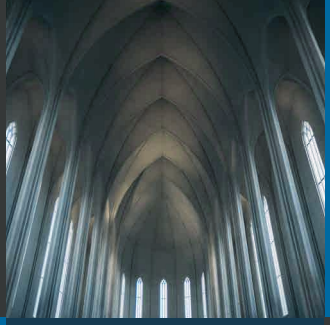

3MURI
Project

3Muri Projet OPEN

STADATA
STRUCTURAL SOFTWARE

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OPEN modellator

The vertical plane modelling of the OPEN module allows you to create structural models of structures which are not box-shaped, with walls of irregular geometry in elevation and curved elements.

Figure 1. Example of a building with walls that are irregular in the elevation and with curved elements at different heights

In order to facilitate the geometric modelling of the wall, OPEN allows the insertion of an orthophoto or a DXF file in the vertical plane of the wall.

In OPEN, the 'Elevation Line' tool allows you to create dashed guide lines on the vertical plane graphic interface at different heights to the ground elevations to facilitate the insertion of objects.

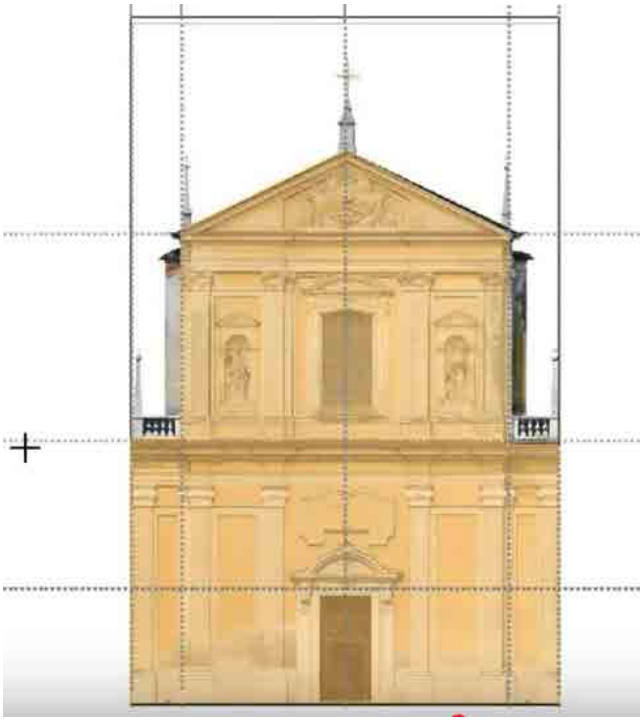

Figure 2. Example of an orthophoto of a wall with irregular curvilinear elements, defined in the OPEN mode in the vertical plane with elevation lines.

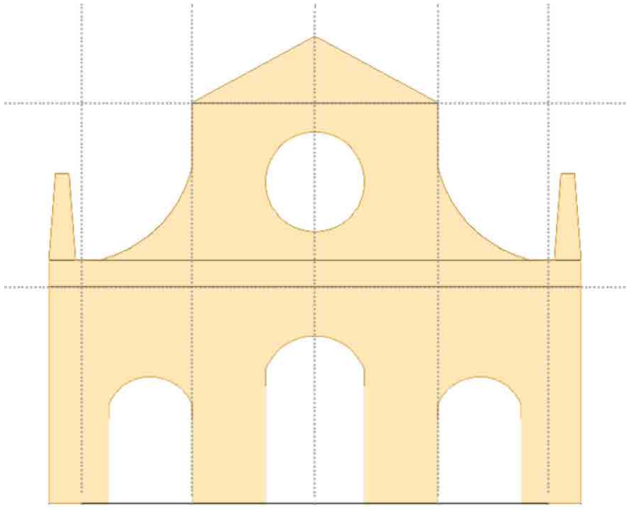

Figure 3. Example of a DXF file of a wall with irregularly curved elements, defined in the OPEN mode in the vertical plane with elevation lines.

The OPEN modeller allows you to join, cut, split and export when modelling a wall.

