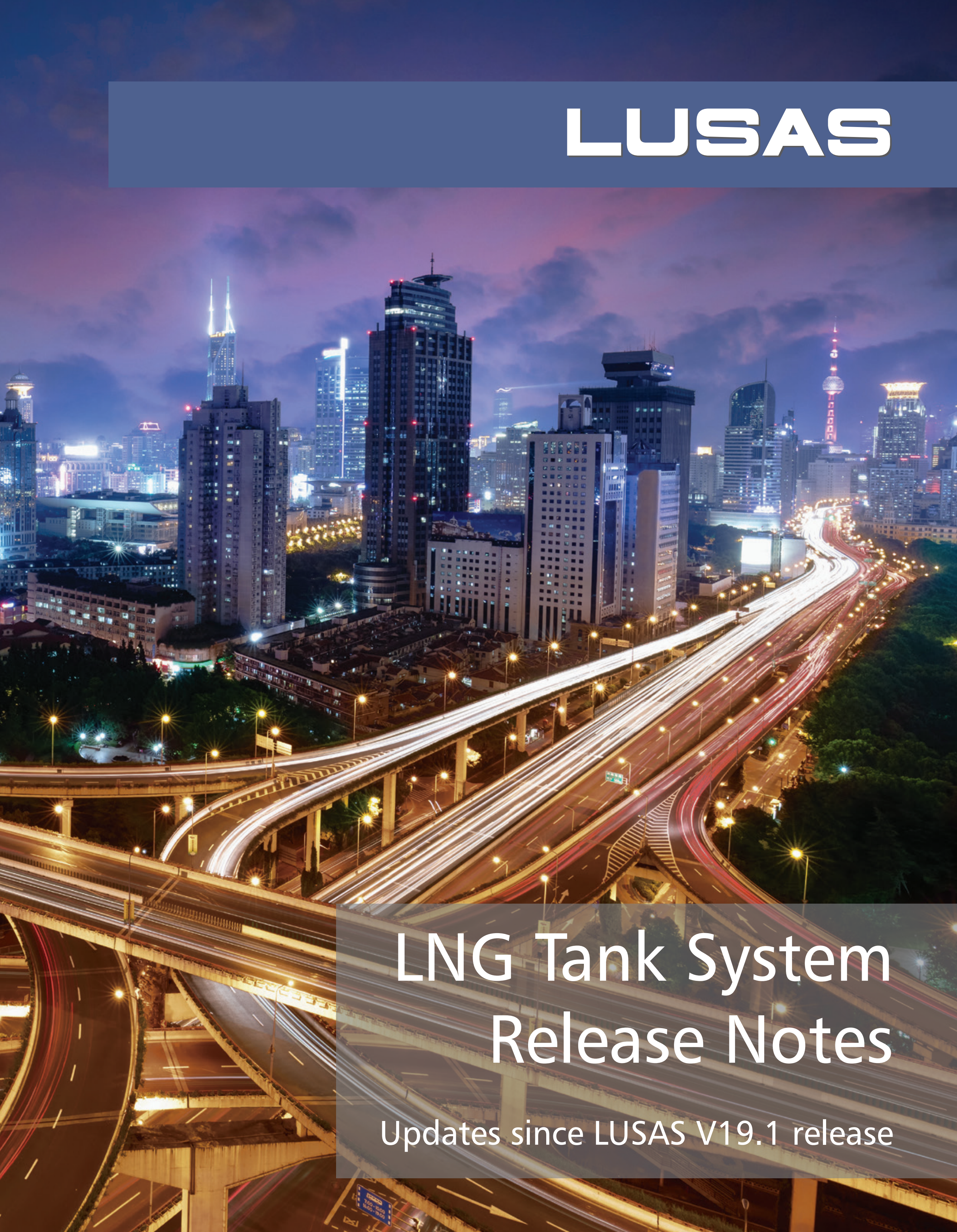

LUSAS

LNG Tank System Release Notes

Updates since LUSAS V19.1 release

LNG Tank System

Updates since LUSAS version 19.1 release : Issue 1

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LNG Tank System update releases

Updates to the LNG Tank System may be released between major LUSAS software releases in order to allow new features to be used by LNG clients as soon as they become available. New features in each update are documented in this release note.

Each major LUSAS software release will include the latest LNG Tank System software available at that time.

New releases of software can be downloaded from the LUSAS website at **https://www.lusas.com/protected/download/index.html**

New features in LNG Tank System Release 2609

Tank definition dialog updated

The tank definition dialog has been updated to allow selection of tank materials (currently concrete, but with steel planned for a future update), tank elevation types (aboveground, elevated/isolated), and specification of target model types.

How to use

- Select the menu item **LNG Tank > Tank Definition…**

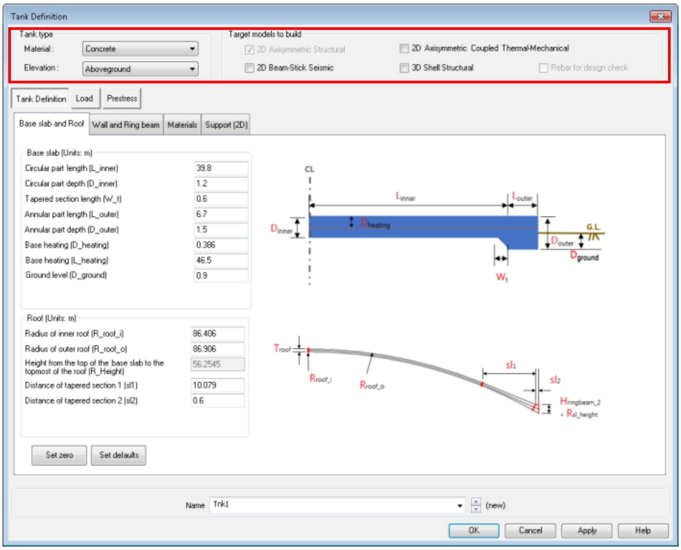

Figure 1 Updated Tank Definition dialog

Specify target models to build

The type of model to be built is now selected as part of a tank definition. Tabs and options on the dialog are added / removed to simplify its use according to the model type selected.

