Release note

Version 2024.0

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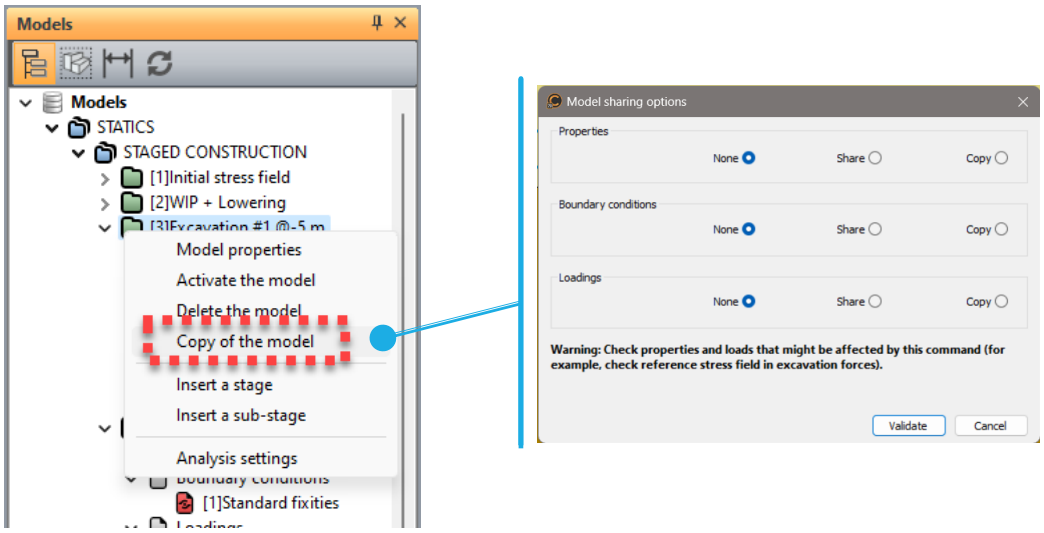
1. Improved management of staged construction

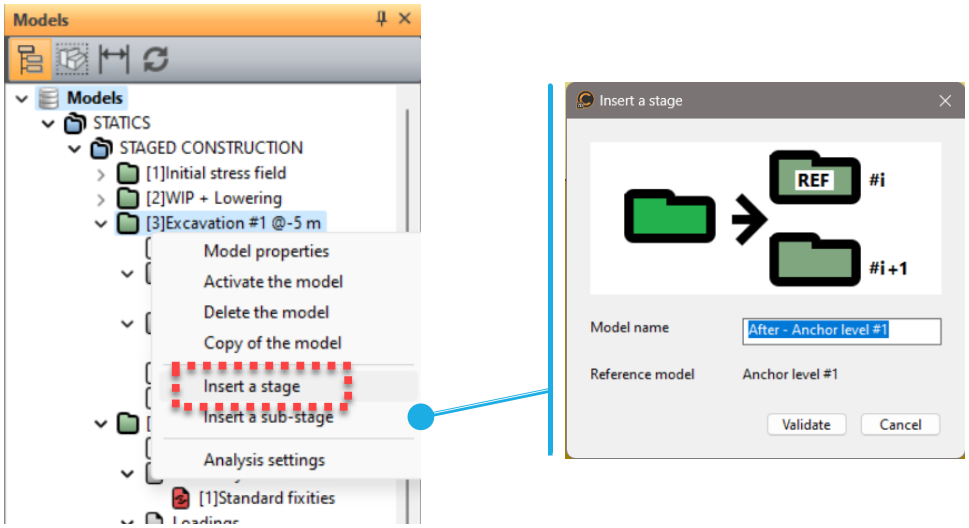
1.1. Edition eased: copy/share option

When using "Copy of a model" for editing a new model, the use has now the choice to specify the actions (Copy, Share, or nothing) to be applied on the various sets of "Properties", "Boundary conditions" and "Loadings".



1.2. Staged construction process

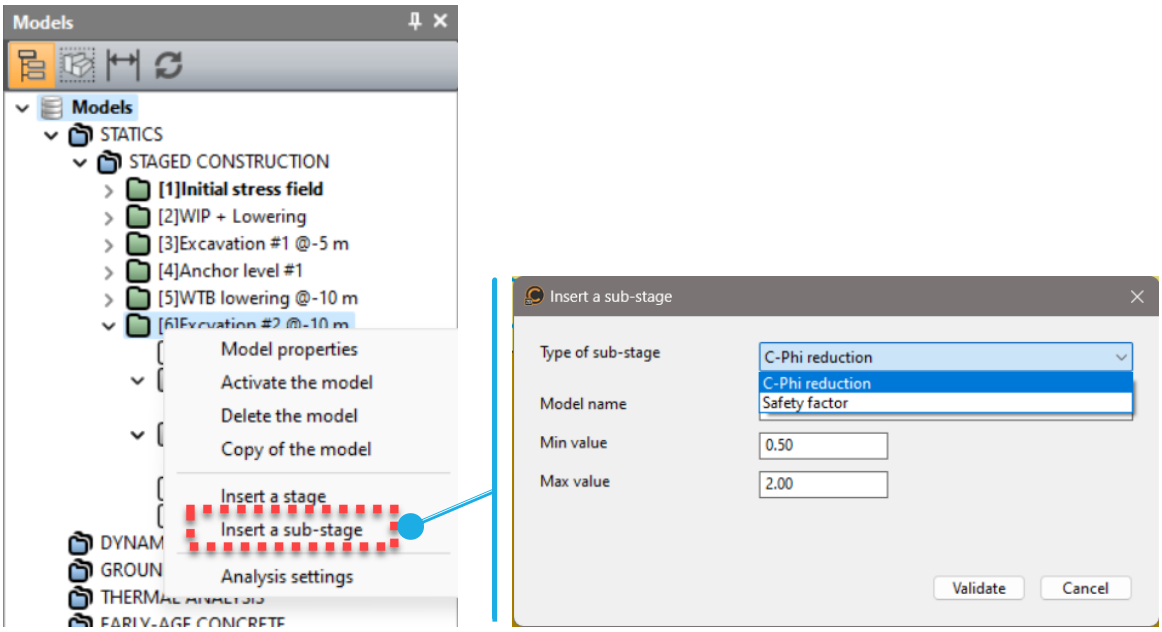
The models defined as "Staged construction" are now all listed in a specific tree.
In this tree; it is now possible to insert a model in a staged construction process. When activating "Insert a stage", the user will the name of the new model, insert after the reference model.



