

Release note Version 2024.0

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Table of contents

1. Improved management of staged construction	5
1.1. Edition eased: copy/share option	5
1.2. Staged construction process	5
1.3. Sub-stages for safety factors analysis	6
2. New features for modeling	7
2.1. Modelling of a pile: friction beam + pile tip	7
2.2. Imposed strains and swelling	8
2.2.1. Imposed strains	8
2.2.2. Swelling	9
2.3. Properties toolbox	10
3. General	11
3.1. Geometry edition	11
3.1.1. Import of points	11
3.1.2. Additional intersection functions	12
3.1.3. Toolbox for import of 2D models in CESAR 3D	12
3.1.4. Toolbox for import of IFC files in CESAR 3D	13
3.2. Mesh	14
3.2.1. GMSH surface mesher	14
3.2.2. Density points	15
3.3. Results	16
3.3.1. Status of the results displayed in the model tree	16
3.3.2. Flow lines	16
3.4. Charts	16
3.4.1. New tools for line set edition	16
3.4.2. Interchange axis	17
3.5. Python scripts	18
3.5.1. Updated manual	18
3.5.2. New access button in GEOMETRY	18
3.5.3. Added modeling functions	18

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.



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 , ε_zz in 2D and 6 components in 3D,
- Imposed strain limited in a cylindric area.

Properties of surface bodies				×
04•95	2 C	Properties set name Mat_1		~
Elasticity parameters Plasticity parameters Damage	☐ Imposed strain Type	ns	Isotropic volumic strain	•
Swelling Imposed strains	ε_v [micro-def]	- Isotropic volumic strain Any imposed strain	
			Imposed strain in 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.

Properties of surface bodies		×
11 14 11 12 12	Properties set name Mat_1	~
Elasticity parameters Plasticity parameters Damage Swelling	 ☐ Swelling Type Uniform swelling stress Swelling pressure of the gravity fluid type Swelling pressure of the fluid type weighing Swelling pressure of the gravity fluid type, i Non-linear swelling model. 	Uniform swelling stress

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.

Properties of surface bodies			×
□[+ ■ � ⊻	Properties set name	Remblais	~
Elasticity parameters	Elasticity parameters		
Plasticity parameters Damage	Туре	Linear isotropic elasticity (+)	•
Swelling	ρ [Kg/m3]	1900.000	
Imposed strains	E [MN/m2]	1.100e+02	
	ν []	3.000e-01	
	Porous		
	ρ _{sat} [Kg/m3]	1950.000	
	Undrained behaviour		
	Kw [MN/m2]	0.000e+00	
	n []	0.000e+00	

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".

X [m]	Y [m]	Z [m]	Open CSV
156.000	45.000	72.000	
-854.000	2.000	72.000	Save CSV
-854.000	2.000	34.000	Add
-854.000	2.000	96.000	
-854.000	2.000	31.000	Delete
2.000	12.000	31.000	
2.000	12.000	36.000	
2.000	12.000	25.000	
2.000	12.000	16.000	
1.000	84.000	74.000	
1.000	53.000	47.000	
1.000	74.000	55.000	
1.000	05.000	5.000	

Example of an imported point cloud



3.1.2. Additional intersection functions



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.

Transform imported geor	metry 🔅
Transformation	
Transformation	V
Plane	
Origin	
X [m]	0.000
Y [m]	0.000
Z [m]	0.000
Rotation angle	
A [deg]	0.000
1/ Select the target plane. 2/ Define the origin in globa 3/ Define an angle of rotatio plane.	al coordinates. In about the normal of the target
	Validate Cancel

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.

mport IFC	×
Automatic translation of model location	
Automatic merging of model faces	
IfcBuildingElementProxy_Group	
IfcBuildingElementProxy	
Corps de sortie (1), Made Ground(1kEUVLgDb2o9cBGrRYjfUx-18	9 🔽
Corps de sortie (2), GT4 - Loess Silt(2JT8h1QB5DSQASVm\$kzR8a-	3 🔽
Corps de sortie (3), GT6 - Clays(1Kl6iq5zD02QxAnNTLEXMi-4963	1) 🔽
Corps de sortie (4), GT2 - Sandstone(10hsZLNuzB_Pwxa6EJ6G3O-	
Corps de sortie (5), GT3 - Siltstone, Claystone(26u1Kzmlb1uuL7C	
Corps de sortie (6), GT2 - Sandstone(3WDRP92QXFHfkAHpASRV	h 🔽
Corps de sortie (7), Bedrock(0UhEYueHHEZQrQusID_dL1-135551) 🔽
Corps de sortie (8), GT2 - Sandstone(18SFWc5cD7uPpXKZPCRvV	c. 🔽
Corps de sortie (9), Bedrock(209HS4ilP1BObcpE0Z3kqC-162926)	V
Val	idate Cancel



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.

Points	д×
Apply Import points	
Definition	
X [m]	0.0
Y [m]	0.0
 Absolute Relative 	
Linked points	
Coordinates of reference point	
Xr [m]	0.0
Vr [m]	0.0
Internal point	
Internal point	\checkmark
○ Node	
Node + density	
Mesh size [m]	0.1
Generation of points in the current co -Click 'Link points' to connect last-co	oordinate system. urrent point with a line.

Examples of inner point influence on the surface mesh.



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.

CO Tool \sim : interactive definition with 2 points (start and end).

Line set		д×
Add Show Delete		_
Line set	line set 1	
© Selection © Points	ine set 1	
Definition		
Points	0.000; 0.000; 0.000; 0	.000; P
P1x [m]	0.000	
P1y [m]	0.000	
P1z [m]	0.000	
P2x [m]	0.000	
P2y [m]	0.000	
P2z [m]	0.000	

C 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 $\overset{\mathbf{x}}{\longleftarrow}$.
- Invert orientation of vertical axis \mathbf{T} .





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.