STADATA
STRUCTURAL SOFTWARE

3muri Project

UPDATES VERSION 13.9

3Muri Project is constantly evolving: with the release of the version 13.9, new features and new modules enrich and enhance the program, to offer users an increasingly performing and complete tool.

Below, we provide further detail of the updates introduced.

LOCAL VERIFICATIONS

Arch module (optimized module)

Compared to the previous version, a great deal of effort has been invested into strengthening both the calculation method and the input method.

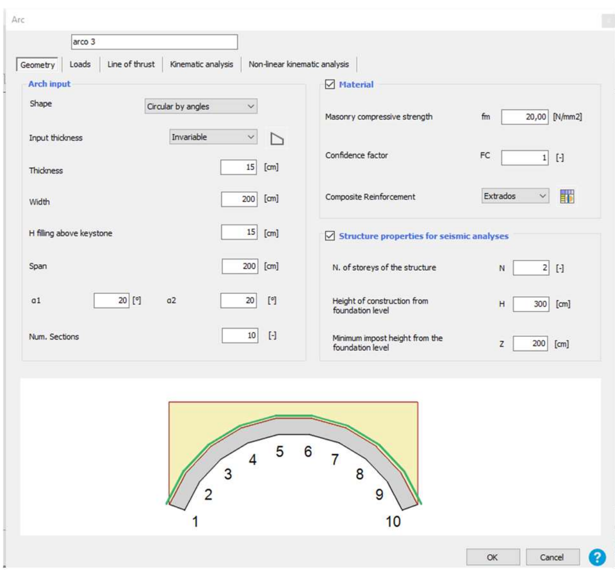
As regards the method of calculating the pressure curve, we moved from a purely elastic approach to one based on the more realistic "no-tension material" approach for materials such as masonry.
As regards the input method, it has been totally renewed to make the product more ergonomic. Also the reading of the results has been made simpler and easier to compare between the countless calculation methods.

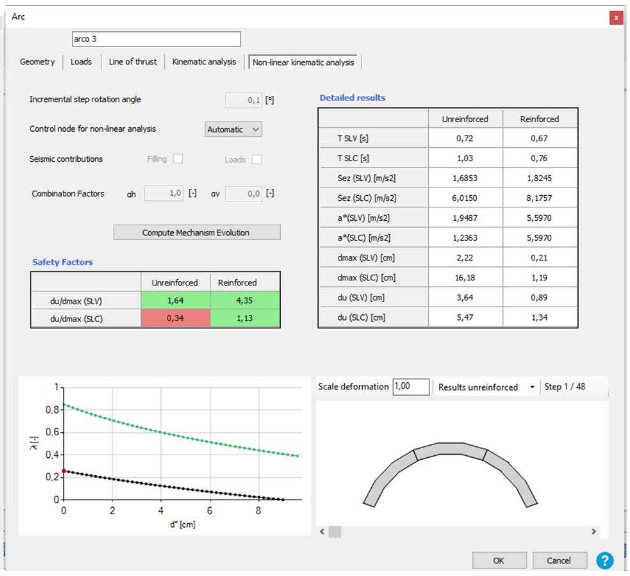
The Arch module allows limit analysis with a static and kinematic approach for arched structures of generic shape, and also fiber-reinforced with FRP / FRCM, pursuant to Circular no. 7 of 21 January 2019, of the LLPP Guidelines of 29 May 2019, of the CNR-DT 200 R1 / 2013 and of the CNR-DT 215/2018.

The calculation using the kinematic approach can be performed in the presence or absence of seismic forces. The general approach of the static method is the tracing of a funicular, which if it falls within the edges of the arch indicates its safety status.
The general principle underlying the kinematic analysis is that the structure is supposed to be three times hyperstatic and that, therefore, the collapse occurs when four degrees of freedom are added (with consequent transformation of the structure into a kinematism).

