STADATA
STRUCTURAL SOFTWARE

3muri Project

2023 NEWS

3MURI PROJECT FME (*global analysis*)

3Muri Project FME (Frame by Macro Elements), based on the principle of the equivalent frame, allows to perform the static and seismic verification of the masonry structure also taking into account all the elements, including the ones in reinforced concrete, steel and wood.

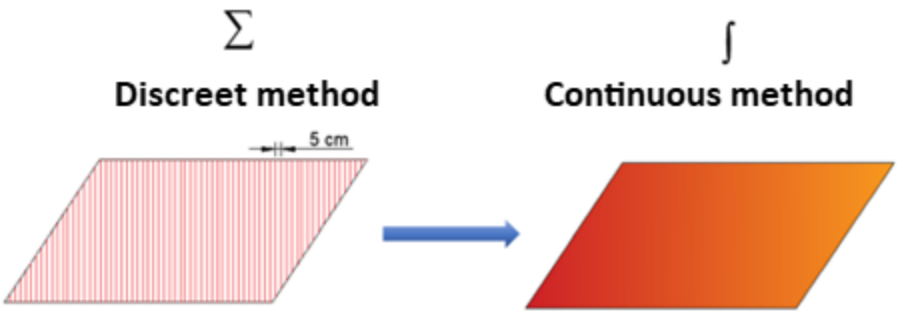
Thanks to the pushover analysis, it identifies the most demanding conditions on which to intervene for seismic retrofitting or improvement, enclosing all the information in a single global model.

Innovative approach to calculating masses (*New Feature*)

The current load distribution method uses a discrete approach with strips parallel to the warping direction, to allow for the correct distribution of loads to be identified, even if the floors have shapes with significant irregularities.

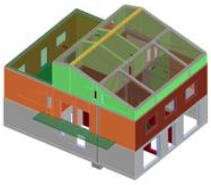
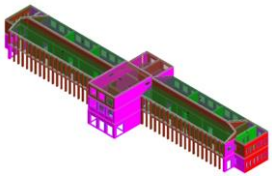
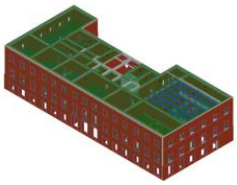
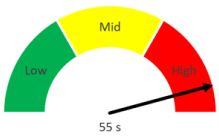
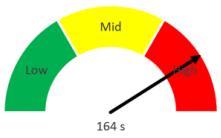
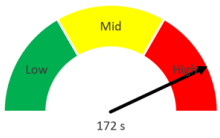
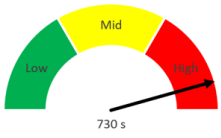
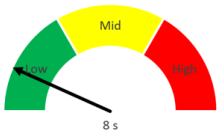
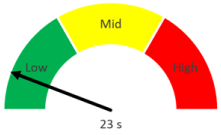
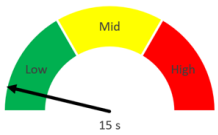
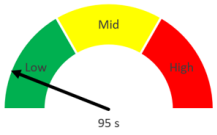
This approach, in order to provide precise results, requires that the "stripes" have sufficiently small dimensions, generating important processing times.

In order to reduce processing times, the approach described above has been modified using a numerical procedure of continuum analysis.



From the experiments on the calculation code, it emerges that in addition to the advantages in terms of time, the distribution of the loads is also more accurate.

To make the extent of the time savings more concrete, we report below a table of some tests conducted on various models.

	Model 1	**Model 2**	**Model 3**	**Model 4**
				
	no. floors: 2+roof *no.floors: 5* *floor area: 372 m2* *60% masonry 40% r.c.*	*no. floors: 4+roof* *no.floors: 11* *floor area: 1065 m2* *75% masonry 25% r.c.*	*no. floors: 3+roof* *no.floors: 25* *floor area: 1470 m2* *90% masonry 10% reinforced concrete*	*no. floors: 3* *no.floors: 92* *floor area: 3400 m2* *85% masonry* *10% reinforced concrete 5% steel*
Current algorithm				
New algorithm				
Time saved	**-85%**	**-86%**	**-91%**	**-87%**

This feature is available to all 3Muri Project users.

