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:

Isolated Isolated Height/Thickness [m] 0.4	Target models to b	suik nme Stie	I etric Structura ok Seismic	20	Assymmetric Coupled Then	mai Mechanical
Isolated View (3D) in Height/Thickness (m) 0.4	Target models to b	suile Stie	d stric Structura sk Seismic	□ 2D . ☑ 3D S	Axisymmetric Coupled Ther	mal-Mechanical
Isolated Isolat	2D Axisyn 2D Beam- ound Section Shape NA	Sti	ok Seismic		Axisymmetric Coupled Then	mal-Mechanical
Isolated Isolated Height/Thickness [m] 0.4 1.0	2D Beam- ound Section Shape NA	Sti	ok Seismic	⊘ 3D 5	Shell Structural	Rebar for design check
Height/Thickness (m)	Section Shape		0161	D2(c)		
e Height/Thickness [m] 0.4 1.0	Section Shape		5163	D2(c)		
e Height/Thickness [m] 0.4 1.0	Section Shape		5163	Dated		
 Height/Thickness [m] 0.4 1.0 	Section Shape		D1 (-1	D2(=1		
 Height/Thickness [m] 0.4 1.0 	Section Shape		016-1	D2()		
e Height/Thickness [m] 0.4 1.0	Section Shape		D1 (D2 ()		
0.4	NA		DI[m]	02 [m]		
1.0		-	0.0	0.0		
	Circular Solid	-	0.8	0.8		
1.0	NA	Ŧ	0.0	0.0		
NA	Circular Hollow	+	0.8	0.013		
NA	Circular Hollow	-	0.7	0.013		
al stiffness [MN/m/m²]	100.0		Hori	ontal stiffness [MN/m/m	ř] 100.0	
Vertical BrN /ml	E22 010E2			Crosswiss Piles) (actional [Ich] (m)]	E22 010E2
venicai (kiv/m)	523.010E3			Crosswise Files	Verucai (kriv/m)	523.010E3
Horizontal [kN/m	1 42.297E3				Horizontal [kN/m]	42.297E3
afined in Material tab al support will follow the in e inputs in Pile Locations t aults	nputs in Ground tab ab					
Name	Tnk1				👻 🚊 (new)	
					ОК	Cancel Apply He
	NA NA NA NA al stiffness (MV/m/m²) are relaced by spring suppor Vertical (RV/m) Horizontal (RV/m) Hori	I.0 Rec NA Circular Hollow NA Circular Hollow I Circular Hollow III 100.0 III 100.0 III 100.0 III 100.0 III 100.0 IIII 100.0 IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	NA Discuss Feature NA Discuss Hollow NA Discuss Hollow I Iterative III III IIII IIII IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	I.O. Rec. U.O. NA Circular Hollow U.B. NA Circular Hollow U.B. I.O. I.O. I.O. I.I. III III	IV0 INA Circular Hollow 0.8 0.013 INA Circular Hollow 0.7 0.013 INA Circular Hollow 0.7 0.013 Intervention Intervention 0.7 0.013 Intervention Intervention Intervention 0.7 0.013 Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention Intervention <t< td=""><td>I/L0 Nex I/L0 Nex I/L0 I</td></t<>	I/L0 Nex I/L0 Nex I/L0 I

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...

Tank - Design Code	
lesign parameters	
Design code	GB50010-2010 -
General	Permittent /Transient
Significance coefficient (Y_0)	1.0
Uncertainty coefficient (Y_Rd)	1.0
Stability coefficient (φ)	1.0
Steel	
Conventional reinforcement type	HPB300 -
Prestressed reinforcement type	Strand 1860 💌
Area of shear reinforcement per surface area [mm²/m²]	0.0
Concrete	
Roof concrete grade	C40 👻
Wall concrete grade	C50 🔻
Slab concrete grade	C40 🔻
Advanced	
Axial stress tolerance (% of fc)	1.0
Computation target	
	Visible
fse is used and PS is being applied as an external loading	

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.

		2005) 🔻
àeneral		
Partial factors for materials	Persistent/Tra	nsient 💌
iteel		
Yield stress of reinforcement (fy)	360.0	MPa
Yield stress of tendon (fyp)	1.32E3	MPa
Elastic modulus of reinforcement (Es)	200.0E3	MPa
Elastic modulus of tendon (Ep)	195.0	MPa
Concrete		
Roof concrete grade	19.1	MPa
- Wall concrete grade	23.1	MPa
Slab concrete grade	19.1	MPa
Long term effect coeff. (α_cc)	1.0	

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.



