SDC VERIFIER

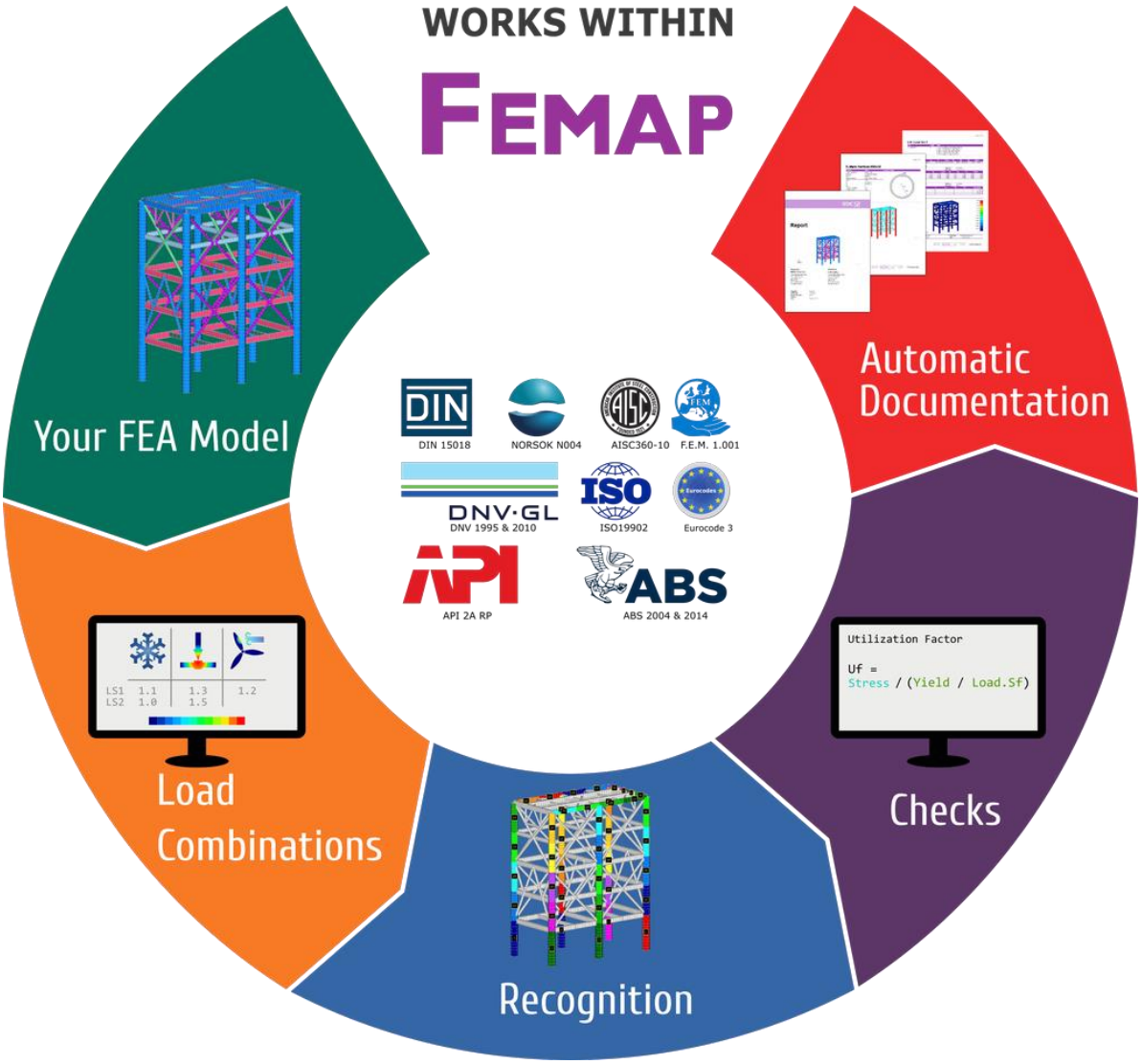
Load Combinations

Recognition

Checks

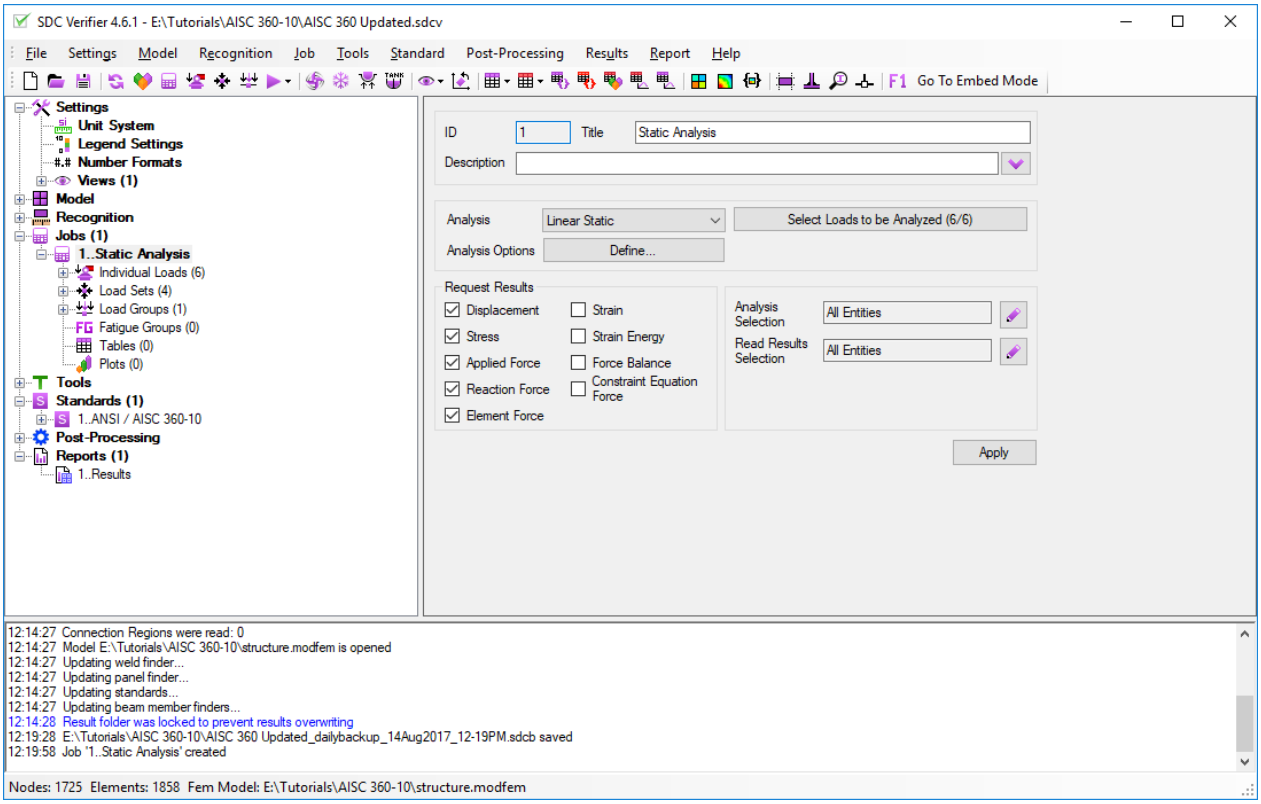
Reports

SDC Verifier is a powerful postprocessor extension for Femap which automates the full FEA workflow.