In-plane kinematic analysis – (*Local mechanisms module*)

A new mechanism calculation approach is introduced: until now only the kinematics with "out of plane" behavior was examined, but now "in plane" verification approaches are being added.

Frames, arches and curved elements formed by colonnades are usually subject to this type of failure, which can find an answer in this calculation method.

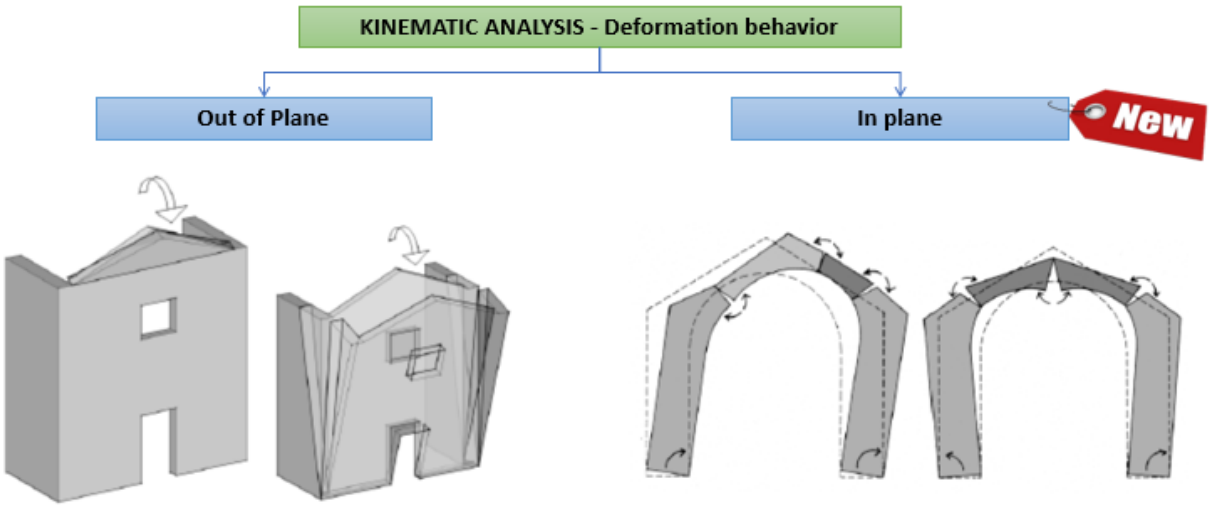


Figure 1: Behavior modes in the kinematic field

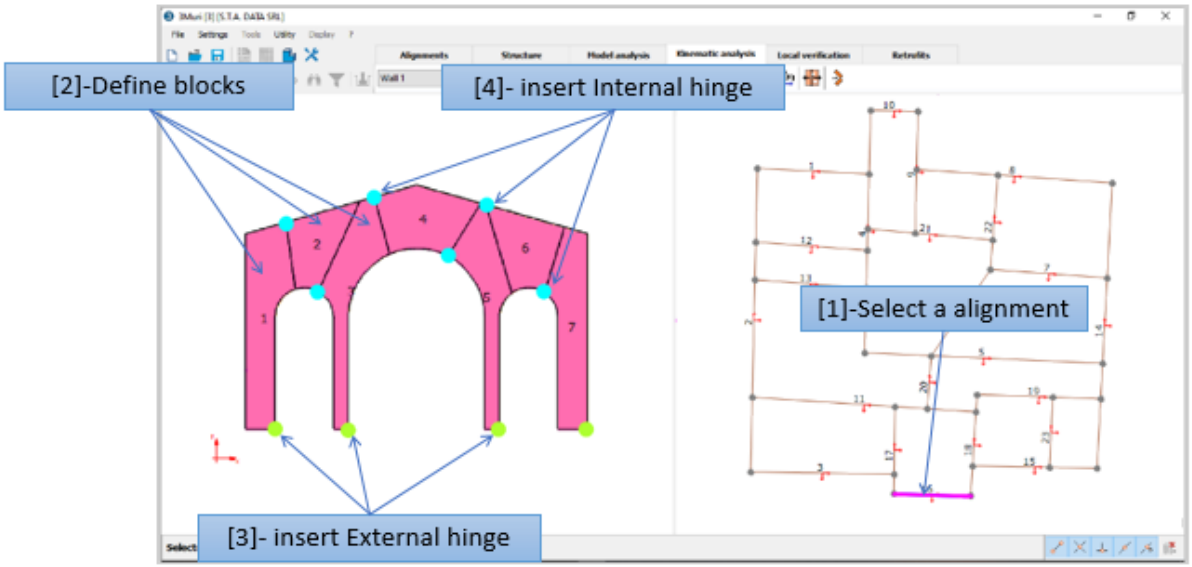


Figure 2: Input mode of a in-plane kinematic mechanism

Nonlinear kinematic analysis - (*Local mechanisms module*)

