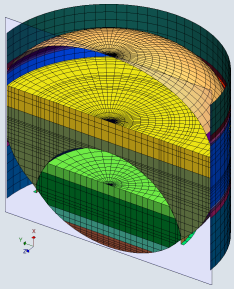
PERMAS Component Generator

A VisPER add-on for launcher model *fast* generation

What is PCGen?

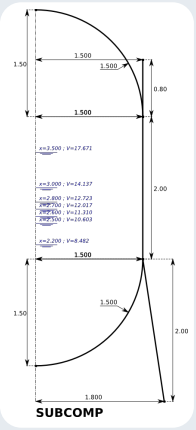
PCGen is a model generator, integrated to VisPER and **specialized** in quasi axisymmetrical structures. Although it generates meshes, PCGen is *not* a mesher. It aims at creating **complete F.E. models** with automatic nodes and elements sets, materials, properties, loadings (for example pressure in tanks and boosters) and analysis situations. Its primary purpose is to **reduce the complexity of the whole F.E. model creation process,** so it generates also **automatic plans and reports**.

Features



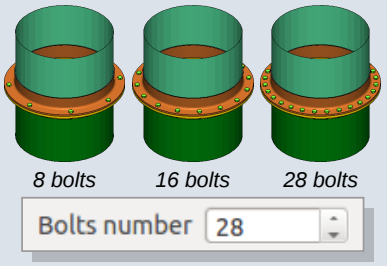
Tank model generated by PCGen
Automatic node and element sets for different filling levels of tanks

Being specialized and integrating standards whenever possible, PCGen tries to work with the minimal amount of inputs, **allowing non-specialists to generate models in a safe and fast way**. Interface's information reflects the physical concept, and petty details such as local definition of material referential angle are kept out the way as much as possible.

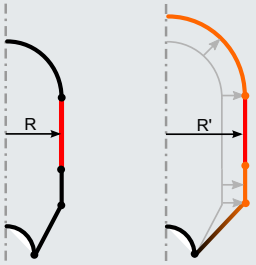


Plan generated by PCGEN

Objects in PCGen are highly dynamic and connected, to avoid information duplication and to **fasten variant generation**, but also to allow for **immediate feedback** about geometries, masses, volumes... or inconsistencies that might arise during the edition. In fact, PCGen can also be used as a desktop calculator for a **primary design verification**, for example to get the analytical volume of a tank. In the future, it will integrate more dedicated tools for convenient inputs (analytical eigen-frequencies computation, analytical inertia, standards bolts dimensions, etc.).



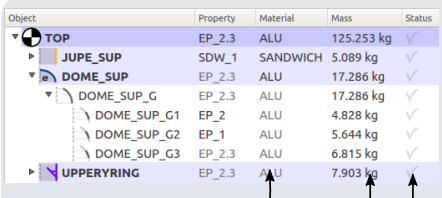
Fast generation of flange variants



Initial geometry *Radius of the red cylinder is changed*

Geometry adaptation

Information duplication is also limited thanks to the use of **inheritance**. Objects are stored in a hierarchy, they inherit default material and properties from their parents, while mass is cumulated bottom-up.



Inherited data are in grey
Analytical masses are cumulated
Objects consistency is checked

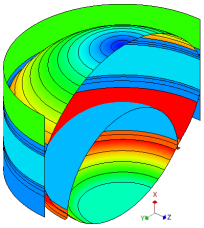
Hierarchy tree

PCGen generates quality PERMAS DAT files, keeping them compact and at a high level of abstraction, using loops or boolean definitions of sets. It also allows the user to **comment each object**, exporting $COMMENT and DESCRIPTION cards. Names are interactively corrected to be unique and abide by PERMAS rules.