1.3. Sub-stages for safety factors analysis

In the tree “Staged construction” user can add “sub-stages” that will propose the 2 predefined analyses: c-phi reduction and safety factor (on load).

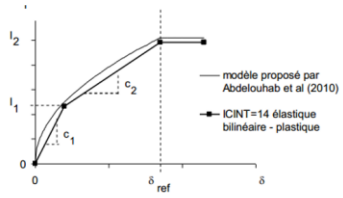
With the future evolution of EC7, it offers an additional useful analysis feature to the geotechnical engineer.



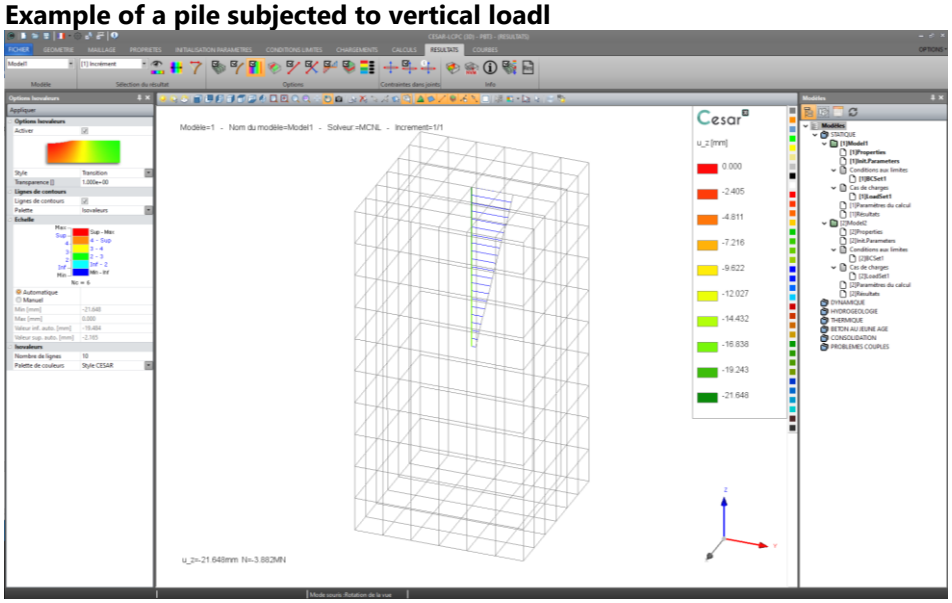
2. New features for modeling

2.1. Modelling of a pile: friction beam + pile tip

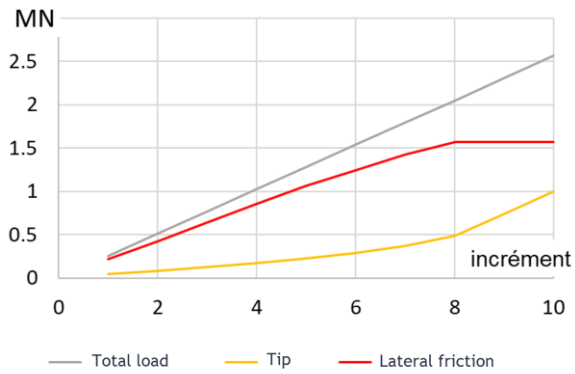
As for the friction bar bodies (integrated in version 2022), the beam 1D-bodies can now have an interface behaviour, related to the lateral friction coefficient qs (see below).
The model of the pile is completed by the introduction of a pile tip which allows to consider the tip capacity.

élastique linéaire + plasticité parfaite	C_i , I_{max}	$C_i = I_{max}$ / longueur nécessaire pour mobiliser q_s $I_{max} = q_s \times \pi \times D$ (pour un boulon)
élastique bilinéaire + plasticité parfaite	C_{i1}, C_{i2}, I_1, I_2	$I = Min\ [C_{i1}\ \delta, I_1 + C_{i2}\ \delta - I_1\ C_{i2}/\ C_{i1}, I_{max}\ ]$ 

Example of a pile subjected to vertical loadl



Graph of the load transfer in the pile



2.2. Imposed strains and swelling

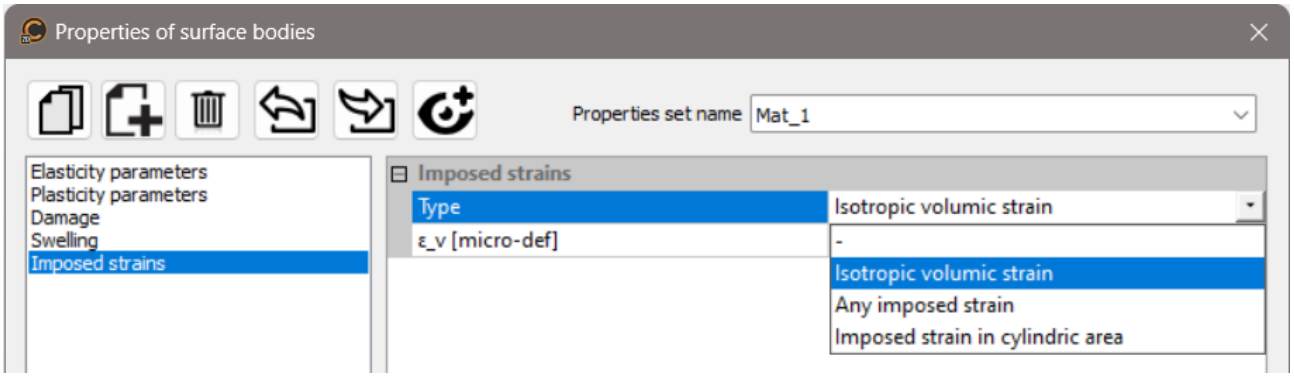
"Imposed strain" of "Swelling" are proposed as additional components of a surface body (2D) or a volume body (3D) property set. The choice of one of these allows to model various types of soil behaviours. For example:

- the swelling during the frost,
- the contraction of an excavation, like during the process of a tunnel boring machine.
- the expansion during injections.