Define elevated / isolated tanks

In addition to above ground tanks, elevated/isolated types of tank can now be specified from the Tank Definition dialog.

How to use

- Select the menu item **LNG Tank > Tank Definition…**
- Select Elevation type **Elevated / Isolated**

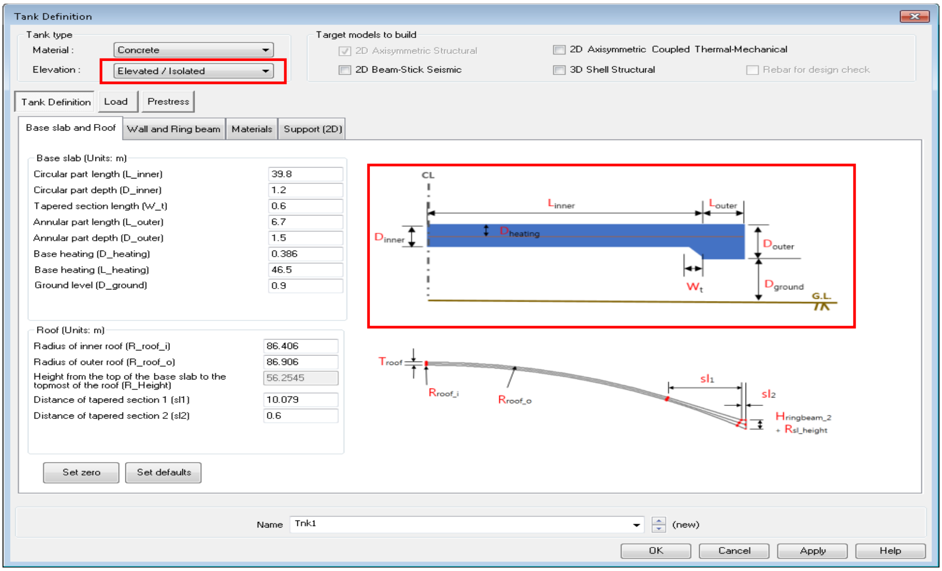

Figure 2 Specifying an elevated / isolated tank

- By selecting the '3D Shell Structural' check box, then the Support (3D) tab, and selecting Support type 'Detailed foundation' the Foundation tab is added to the dialog, allowing foundation details to be selected and specified:

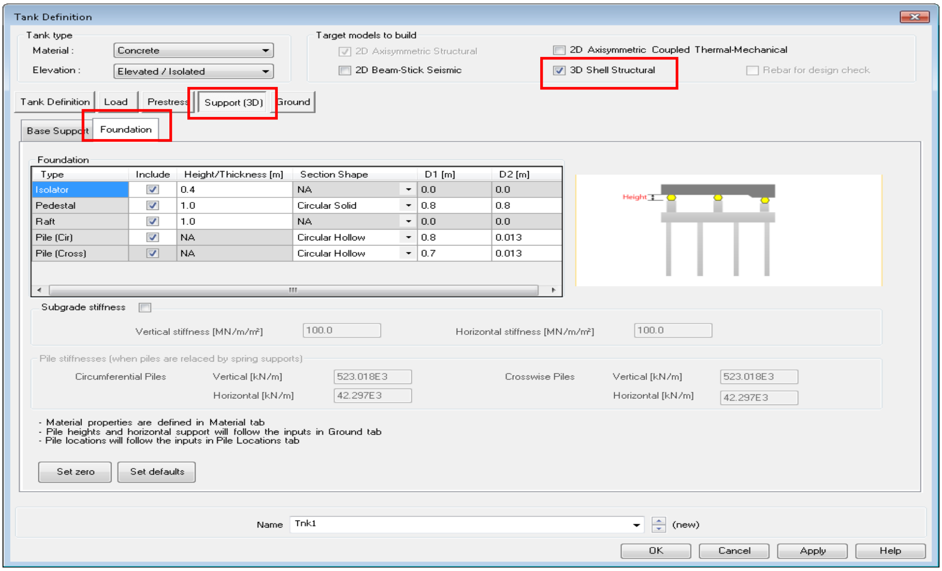

Figure 3 Tabs added and removed according to selected model type

Add foundations to 3D shell models

Pile foundations can now be added to 3D shell models. For elevated tanks, details of isolators, pedestals and a raft can also now be specified.

How to use

- Select the menu item **LNG Tank > Tank Definition…**

The details of foundations should be defined in the Tank Definition.

Create 3D Model

When a 3D shell model is built from the menu item ‘LNG Tank > Static Analysis’ or from ‘LNG Tank > Base Model for Design Check’, the model will also include foundations if details for these are specified in the Tank Definition.

How to use

- Select the menu item **LNG Tank > Add Foundation to Shell Model**

Models previously created without foundation details can have foundations added by using this option.

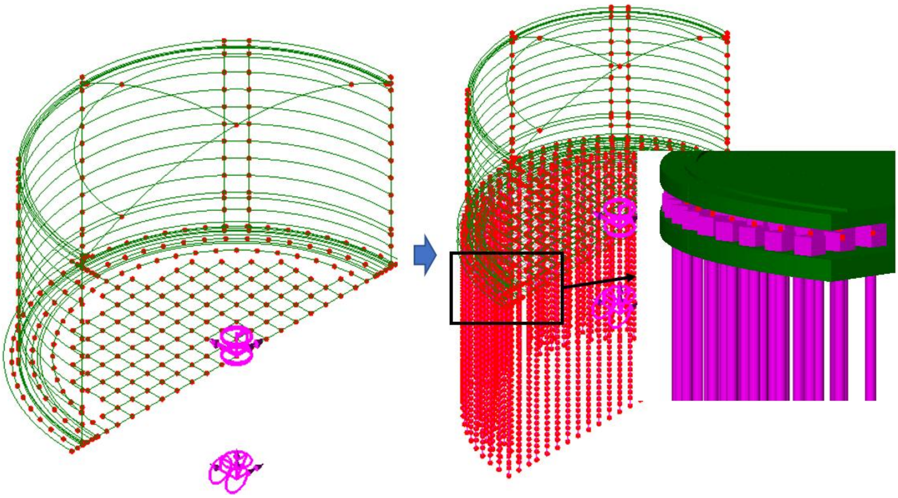

Figure 4 Foundations added to the existing shell model

Design checks to GB50010

In addition to existing design checks to ACI 318-14 and EN 1992-1-1, design checks to GB50010 (a Chinese code) have been added.