Products

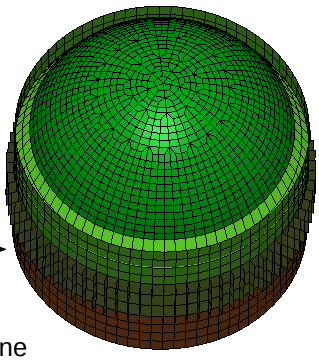
PCGen is not an all-purpose mesher, it is a **specialized** tool, that aims at integrating standards for model generation, as well as providing a convenient and adapted interface for model definition. Thus, it focuses mainly on the following products:

Shell structures



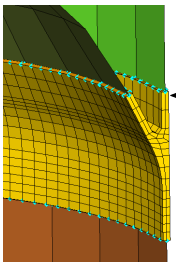
Pull and plug parts from a **library.**

Once parts are connected, their **geometry are automatically adapted to each other**, so one radius change for example calls for an automatic update of all parts.

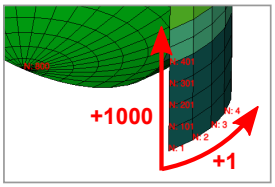


Special quad-only mesher for bottom parts.

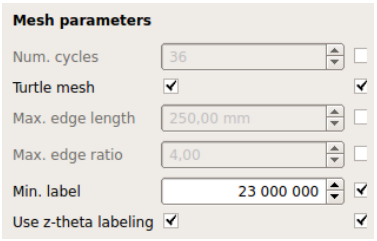
Shell property: handling of **thickness variation**.
Possibility to split a section and affect various properties along a line (for example, to modelize circumferential welds)



In progress **Volumic meshing of** thick parts, with handling of the solid-shell transition, and generation of the fluid interface and pressurization skins whenever needed.



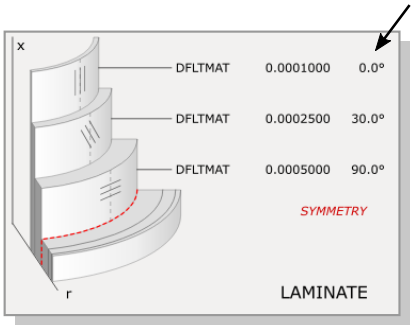
Nodes and elements numbering are related to their vertical and circumferential position (optional).



One minimum label, available for each object in PCGen, pilots the numbering of nodes, elements, local systems, lines and surfaces, and MPC definitions belonging to that object.

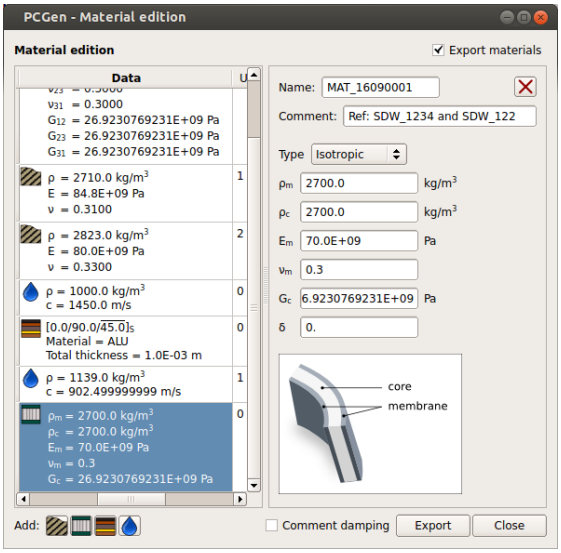
Laminate

Interactive edition of the laminate with preview

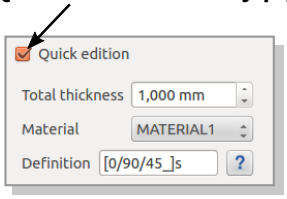


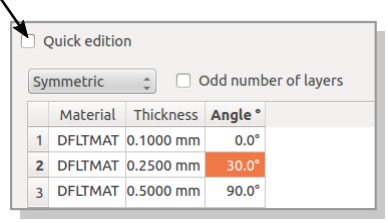
Systematic definition of the **material referential** whenever needed

Basic material database for the definition of homogeneous, sandwich, laminate and fluid materials