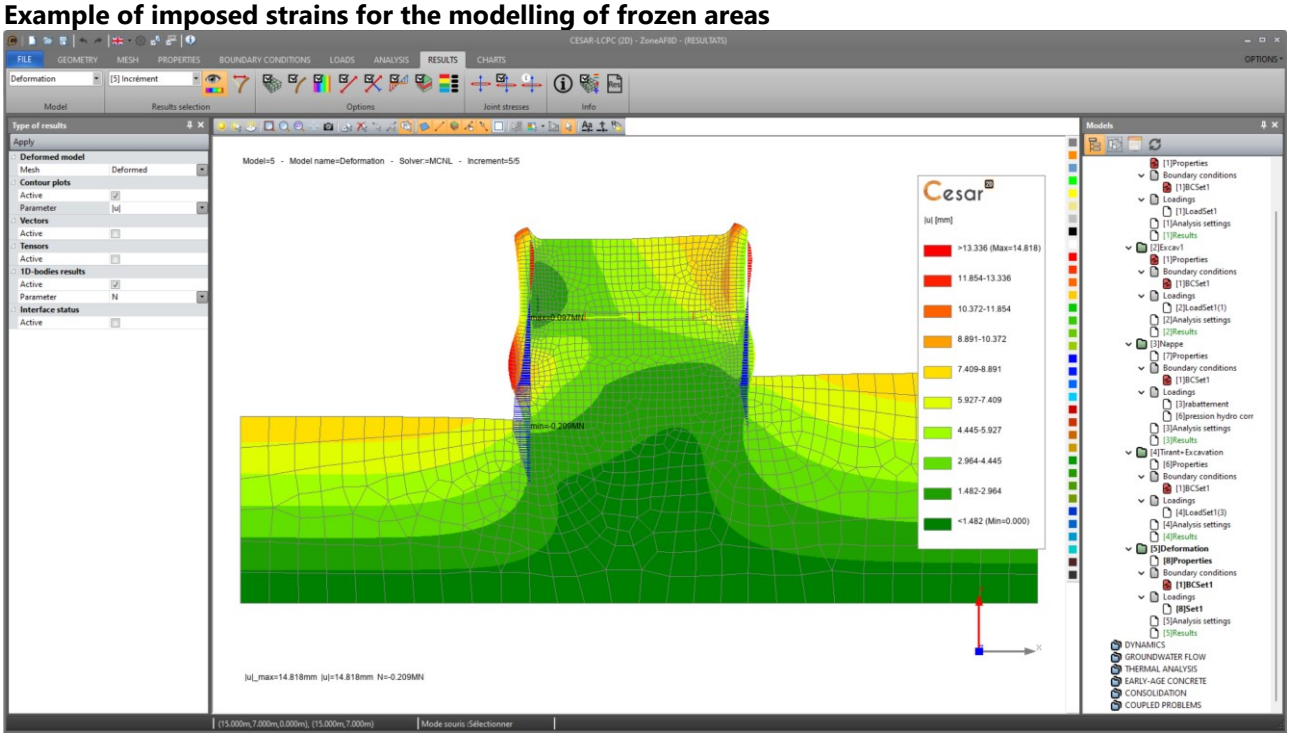
2.2.1. Imposed strains

3 types are proposed in both 2D and 3D environments:

- Standard isotropic volumic strain: ε_v in 2D and 3D,
- Generalised strain: ε_xx, ε_yy , ε_xy , εzz in 2D and 6 components in 3D,
- Imposed strain limited in a cylindric area.



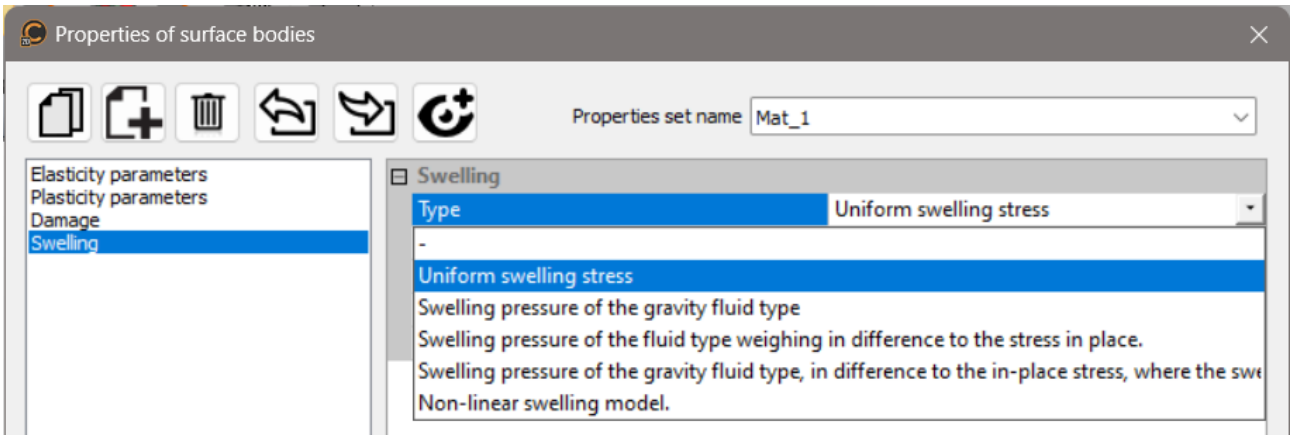
Example of imposed strains for the modelling of frozen areas