How to use

- Select the menu item **LNG Tank > Enable Design Check…**

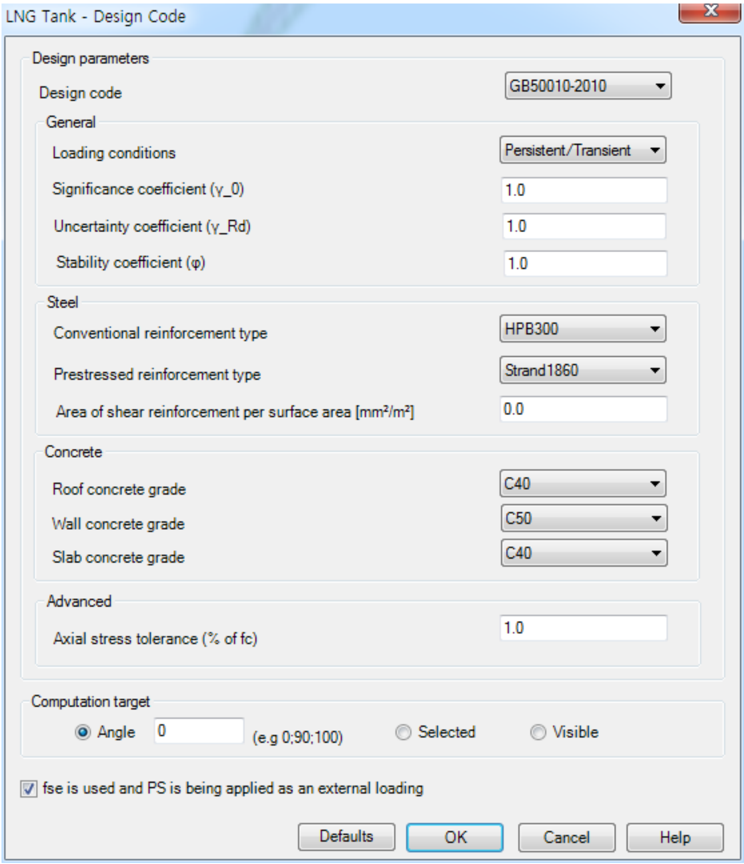

Figure 5 Design Code settings dialog for GB50010

Design check for target angles

For LNG tanks that can be regarded as and modelled as being axisymmetric, a design check for every node is not necessarily required. Instead, design checks for a few selected angles (as measured anti-clockwise in the xy plane from the x-axis) may be sufficient, saving time in producing and viewing results.

How to use

- Select the menu item **LNG Tank > Enable Design Check…**

A range of target angles can now be specified. Results are only calculated for the nodes located at the selected angles.

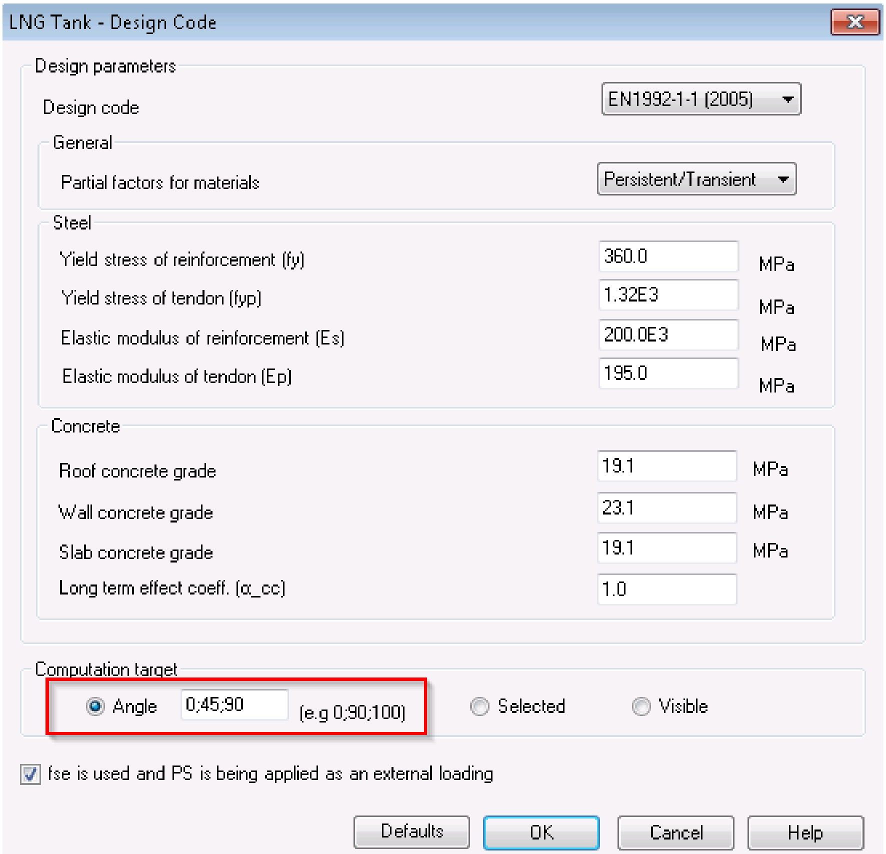

Figure 6 Design Code dialog showing Computation target for three specified angles