Туре	Mom	ent	Sign Convention									
Location	Wal_Rin	gbeam	m (+): Inner side Tension									
Direction	Vert	cal				-						
Unit	kN-n	vim										
LoadCase	Max	Min	20 deg: Self.We	20 deg: Dead	20 deg Dead	20 deg: Dead	20 deg: Dead	40 deg: SelfM	40 deg. Dead	40 deg: Dead	40 deg Dead	40 deg: D
Max (idi-m/n	551.98	0.04	59.81	3.18	4.85	8.23	10.95	0.67	1.78	3.01	4.25	5
Min (kN-m/m	-0.02	-2721.54	-515.85	-2.24	-25.46	-64.57	-4.04	-122.04	-153.67	-185.35	-217.04	-248
Distance(m)	Max	Min	20 deg: SelfWe	20 deg: Dead	20 deg: Dead	20 deg Dead	20 deg: Dead	40 deg. Self/	40 deg: Dead	40 deg: Dead	40 deg: Dead-	40 deg: D
0.0	0 10.95	-2721.54	-615.85	3.18	-16.58	-23.15	10.95	-162.04	-153.67	-185.35	-217.04	-248
0.5	9.72	-2158.37	-451.49	2.70	-14.81	-20.70	9.72	-107.02	-135.90	-164.22	-192.56	-220
1.0	0 8.61	-1742.30	-416.66	An	ale 1 : I	oadcas	e 1~5	-95.56	An	gle 2 :	Loadcas	e 1~
2.0	0 6.39	-910.16	-327.00					-71.44				
2.5	0 5.36	-542.17	-283.75	1.30	-9.13	-12.77	5.36	-60.10	-77.53	-95.00	-112.49	-129
3.0	0 65.62	-366.52	-246.79	1.11	-7.94	-11.11	4.62	-51.60	-66.78	-81.98	-97.20	-112
3.5	0 161.92	-271.34	-209.84	0.91	-6.75	-9.46	3.88	-43.11	-56.03	-68.96	-81.92	-94
4.0	258.23	-227.23	-172.89	0.71	-5.56	-7.80	3.14	-34.61	-45.27	-55,95	-05.04	-11
4.5	9 354.53	-183.12	+135.94	0.52	-4.37	-0.15	2.40	-20.12	-34.52	-42.93	-51.35	-09
· 5h	earForce_Hoop	ShearFor	ce_RV Morr	ient-Hoop	Moment-RV	۲	1	-JOLAC				-44
									B			

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.

LNG Tank - Combination from	Extracted Forces	×
Output filename		
Working folder	● Current 🔘 User Defined	
Save in	D:₩LNG Test₩noramI test	
Design Load Combination		Template Download
Combination Data		Browse
Loadcase Forces		
Roof Forces		
Wall+Ringbeam Forces		
Base Slab Forces		
* Extracted loadcase forces	s are converted to combination forces	
	ОК	Cancel Help

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).