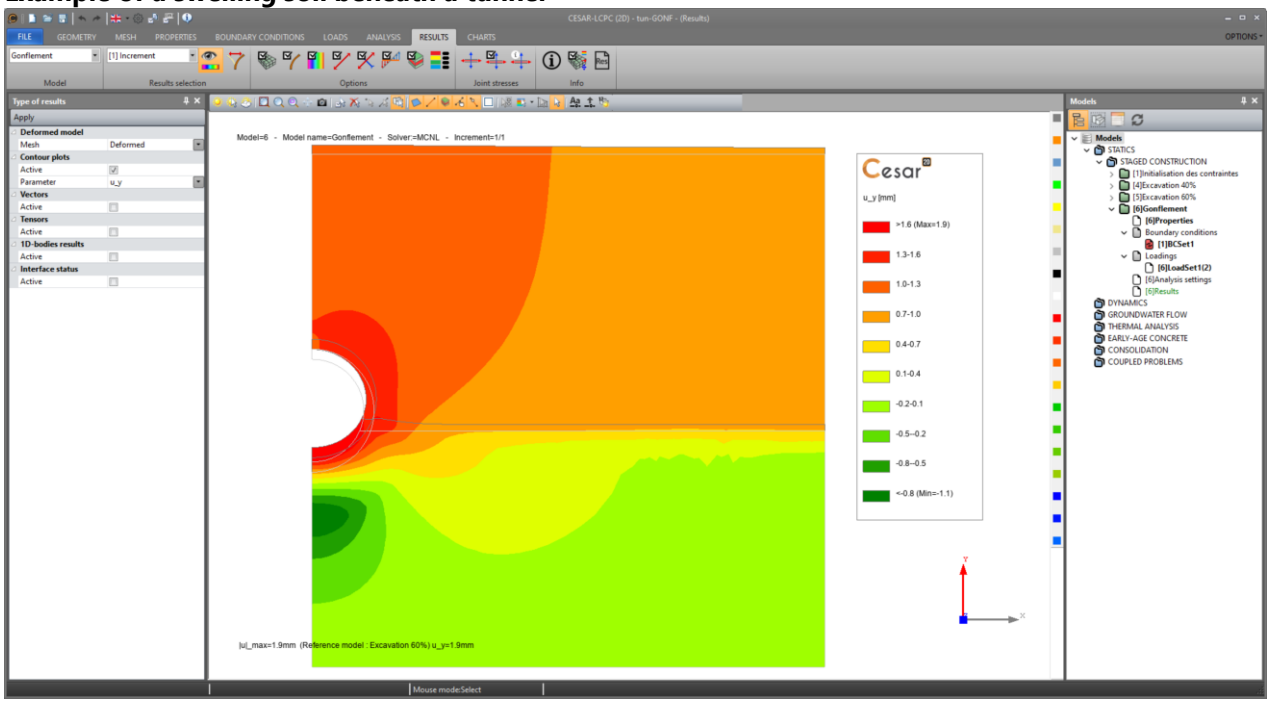
2.2.2. Swelling

Various types of swelling are offered:

- Uniform swelling stress,
- Fluid weight isotropic pressure (and variants with the in-place stress)
- Non-linear swelling model.



Example of a swelling soil beneath a tunnel

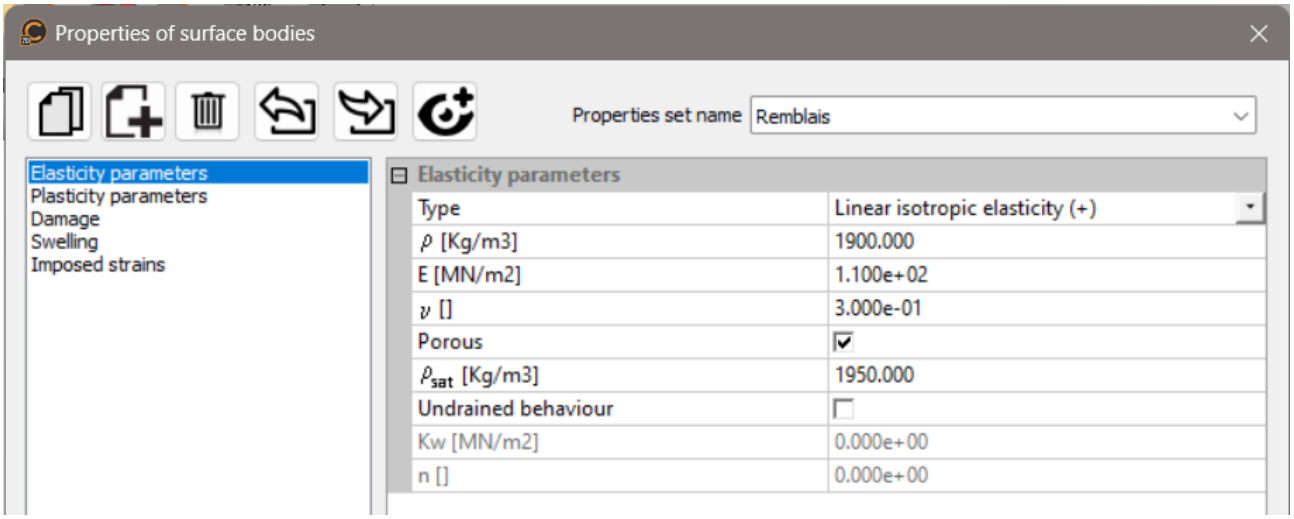


2.3. Properties toolbox

This update of the toolbox prefigures the evolution of this tool in next version 2025, where the materials will be defined by a type.

In the present version, the user sets if the material is porous or not. Thus, the user can set additional associated parameters:

- ρ_sat, used in the definition of the water-table (load WTB),
- Drained or undrained behaviour.



During the edition of the water table initialisation and variations using the load type “WTB” (under LOADS), the unit density, ρ, and saturated density, ρ_sat, will be used as volume weights and applied to selected bodies.