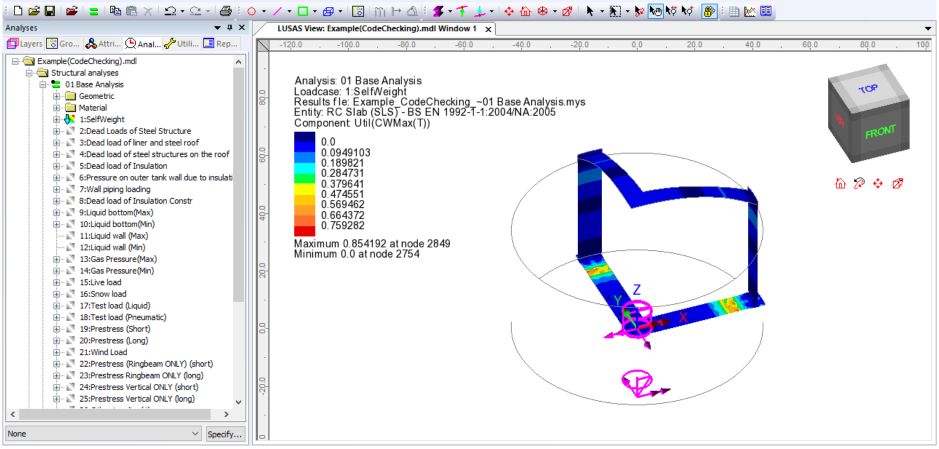

Figure 7 Example of design results at angles 0 and 90

Load combinations from spreadsheet

When forces have been extracted to a spreadsheet or spreadsheets, load combinations can now be defined using the LNG tank system facility to create a combination from the extracted forces. When a large results file is loaded this can be quicker than extracting combination results from Modeller.

How to use

- Select the menu item **LNG Tank > Export forces to Excel(2D)** or **LNG Tank > Export forces to Excel (3D)**

This produces a spreadsheet report for forces/moments as illustrated in the figure below.

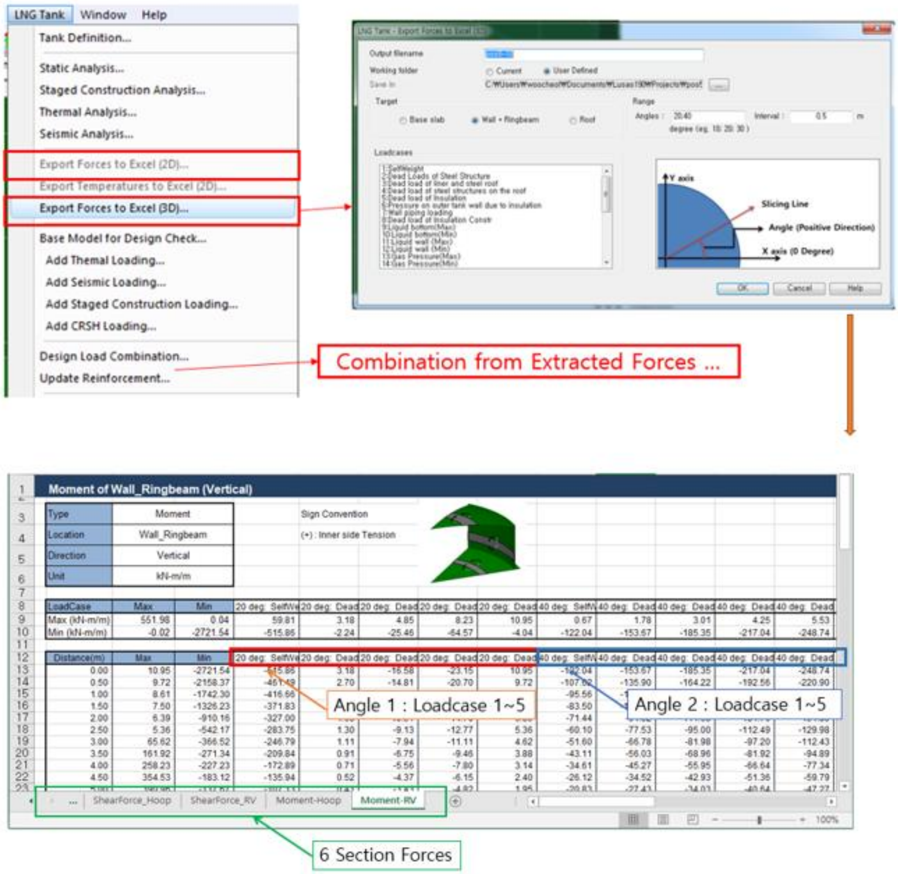

Figure 8 Force export options and the section force report produced

How to use

- Select the menu item **LNG Tank > Combination from extracted forces**

The extracted force files are used as the input for the dialog below.

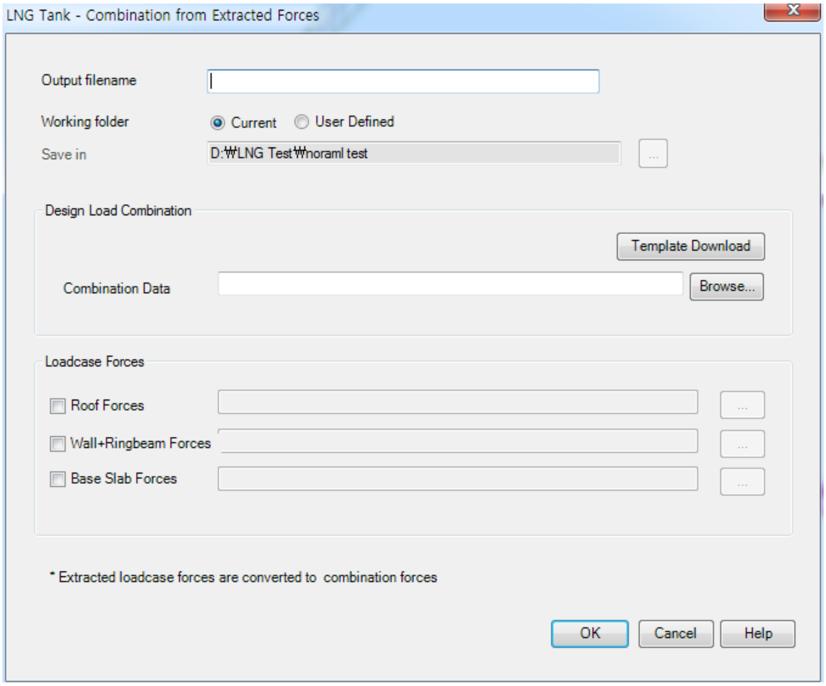

Figure 9 Dialog for spreadsheet combination

Combinations with spreadsheets

The design combinations are computed and reported in a single spreadsheet for each structural component (roof/wall/slab).

