



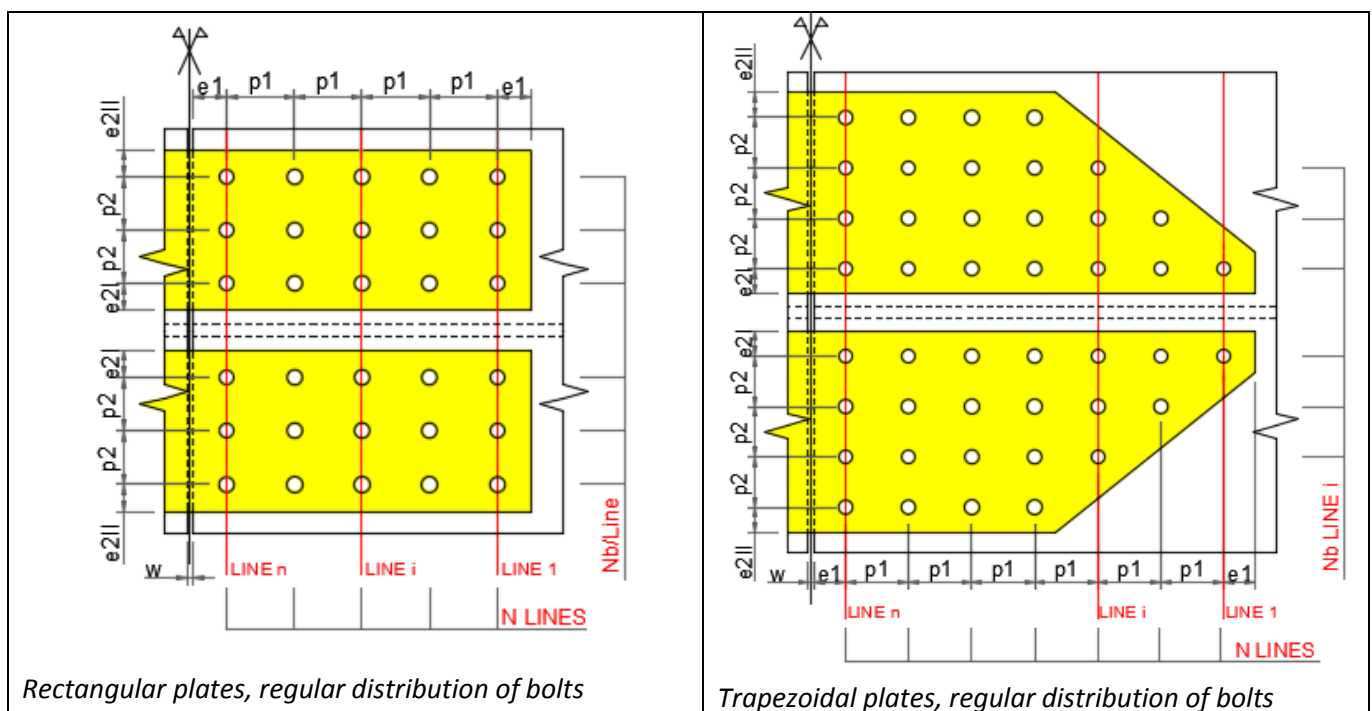
NEWS of PontiEC4 release 3.3

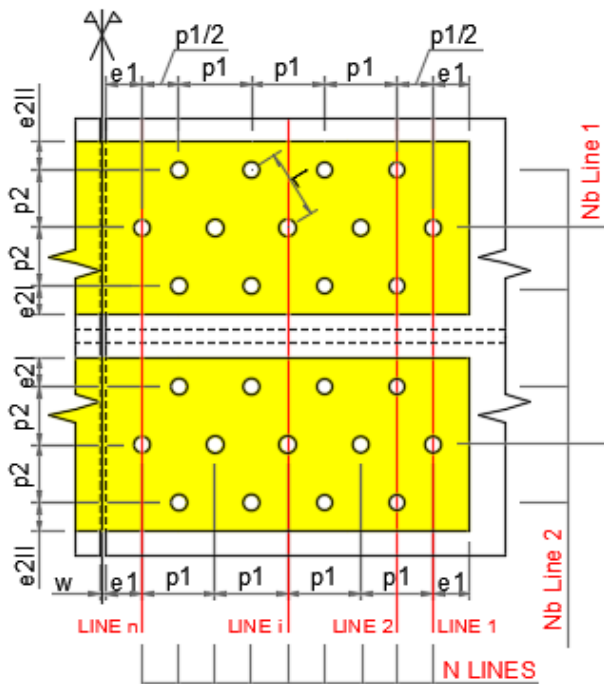
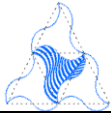
New types of bolted joints

The **regular distribution** of bolts [or if you wanted “The ability to regularly distribute bolts”], already available in PontiEC4, has been extended to include **staggered distribution**, according to two possible schemes: with different numbers of bolts on the even and odd rows (**type 1**) or with an equal number of bolts on different rows (**type 2**).