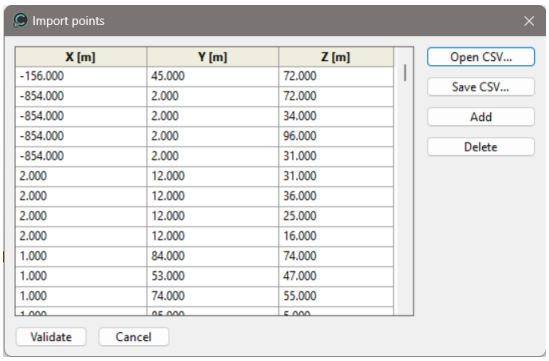
3. General

3.1. Geometry edition

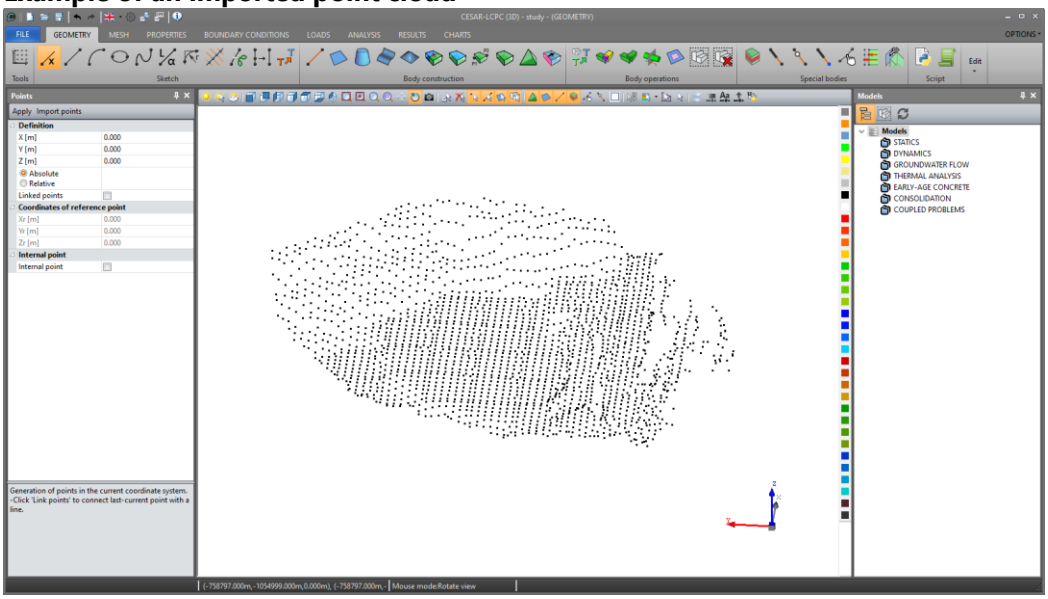
3.1.1. Import of points

Txt or csv files import is proposed for the geometry definition in both 2D and 3D.

Access **Points** tool, then click on “Import points”.

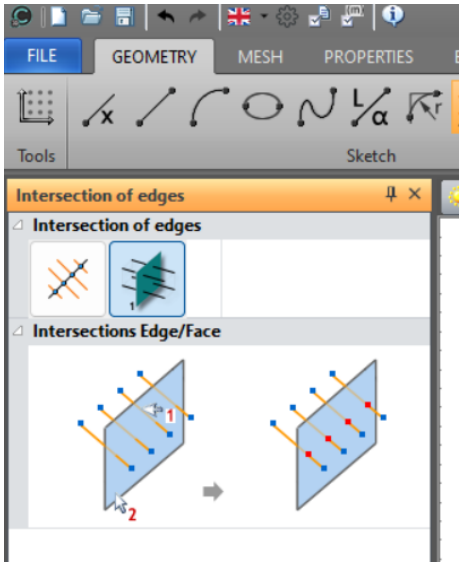


Example of an imported point cloud

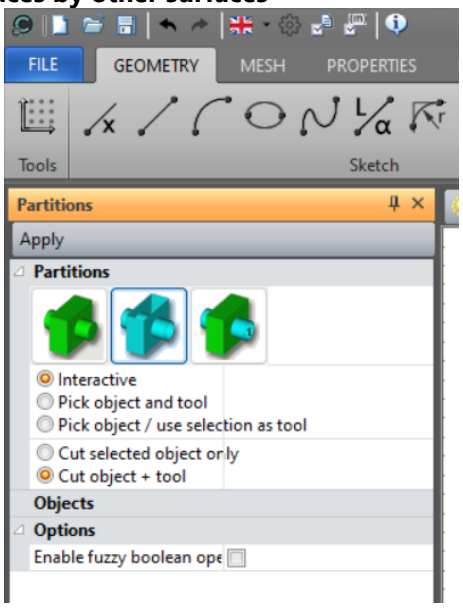


3.1.2. Additional intersection functions

lines and surfaces



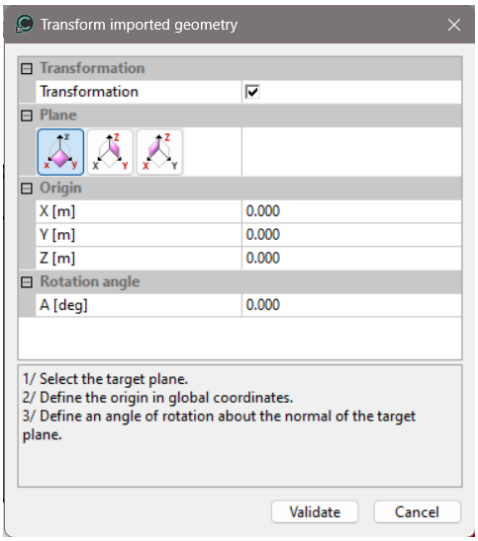
surfaces by other surfaces



3.1.3. Toolbox for import of 2D models in CESAR 3D

In FILES menu, the user accesses the tool “Import”. When activated, this tool proposes several types of files format. When selecting “*.cleo26”, a specific toolbox is displayed.