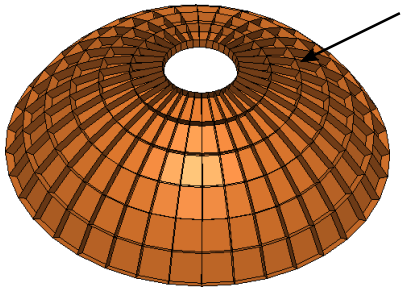


Quick definition or by ply definition of the material

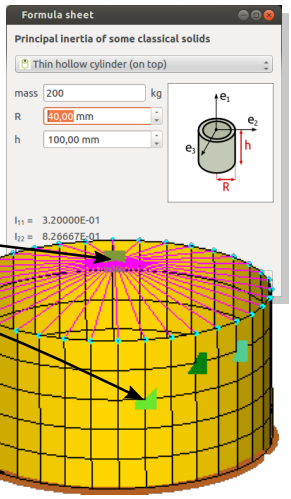




Various equipments for shell parts



Stiffners system for any type of surface (ribs, belts or orthogrids)
Direct control over mesh refinement.
Mesh can be either compatible or incompatible with the shell part (in the later case, an MPC ISURFACE is created).

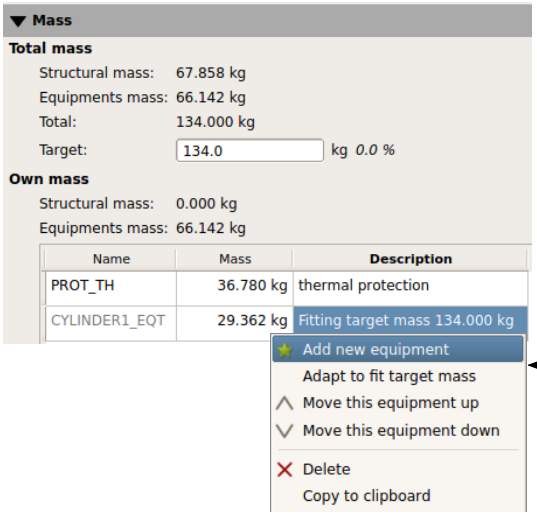


Punctual mass with suspension:

- on a rigid wheal or a WLSCON
- stuck on a wall

Convenient input (equivalence mass-stiffness / frequency, formula for inertia of classical solids)

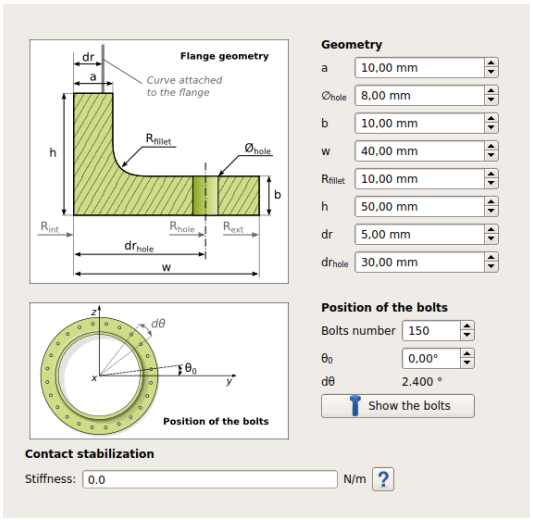
Circumferential flange

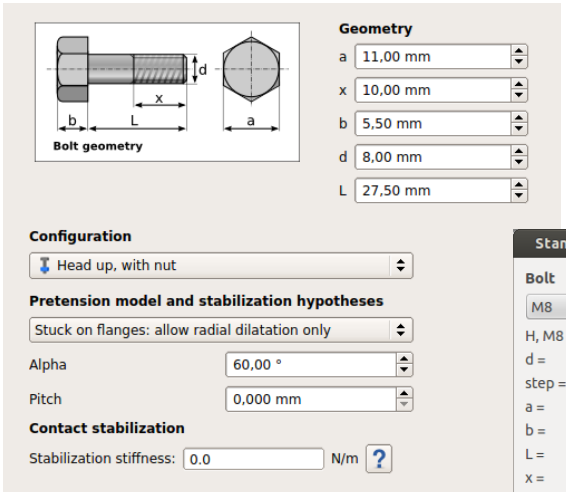


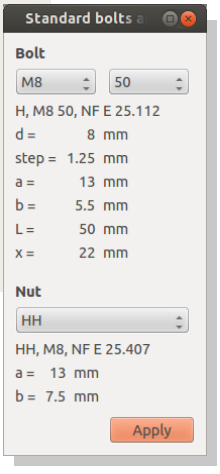
WLSCON wheal for centers of sections.