The non-linear calculation process is added to the linear kinematic analyzes currently present.

The advantages of this type of analysis become particularly evident in all those cases in which there are non-linear elements capable of influencing the mechanism: first of all, it is the insertion of a tie rod with elastic-plastic behavior which influences the result in the non-linear field.

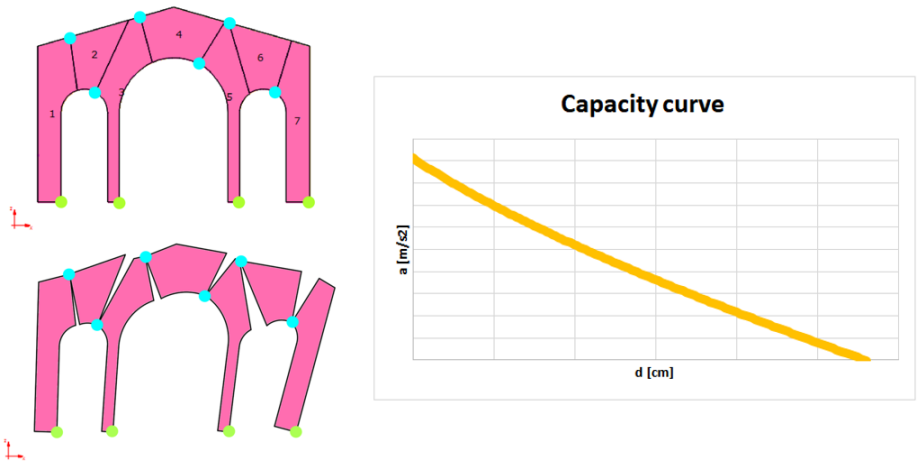


Figure 3: This figure shows the capacity curve produced by a non-linear analysis

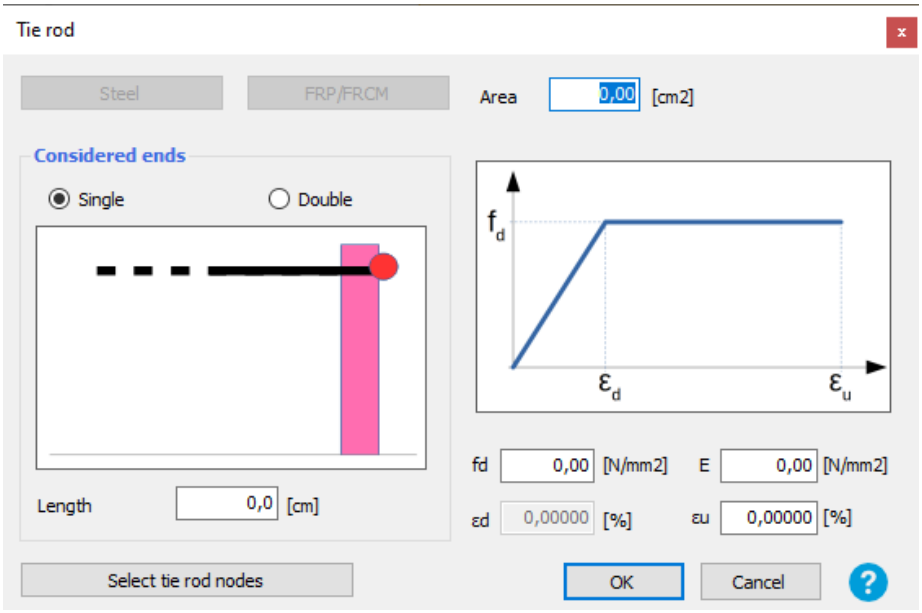


Figure 4: Tie rod insertion wizzard

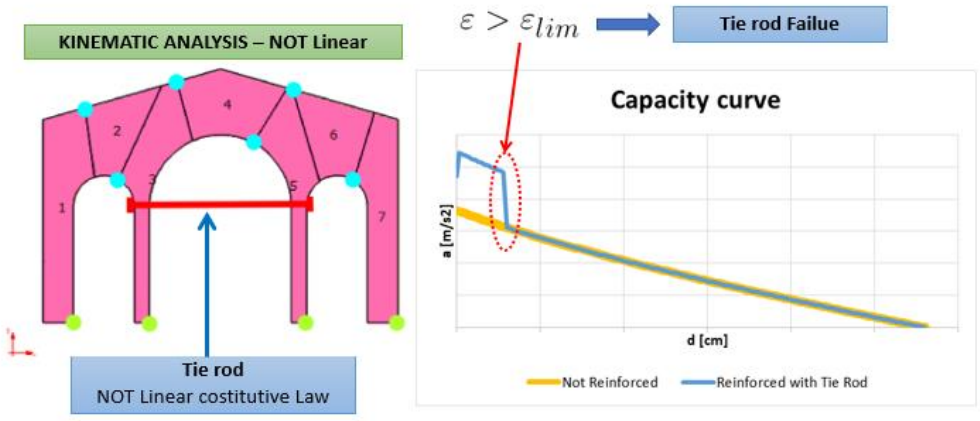


Figure 5: Benefits of a chain in a non-linear analysis

OPTIONAL MODULES

3MURI PROJECT OPEN

During the day-to-day design, we were too often constrained by the limitations of the calculation in defining the model.

In truth, it is the calculation that should be at the service of the structure and not vice versa.

Let's try to think of the Pushover calculation for seismic verifications: the requirement to be able to apply it is that the structure needs to have box-like behaviour, but very often we find ourselves working with buildings in which the box behaviour is only partially present, such as monumental buildings or building aggregates, in which the concept of plane depends on the structural unit in question.

This bears the question: Is this type of structure not possible to be calculated?, or does it simply need special attention that takes into account its peculiarities?