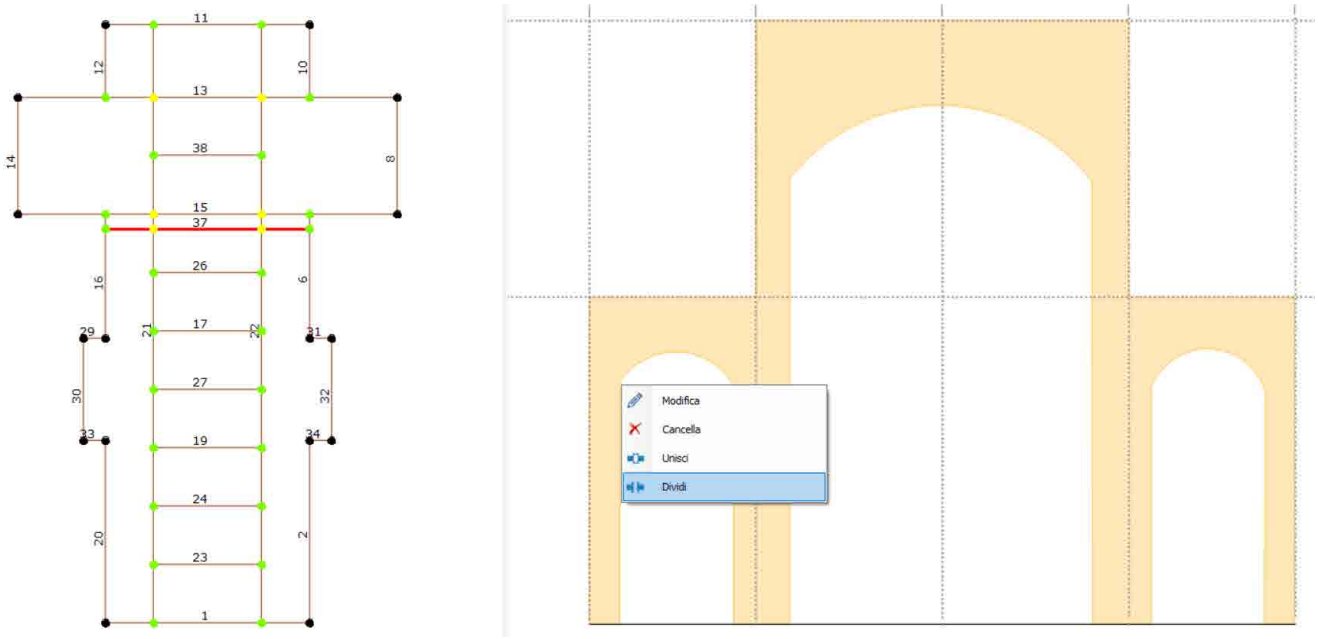

Figure 4. OPEN modelling example of a 3 arch cathedral wall

3Muri Project shows the 3D graphical view of the structure without boxiness at all stages of wall modelling in OPEN.

The entire model is analysed with the global static analysis performed in the FEM environment and 3Muri Project allows the mesh size to be modified if necessary.