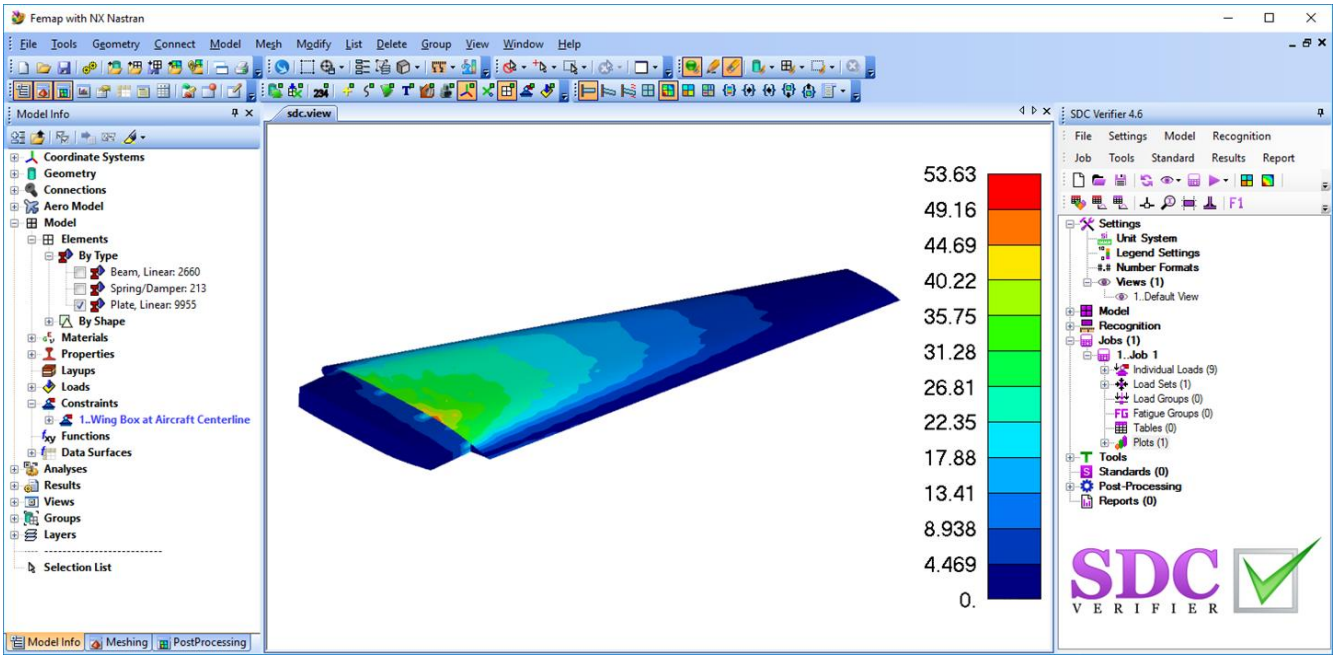


SDC Verifier works within Femap

SDC Verifier is a powerful post-processor program that is used to verify structures in accordance with required safety standards and generate a report in an efficient and simple way.



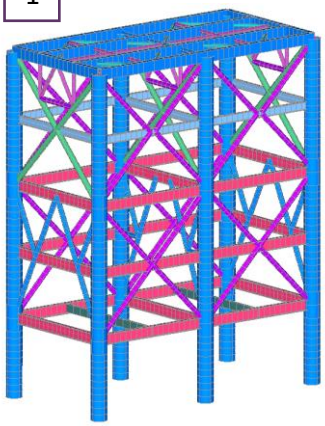
Femap offers an advanced engineering analysis environment for simulation of complex engineering problems. SDC Verifier together with CAE program makes the calculation procedure more transparent and facilitates checking of a complete set of load cases according to predefined design code rules or own standards. Full model description and all calculations are presented in reports. Consequences of updates to the design can be reviewed and compared with the original design using report regeneration.



SDC Verifier – Calculation Procedure

The complete verification procedure of the structure is stored. When the design is modified it requires only one-click on "Regenerate" to rerun all the calculations and regenerate the report.

1



FEA Model

2

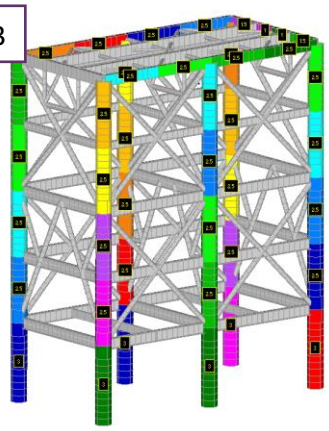
it Load Sets

	Safety Factor	IL1..IL1	IL2..IL2	IL3..IL3	IL4..IL4	IL5..IL5	IL6..IL6	IL7..IL7	IL8..IL8	IL9..IL9	IL10..IL10	IL11..IL11	IL12..IL12
LC1_Long_forestay_1	1.33	1.43				1.1		-1.1				-1.1	
LC1_Long_forestay_2	1.33	1.43				1.1		-1.1				-1.1	
LC1_Long_forestay_3	1.33	1.43					1.1	-1.1				-1.1	
LC1_Long_forestay_4	1.33	1.43					1.1	-1.1				-1.1	
LC1_Long_short_1	1.33		1.43			1.1			-1.1				-1.1
LC1_Long_short_2	1.33		1.43			1.1			-1.1				-1.1
LC1_Long_short_3	1.33		1.43				1.1		-1.1				-1.1
LC1_Long_short_4	1.33		1.43				1.1		-1.1				-1.1
LC1_Short_forestay_1	1.33			1.43		1.1				-1.1			
LC1_Short_forestay_2	1.33			1.43		1.1				-1.1			
LC1_Short_forestay_3	1.33			1.43			1.1			-1.1			
LC1_Short_forestay_4	1.33			1.43			1.1			-1.1			

OK Cancel

Load Combinations

3



4

Custom Check

ID 4 Title Bending

Alias Bending

Description

Show Parameter Description

Options

Calculate Results over Directions

Calculate Results over Points

Load Calculation All Loads

Selection Component '2..s1.AISC360 bendi

Parameters (6) / Replacements (1)

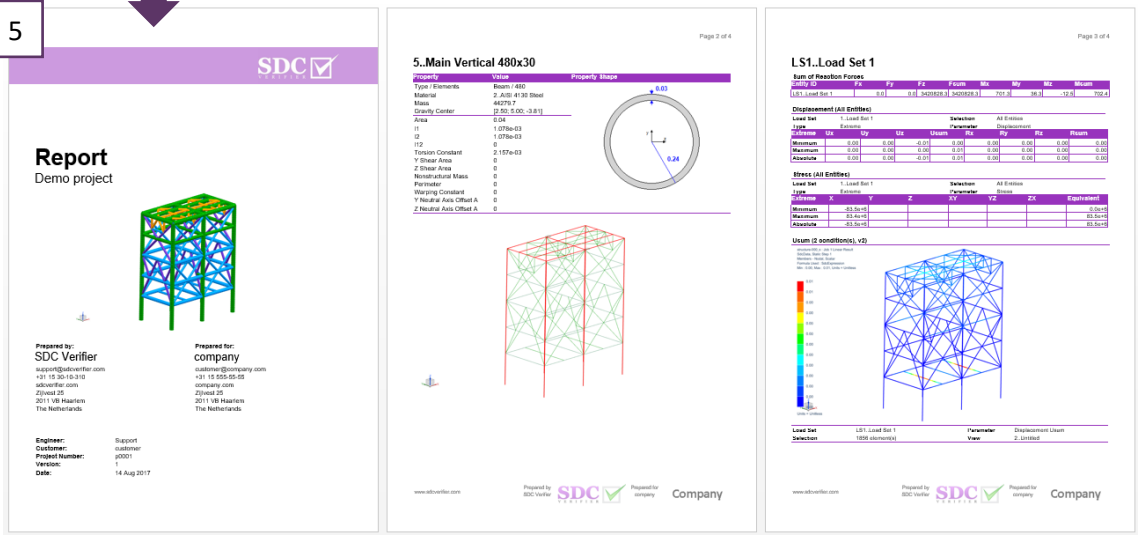
```
Replacement = BeamI_Mn_Major (BeamI Mn Major)
Switch(BeamI.Slender_Type_Webs, compact, F2_F3.Mn, noncompact, F4.Mn, slender, F5.Mn)

Parameter = Mn_Major (Mn Major)
Switch(SDCSectionType, sdc_IBeam, BeamI_Mn_Major, sdc_CircleBeam, Circle.Mn, sdc_BoxBeam, Box.
Mn_Major)

Parameter = Mn_Minor (Mn Minor)
Switch(SDCSectionType, sdc_IBeam, F6.Mn, sdc_CircleBeam, Circle.Mn, sdc_BoxBeam, Box.Mn_Minor)

Parameter = Bending_Major (Bending Major)
if(VerticalAxis = AxisY, AbsMax(Mbend1[Top], MBend1[Bot]), AbsMax(Mbend2[Top], Mbend2[Bot]))

Parameter = Bending_Minor (Bending Minor)
if(VerticalAxis = AxisY, AbsMax(Mbend2[Top], Mbend2[Bot]), AbsMax(Mbend1[Top], MBend1[Bot]))

Parameter = Uf_Major (Uf Major)
if((SDCSectionType = sdc_Ibeam or SDCSectionType = sdc_BoxBeam or SDCSectionType =
sdc_CircleBeam) and Double_Symmetric = true, Abs(Bending_Major / (F_b * Mn_Major)),
NotSupported)
```