The module contains:

- Calculation of the pressure curve (non-reinforced arches)
- Checks of the structure following the static analysis
- Calculation of the kinematic chain under static loads (non-reinforced and reinforced arches)
- Calculation of the kinematic chain under seismic loads (non-reinforced and reinforced arches)
- Non-linear calculation of the kinematic chain (evolution of the collapse mechanism)
- Checks of the structure following the kinematic analysis.





Floors

Dowel bars (New module)

The dowel bar Module is a new module that works within the floor module

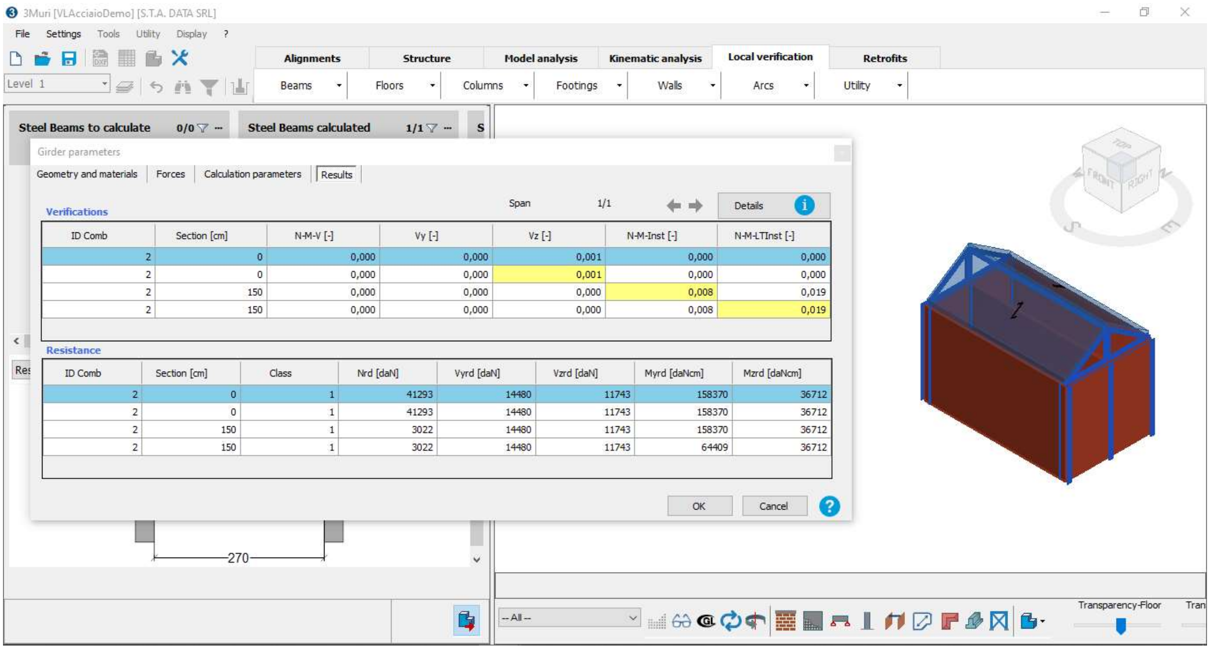
The Dowel bars module provides the verification of these elements, widely used in structural reinforcement interventions, which have the purpose of connecting two structural parts of the building (for example the floor with the perimeter wall) ensuring the resistance to sliding suitable to absorb the stresses of shear that are generated.

The dowel technique is relatively simple, inexpensive and minimally invasive.

Local verifications on steel (New optional module)

The panorama of existing masonry buildings is actually made up mostly of "mixed" buildings with most elements made of masonry, ie they simultaneously present structural elements in different materials (reinforced concrete, steel, wood, etc.), commonly modeled as rod elements (beams and columns).

The new verification feature of steel elements allows you to automatically extract, from the global model, the stresses acting in their sections of the element, to carry out their static verification.



Graphic results

The stresses in question are always exposed to the user in order to allow for any manual modification in order to manage any special cases that the designer must face in practice.

