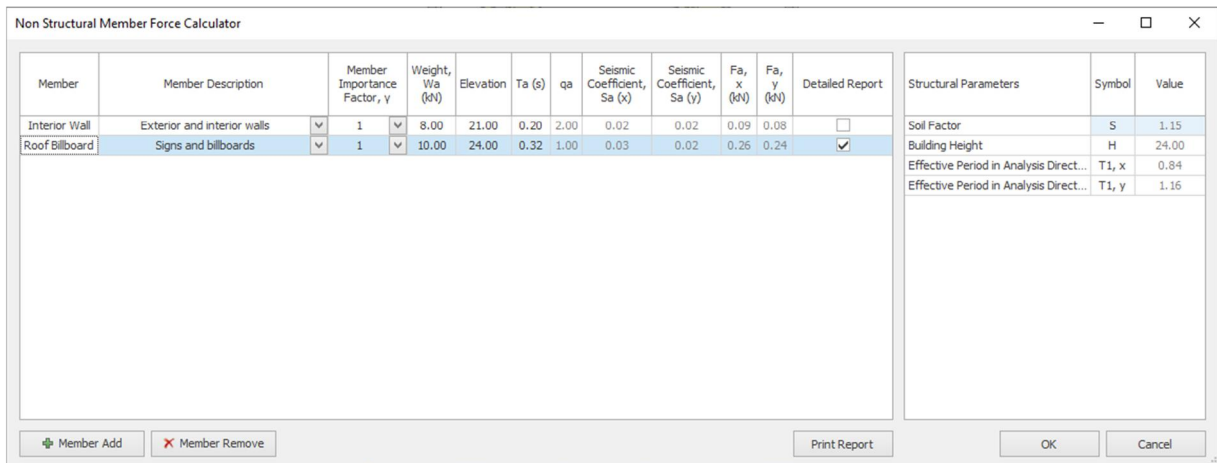
Building Model Details

The building model consists of 7 regular floors. 3D and typical story plan view are shown below.
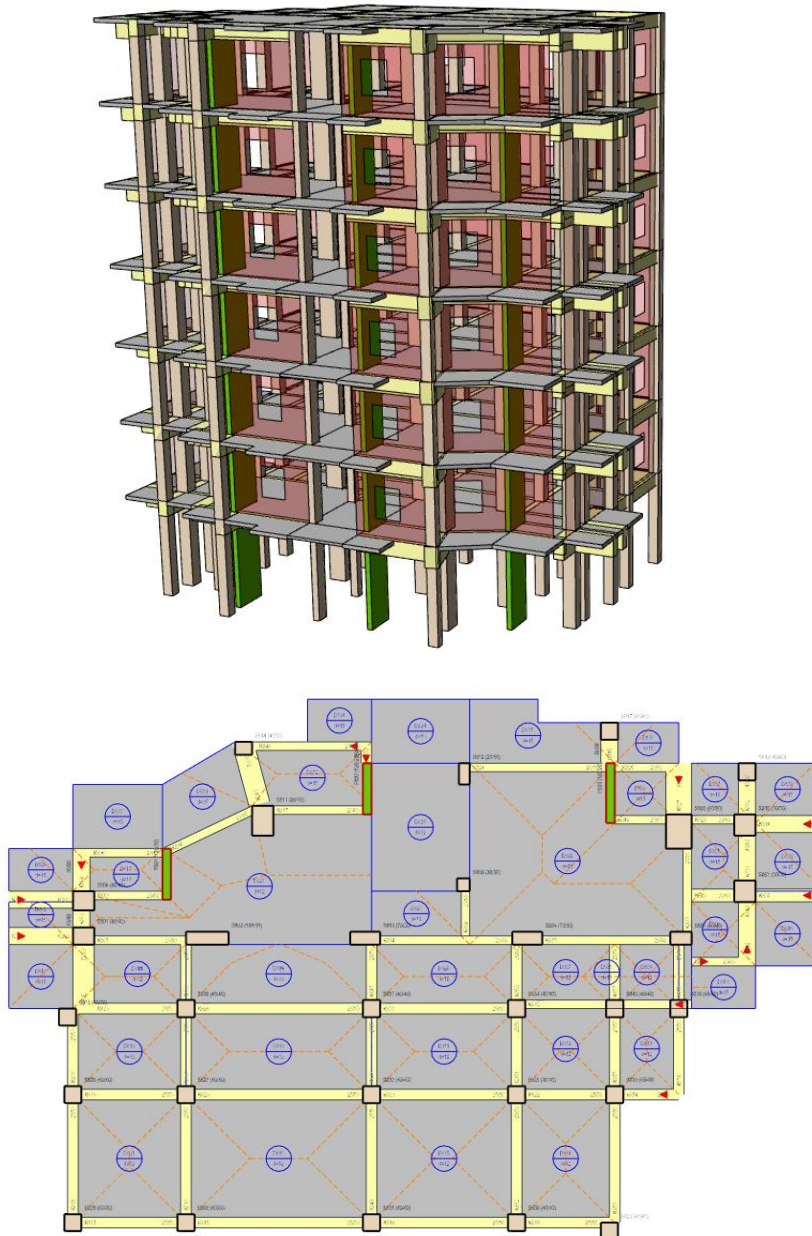
3D and Typical Plan View of Building Model