Non structural mass to simulate non modelized details or equipments, like thermal protection.

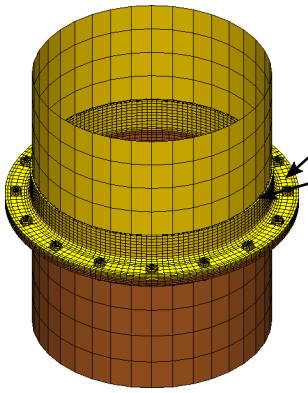
Bolted flanges







Library of **standard nuts and bolts** dimensions



Volumic mesh of the flange, bolts and nuts

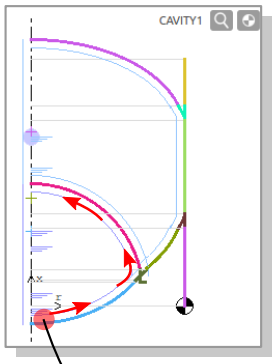
Volume - shell transition

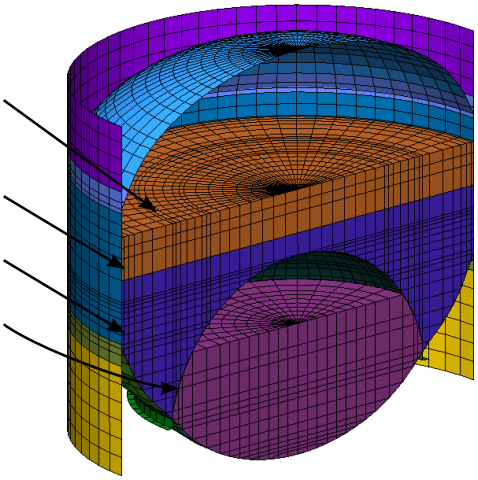
Generation of all needed surfaces and node sets for pretension and contact definition, export of the pretension card

Bolt pretension

Contact stabilization elements

Fluid tanks





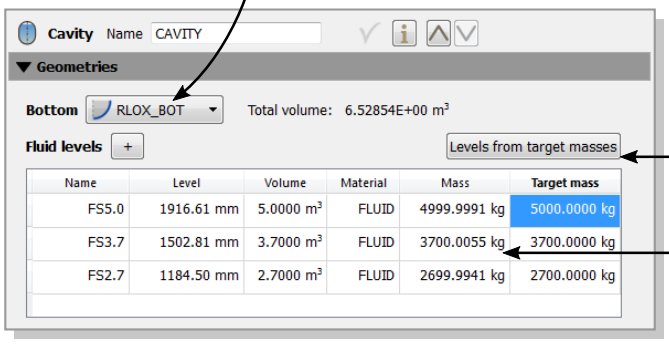
Node and element sets for each free surface level

Fluid-structure **interface elements**

Pressure skin for tank pressurization

Handling of cavities with **common bottom**, using incompatible meshing

Automatic determination of the cavity enveloppe for a given a bottom

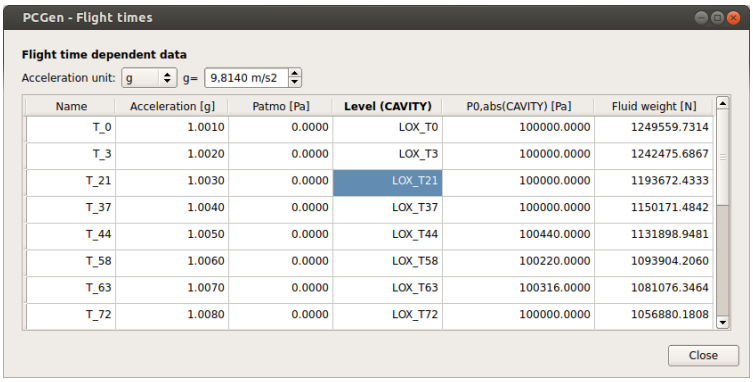


Name	Level	Volume	Material	Mass	Target mass
FS5.0	1916.61 mm	5.0000 m³	FLUID	4999.9991 kg	5000.0000 kg
FS3.7	1502.81 mm	3.7000 m³	FLUID	3700.0055 kg	3700.0000 kg
FS2.7	1184.50 mm	2.7000 m³	FLUID	2699.9941 kg	2700.0000 kg