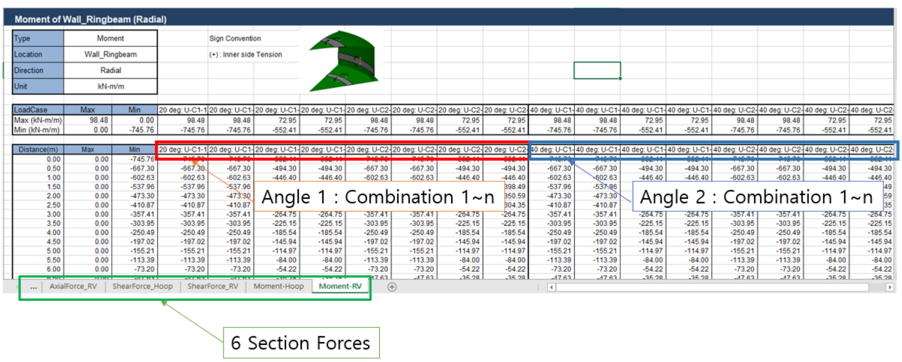

Figure 10 Combination results file

Merge extracted forces

It is common to require and obtain forces from different models, for example, thermal forces from a 2D axisymmetric model and structural forces from a 3D shell model. A subsequent requirement is to create a design combination using this data.

Two spreadsheets containing extracted forces can now be merged into one spreadsheet, which can be used to create a design combination using the menu item **LNG Tank > Combination from extracted forces**

How to use

- Select the menu item **LNG Tank > Merge Extracted Forces**

A merged force spreadsheet is created from settings made on this dialog.

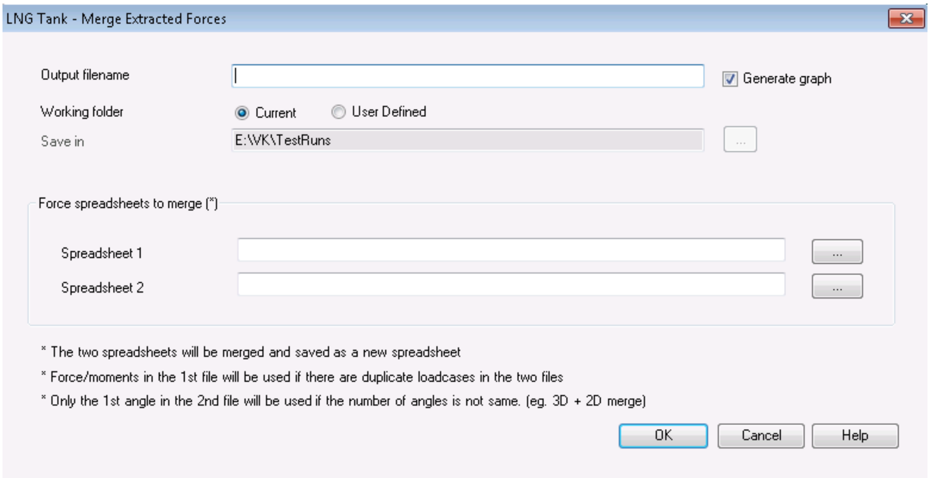

Figure 11 Merge extracted forces dialog

Improved Thermal Analysis Wizard

Thermal analysis is now improved for the following situations:

- Additional loadcase for spillage event
- Structural loading combined with thermal stress/strains

How to use

- Select the menu item **LNG Tank > Thermal Analysis**

The dialog has been updated to consider the structural loadings and spillage event

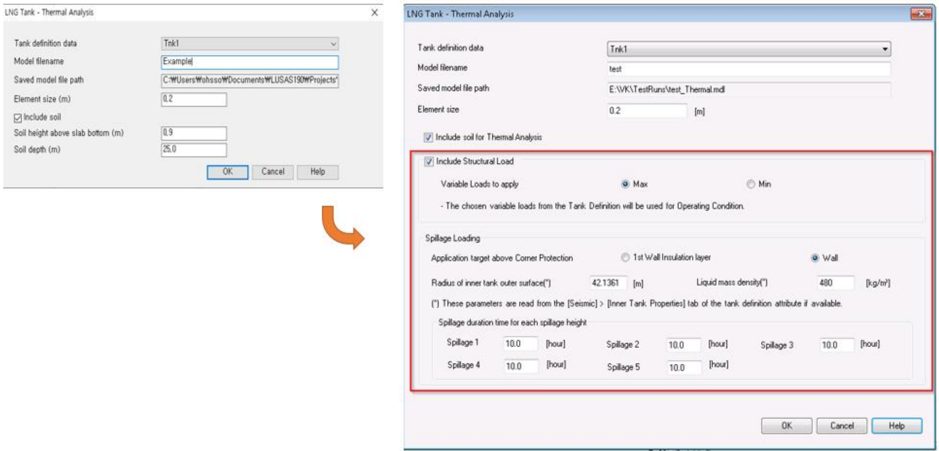

Figure 12 Dialog for Thermal Analysis wizard

Thermal and structural loadings are added as shown below.