Clear results Debug C P OK Cancel

Checks

Recognition

5



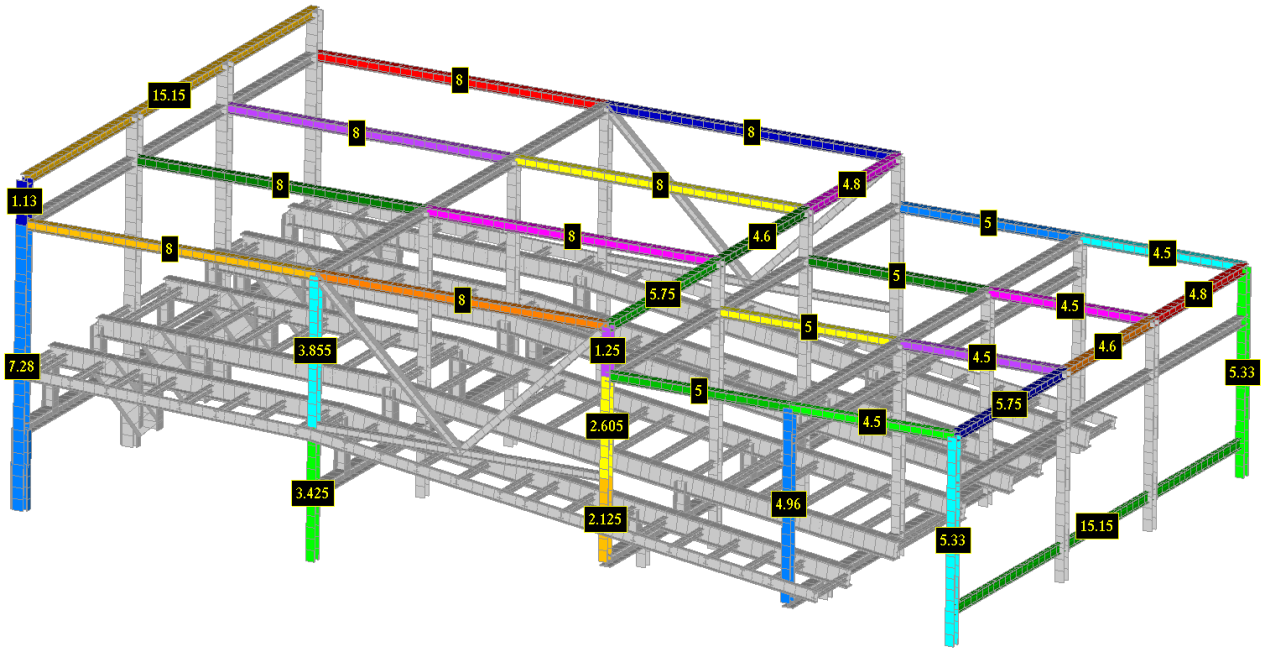
Reports

Member Checks. Buckling length recognition

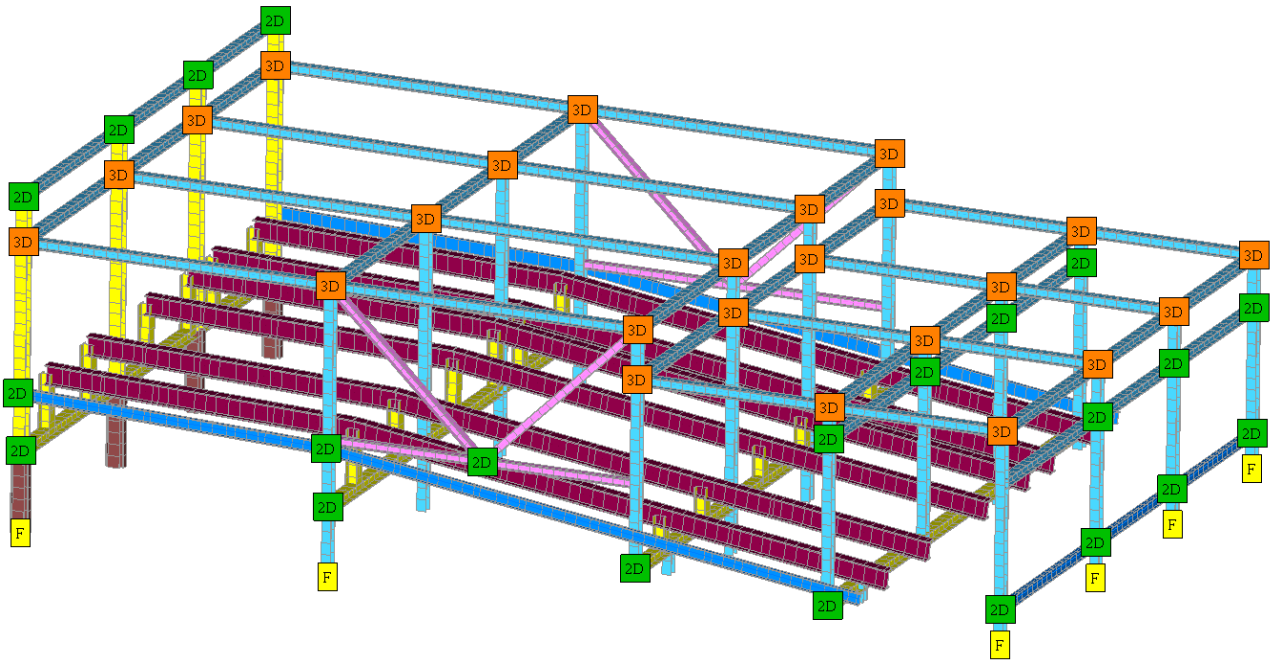
SDC Verifier implements the following standards for checking large (offshore) lattice structures: AISC/ANSI 360-10, API RP 2A, Eurocode3, ISO 19902 and Norsok N004.

AISC 360-10 | API 2A RP | ISO 19902 | Eurocode3 | Norsok N004

Beam Member Finder recognizes beam members (buckling) lengths automatically for 3 directions (Y, Z and torsional)



Buckling length is calculated between the Joints and does not depend on the model mesh.

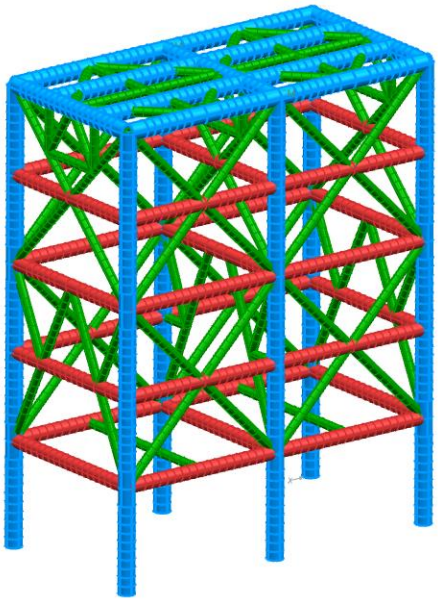


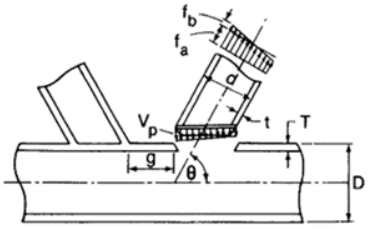
Joint Check

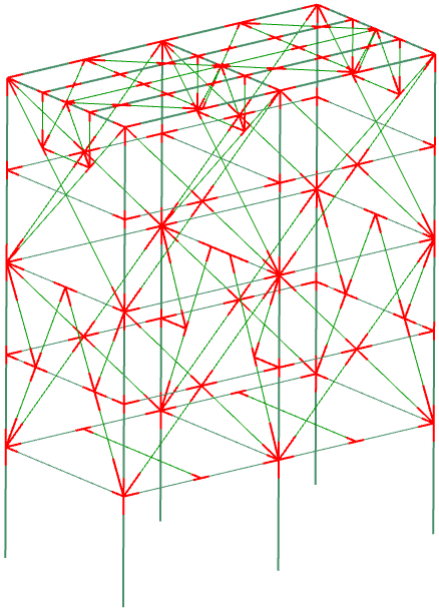
Verification of the tubular joints is performed by Joint Check according to the following standards: API RP 2A, Eurocode3, ISO 19902 and Norsok N004.