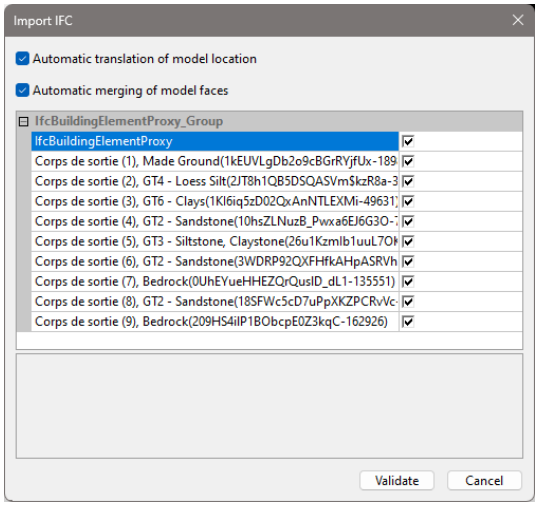
The common use is to define the Oyz or Oxz plane as final destination.



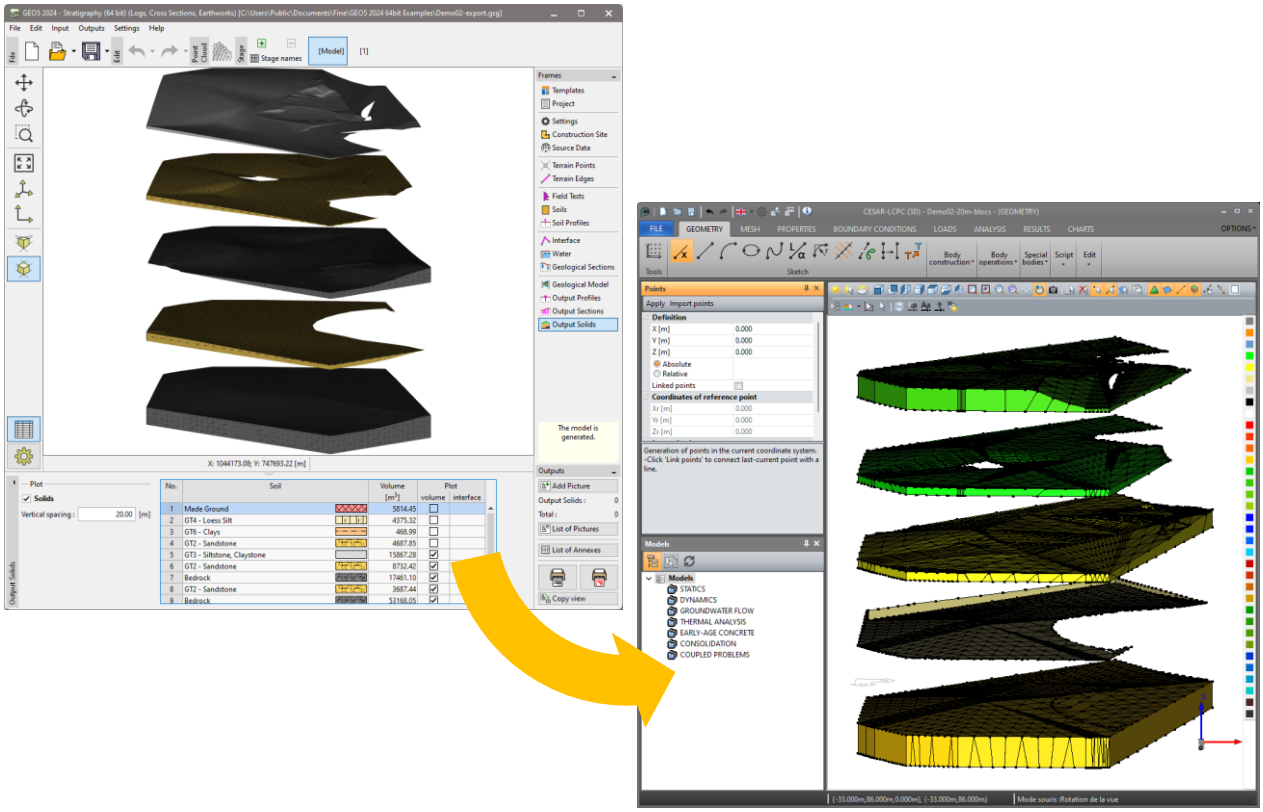
3.1.4. Toolbox for import of IFC files in CESAR 3D

With the emerging of BIM, the IFC format is recognized as a universal standard.
The toolbox will be continuously updated to fit various types of geometries and formats proposed by editors.
In the present version, we developed the import of IFC from the GEO5 programs. The resulting geometry is composed of surface bodies that can be edited for the completion of a volume model.

FILE> Import > "ifc" or "ifzip" file > Open.



IFC import from GEO5 Stratigraphy



3.2. Mesh

3.2.1. GMSH surface mesher

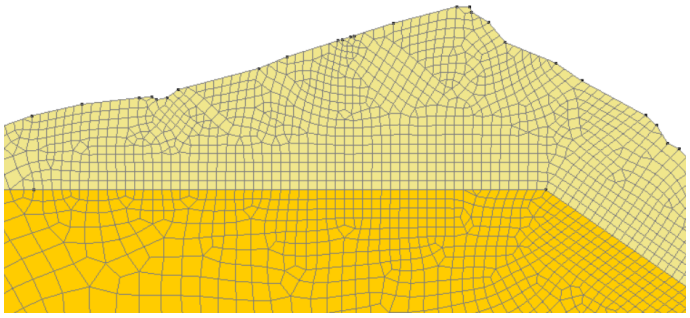
The GMSH library is now introduced as an alternative for the surface meshing.
For quadrangular meshes, it is the default mesher. It fills surfaces with quadrangular elements as much as possible. It is therefore very well suited for the meshing of surface bodies that are dedicated to the modelling of structures (like walls, linings…).