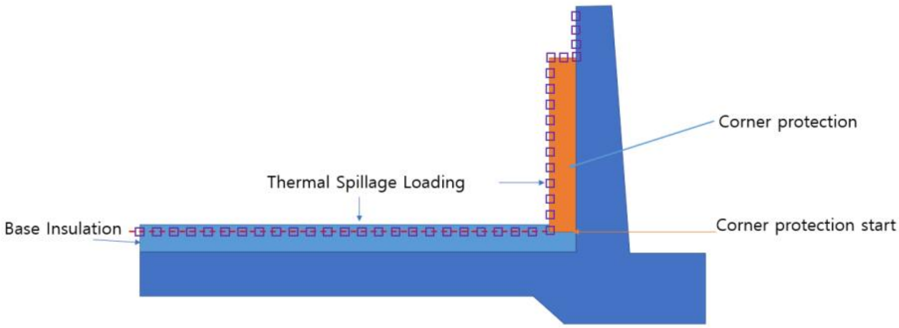

Figure 13 Spillage thermal loading for a model without PUF

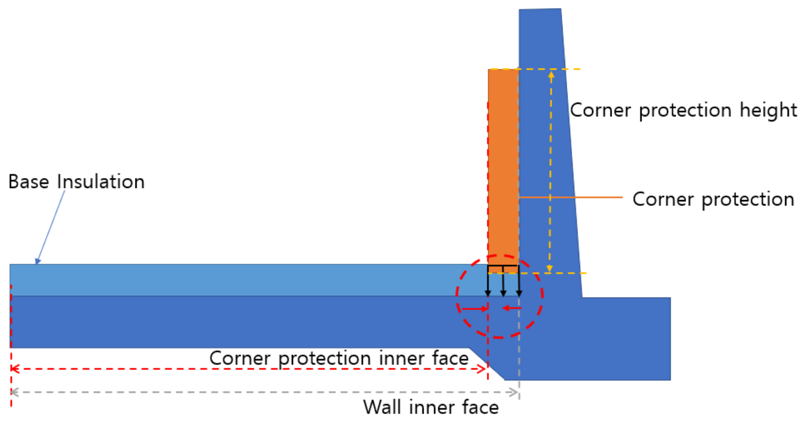

Figure 14 Vertical liquid pressure under the corner protection area for a model without PUF

How to use

- Select the menu item **LNG Tank > Add Spillage Loading**

The thermal results are mapped to the existing 3D shell model to allow the thermal results to be combined with 3D structural results in Modeller.

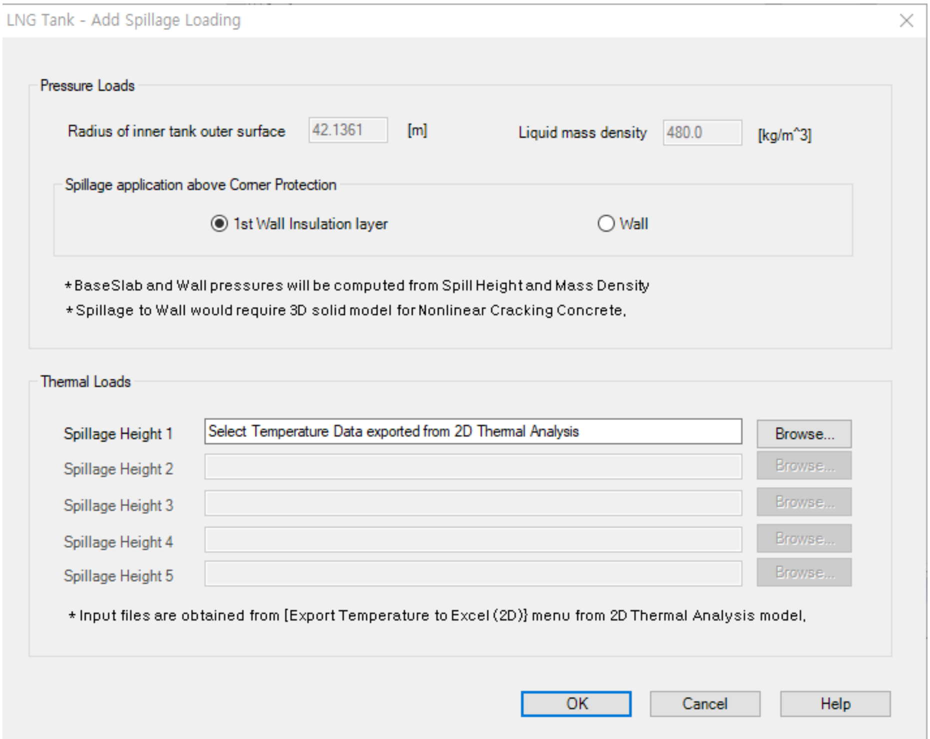

Figure 15 Add Spillage Loading Dialog

Wind loading to GB50009

In addition to existing wind loading for EN 1992-1-1, wind loading to GB50009 (a Chinese code) has now been added.

How to use

- Select the menu item **LNG Tank > Add Wind Loading**

Previously parameters for wind loading to EN 1991-1-4) were specified in the dialogs for the 3D shell model wizard (LNG Tank > Static Analysis, LNG Tank > Base Model for Code Checking). Now these are separated for both EN 1991-1-4 and GB50009.

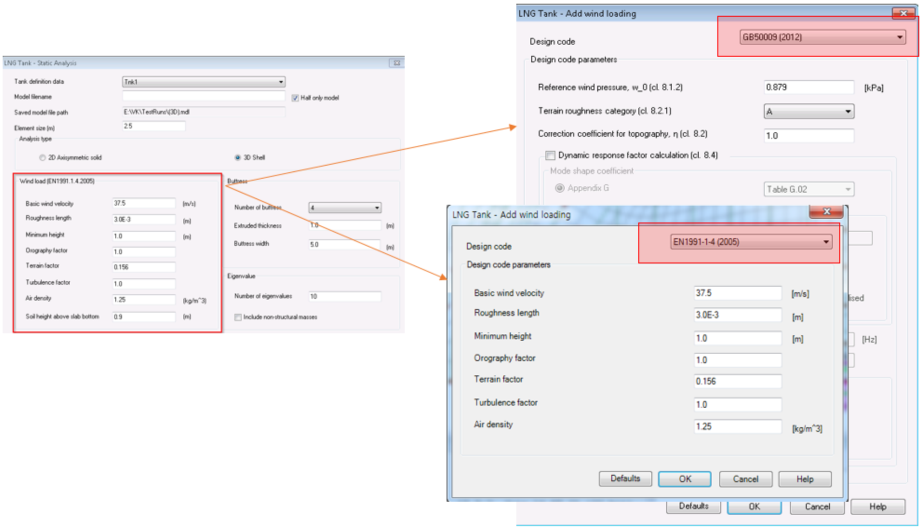

Figure 16 Dialogs for wind loading

Planned future updates

Double steel tank

The ability to define double steel tanks will be added, and this will accessible from Material drop-list of the tank definition dialog.