API 2A RP **ISO 19902** **Norsok N004**

Fully automated recognition of connections with their geometrical parameters.

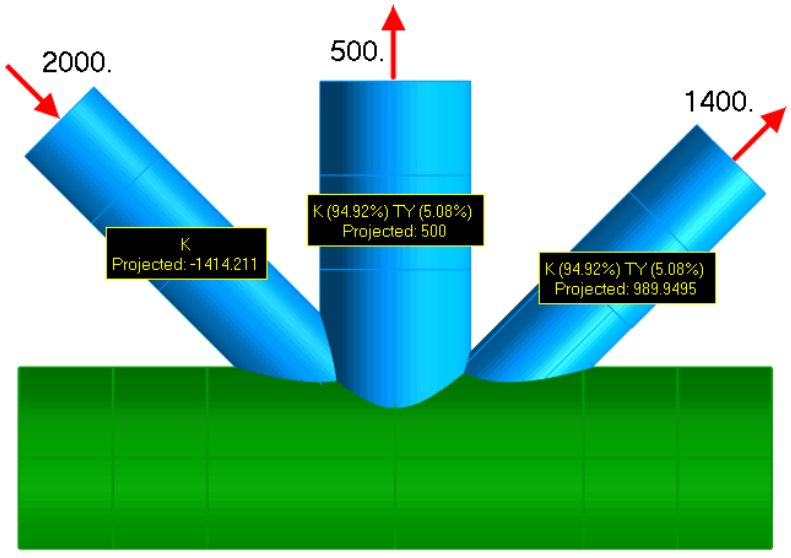


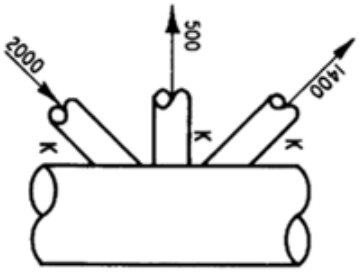




FEA Model **Joints**

Brace classification (depends on the load pattern) is calculated for each load situation automatically, which significantly speeds-up the verification process.





Connection ID	Brace Number	Joint Type
1	#1 (ElemID = 27)	K
	#2 (ElemID = 13)	K (94.92%) TY (5.08%)
	#3 (ElemID = 19)	K (94.92%) TY (5.08%)

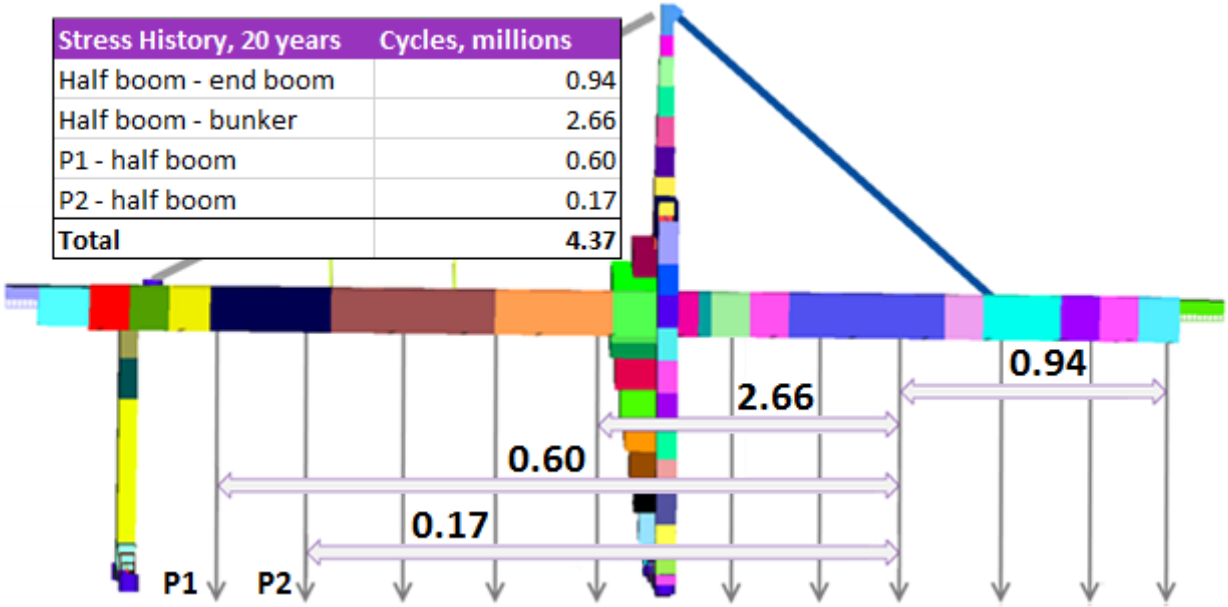
Fatigue and Weld Recognition

Fatigue is a progressive structural damage of materials under cyclic loading. SDC Verifier implements the following standards (based on the Palmgren-Miner S-N curves): Eurocode3, F.E.M 1.001 and DIN 15018

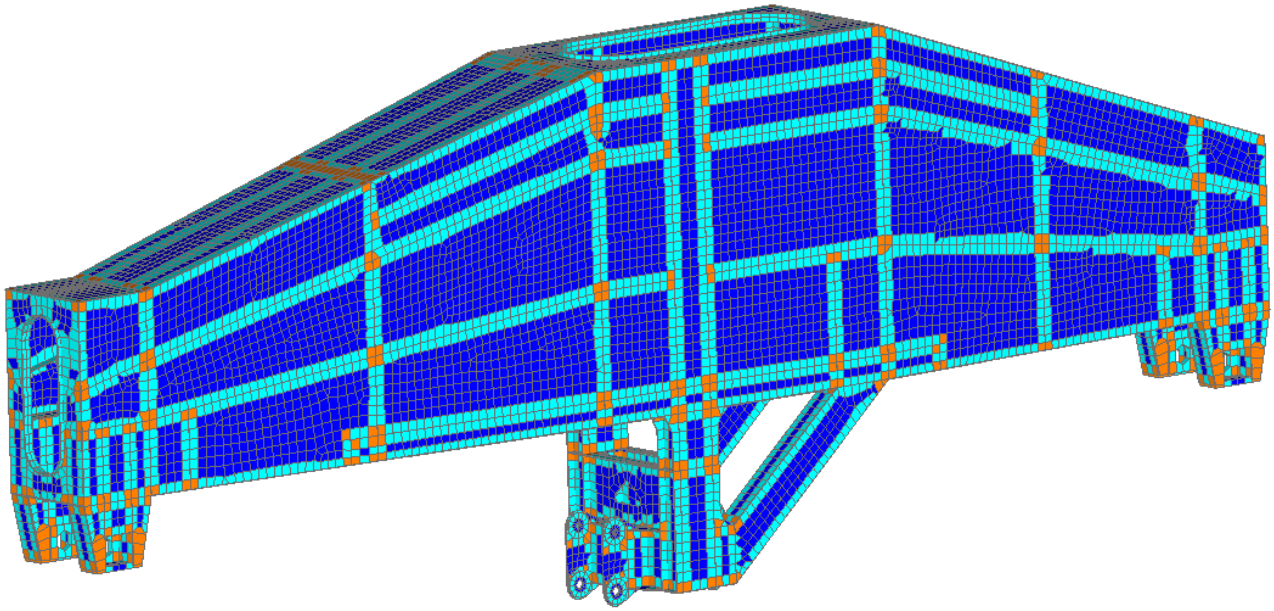
Eurocode 3 **DIN 15018** **F.E.M. 1.001**

The fatigue damage method allows for different loading patterns (stress history) and calculates fatigue life consumption for each cycle based on the stress variation and the number of load cycles.