The GMSH mesher is proposed with several algorithms:

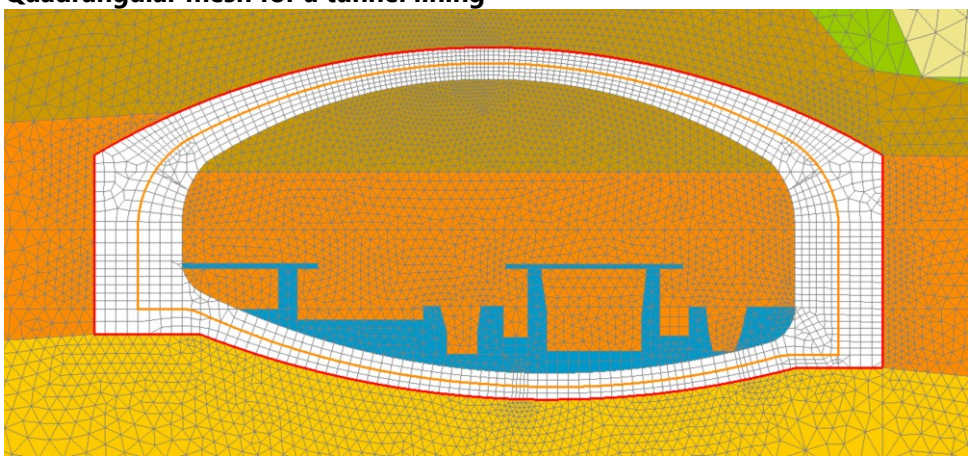
- MeshAdapt : robust for complex, curved surfaces
- Frontal-Delaunay : When high element quality is important
- Delaunay : the fastest (for very large meshes)
- Automatic : Delaunay for planes / MeshAdapt for other surfaces
- DelQuad : best suited for quadrilateral meshes

The DelQuad is proposed as default option.

Quadrangular mesh for a general surface.

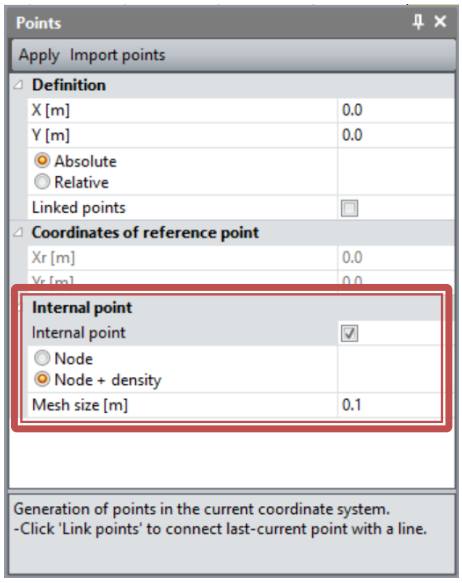


Quadrangular mesh for a tunnel lining

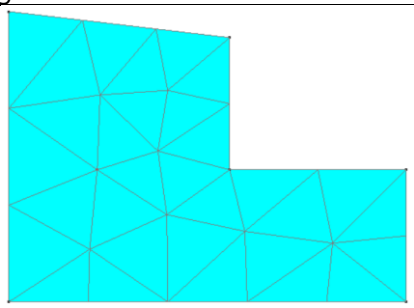
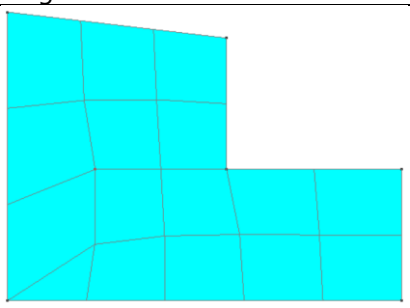
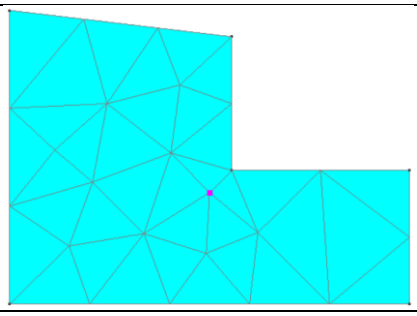
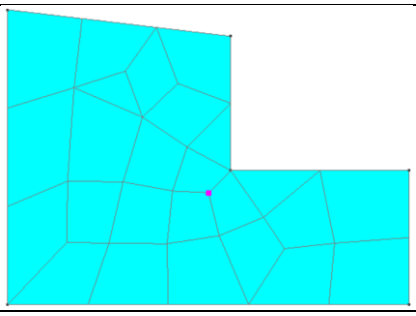


3.2.2. Density points

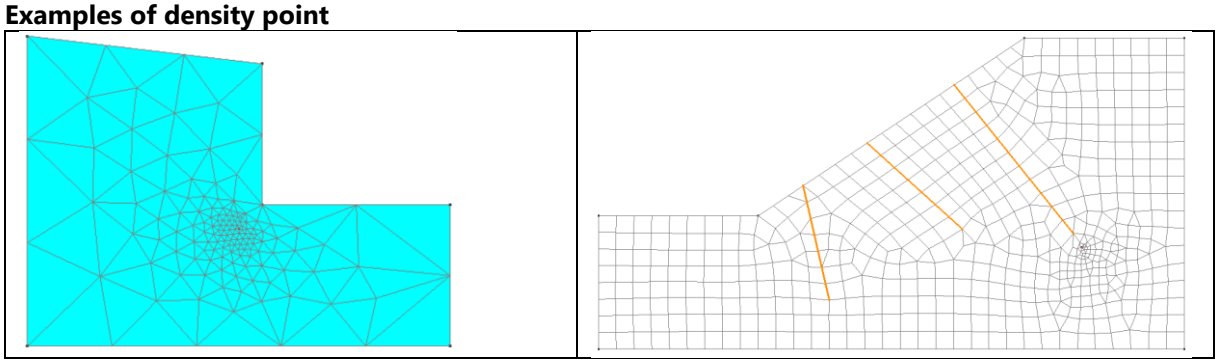
This feature is proposed in GEOMETRY as an option when editing a point. It can be a simple internal point forcing the mesh to pass through it or a density point with a mesh prescribed density defined around it.



Examples of inner point influence on the surface mesh.