How it will be accessed

- Select the menu item **LNG Tank > Tank Definition**

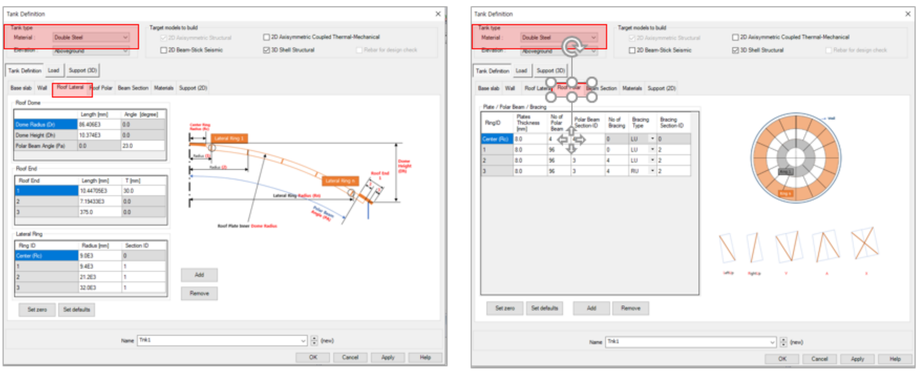

Figure 17 Tank Definition dialog for double steel tanks

- Once defined, select the menu items **LNG Tank > Static Analysis,** or **LNG Tank > Thermal Analysis,** or **LNG Tank > Staged Construction Analysis**

A 2D model will be built in each case.

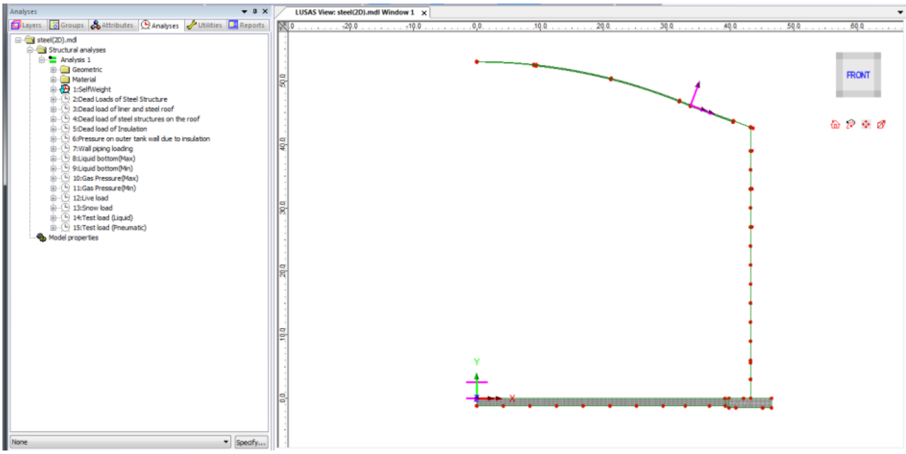

Figure 18 Double steel tank 2D model

- Select the menu item **LNG Tank > Static Analysis, Base Model for Code Checking**

A 3D shell model will be built.

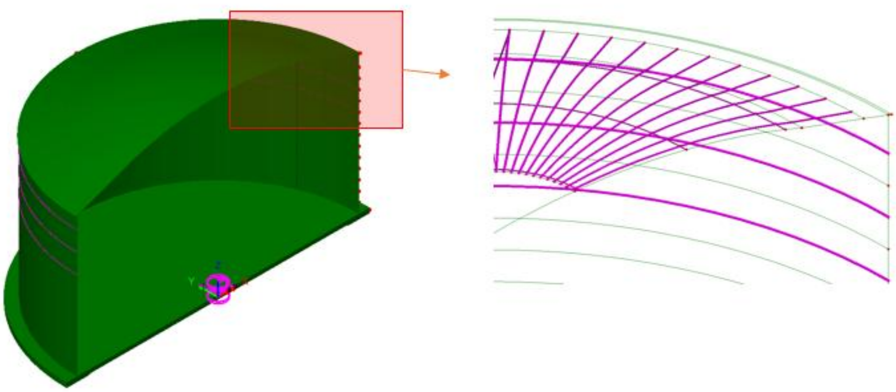

Figure 19 Double steel tank 3D model

Design Check Report in spreadsheet

Currently, a force/moment (PM) design check report is provided that is mainly for the purpose of verifying the design results. This will be updated to create comprehensive design results in a single spreadsheet.

How it will be accessed

- Select the menu item **LNG Tank > Enable Design Check**
- Specify the Code of Practice to be used in the design checks.
- Select the menu item **LNG Tank > Design Check Report**

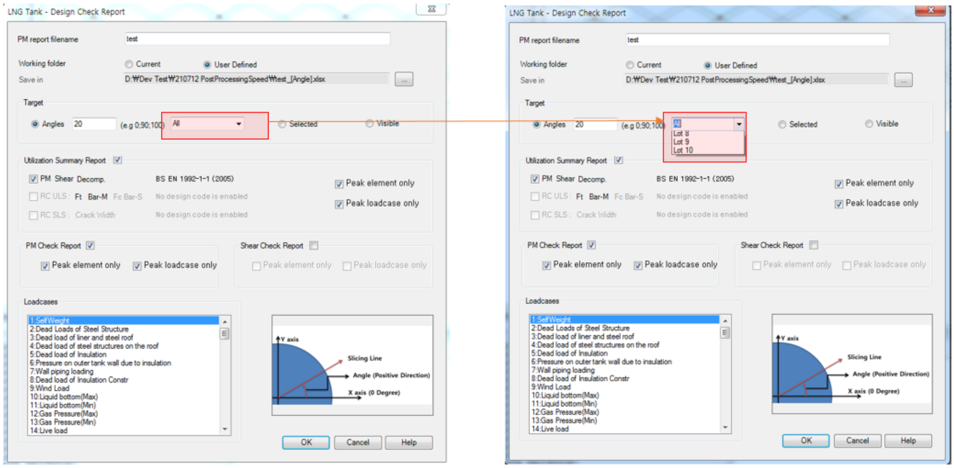

Figure 20 Dialog for design report

The design check results for the selected zone, design check components, and loadcases will be output.

PM check report

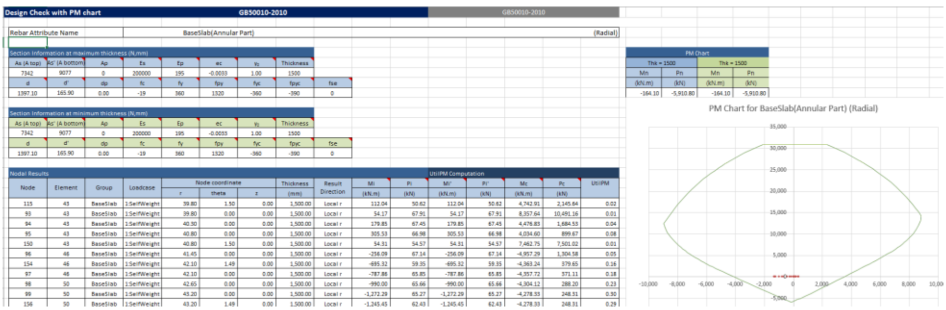

Figure 21 Example PM check report

Shear check report

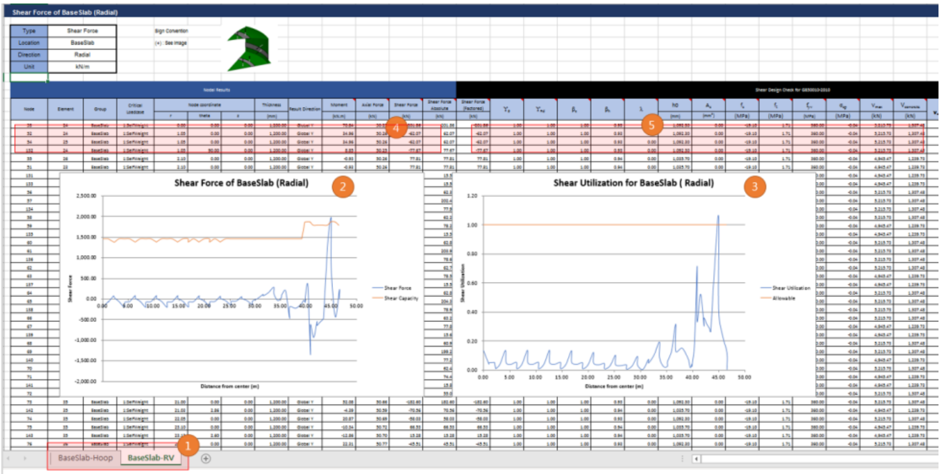

Figure 22 Example shear check report

Notes

- As opposed to what has been implemented for the PM report, worksheets are added for major tank components such as roof, wall, and base slab, but not for the rebar attributes. For each group, two sheets are added, one for hoop/Global-X direction, the other for radial/height/Global-Y direction.

- The data is sorted by the coordinate (z for wall and r for slab and roof), so that the graph can be generated along the distance. X axis is the distance (from centre, or from bottom), Y axis is the shear forces obtained from the nodes. The orange line represents the shear capacities for each node computed with the result force/moment considered.

- The computed shear utilization is presented from this graph. The orange line represents the allowed limit for the utilization. (i.e. = 1)

- The node/element information as used in the summary report.

- The intermediate values required to compute the shear capacity and utilizations are printed, so that a user can see if the computation was done correctly. This is code-dependent, and different templates are used for different codes. The tooltips are added to advise the phrase or formula reference in the design code.

Utilization summary

All the design check results for a selected zone and loadcases are summarized in a single spreadsheet. Utilization values of less than 1 confirm that the result satisfies the design code.

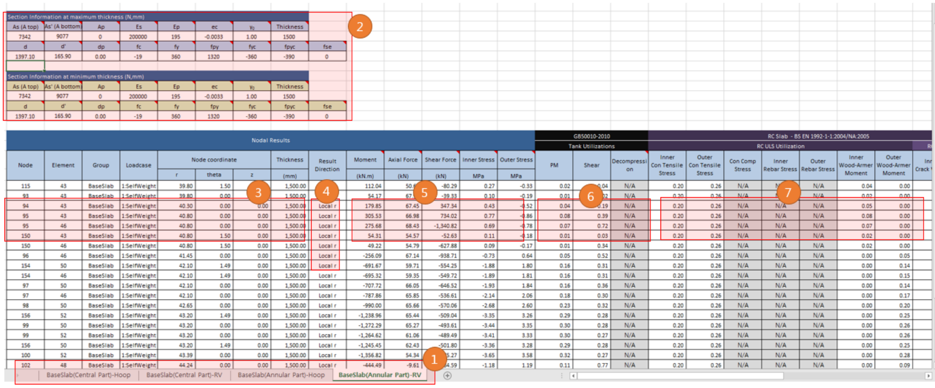

Figure 23 Example of Utilization summary report

Notes

- Sheets are created for each of the rebar attributes.
- Rebar information for the sections is printed. For varying sections, those for the max/min thickness are output.
- Group names, loadcases, cylindrical coordinates, and thicknesses for the target nodes and elements are output.
- The direction of results is specified. If the node coordinate is within the crosswise rebar limit radius, the direction of results would be global x or y; otherwise the direction would be r, theta, z or phi depending on the assigned result transformations.
- The nodal results, forces, moments, top/bottom stresses are printed.
- The tank design utilizations such as UtilPM and UtilShear are printed.

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