Possibly **many fluid levels** in the same model

Computation of the **surface position from a target fluid mass**

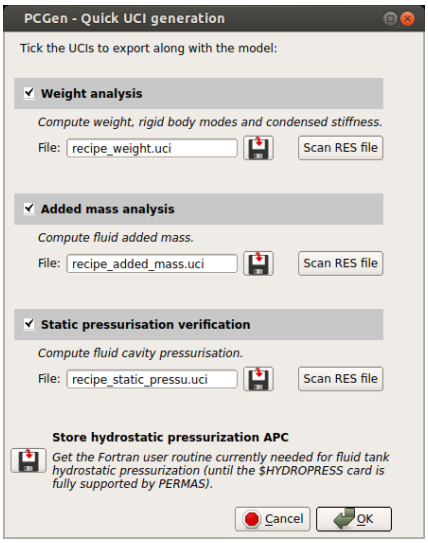
Computation of **analytical volums and masses** for the whole cavity and for each level



Name	Acceleration [g]	Patmo [Pa]	Level (CAVITY)	P0,abs(CAVITY) [Pa]	Fluid weight [N]
T_0	1.0010	0.0000	LOX_T0	100000.0000	1249559.7314
T_3	1.0020	0.0000	LOX_T3	100000.0000	1242475.6867
T_21	1.0030	0.0000	LOX_T21	100000.0000	1193672.4333
T_37	1.0040	0.0000	LOX_T37	100000.0000	1150171.4842
T_44	1.0050	0.0000	LOX_T44	100440.0000	1131898.9481
T_58	1.0060	0.0000	LOX_T58	100220.0000	1093904.2060
T_63	1.0070	0.0000	LOX_T63	100316.0000	1081076.3464
T_72	1.0080	0.0000	LOX_T72	100000.0000	1056880.1808

Variant table
Central handling of the simulation situations for the fluid, containing **pressurization** data, **acceleration** and fluid weight, active fluid level and fluid boundary limit condition.

In progress Generation of the multiple variants based on this table:
- base systems,
- boundary limit conditions,
- loadings,
- pressurization situations,
- pressurized systems,
- etc.



Generation of **UCI files** (with model complement) for some standard tests (such as weight analysis, hydrostatic pressurization check, added mass, rigid body modes decoupling, etc.)

The corresponding **RES files** can then be parsed by PCGen, and results such as structure and fluid mass are compared with analytical masses (or target masses). Correction coefficients are also computed and can be input in PCGen.

Interface and workflow

PCGen allows the user to:

- **focus only on the current task**, using closable panels for each separated task (geometry, property, mass fitting, mesh parameters...)
- **go back and forth in the modelization process** to study variants: all objects being connected and highly dynamic, they can adapt to a late modification of geometry automatically.
- **keep an eye on all the relevant data** in the hierarchy tree. Anything edited by the user should stay well on sight.

Hierarchy tree

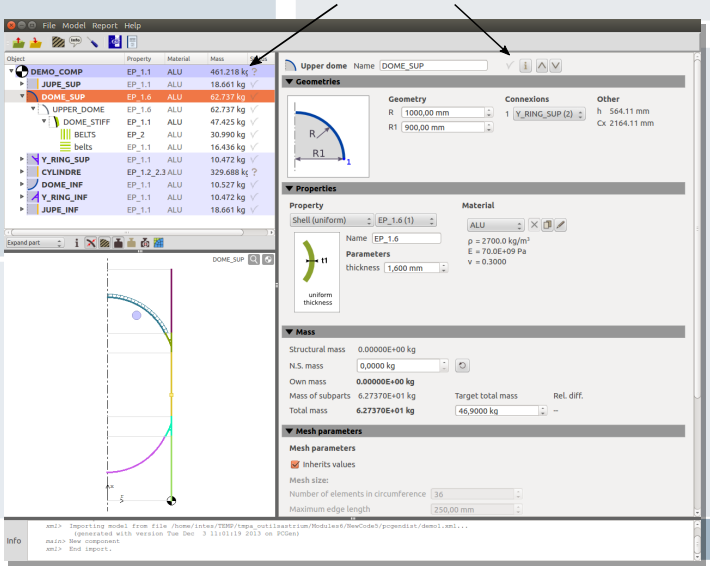
- Display needed informations
- Edit some data, like names or target masses