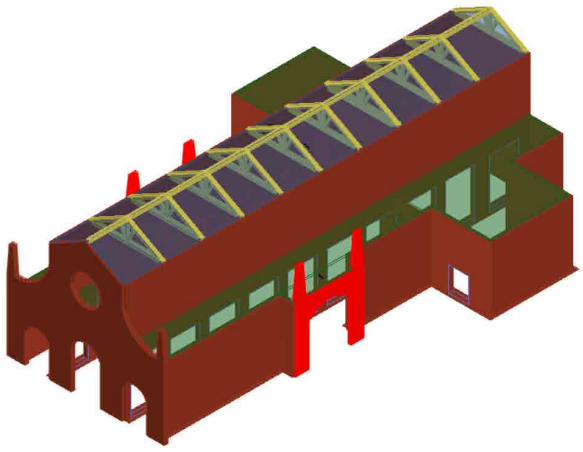

Figure 5. 3D model in 3Muri Project

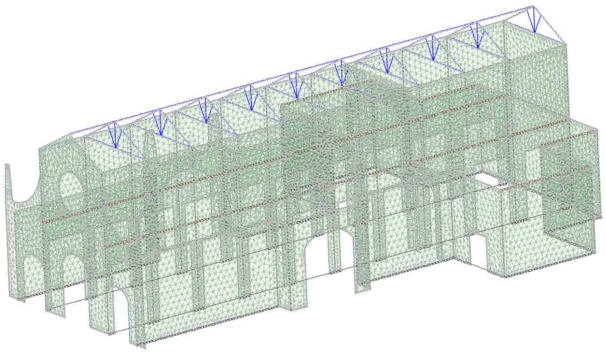

Figure 6. 6 Mesh of the 3D model in FEM environment

In the FEM environment, the magnitude of the stresses acting on the analysed 3D model can be observed. The desired load combination can be selected.

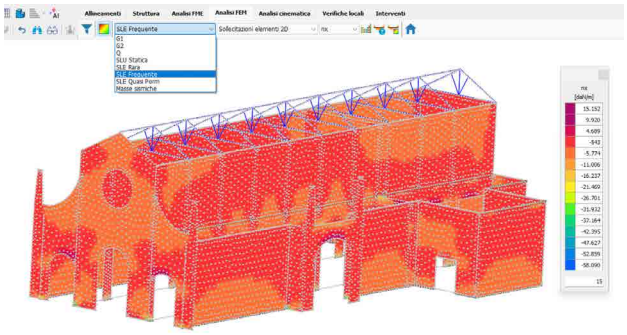

Figure 7. Stresses in 2D model elements analysed with SLU global static analysis

The analysis provides stresses for both two-dimensional elements like walls and one-dimensional elements like the trusses in the figure.

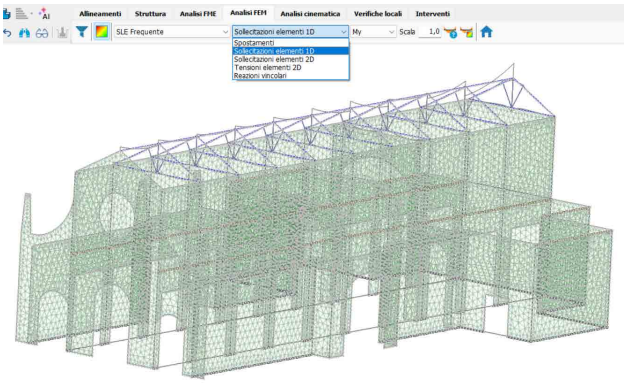

Figure 8. Stresses in 1D model elements analysed by global static analysis with frequent SLE

3Muri Project displays at each node of the mesh the stress value obtained from the selected global analysis. By hovering the mouse over the mesh node or looking at the reference colour map, the designer can instantly visualize the stress values acting on the elements of interest.

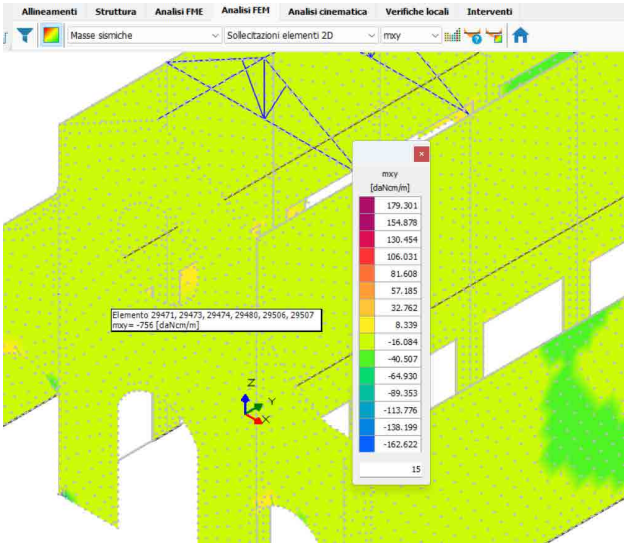

Figure 9. Stresses can be displayed for each node of the mesh of the 2D model elements.

The seismic vulnerability check of the unboxed structure is performed by analysing the kinematics of the in-plane and out-of-plane walls modelled in OPEN.