	Triangle	Quadrangle
Without inner point		
With inner point		

Examples of density point



3.3. Results

3.3.1. Status of the results displayed in the model tree

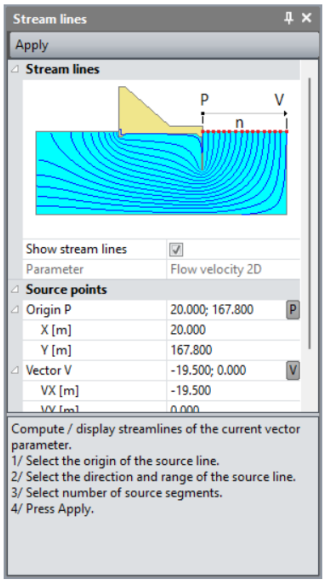
The status of the calculation is now displayed in the tree, following this colour scheme:

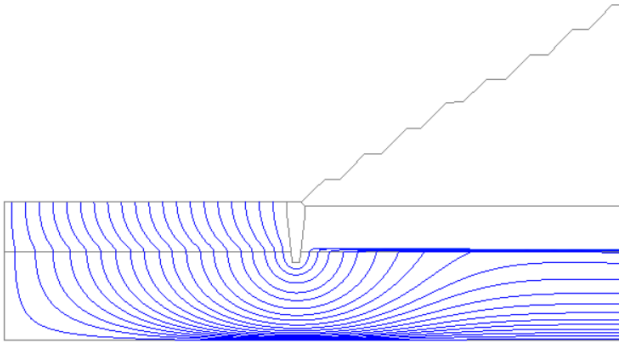
- Green: calculation is ok.
- Red: the calculation is not completed due to non-convergence of the iteration process or to an error.
- Orange: the calculation was previously ok, but a modification of the model made the results incompatible with the actual state of the model. A new calculation of the model is required.

3.3.2. Flow lines

For Hydrogeological analysis, the display of flow lines is proposed.

Activate the tool  *.Streamlines.*



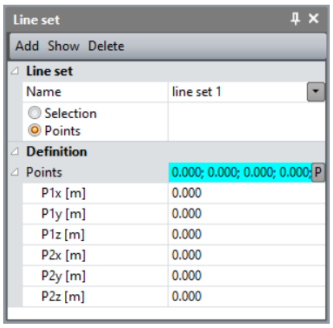


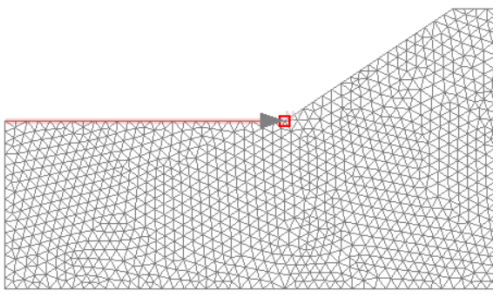
3.4. Charts

3.4.1. New tools for line set edition

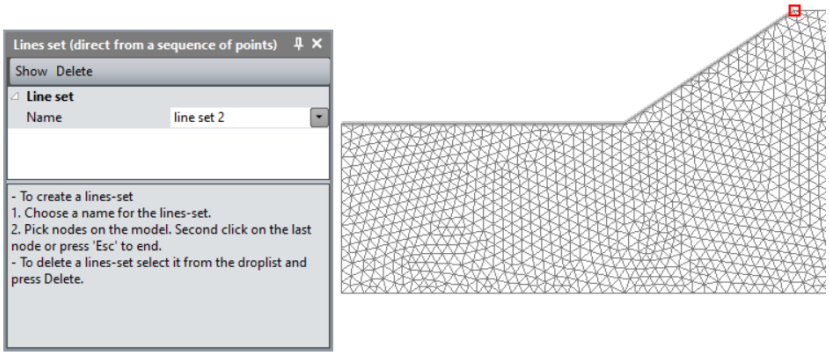
The edition of a line set is now possible in a more interactive way, by the sequence of selection of 2 (or more) points on the model.

Tool  *: interactive definition with 2 points (start and end).*





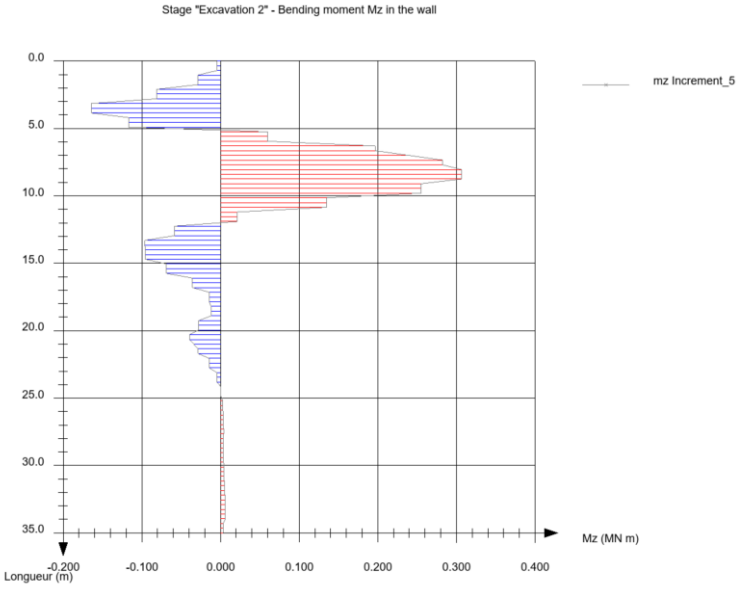
Tool : interactive definition with several segments.



3.4.2. Interchange axis

Additional options are proposed for better charts edition:

- Swap x-axis and y-axis .
- Invert orientation of vertical axis .



3.5. Python scripts

3.5.1. Updated manual

3.5.2. New access button in GEOMETRY

3.5.3. Added modeling functions

The development of CESAR features with Python is under continuous process through the various releases.

In the present version and as example, several modeling functions have been added. Among them, we listed:
- Make an edge based on circle (current version creates an edge on ellipse),
- Make a face of revolution from a selection of edges,
- Make a face of revolution by revolving an edge,
- Find the common faces of bodies.