Comments Properties Materials Analytical mass Added mass Target mass Mesh data

Validity of the objects

With tooltip containing detailed error message

Complete → Erroneous



Editors

Closable, to display only the information needed at a given point of the workflow.

- Name and comment
- Geometries
- Properties
- Mass
- Mesh parameters

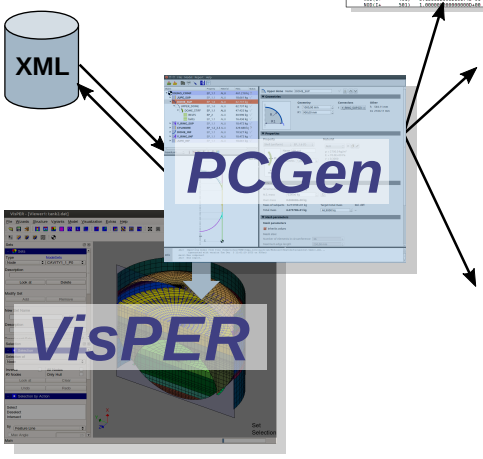
Clickable 2D view

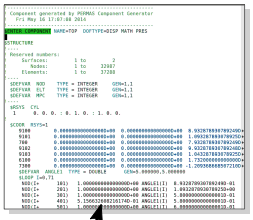
- Clickable (for selection)
- Distance measurement tool

Generated files

XML database

Models are saved in an open xml format, to be re-loaded and modify later.



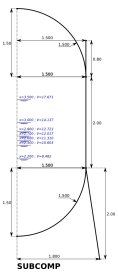


DAT file

Additionnaly to the VisPER export, it is possible to generate a PERMAS DAT file, which is more compact than standard VisPER export, as it makes massive use of loops for example, or uses a compact definition for sets.
Some UCI command files for standard model tests, for example mass check, can be exported as well.

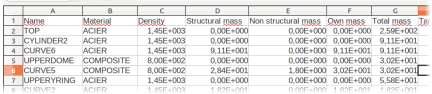
Plans

Plans of the geometry, material and properties affectations, mesh print are exported in **SVG format**.
SVG is a vectorial format that can be easily edited in Inkscape for example (free open-source software, Linux and Windows platforms). It can also be read in modern web browsers.



Report

Reports including plans, mass summary, mesh summary, material definition, comments about the model, etc. can be exported. PCGen also generates spreadsheets, for example mass summary.



	Name	Material	Density	Structural mass	Non structural mass	Own mass	Total mass
2	TOP	ACIER	1,45E+003	0,00E+000	0,00E+000	0,00E+000	2,59E+002
3	CYLINDER2	ACIER	1,45E+003	0,00E+000	0,00E+000	0,00E+000	9,11E+001
4	CURVE6	ACIER	1,45E+003	9,11E+001	0,00E+000	9,11E+001	9,11E+001
5	UPPERDOME	COMPOSITE	8,00E+002	0,00E+000	0,00E+000	0,00E+000	3,02E+001
6	CURVE5	COMPOSITE	8,00E+002	2,84E+001	1,80E+000	3,02E+001	3,02E+001
7	UPPERYRING	ACIER	1,45E+003	0,00E+000	0,00E+000	0,00E+000	5,58E+001

F.E. model in VisPER

PCGen is an add-on of VisPER. As it is integrated, it is possible at any step to push the model into VisPER to check its geometry, mesh, etc. Also, VisPER can read directly the XML model database generated by PCGen, the interpretation and meshing are done on the fly.

For more information, please contact us:
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