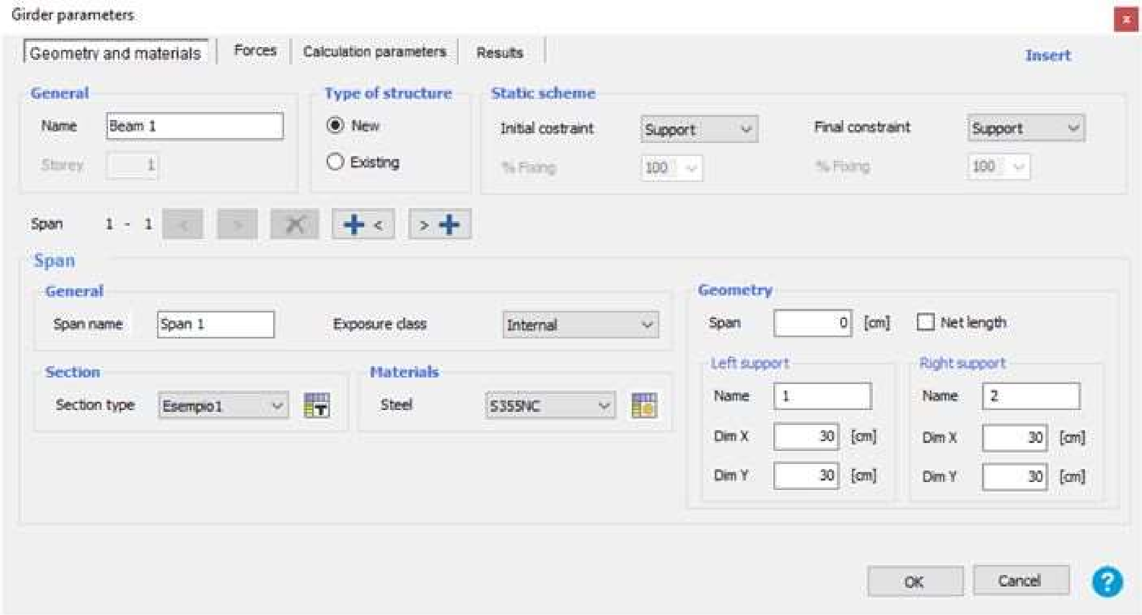
For steel rods the software performs:

• Classification of sections,

• Calculation of the effective sections if they fall into Class 4,

• Strength checks by combination of normal stress, shear and bending moment in the main directions,

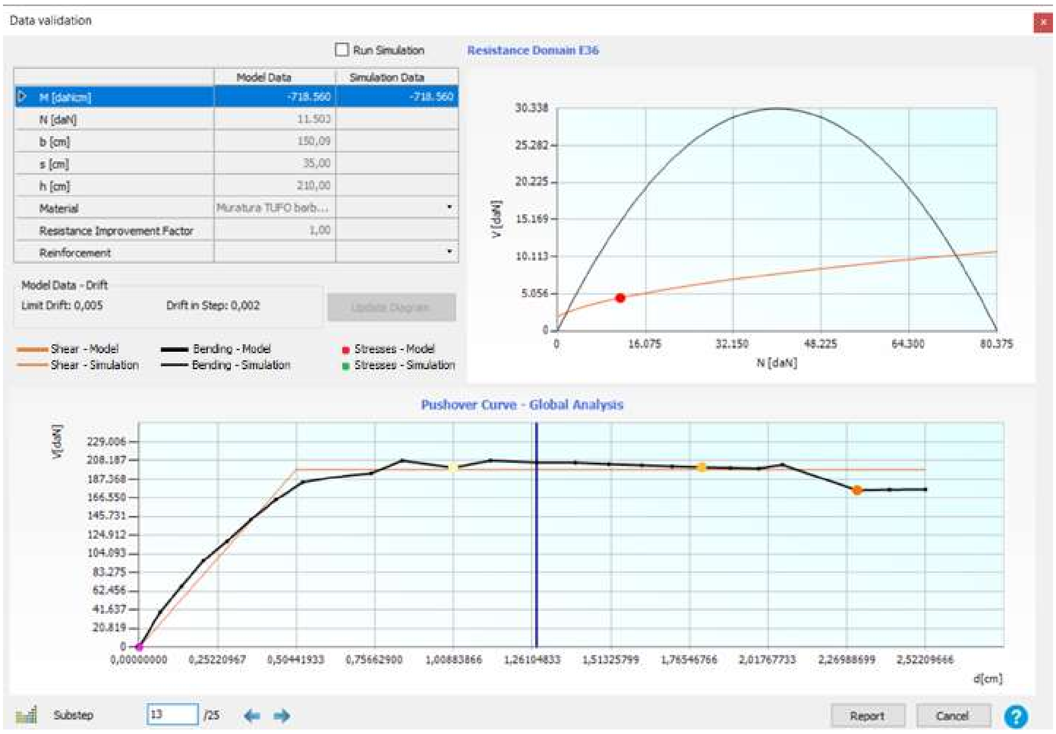
• Verification of instability for pressure and lateral flexion.