Obviously these structures must and can be calculated, but we must know how to identify the correct approach according to the portion of the building we are examining. Therefore, there will be parts of the building that can be calculated with the pushover (since they present Box-like behaviour) and other parts, for which a local verification such as a kinematic mechanism is necessary.

In order to be able to deal with the design as described above, *a modeling tool without geometric limits* is needed, this will be possible through a new input method that will be added to the one already present.

In addition to the modeling for horizontal planes made up of levels, there is also a modeling for vertical planes which allows you to enter irregular geometries in elevation with curved portions.

Obviously, the portions that meet the boxarity requirements can be calculated by pushover, while the excluded parts can be evaluated by kinematic analyses.

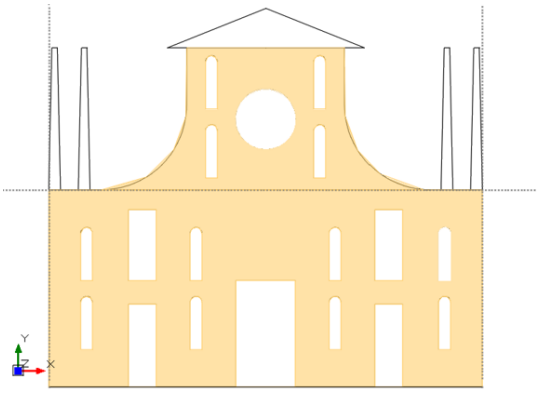


Figure 6: Example of a wall defined by irregular curvilinear elements

The walls modeled with these new methods can therefore be analyzed with all the kinematic analyzes currently available in 3Muri Project, that is to say: both in-plane and out-of-plane analyses, both linear and non-linear.

The functions described above (“In-plane kinematic analysis”, “Nonlinear kinematic analysis” and the “3Muri Project Open” optional module) are available for customers who already use the ML local mechanisms module as an optional module, to expand the range of the structures for which it is possible to carry out kinematic analyses.

For customers who do not yet have the ML module and want to enrich their configuration, the ML module is also available in its version extended to include the new 3Muri Project Open features.