The LV (Local Verifications) module of the 3Muri Project is complementary to the OPEN module and allows kinematic analyses in the plane and out of the plane of both linear and non-linear types.

The kinematic verification provides the multiplier for the activation of the mechanism α and thus the acceleration of the activation of the mechanism.
3Muri project shows movement of kinematics in and out of the verified plane.

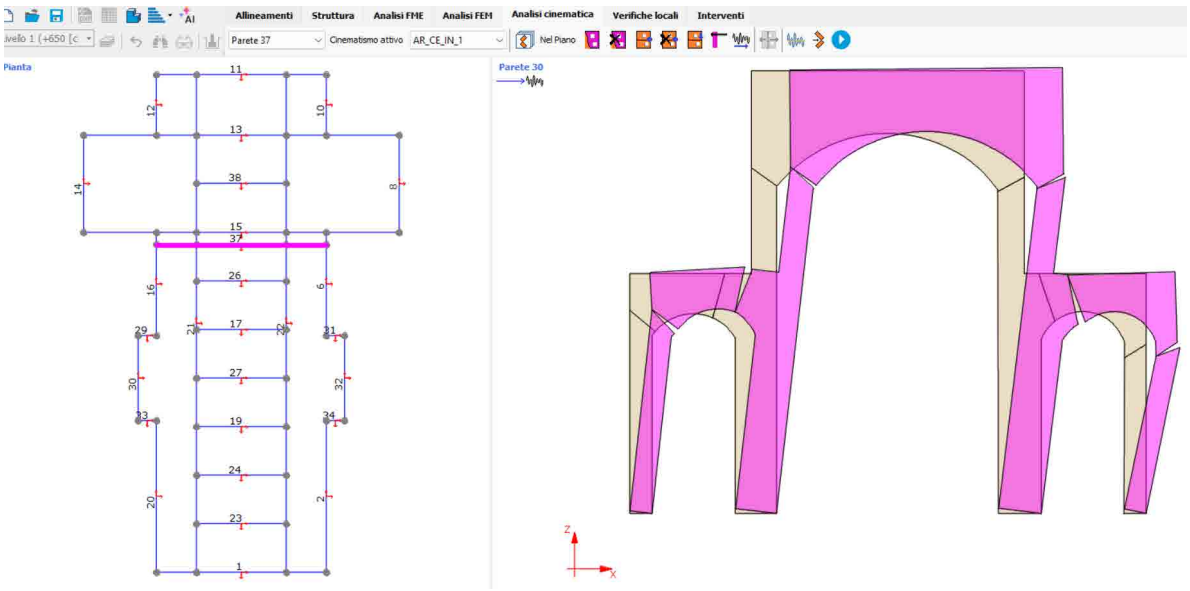

Figure 10. An example of the verification of the kinematic activation in the plane of a wall with arches.

In-plane mechanism analyses consider the mechanical properties of the wall and the shear planes placed on the wall by the designer.

To improve seismic vulnerability in the plane and out-of-plane of the wall, 3Muri Project's LV module allows the insertion of a reinforcement, such as a steel chain, which works together with the wall, with the plane band and with the piers.

3Muri Project shows the result of the nonlinear kinematic analysis with the capacity curve, which represents the evolution of the wall kinematics with or without reinforcement following the seismic input.