Stress History, 20 years	Cycles, millions
Half boom - end boom	0.94
Half boom - bunker	2.66
P1 - half boom	0.60
P2 - half boom	0.17
Total	**4.37**

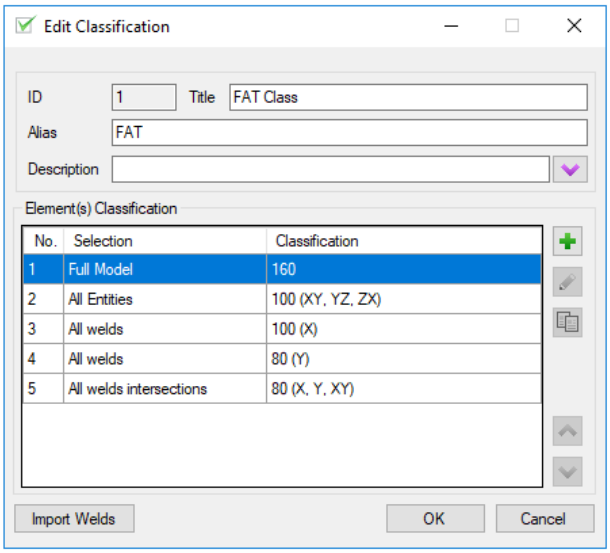


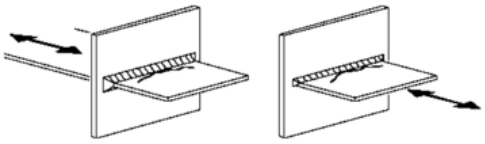
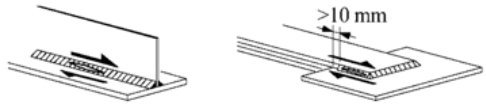
Weld Finder recognizes automatically: **non-welds**, welds and **crossing welds**:

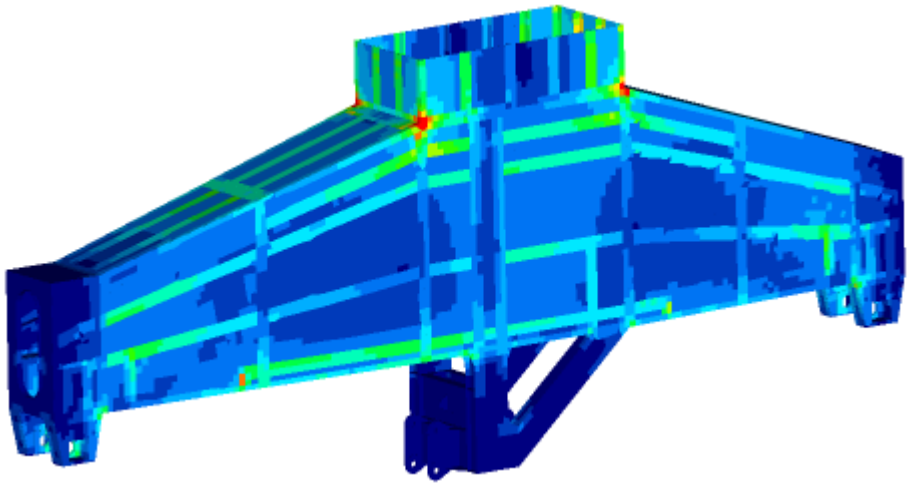


Weld Classification

The notch group classification or fatigue strength of the welds depend on the quality and the stress direction, along the weld (X), perpendicular to the weld (Y) and the shear (XY). Stresses are converted into weld direction automatically by weld finder.



Detailed Category	Constructional detail
100	
80	
80	



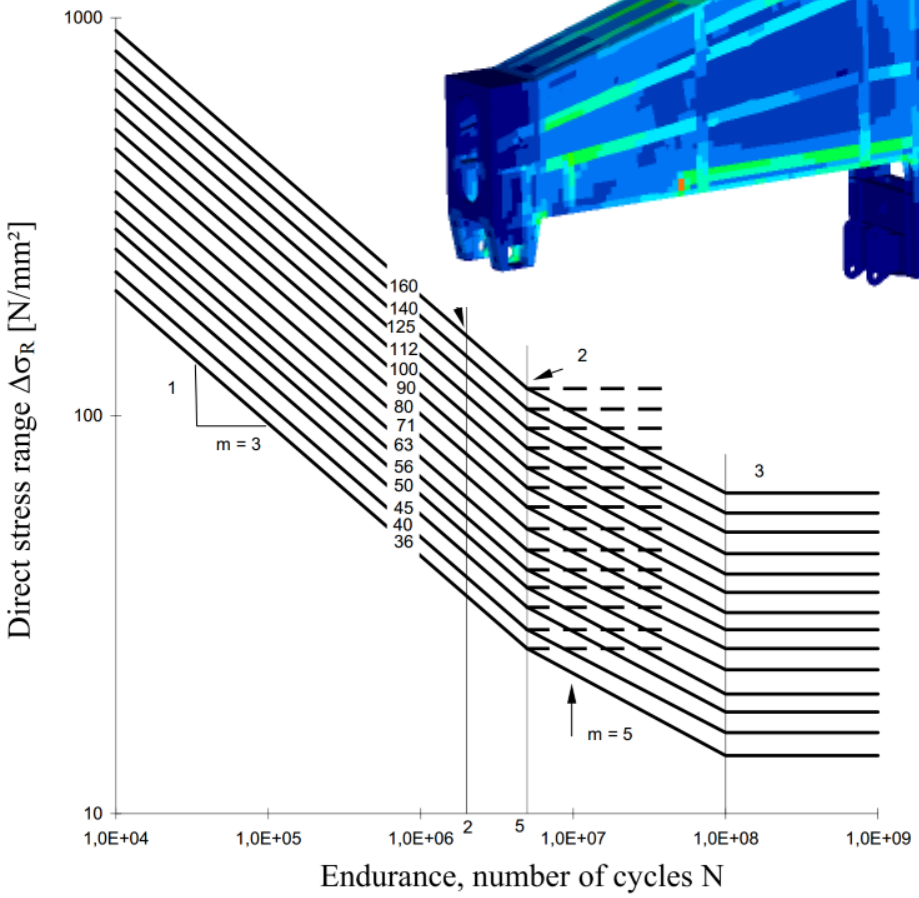


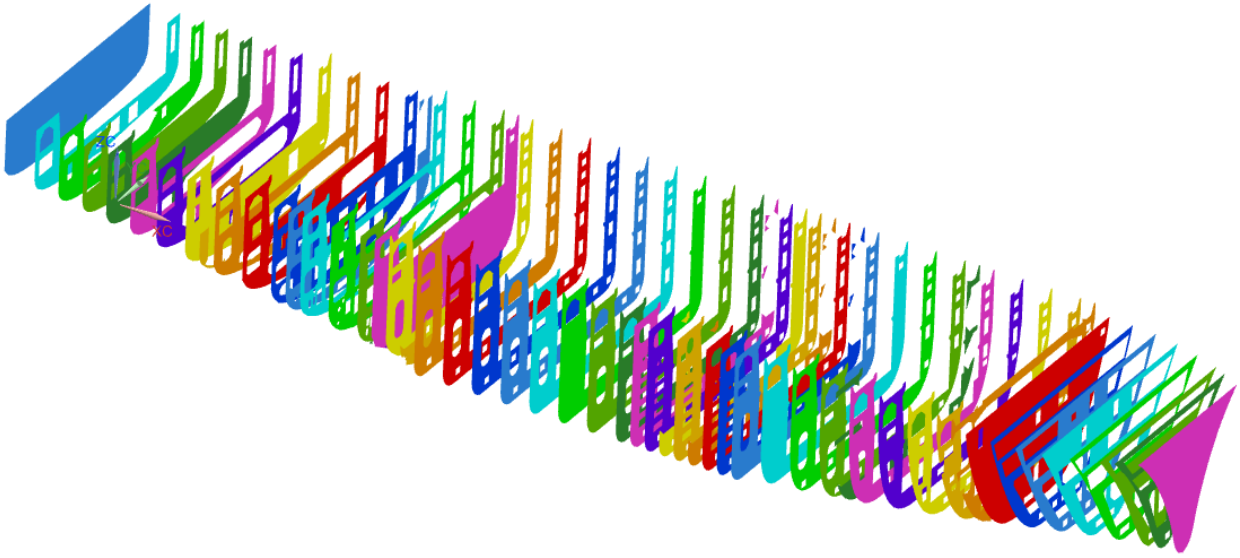
Plate Buckling. Buckling Plate recognition