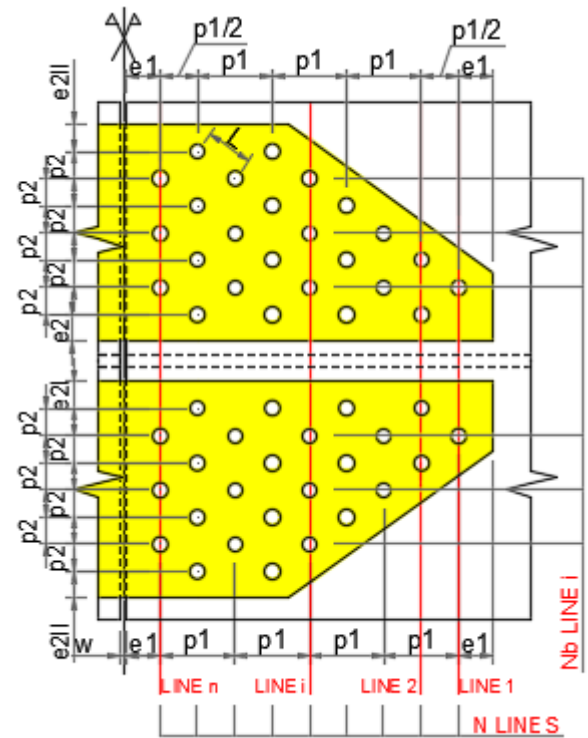
Furthermore, for flanges, the use of trapezoidal-shaped plates has been introduced. These allow a more gradual migration of normal force from the profile flanges to the joint plates, reducing the force in the more perforated sections of the profile.

The new options for flanges are shown below.

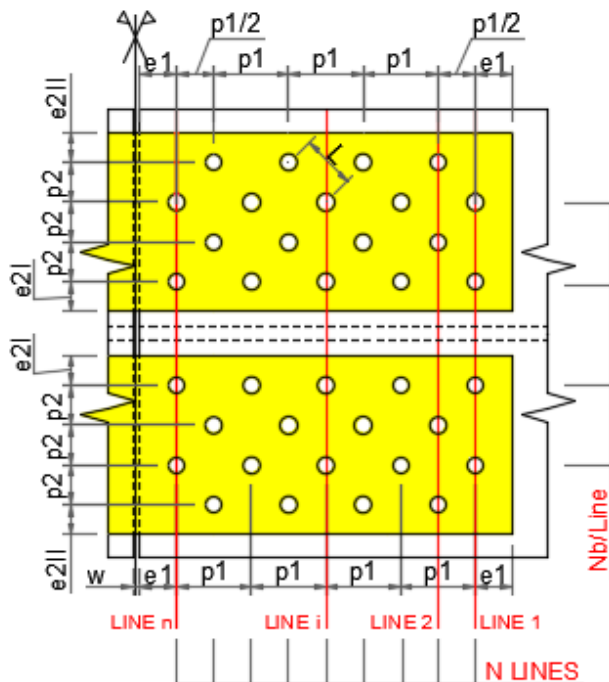




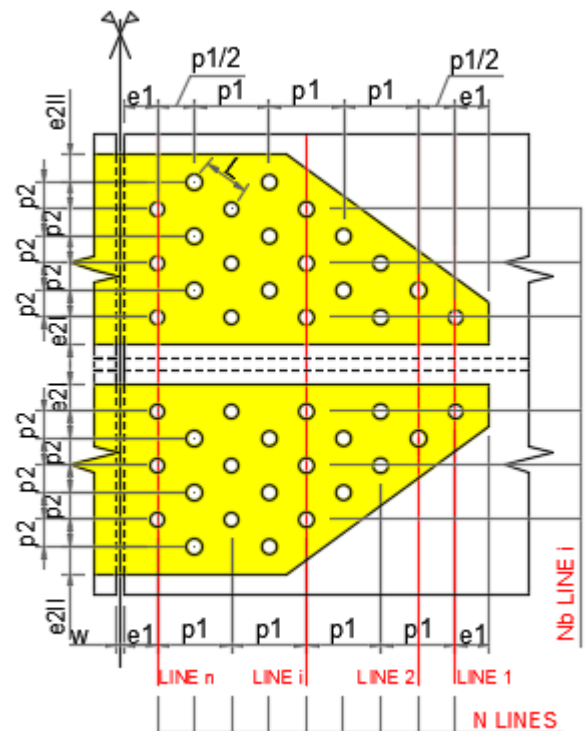
Rectangular plates, distribution type 1 of bolts with staggered lines