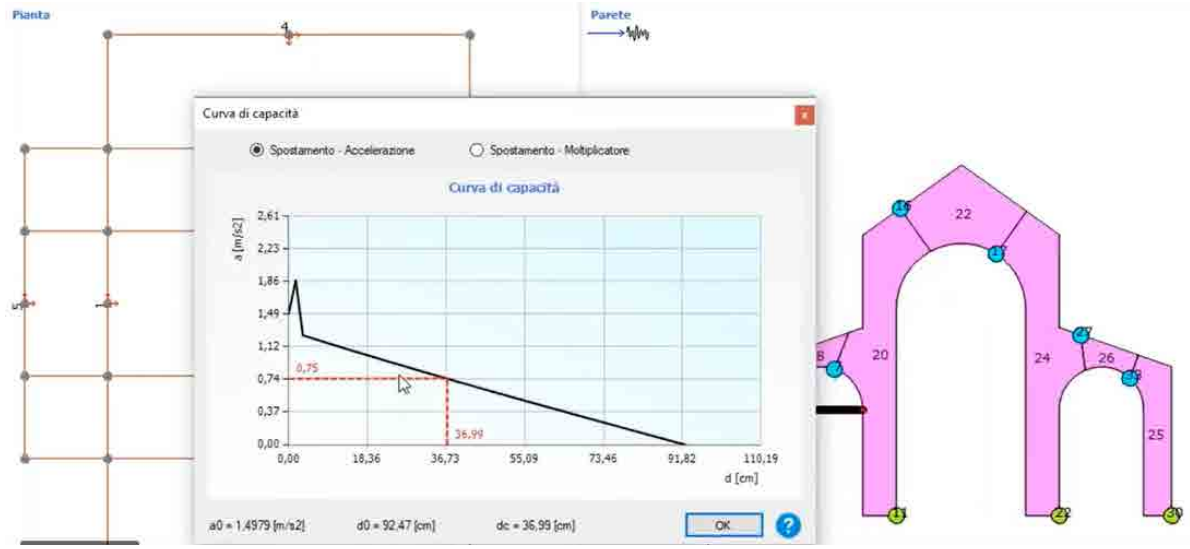

Figure 11. Displacement-acceleration" capacity curve of a mechanism in the plane of a wall with three arches, reinforced with a steel chain in one of the arches.

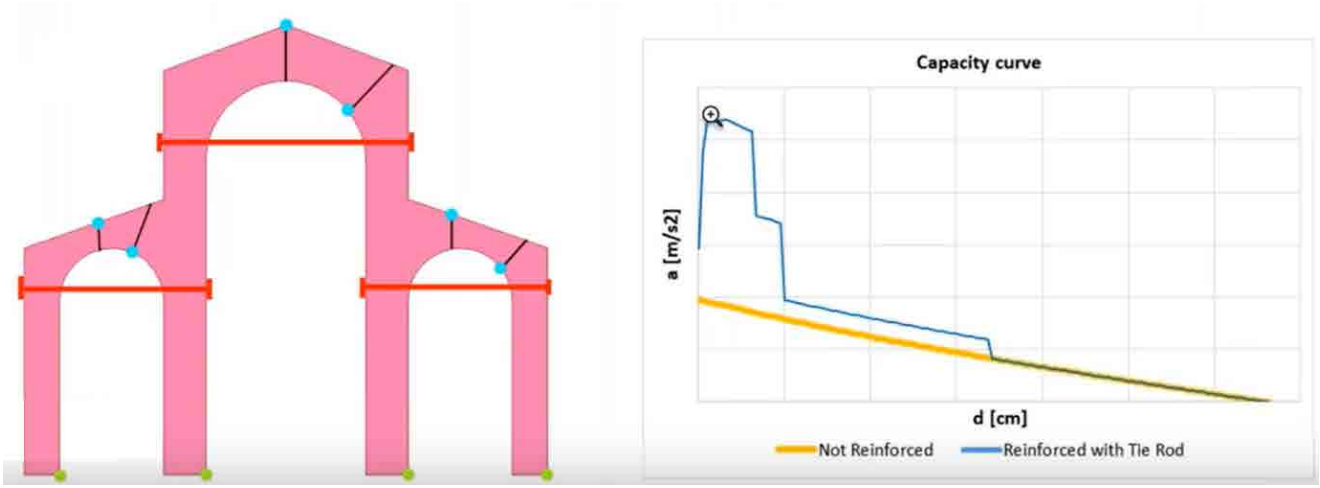

Figure 12. Displacement-acceleration" capacity curve of a kinematic mechanism in the plane of a wall with three arches, each reinforced with a steel chain.