User Interface

At the "**Non-structural Member Force Calculator**" user interface, member label, non-structural member type according to **EC8 Table 4.4**, member elevation from the base, and member weight are set by the user. The other parameters such as seismic coefficient and member forces are calculated according to **EC8 Chapter 4.3.5**

Seismic Coefficient

According to **EC8 4.3.5.2 (2)** seismic coefficient, S_a is defined as, "Seismic coefficient applicable to non-structural elements". Calculation details are given in subclause **4.3.5.2 (3)** which states the formula **(4.25)** given below.

$$S_a = \alpha\, S\, [3\,(1 + {}^{z}\!/_{H})/(1 + (1 - {}^{T_a}\!/_{T_1})^2) - 0.5]$$

α : Ratio of the design ground acceleration on type A ground, α_g, to the acceleration of gravity g

S : Soil factor

T_a : Fundamental vibration period of the non-structural element

T_1 : Fundamental vibration period of the building in the relevant direction

z : Height of the non-structural element above the level of application of the seismic action (foundation or top of a rigid basement)

H : Building height measured from the foundation or the top of a rigid basement

X Direction	Y Direction
$\alpha = 0.07$ $S = 1.15$ $T_a = 0.32\,s$ $T_1 = 0.836\,s$ $z = 24\,m$ $H = 24\,m$ $\boldsymbol{S_a = 0.026}$	$\alpha = 0.07$ $S = 1.15$ $T_a = 0.32\,s$ $T_1 = 1.16\,s$ $z = 24\,m$ $H = 24\,m$ $\boldsymbol{S_a = 0.024}$

Seismic Force

According to **EC8 4.3.5.2 (2)** horizontal seismic force, F_a, is defined as," the horizontal seismic force, acting at the center of mass of the non-structural element in the most unfavorable direction". Calculation details are given in subclause **4.3.5.2 (3)** which states the formula **(4.24)** given below.

$$F_a = \frac{S_a * W_a * \gamma_a}{q_a}$$

S_a : Seismic coefficient applicable to non-structural members

W_a : Weight of the non-structural member

q_a : Behavior factor of the non-structural member

γ_a : Importance factor for the member, according to **EC8. 4.3.5.3**

Type of non-structural element	q_a
Cantilevering parapets or ornamentations	
Signs and billboards	1,0
Chimneys, masts and tanks on legs acting as unbraced cantilevers along more than one half of their total height	
Exterior and interior walls Partitions and facades Chimneys, masts and tanks on legs acting as unbraced cantilevers along less than one half of their total height, or braced or guyed to the structure at or above their centre of mass Anchorage elements for permanent cabinets and book stacks supported by the floor Anchorage elements for false (suspended) ceilings and light fixtures	2,0

X Direction	Y Direction
S_a = 0.026 W_a = 10 kN γ_a = 1.0 q_a = 1.0 $\boldsymbol{F_a}$ = **0.26 kN**	S_a = 0.024 W_a = 10 kN γ_a = 1.0 q_a = 1.0 $\boldsymbol{F_a}$ = **0.24 kN**

Summary

In this document, calculation details of seismic forces acting on the non-structural elements according to EC8. Clause 4.3.5 is explained. Results of the "Non-Structural Member Force Calculator" macro are verified with hand calculations.

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