Trapezoidal plates, distribution type 1 of bolts with staggered lines



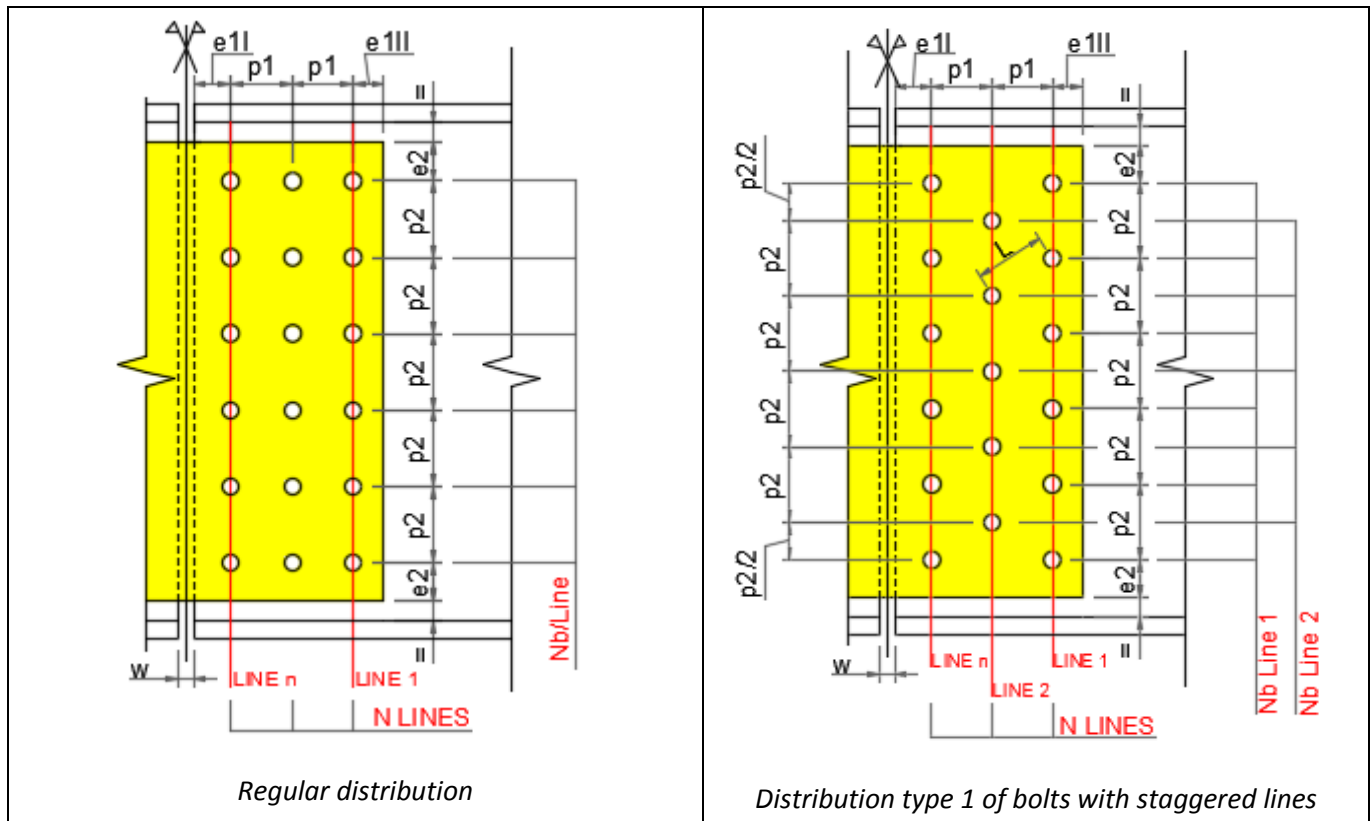
Rectangular plates and distribution type 2 of bolts with staggered lines



Trapezoidal plates, distribution type 2 of bolts with staggered lines



For web connections it is possible to choose either regular or staggered distribution type 1 as shown in the following pictures.

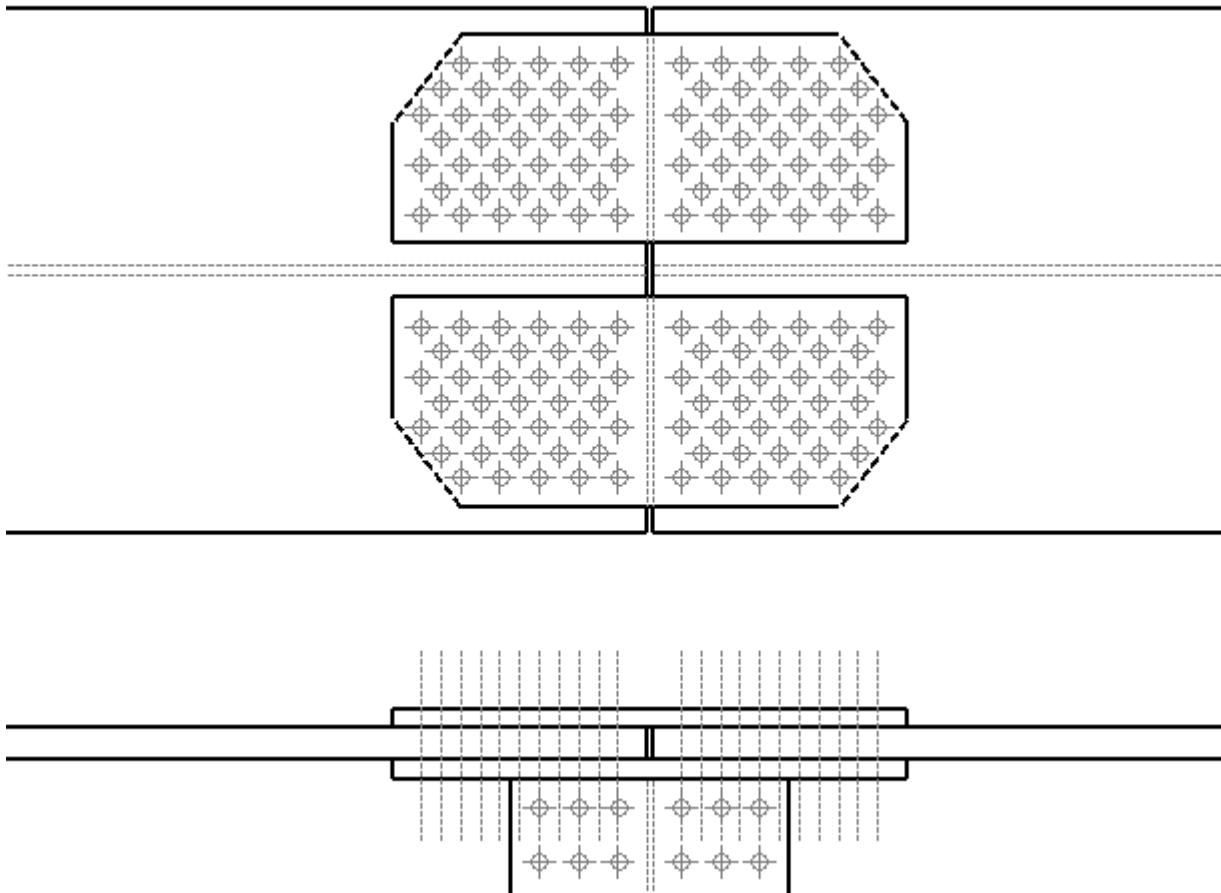


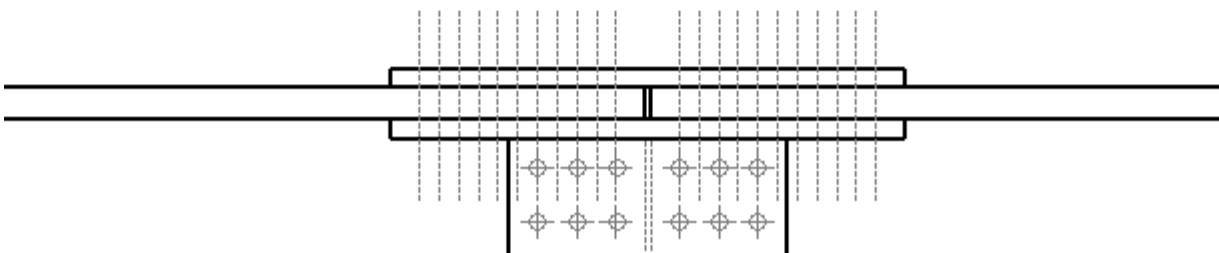
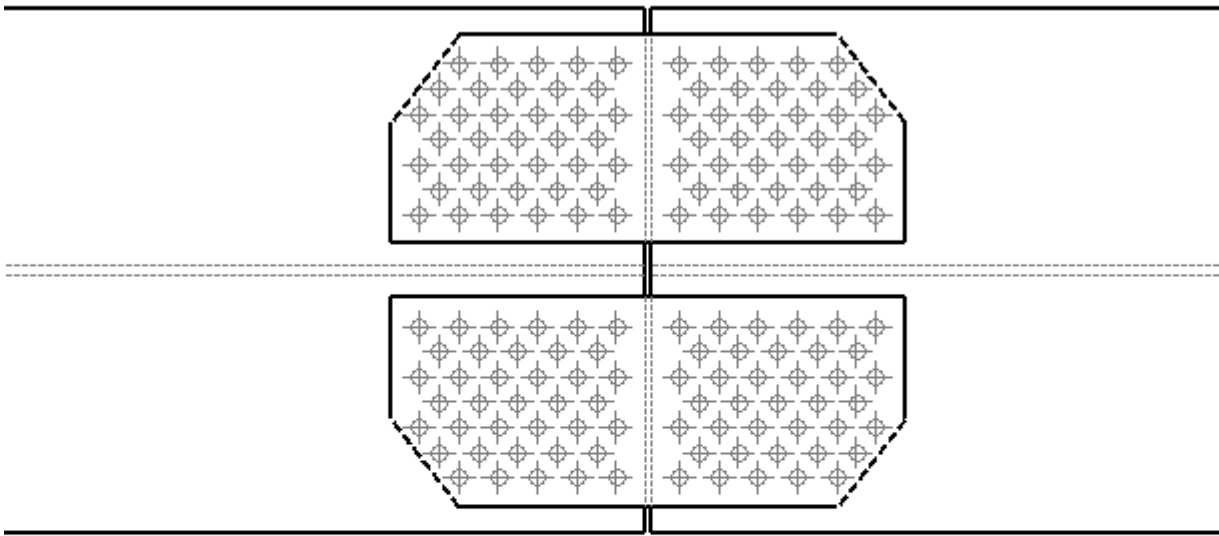
Fatigue checks

For all types of joints, fatigue verification of the profile and plates has been introduced, with reference to the net or gross cross sections, and the verification of the tangential tensions in the bolts.

Automatic joint design

A graphical representation of the bolted connection has been added, providing an immediate visual means of checking the consistency of the data entered, and the proportions and dimensions of the various components. In addition, it is possible to analyze the drawing in detail by means of zoom and pan operations, and export it in DXF format.





Detail of the design of a joint



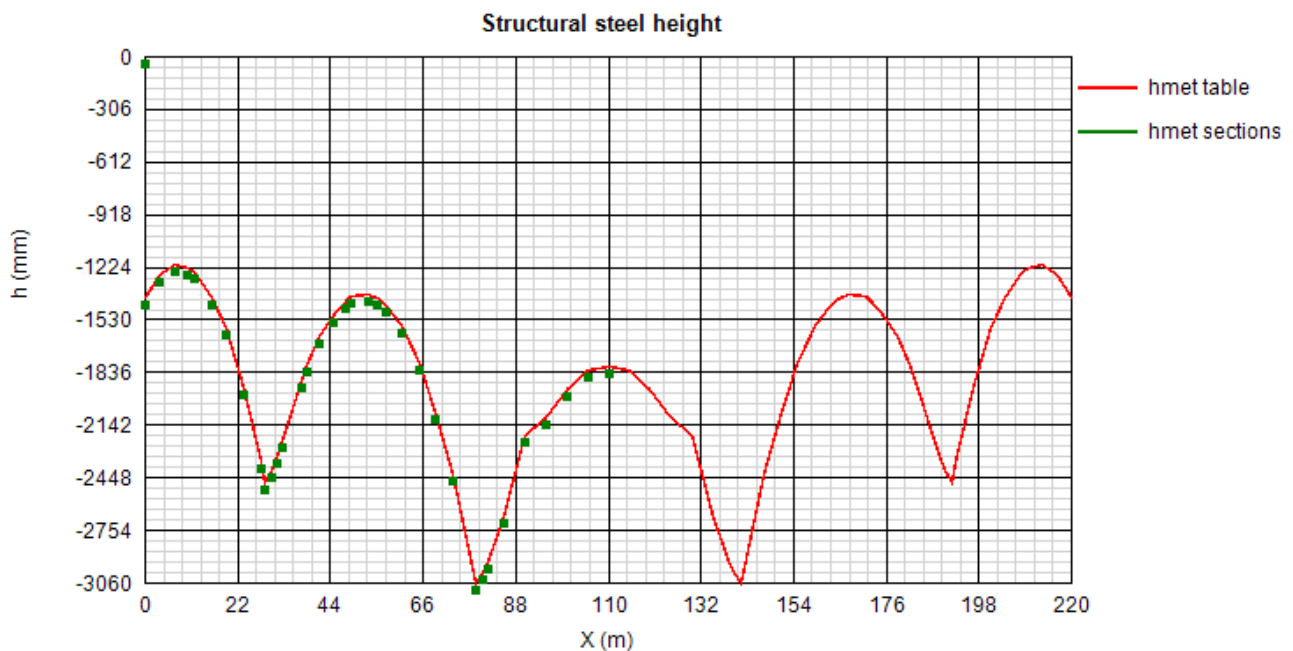
NEWS of release 3.2

Auto calculation of steel section height

It is now possible to define a line variation by a series of X distances and the heights, to be interpolated between those distances.

This line variation is used also to define the height of new sections detected when importing Force and Moments from xls file.

A new item in the graphs list allows plotting of the variation of the height along the bridge.



Automatic selection of paragraphs to include in the Report

It is now possible to automatically include all checks in the report for utilization ratios that exceed predefined values.

Main report | Other reports | Settings

Section	General data	Domain	Classific.	ULS checks (Mmax)
A_1_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A_1_11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A_4_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A_4_11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_5_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_5_11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_12_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_12_11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_39_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_39_11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C_43_1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Context menu for A_1_1:

- Check selected area
- Un-check selected area
- Check all
- Un-check all
- Hide rows
- Hide columns
- Show all rows
- Show all columns
- Auto select

Limits of utilization ratio to consider for the main report

Check	utilization ratio limit
ULS: Bending and shear resistance check	0.85
SLS: Stresses limitation check	0.85
ULS: Shear connections check	0.85
SLS: Shear connections check	0.85
Fatigue: Shear connections check	0.85
Fatigue: Structural details	0.85
Fatigue: Reinforcements bar	0.85
SLS: Web breathing	0.85

Defaults



Reinforcement bars fatigue assessment

It is now possible to apply a traffic loading factor, depending on the segment position, to the maximum and minimum Phase 3b forces and moments of the Fatigue combination. This allows you to apply EN1992-2 Annex NN.2.1 (101) that requires you to scale force and moments arising from a fatigue loading model FLM3 for the equivalent stress range calculation in the reinforcement bars.

Furthermore the fatigue reinforcement bars assessment can be included in the rtf report.

Influence of Shrinkage and thermal action on the studs design at deck ends

The calculation of the minimum number of studs in the deck ends region has been reviewed and now it is performed according to EN1994-2, 6.6.2.4(3). The utilization ratio arising from the check is included in the ULS summary and a paragraph about this check can be included in the rtf report.

Web breathing check

It is now possible to add into the rtf report a paragraph about the web breathing check. It includes a summary of the force and moments from the SLS frequent combination and a table of the stresses in the section.



NEWS of release 3.1

Longitudinal and vertical stiffeners checks

In the new release 3.1 of PontiEC4 the following checks have been added:

- The torsional buckling of vertical and longitudinal stiffeners with open cross-section according to EN 1993-1-5, 9.2.1, (8) , (9)
- The effective section of intermediate vertical stiffeners acting as rigid support for web panels according to EN 1993-1-5, 9.3.3 (3)
- The maximum stress and the additional deflection in the vertical stiffeners according to EN 1993-1-5, 9.2.1, (4)

Stresses	Shear	Geometric properties 0	Geometric properties 1	Geometric properties 2	Domains Mpl-N	Studs. ULS, SLS	SLS. Web Breathing	Fatigue LS 1	Fatigue LS 2	Stiffeners																						
<div> <div> <p>Torsional buckling check</p> <p>Rectangular shape T, L shape</p> $\frac{I_T}{I_p} \geq 5.3 \frac{f_y}{E}$ $\sigma_{cr} \geq 6 f_y$ <table border="1"> <thead> <tr> <th></th> <th>Vertical stiffeners</th> </tr> </thead> <tbody> <tr> <td>Check</td> <td>0.162</td> </tr> <tr> <td>Type</td> <td>Vert. (R)</td> </tr> <tr> <td>σ_{cr}</td> <td>--</td> </tr> <tr> <td>$6f_y$</td> <td>--</td> </tr> <tr> <td>ICr</td> <td>--</td> </tr> <tr> <td>lw</td> <td>--</td> </tr> <tr> <td>IT</td> <td>1.562E+6</td> </tr> <tr> <td>IP</td> <td>2.832E+7</td> </tr> <tr> <td>IT/IP</td> <td>0.055</td> </tr> <tr> <td>$5.3 f_y$</td> <td>0.009</td> </tr> </tbody> </table> </div> <div> <p>Vertical stiffeners as rigid supports</p> $I_{ST} \geq 1.5 h_W^3 t_W^3 / a^2$ $I_{ST} \geq 0.75 h_W t_W^3 / a^2$ $a / h_W < \sqrt{2}$ $a / h_W \geq \sqrt{2}$ <p>lst = 2.271E+7 mm⁴ > lst min = 8.543E+6 mm⁴</p> <p>CHECK PASSED</p> <p>a = 4000 mm hw = 3000 mm a/hw = 1.333</p> <p>tw = 15 mm bw = 391.1 mm</p> <p>Ast = 9616.9 mm² e1 = 32.2 mm²</p> </div> <div> <p>Minimum requirements for transverse stiffeners</p> <p>Maximum stress Maximum deflection</p> $\sigma_{max} \leq \frac{f_y}{\gamma_{M1}}$ $w \leq \frac{h_w}{300}$ <p>cmax = 92.2 < 322.7 N/mm² w = 5.6 < 10 mm</p> <p>CHECK PASSED</p> <p>$\Sigma N_{st,Ed} = N_{st,Ed} + \Delta N_{st,Ed} = 5.258E+5 + 0E+00 = 5.258E+5$ N</p> <p>$N_{st,Ed} = N_{st,ten} + N_{st,ex} = 5.258E+5 + 0E+00 = 5.258E+5$ N</p> <p>$\sigma_m = 0$ N/mm² $\sigma_{cr}(C)/\sigma_{cr}(P) = 0 > 0.5$</p> <p>$\sigma_{cr}(P) = 1E+300$ N/mm² $\sigma_{cr}(C) = 2.67$ N/mm²</p> <p>$N_{Ed} = 0E+00$ N $\lambda_w = 2.385$ $N_{cr,st} = 5.23E+6$ N</p> <p>e1 = 32.2 mm emax = 125.3 mm w0 = 10 mm</p> <p>$\delta_m = 3.217$</p> </div> </div>												Vertical stiffeners	Check	0.162	Type	Vert. (R)	σ_{cr}	--	$6f_y$	--	ICr	--	lw	--	IT	1.562E+6	IP	2.832E+7	IT/IP	0.055	$5.3 f_y$	0.009
	Vertical stiffeners																															
Check	0.162																															
Type	Vert. (R)																															
σ_{cr}	--																															
$6f_y$	--																															
ICr	--																															
lw	--																															
IT	1.562E+6																															
IP	2.832E+7																															
IT/IP	0.055																															
$5.3 f_y$	0.009																															



In the new release 3.0 of PontiEC4 it is possible to check bolted connections loaded in shear, standard or slip-resistant, starting from the sections geometric properties and force/moments already input in PontiEC4, according to EN 1993-1-8.

All geometric and material data specific for the bolted connections are input in the following window dialog.

Bolted connections

Material Bolts

Class:

☒ Shear through threaded portion
☐ Shear through unthreaded portion

Plates

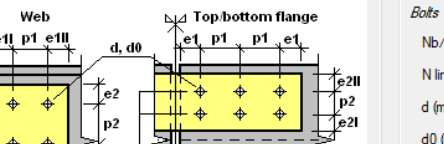
	t ≤ 40 mm	t > 40 mm
f _u (N/mm²)	<input type="text" value="510"/>	<input type="text" value="470"/>
f _y (N/mm²)	<input type="text" value="355"/>	<input type="text" value="335"/>

Slip resistance

k_s:
μ:

Partial factors

γ M2	<input type="text" value="1.25"/>
γ M3, ULS	<input type="text" value="1.25"/>
γ M3, SLS	<input type="text" value="1.1"/>



Connections definition

Category:

Sections

- P1-centr_60_1
- P1-centr_191_1
- P1-centr_291_1
- P1-centr_294_11
- P1-bordo_89_1
- P1-bordo_215_1
- P1-bordo_311_1
- P1-bordo_314_11
- P2-centr_367_1
- P2-centr_491_1
- P2-centr_591_1
- P2-centr_592_1
- P2-centr_592_11

Connections

- P1-bordo_314_11 - P2-bordo_377_1
- P1-centr_294_11 - P2-centr_367_1

Top flange connection

Bolts

Nb/line	<input type="text" value="4"/>
N lines	<input type="text" value="5"/>
d (mm)	<input type="text" value="27"/>
d0 (mm)	<input type="text" value="29"/>

Distance \ Spacing

e1 (mm)	<input type="text" value="60"/>
p1 (mm)	<input type="text" value="81"/>
e2l (mm)	<input type="text" value="50"/>
e2ll (mm)	<input type="text" value="50"/>
p2 (mm)	<input type="text" value="90"/>

Packing plates

t L (mm)	<input type="text" value="5"/>
t R (mm)	<input type="text" value="0"/>

Inside \ Outside plates

t (mm)	<input type="text" value="20"/>
--------	---------------------------------

Web connection

Bolts

Nb/line	<input type="text" value="15"/>
N lines	<input type="text" value="3"/>
d (mm)	<input type="text" value="27"/>
d0 (mm)	<input type="text" value="29"/>

Distance \ Spacing

e1l (mm)	<input type="text" value="60"/>
e1ll (mm)	<input type="text" value="60"/>
p1 (mm)	<input type="text" value="81"/>
e2l (mm)	<input type="text" value="70"/>
p2 (mm)	<input type="text" value="135"/>
w (mm)	<input type="text" value="0"/>

Packing plates

t L (mm)	<input type="text" value="0"/>
t R (mm)	<input type="text" value="0"/>

Inside \ Outside plates

t (mm)	<input type="text" value="15"/>
--------	---------------------------------

Bottom flange connection

Bolts

Nb/line	<input type="text" value="7"/>
N lines	<input type="text" value="6"/>
d (mm)	<input type="text" value="27"/>
d0 (mm)	<input type="text" value="29"/>

Distance \ Spacing

e1 (mm)	<input type="text" value="60"/>
p1 (mm)	<input type="text" value="81"/>
e2l (mm)	<input type="text" value="42.5"/>
e2ll (mm)	<input type="text" value="42.5"/>
p2 (mm)	<input type="text" value="85"/>

Packing plates

t L (mm)	<input type="text" value="5"/>
t R (mm)	<input type="text" value="0"/>

Inside \ Outside plates

t (mm)	<input type="text" value="20"/>
--------	---------------------------------

In detail, according to the paragraph 3.4.1 and table 3.2 of the EN 1993-1-8, the bolted connection loaded in shear, are designed in category A, B or C, following the scheme below:

Category A - Bearing type

Expected checks:

- Shear resistance of bolts (ULS)
- Bearing resistance of connected plates and members (ULS)

Bolt specifications:

- No preloading required
- Bolt classes from 4.6 to 10.9 may be used

Category B - Slip-resistant at serviceability limit state

Expected checks:

- Shear resistance of bolts (ULS)



- Bearing resistance of connected plates and members (ULS)
- Slip resistance at serviceability limit state (SLS)

Bolt specifications:

Only preloaded class 8.8 or 10.9 bolts should be used

Category C - Slip-resistant at ultimate limit state

Expected checks:

- Bearing resistance of connected plates and members (ULS)
- Slip resistance at ultimate limit state (ULS)
- Plastic resistance of the net cross-section at bolt holes for the connected members (ULS, only for tension forces)

Bolt specifications:

Only preloaded class 8.8 or 10.9 bolts should be used

For each connection category, distances and spacings of the bolts are checked with reference to the dimensional limits expected in table 3.3, EN 1993-1-8. Also the resistance at ultimate limit state of the connected plates is checked.

All results are organized in tables, where it is possible to view either a summary **of the utilization factors** of the checks performed and **all details with step by step results.**

Giunti bullonati - Risultati											
	Nome	Dim_Check	Comb.	Comp.	FvEd/FvRd	FbEd/FbRd	VEd/VpRd	N-MEd/N-MpRd	Comb.	Comp.	
▶	P1-bordo_314_11 - P2-bordo_...	Ali sup.:True	SLU, Mmax	Ali sup.	0.066	0.06	0	0.099	SLE c., Mmax	Ali sup.	C
		Anima:True		Anima	0.101	0.098	0.016	0.11		Anima	C
		Ali inf.:True		Ali inf.	0.039	0.03	0	0.104		Ali inf.	C
			SLU, Mmin	Ali sup.	0.357	0.299	0	0.534	SLE c., Mmin	Ali sup.	C
				Anima	0.73	0.704	0.127	0.788		Anima	C
				Ali inf.	0.369	0.28	0	0.987		Ali inf.	C
			SLU, Vmax	Ali sup.	0.033	0.03	0	0.049	SLE c., Vmax	Ali sup.	C
				Anima	0.058	0.053	0.031	0.056		Anima	C
				Ali inf.	0.019	0.015	0	0.051		Ali inf.	C
			SLU, Vmin	Ali sup.	0.289	0.247	0	0.432	SLE c., Vmin	Ali sup.	C
				Anima	0.698	0.67	0.152	0.741		Anima	C
				Ali inf.	0.342	0.264	0	0.913		Ali inf.	C

	Ala superiore	SX	DX	Anima	SX	DX	Ala inferiore	SX	DX
▶	DATI GENERALI			DATI GENERALI			DATI GENERALI		
	Definizione del giunto			Definizione del giunto			Definizione del giunto		
	Categoria	B: Unioni a...		Categoria	B: Unioni a...		Categoria	B: Unioni a...	
	Sezioni	P1-bordo_...	P2-bordo_...	Sezioni	P1-bordo_...	P2-bordo_...	Sezioni	P1-bordo_...	P2-bordo_...
	Bulloni			Bulloni			Bulloni		
	Classe	10.9		Classe	10.9		Classe	10.9	
	Taglio su sezione:	filettata		Taglio su sezione:	filettata		Taglio su sezione:	filettata	
	Nb/fila	4		Nb/fila	15		Nb/fila	7	
	N file	5		N file	3		N file	6	
	d (mm)	27		d (mm)	27		d (mm)	27	
	d0 (mm)	29		d0 (mm)	29		d0 (mm)	29	
	Apomb (mm^2)	573		Apomb (mm^2)	573		Apomb (mm^2)	573	

Finally, it is possible to compile a **report in rtf format** containing all input data entered and checks carried out for all joints and all design combinations.

NEWS of release 2.0

Composite and Orthotropic box-girder

In the new version 2.0 of PONTIEC4 is possible an input of detail data that enable the management and calculation of the Shear lag and / or the buckling of the flanges longitudinally stiffened.

These options are particularly useful for the management of the flanges of the boxes in the orthotropic decks and in the composite steel-concrete box-girder.

The dialog box asks the user to indicate, separately for the flange of the right and the left:



Advanced options for the top flange (A)

Left flange

b (mm) 950 ☐ Internal flange ☒ Outstand flange

No stiffeners ☐ V ☒ L ☐ T ☐

Ksigma 2

Include stiffeners in geometric properties calculation ☐

Stiffener geometry

n 2 bIV (mm) 100

bI (mm) 225 bVI (mm) 200

bII (mm) 150 tsl (mm) 8

bIII (mm) 150 tsl IV (mm) 0

Shear lag coefficients

β (SLE) 0.996,0.996,0 β (SLU) 1.1,1.1

Right flange

b (mm) 1400 ☒ Internal flange ☐ Outstand flange

No stiffeners ☐ V ☒ L ☐ T ☐

Ksigma 0

Include stiffeners in geometric properties calculation ☒

Stiffener geometry

n(>=1.5) 3.5 bIV (mm) 100

bI (mm) 225 bVI (mm) 0

bII (mm) 150 tsl (mm) 8

bIII (mm) 150 tsl IV (mm) 0

Shear lag coefficients

β (SLE) 0.991,0.991,0 β (SLU) 1.1,1.1

Default OK Exit

- The type of flange: **Outstand / Internal**
- The width of the flange.
- The presence or absence and possibly the type of stiffener used ("V", "T", "L"). In the presence of stiffener are required geometric data indicated in the schematic figures proposals.



- A series of beta coefficients (as many as there are sections of ashlar) of shear lag for SLU and SLE, calculated automatically.

In the presence of stiffeners the user can choose the option "include in the calculation": This option allows to take into account the area of the stiffeners in the calculation of the geometric properties of the entire gross and effective section; anyway for the buckling and shear lag, the stiffening are taken into account, even if excluded from the calculation of effective properties.

For outstand stiffened flanges, no calculation is carried out automatically for K_{σ} , that is asked to the user as input. For internal flange K_{σ} is not required and is automatically calculated, assuming that there are at least 3 equally spaced over the entire stiffened flange (at least 1.5 stiffeners in half flange).

A series of automated checks verify the congruence of the geometric data entered. The input file PontiEC4 compiled with versions prior to 2.0 are automatically interpreted in these latest hypotheses.

The Results dialog box contains the following new data sets:

- Reduction factors for buckling of the flanges and / or shear lag

Are shown in tabular form the coefficients of reduction, and the effective area, for instability and / or shear lag for the flanges (separate into flange top, bottom, left and right).

- Effective areas of subpanels

In tabular form are given the reduction factors for instability, and the effective area of the subpanels with stiffened flanges (separate into upper, lower, left and right flange).

- Stiffening flanges

In tabular form is reporting data relating to the geometry of the stiffened flanges



- Instability of stiffened flanges

In tabular form are given the reduction factors, and the effective area for instability of the whole stiffened flanges (separate for top, bottom, left and right)

Improvements to operations

- ✓ It has been enhanced the ability to delete or add sections within a segment, during both the input and edit mode. For example in the following figure is shown the possibility of eliminating the sections using a multiple selection

	Name	X (m)	h met (mm)	b eff (mm)	b eff SX (mm)
	38_1	12.15	2700	6356.3	2870.9
	38_11	13.252	2700	6375	2875
	33_1	19.2506...	2700	6375	2875
	33_11	20.25	2700	6375	2875
	18_1	30.254	2700	6375	2875
	18_11	31.2533...	2700	6375	2875
	13_1	37.252	2700	6375	2875
	13_11	38.354	2700		
*					

Copy
 Paste
 Delete
 Insert rows
 Remove rows

- ✓ When you import the forces and moments using the menu **File> Import forces/moments**, are automatically identified for existing segment any sections not included in PontiEC4, you then have the ability to automatically insert them. The name of the sections and the segment must simply meet the following specification:

"Segment name" + "_" + "Section name"

For example, if in the Excel file there is a section called: "A_S5" and the segment "A" in PontiEC4 does not contain any section called "S5", then it will be added automatically.

This possibility makes the input of forces and moments much easier and eliminates the working phase which consists in defining within each segment the individual sections before proceeding to the import of forces/moments



- ✓ It was enhanced the ability to use the dual language English / Italian; the user interface will be in English or Italian depending on the system regional settings of your PC. The report will be written in either Italian, English or French
- ✓ **(Lusas USERS ONLY)** For users who use the finite element analysis system LUSAS, is provided in the setup package of PontiEC4, a wizard named **EXPPontiEC4** that allows fully automatic filling of the xls file containing sections and forces/moments. The user only needs to preselect the finite elements to check and identify the Smart Combination / envelopes for the various design phases. The wizard recognizes the cracked areas and also automatically sets the column of coefficients ψ γ for the shrinkage and thermal actions.
- ✓ **(Lusas USERS ONLY)** The examples directory contains a new example "guided step by step" to use in combination with Lusas PontiEC4