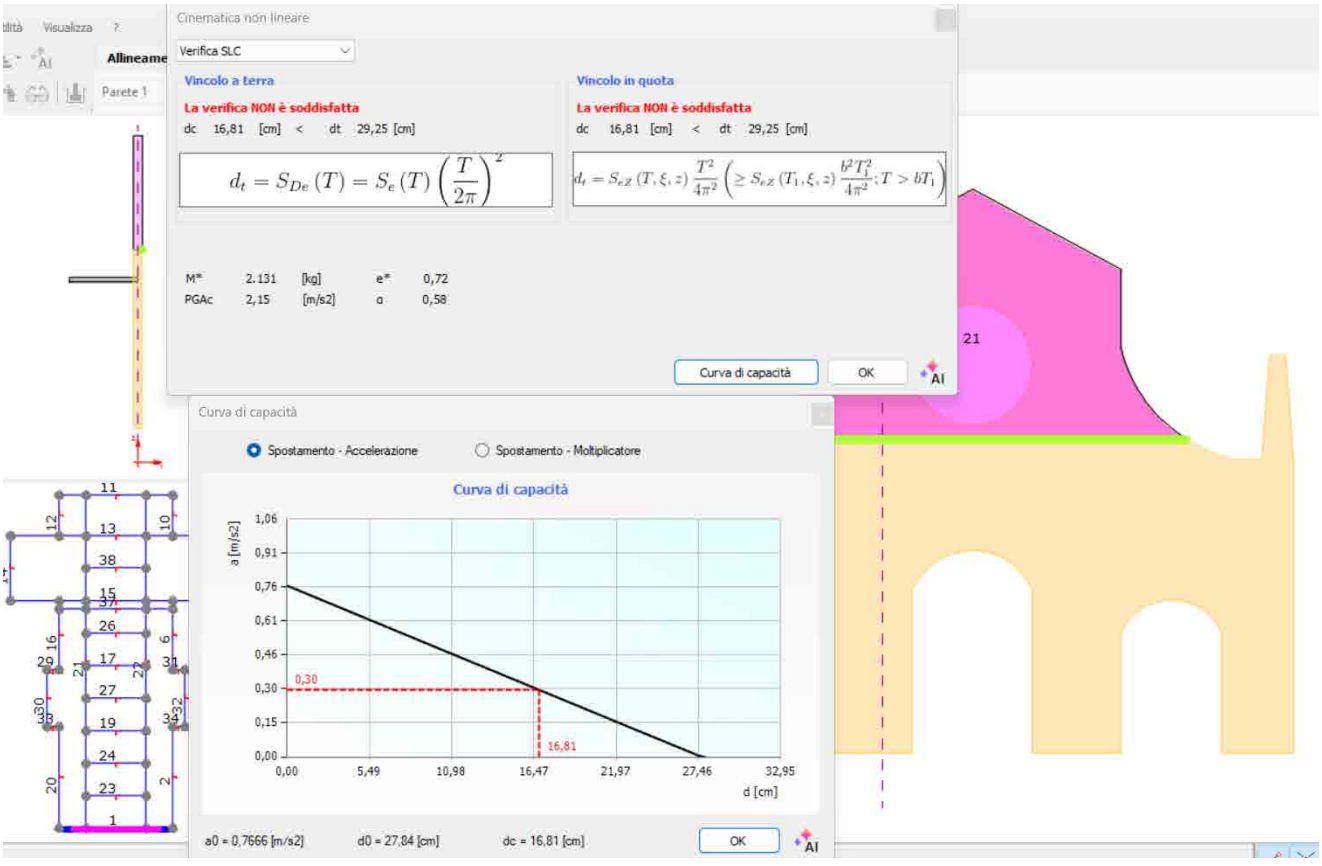

Figure 13. The 'displacement - acceleration' capacity curve of a kinematic movement out of the plane of a wall without reinforcement..

In the verification of the kinematic movement of a chain-reinforced wall, 3Muri Project takes into account the failure mechanisms of the inserted reinforcement and calculates the minimum tensile force that is able to counteract the overturning moment acting on the facade.
The wall reinforcement created in OPEN is easily and intuitively inserted through the special wizard mask.

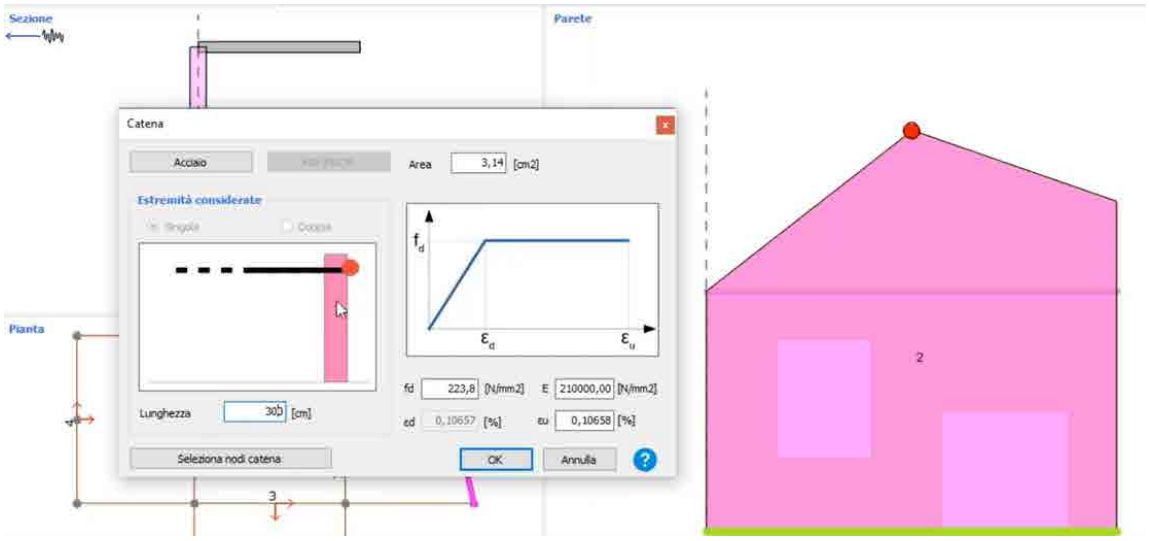

Figure 14. Mask for inserting the reinforcement chain to prevent the mechanism from tipping out of the plane

3Muri Project visualizes in 3D the movement of the in-plane and out-of-plane kinematics generated by the analyses under consideration.

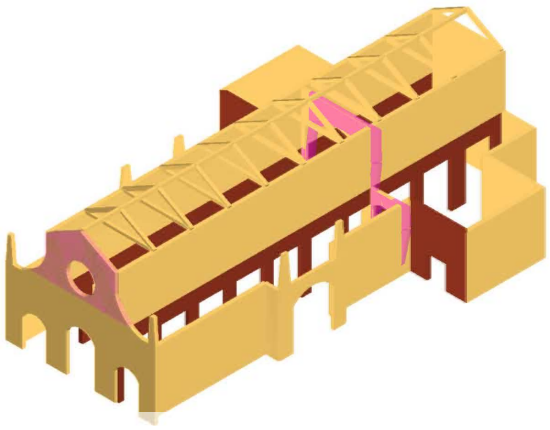

Figure 15. Graphical visualisation of the kinematic motion in the plane of the inner wall analysed

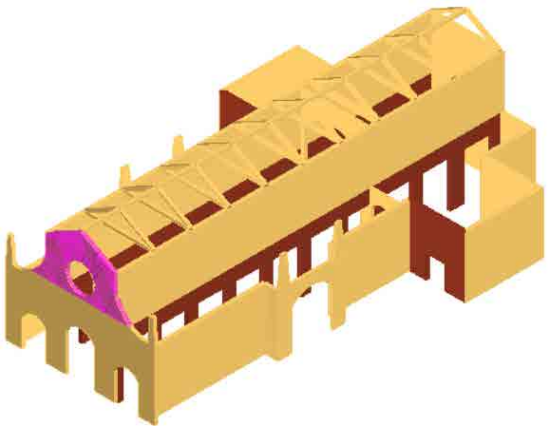

Figure 16. Graphical visualisation of the out-of-plane kinematics of a part of the façade

The LV kinematics module and the OPEN module are independent. The modules can be added to the customer's 3Muri Project configuretion to perform the seismic vulnerability analysis of the structure without boxing.