Plate buckling strength is an important aspect in offshore steel construction design. Each plate should be checked as it influences on the strength and stability of the whole construction. In SDC Verifier plates can be checked against buckling according to ABS 2004/2014 and DNV RP-C201 2010 rules:

ABS 2004 & 2014

DNV 1995 & 2010

Plate dimensions are required to perform plate buckling check. **Panel Finder** recognizes X/Y/Z and custom (inclined and curved) section:



Plates with their dimensions are recognized automatically for each section:

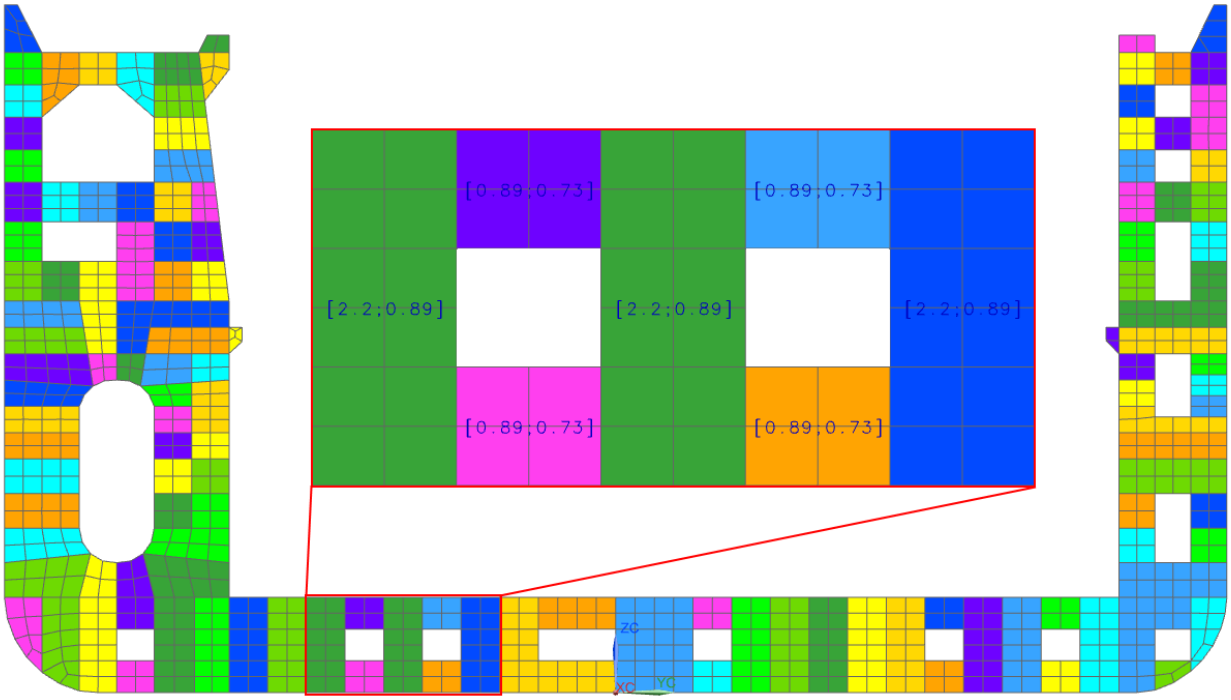
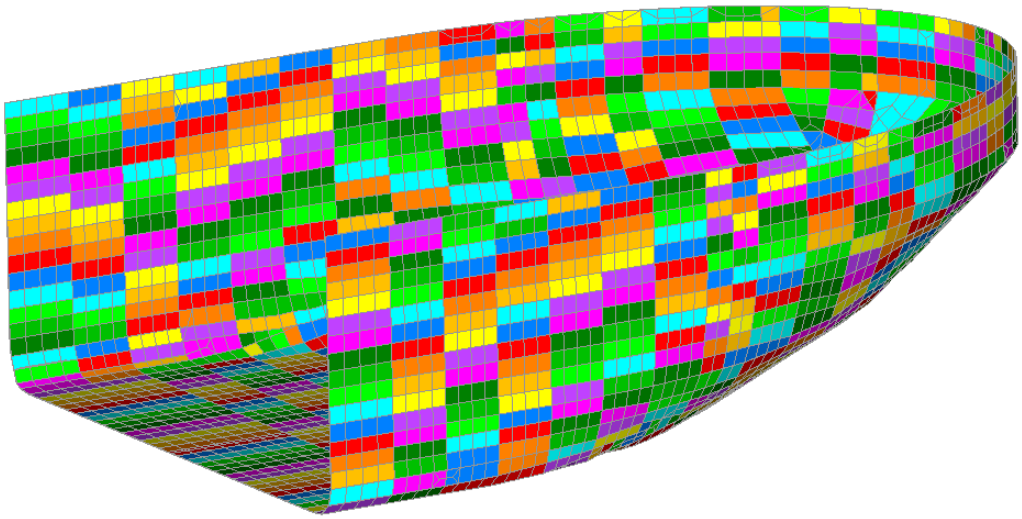
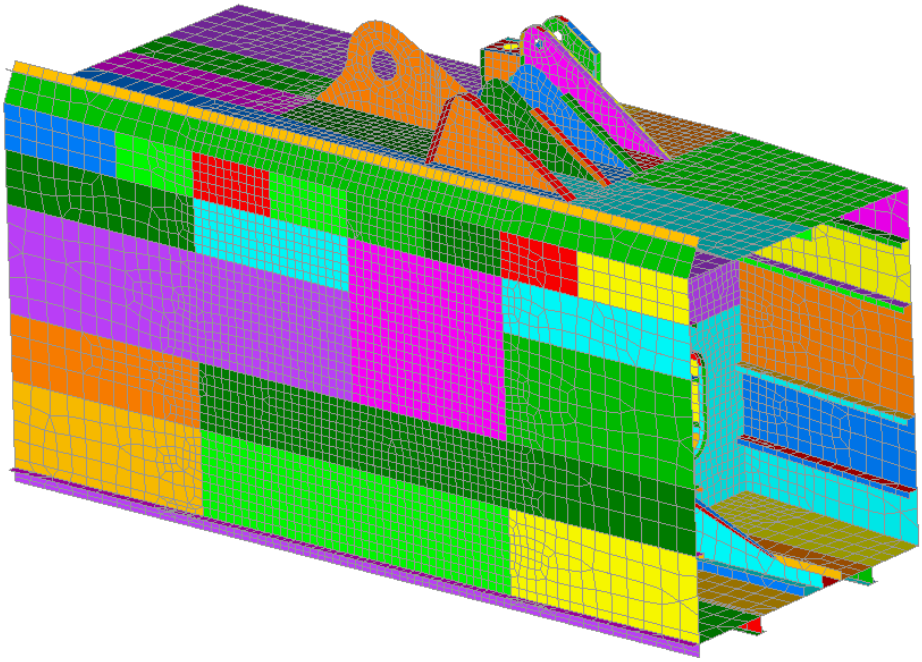


Plate Buckling. Buckling Plate recognition

Colored plots with labels (dimensions) make it easy to preview the results of the tool. The following plot present buckling plates on part of the hull (curved section).