RELEVANT NEWS VERSION 13.5

Validation tools

The interpretation of the results obtained through a pushover analysis is often complex and this affects the choice of interventions to be applied to the structure.



Using this tool, it will be possible to view the relative resistance domains for each masonry pier and for each step of the curve.

The validation window provides the geometric and mechanical data of the wall segment in question, the stresses to which it is subjected, the limit drift of the element and the drift in steps.
There is also a graphic area in which the resistance domains of the element are traced and, by means of two circular indicators, the stress state of the element.
It is also possible to start a simulation by varying the parameters of the element (thickness, material, insertion of a reinforcement etc...) thus evaluating how the behavior of the element varies according to the changes made.
Finally, it is possible to create a report to be included in relation with formulations, graphs and results illustrated step-by-step.

This potential allows the designer to hypothesize “targeted” intervention choices, assessing potential improvements in advance, even before re-executing any pushover calculation.

A renovated solver

3Muri Project has been equipped with a new calculation solver that is even more powerful, reliable and efficient.

Each calculation engine constitutes a "container of knowledge" transformed into mathematics and is made up of two main components:

- Technical scientific knowledge
- Regulatory knowledge

Normative knowledge is not sufficient to perform a structural calculation since the normative texts consider that the technician is trained to conduct structural analyzes and contain little information to be considered completely thorough.

The information contained on current regulations therefore constitutes the guide to good performance design and to obtaining the minimum values that must be met.

To follow these directives, one cannot ignore the results of scientific research provided in countless publications.

The world of university research is in constant movement, in the constant search for procedures that can better represent reality through numerical modeling.

We have always worked closely with the academic world and, therefore, we are able to collect a large number of case studies, which arise from the direct and real experiences of designers who use software tools in real cases.

Addressing the practical problems that professionals have to overcome on a daily basis helps us to push ourselves further. We are constantly acknowledging the results of scientific research and looking for solutions that show results that are increasingly consistent with what was found on site. We then use different methods to address the problems that cannot be solved with only the support of current regulations.

The masonry can be schematized by different constitutive bonds to be adopted based on the characteristics of the masonry texture. Regarding this, the legislation is clear: the choice of reinforcing with FRP, FRCM or reinforced masonry is not made explicit for all the bonds. For this reason, well-founded and sufficiently tested theoretical assumptions are necessary to be considered valid for the greatest number of practical cases possible. This is just one of the countless examples in which scientific assumptions allow us to perform calculations that are aligned to the reality being examined, without which this would not be possible.

Scientific research is constantly evolving and, along with this, also our software: hence the birth of the new calculation solver integrated in the new version of 3Muri Project.

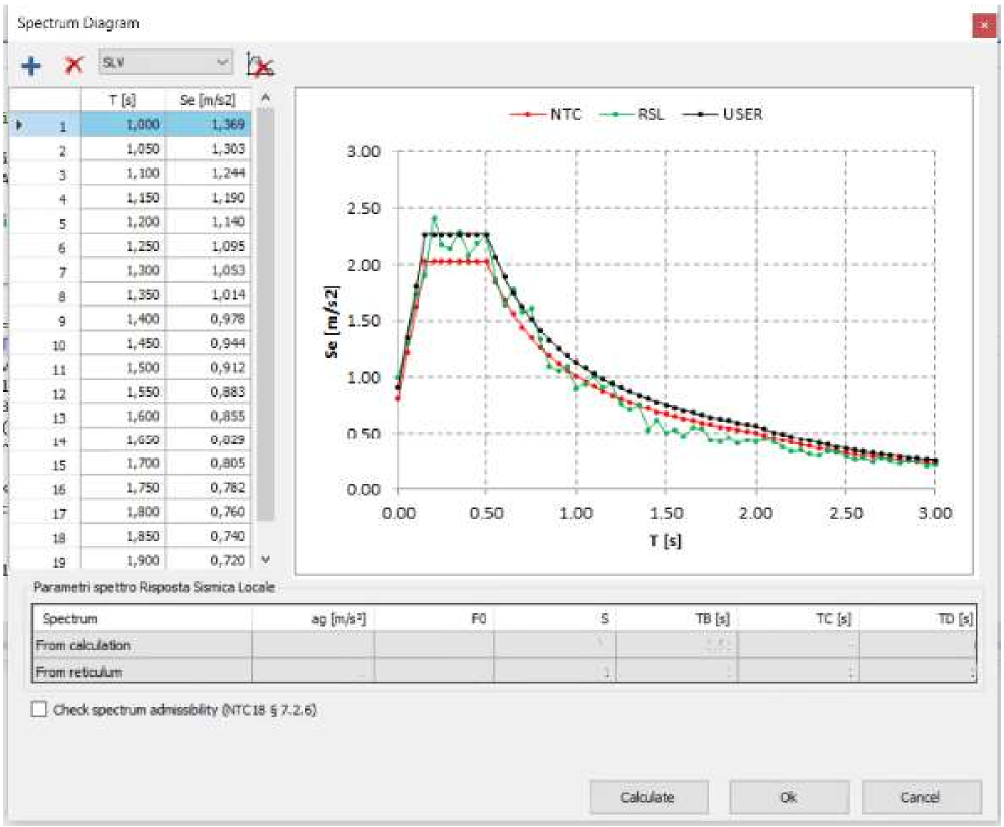
It can be observed that a calculation performed with the new solver will provide slightly different results from the previous one, but it is important to mention that this calculation is different because as research advances, the model can represent reality more accurately.

Local seismic response

Based on what is reported in Appendix 1- Annex 1 of Ordinance no. 55 of 24 April 2018, a procedure for regularizing a response spectrum produced by a numerical simulation is indicated, transforming it into a standard spectrum.

Thanks to the new module "Local Seismic Response" it will therefore be possible to transform the response spectrum, resulting from the numerical simulations in the MS3 studies, into a spectrum with a standard form, consisting of:

- a segment with linear increasing acceleration,
- a segment with constant acceleration,
- a segment in which the acceleration decreases with 1 / T and, therefore, at a constant speed.



At the end of the procedure, all the parameters for entering the elastic spectrum (a_g (m/s^2), T_B (s), T_C (s), T_D (s), F0, S) will also be available:

Spectrum Parameters Local Seismic Response

Spectrum	ag [m/s²]	F0 [-]	S [-]	TB [s]	TC [s]	TD [s]
from calculation LSR	1,00	2,20	1,00	0,17	0,51	2,01
from reticulum NTC						

This will allow to obtain a correct identification of the vulnerability parameters, both in terms of acceleration and return period, otherwise impossible through a single input point by point.

Kinematic analysis: conservation of mechanisms with mesh regeneration

In previous versions, the remaking of the model mesh forced the elimination of any local mechanisms previously defined.

With the addition of this novelty, it will be possible to keep, even after the model mesh has been remade, all the mechanisms whose definition is aligned with the data defined in the structure.

For this reason, a series of automatic checks have been included with the aim of helping the user in assessing the compliance of the mechanism with the model and therefore in the choice of keeping the defined mechanisms or not.