Moment of V	Wall_Ringb	eam (Radi	ial)															
Туре	Mom	sent		Sign Convention	on	100												
Location	Wall_Rin	ngbearn		(+): Inner side	Tension		-											
Direction	Rac	fial																
Unit	kN-r	n/m																
LoadCase	Max	Min	20 deg: U-C1-1	20 deg: U-C1-	20 deg: U-C1-	20 deg: U-C1-2	0 deg: U-C2-	20 deg: U-C2-	20 deg: U-C2-	20 deg: U-C2-	40 deg: U-C1-	40 deg: U-C1-	40 deg: U-C1-	40 deg: U-C1-	40 deg: U-C2-	40 deg: U-C2-	40 deg: U-C2-	40 deg: U-C2-
Max (kN-m/m)	98.48	0.00	98.48	98.48	72.95	72.95	98.48	98.48	72.95	72.95	98.48	98.48	72.95	72.95	98.48	98.48	72.95	72.95
Min (kN-m/m)	0.00	-745.76	-745.76	-745.76	-552.41	-552.41	-745.76	-745.76	-552.41	-552.41	-745.76	-745.76	-552.41	-552.41	-745.76	-745.76	-552.41	-552.41
Distance(m)	Max	Min	20 dec: U-C1-1	20 deg: U-C1-	20 deg: U-C1-	20 dec: U-C1-2	0 deg: U-C2-	20 deg: U-C2-	20 deg: U-C2-	20 deg: U-C2-	10 deg: U-C1-	40 deg: U-C1-	40 dec: U-C1-	40 deg: U-C1-	40 deg: U-C2-	40 deg U-C2-	40 deg: U-C2-	40 deg: U-C2-
0.00	0.00	-745.76	716.70	710.70	660.11	660.11	710.70	710.70	550.11	660.11	746.70	746.70	552-11	660.11	746.70	710.70	000.11	662.11
0.50	0.00	-667.30	-667.38	-667.30	-494.30	-494.30	-667.30	-667.30	-494.30	-494.30	-667.30	-667.30	-494.30	-494.30	-667.30	-667.30	-494.30	-494.30
1.00	0.00	-602.63	-602.63	-602.63	-446.40	-446.40	-602.63	-602.63	-446.40	-446.40	-602.63	602.63	-446.40	-446.40	-602.63	-602.63	-446.40	-446.40
1.50	0.00	-537.96	-537.96	-537.96						398.49	-537.96	-537.96			-			49
2.00	0.00	-473.30	-473.30	-473.90	Angl	e 1 · (omb	pinatio	on 1∼	n 350.59	-473.30	-473.30	And And	nle 2 '	· Com	nbinat	ion 1	~n 👳
2.50	0.00	-410.87	-410.87	-410.87	,g.					804.35	-410.87	-410.87	1 1 1	, c _				35
3.00	0.00	-357.41	-357.41	-357.41	-264.75	-264.75	-357.41	-357.41	-264.75	-264.75	-357.41	-357.41	-264.75	-264.75	-357.41	-357.41	-264.75	-264.75
3.50	0.00	-303.95	-303.95	-303.95	-225.15	-225.15	-303.95	-303.95	-225.15	-225.15	-303.95	-303.95	-225.15	-225.15	-303.95	-303.95	-225.15	-225.15
4.00	0.00	-250.49	-250.49	-250.49	-185.54	-185.54	-250.49	-250.49	-185.54	-185.54	-250.49	-250.49	-185.54	-185.54	-250.49	-250.49	-185.54	-185.54
4.50	0.00	-197.02	-197.02	-197.02	-145.94	-145.94	-197.02	-197.02	-145.94	-145.94	-197.02	-197.02	-145.94	-145.94	-197.02	-197.02	-145.94	-145.94
5.00	0.00	-155.21	-155.21	-155.21	-114.97	-114.97	-155.21	-155.21	-114.97	-114.97	-155.21	-155.21	-114.97	-114.97	-155.21	-155.21	-114.97	-114.97
5.50	0.00	-113.39	-113.39	-113.39	-84.00	-84.00	-113.39	-113.39	-84.00	-84.00	-113.39	-113.39	-84.00	-84.00	-113.39	-113.39	-84.00	-84.00
6.00	0.00	-73.20	-73.20	-73.20	-54.22	-64.22	-73.20	-73.20	-54.22	-64.22	-73.20	-73.20	-54.22	-54.22	+73.20	-73.20	-54.22	-54.22
) Axia	lForce_RV	ShearForce_H	Hoop Shear	Force_RV	Moment-Hoop	Moment	RV (Ð	.0.90	.0.92			.05.201	. (6. 791			. 16. 7911	¥16.500

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.

NG Tank - Merge Extracted Forces			×
Output filename	[🔽 Generate graph	
Working folder	Current User Defined		
odve m	L. WINT GSU IUIIS		
Force spreadsheets to merge (*)			
Spreadsheet 1			
Spreadsheet 2			
* The two spreadsheets will be r	nerged and saved as a new spreadsheet		
* Force/moments in the 1st file (will be used if there are duplicate loadcases in the two files		
^ Unly the 1st angle in the 2nd I	ile will be used if the number of angles is not same. (eg. 3D + 2D merge)		
	ОК	Cancel Help	

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

NG Tank - Thermal Analysis	×	LNG Tank - Thermal Analysis
Tank definition data Model filename Saved model file path Element size (m) ∑ Include soil Sal boths beam club bottom (m)	Tel:1 Example1 C:HTUsers Wulksch#Cocuments W.U.S.K1150WProjects* 0:2	Tark dehinten data Tark • Model filename test Saved model file path E:VVX/Ters/Burs/Sect_Themat.and Element size 0.2
ann aigen teo	OK Cancel Help	Include Stackhal Load Variable Loads to apply Waik OMin The charam variable loads tom the Tank Definition will be used for Operating Condition. Spillage Loading Application target above Corree Protection O 1st Wall Insulation layer Wall
		Hadard inner tank deter subsect] 421351 (m) Load misst densify[] 400 (h) (h) (h) (1) These parameters are read from the [Seimic] > [Inner Tank. Properties] lab of the tank definition attribute if analable. Splage attribute in terms density height Splage attribute in terms density height Splage attribute in terms density height Splage 3 10.0 (how) Splage 4 10.0 (how) Splage 5 10.0 (how)

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.

	ik outer surface 42.1361 [m]	Liquid mass density 480.0	[kg/m^3]
Spillage application	above Comer Protection		
	Ist Wall Insulation layer	() Wall	
mai Loads			
mai Loads Spillage Height 1	Select Temperature Data exported from 2	D Thermal Analysis	Browse
maiLoads Spillage Height 1 Spillage Height 2	Select Temperature Data exported from 2	D Thermal Analysis	Browse Browse
mai Loads Spillage Height 1 Spillage Height 2 Spillage Height 3	Select Temperature Data exported from 2	D Thermal Analysis	Browse Browse
mai Loads Spillage Height 1 Spillage Height 2 Spillage Height 3 Spillage Height 4	Select Temperature Data exported from 2	D Thermal Analysis	Browse Browse Browse
nai Loads billage Height 1 billage Height 2 billage Height 3 billage Height 4 billage Height 5	Select Temperature Data exported from 2	D Thermal Analysis	Browse Browse Browse Browse Browse

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.

							LNG Tank -	Add wind loading				
							Design o	ode parameters		GB5000	9 (2012)	
nk definition data def litename ved model file path ment size (m) Inalysis type	Tak1 E-WK\TestRunn((ID)m 25	d	• 🛛 🖉 Hall only model				Refere Terrain Correct	nce wind pressure, w roughness category tion coefficient for top	_0 (cl. 8.1.2) (cl. 8.2.1) pography, n (cl. 8.2)	0.3 A	879	[kPa]
 2D Avignmetric sold Vind load (EN1991.1.4.2005) Basic wind velocity Roughness length Minisum height 	37.5 3.0E-3 1.0	(n/2) (m) (m)	30 Shel Differen Norber of buffress Extuade discheress 17 [m] Duffere subb		LNG Ta	nk - Add	wind loading	lynamic response fac de shape coefficient) Appendix G 19	EN1991-1-4	Ta (2005)	able G.02	
Drography factor Tenain factor Turbulence factor Air density Soil height above slab botton	1.0 0.156 1.0 1.25 0.9	kp/n^3) (n)	Eigenvalue Number of eigenvalues 10 Include non-shuchanal masses	-	Des	ign code pa asic wind v oughness k	elocity ength		37.5 3.0E-3	1	[m/s] [m]	lised
					М О Ті Ті	inimum hei rography fa errain facto urbulence f	ght actor r actor		1.0 1.0 0.156 1.0		[m]] [Hz]
					A	r density		Default	0K	Cancel	[kg/m^3] Help Cancel	Help

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

	Printeport mename tow
g folder O Current O User Defined	Working folder O Current O User Defined
D.WDev TestW210712 PostProcessingSpeedWtest_[Angle]xtsx	Save in D.#Dev Test#210712 PostProcessingSpeed@test_[Angle].xtex
t	Target
Angles 20 (e.g. 0.50.100 Al Selected Visible	Angles 20 (e.g.0.90.120 Lot 8 Lot 9
tion Summary Report	Utilization Summary Report
PM Shear Decomp. BS EN 1982-1-1 (2005)	V PM Shear Decomp. BS EN 1982-1-1 (2005) V Peak element only
RC ULS : Ft Bar-M Fc Bar-S No design code is enabled	RC ULS: Ft Bar-M Fc Bar-S No design code is enabled RP Peak Inaricase only
RC SLS: Crack Width No design code is enabled	RC SLS: Crack Width No design code is enabled
heck Report 🔽 Shear Check Report 📃	PM Check Report
Peak element only Peak loadcase only	Peak element only Peak loadcase only Peak element only Peak loadcase on
3869	Loadcases
Averat Averation Averatioa Averatioa Averatioa Averatioa Averatioa Averatioa Averatioa	2.Dead Load of Steel Structure 3.Dead load of liner and steel nof 1 4Y axis
aad load of steel structures on the roof ead load of Insulation	4:Dead load of insulation 5:Dead load of insulation Slicing Line
essure on outer tank wall due to insulation all piping leading Angle (Positive Direction)	5. Pressure on outer tank was due to instalation 7. Wall pipel loading 9. Pour load in the failure france.
sed load of insulation Constr Ind Load X axis (0 Degree)	9. Used load of instation Conter 9. Wind Load 10. line (d bottom (direct)
Jqua bottom (Min)	11:Liquid bottom(Mn) 12 Gas Press with the first
Jas Pressure(Max) Jas Pressure(Min)	12 Gas Pressure(Mn)

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 <u>rebar attributes</u>.
- 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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