Recognition is based on mesh connectivity and can be performed on any structure build using plate (shell) elements:



Results can be presented over sections (frames/longitudinals/decks) and results which are above the limit are highlighted with red:

Buckling(LS2, 5 Sections)

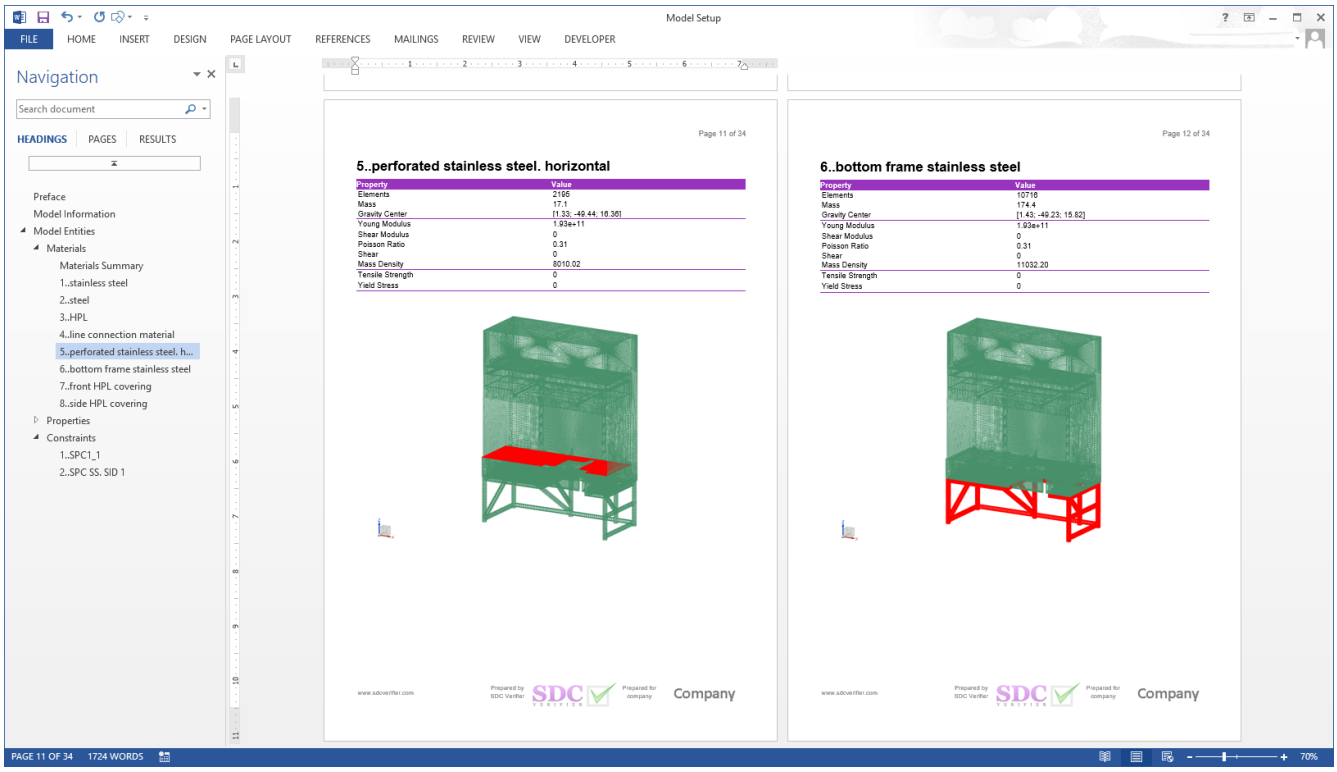
Standard	10..Plate Buckling DNV 2010	**Check**	1..Plate Buckling (Element Avg)
Load Set	2..Load Set 2	**Sections**	5
Search Type	Related To Last		

Section Title	Stress X in plate direction	Stress Y in plate direction	Stress XY in plate direction	Equivalent Stress	Buckling Factor Combined	Buckling Factor Overall
1..Section X 1 (X = 70) [MaxID=86]	-62.0e+6	-38.3e+6	-38.4e+6	85.8e+6	0.952	0.976
2..Section X 2 (X = 71.68) [MaxID=10]	-7.2e+6	-31.6e+6	-8.1e+6	31.9e+6	0.335	0.579
3..Section X 3 (X = 73.36) [MaxID=63]	-57.0e+6	-42.5e+6	-44.3e+6	92.3e+6	1.034	1.017
4..Section X 4 (X = 75.04) [MaxID=9]	-7.2e+6	-31.5e+6	-8.1e+6	31.9e+6	0.334	0.578
5..Section X 5 (X = 76.72) [MaxID=67]	-63.7e+6	-38.9e+6	-39.2e+6	87.8e+6	0.993	0.996
Max over Sections [3 / 63]	-57.0e+6	-42.5e+6	-44.3e+6	92.3e+6	1.034	1.017

Report. Model Setup

Preparing full calculation report is one of the most time-consuming parts of the project. An engineer has to make the same routine processes to create calculation report from project to project. SDC Verifier allows the process of report generation to be done automatically, reducing time expenses.

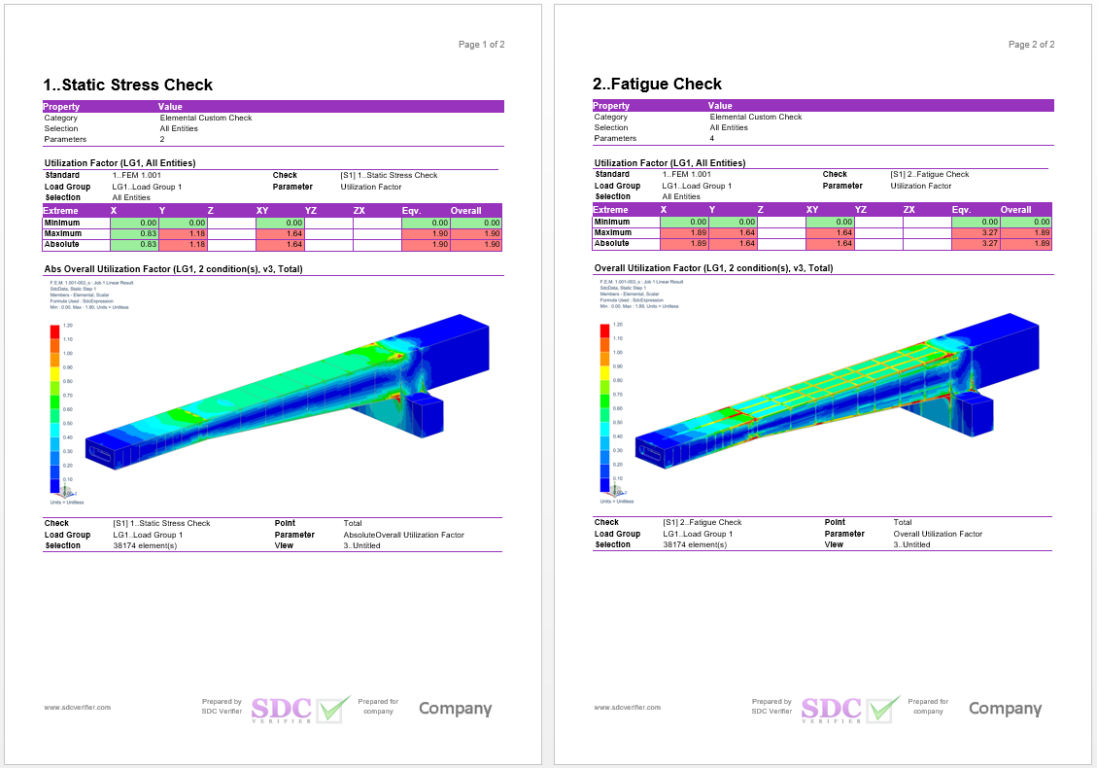
Description of materials and properties data (including mass overview). Elements related to material/property are highlighted:



Description of applied loads and constrains, mass overview over materials/properties/groups:

Report. Results

Results contain plots and tables. It is possible to view detailed results for each entity, extreme results on selection and advanced tables to compare load results:



Page 1 of 2

1..Static Stress Check

Property	Value
Category	Elemental Custom Check
Selection	All Entities
Parameters	2

Utilization Factor (LG1, All Entities)

Standard	1..FEM 1.001	Check	[S1] 1..Static Stress Check
Load Group	LG1..Load Group 1	Parameter	Utilization Factor
Selection	All Entities		

Extreme	X	Y	Z	XY	YZ	ZX	Eqv.	Overall
Minimum	0.00	0.00		0.00			0.00	0.00
Maximum	0.83	1.18		1.64			1.90	1.90
Absolute	0.83	1.18		1.64			1.90	1.90

Abs Overall Utilization Factor (LG1, 2 condition(s), v3, Total)

Check	[S1] 1..Static Stress Check	Point	Total
Load Group	LG1..Load Group 1	Parameter	AbsoluteOverall Utilization Factor
Selection	38174 element(s)	View	3..Untitled

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Page 2 of 2

2..Fatigue Check

Property	Value
Category	Elemental Custom Check
Selection	All Entities
Parameters	4

Utilization Factor (LG1, All Entities)

Standard	1..FEM 1.001	Check	[S1] 2..Fatigue Check
Load Group	LG1..Load Group 1	Parameter	Utilization Factor
Selection	All Entities		

Extreme	X	Y	Z	XY	YZ	ZX	Eqv.	Overall
Minimum	0.00	0.00		0.00			0.00	0.00
Maximum	1.89	1.64		1.64			3.27	1.89
Absolute	1.89	1.64		1.64			3.27	1.89

Overall Utilization Factor (LG1, 2 condition(s), v3, Total)

Check	[S1] 2..Fatigue Check	Point	Total
Load Group	LG1..Load Group 1	Parameter	Overall Utilization Factor
Selection	38174 element(s)	View	3..Untitled

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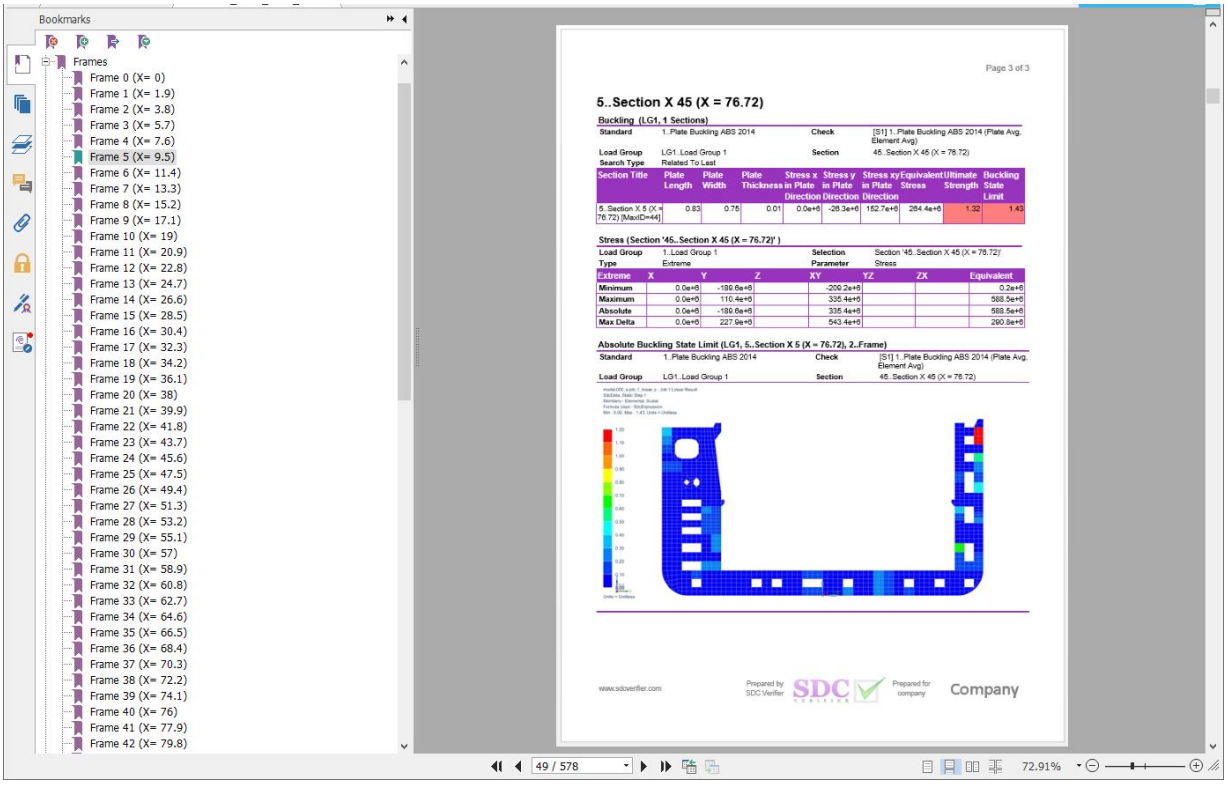
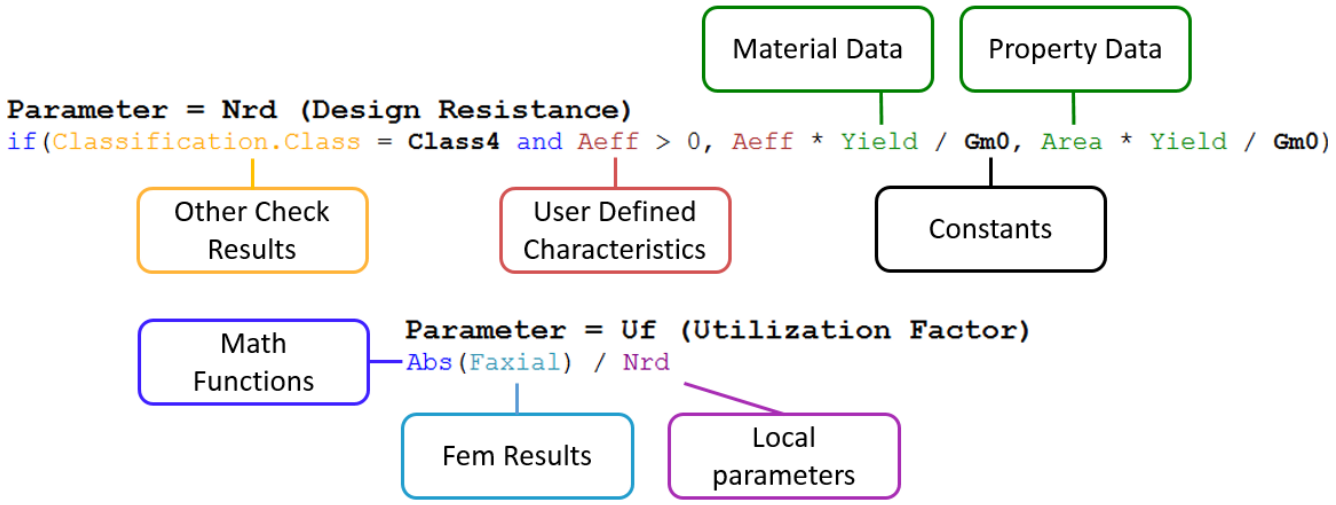
A complete setup of reports, with headings and bookmarks, enable quick navigation through the reports.



With help of Report designer, it is possible to completely control structure of the report and easily preview and modify it. A variety of tools helps to create quickly huge amount of plots and tables.

Customized Checks

The checks in SDC Verifier are completely customizable. With help of formula editor user-defined formulas can be created based on results, model properties and recognized dimensions.



The following example performs verification of bolted connections. Axial Force of bolts is compared with bolt design resistance: