SDC VERIFIER

STRUCTURAL OPTIMIZATION

WORKS INDEPENDENTLY AND WITHIN

Ansys FEMAP Simcenter 3D

Simulation

Automatic Documentation

Load Combinations

Checks

Recognition

STANDARDS Australia, FKM, VDI, DVS, AISC, Eurocodes, ISO, FEM, DNV, BUREAU VERITAS, DIN, API, ASME, CEN European Committee for Standardization, ABS, AIJ, norsok standard

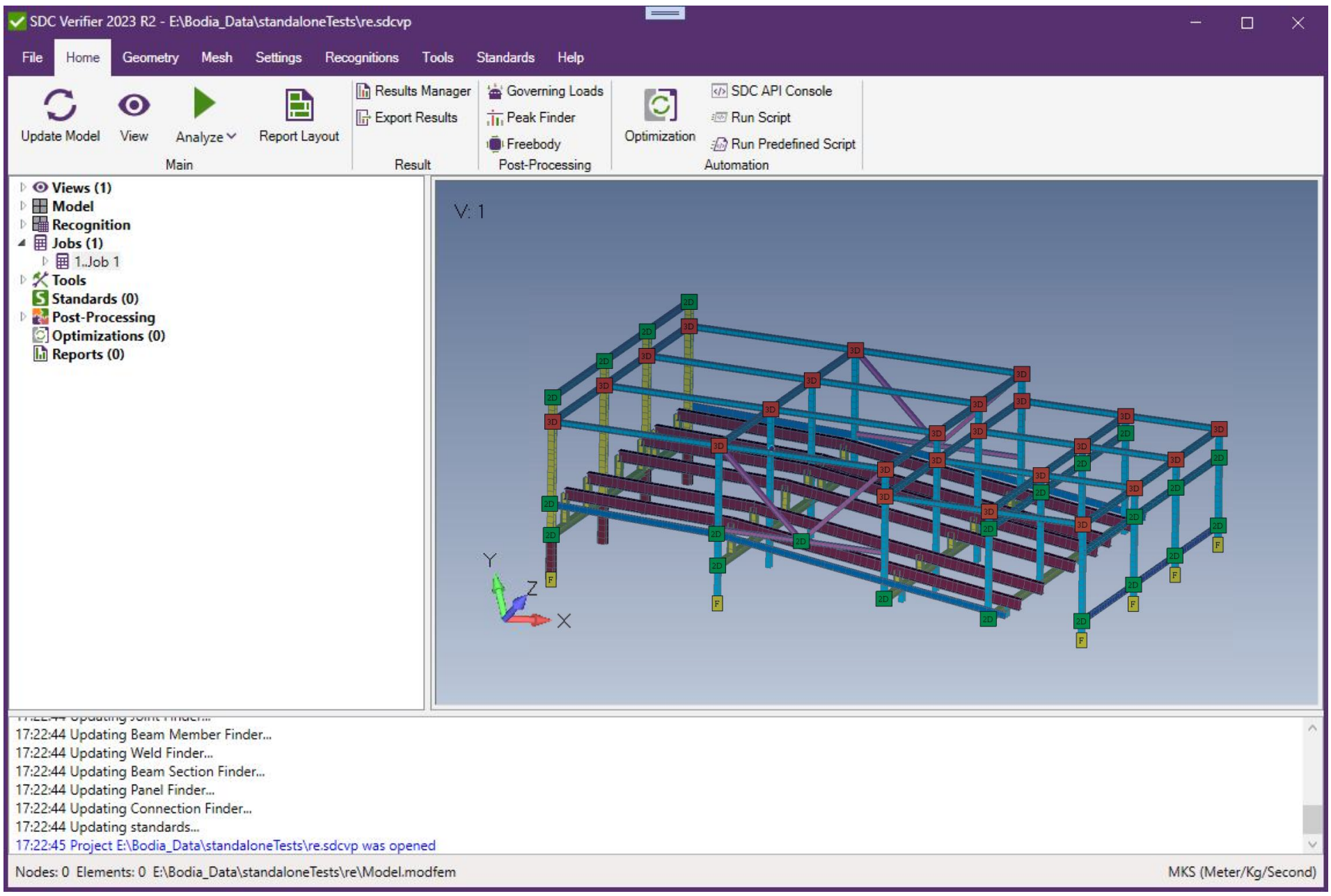
STRUCTURAL VERIFICATION ACCORDING TO STANDARDS

ANSYS ADVANCED SOLUTION PARTNER

Solution Partner PLM

SIEMENS

SIMULATION AND VERIFICATION SOFTWARE



Import your drawings, 3D file, or existing FEA model from any other FEA software. Or build your own design with a modern and intuitive graphical interface.

Analyze your design with a proven Simcenter Nastran solver. A reliable solution combined with the features of SDC Verifier allows engineers to cover simulation and verification with just a few clicks.

TAILOR MADE FOR THE FOLLOWING INDUSTRIES

- **Offshore and Maritime**
- **Oil and Gas**
- **Heavy Lifting**
- **Machinery Equipment**
- **Railway**
- **Civil Engineering**
- **Pipes and Petrochemical**
- **Aerospace**
- **Renewable Energy**
- **Defense**

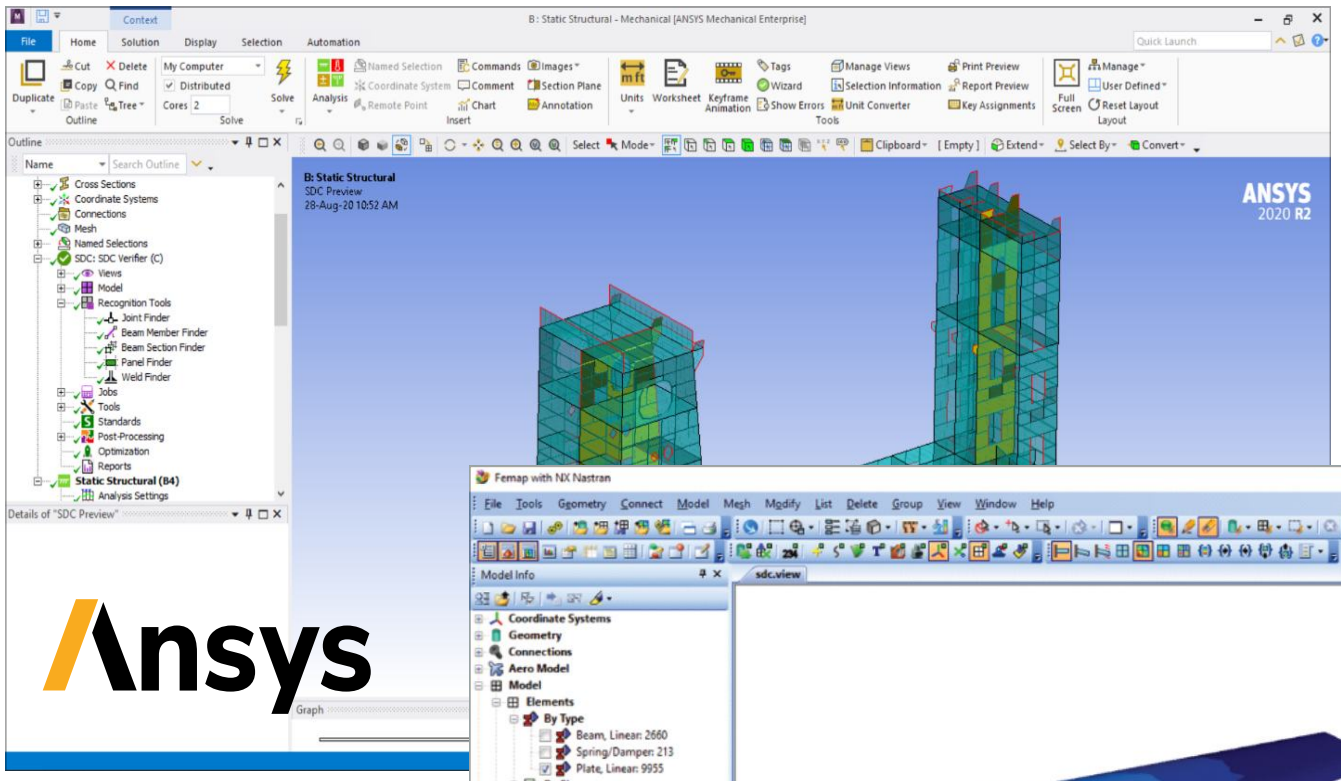
SDC Verifier can be used independently or in tandem with Ansys, Femap, and Simcenter.

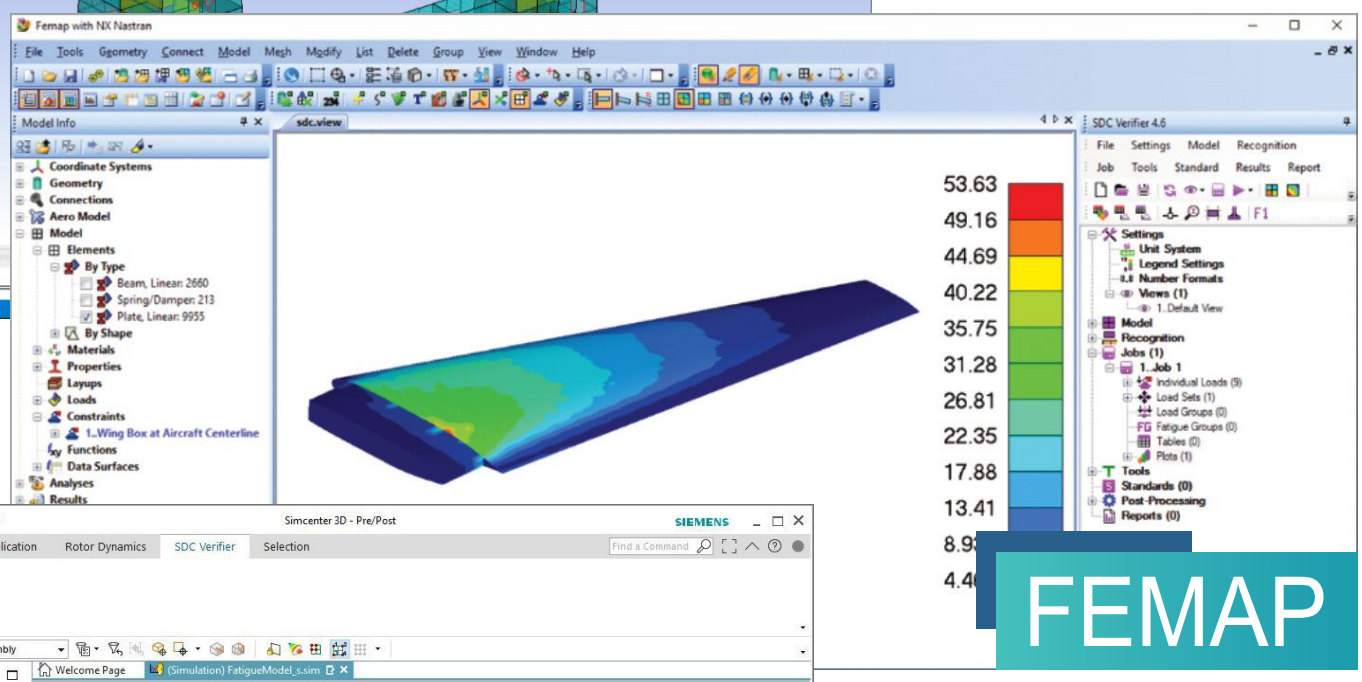
SDC Verifier automates the verification of the FEA model against predefined industry standards, design codes, rules and regulations, or your own criteria.

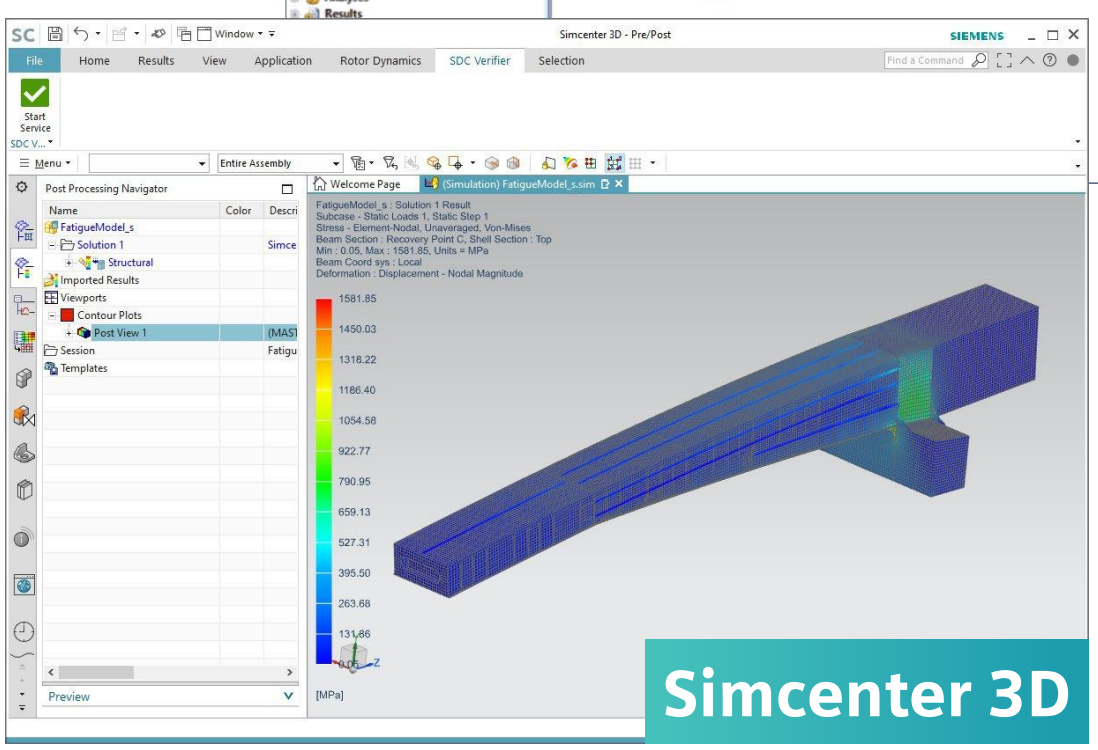
Report Designer is an advanced tool for automatic report generation. Reports in SDC Verifier have a template-based structure and contain model setup, model description, and calculated results presented as plots and tables. With report generation feature engineers can review and compare the design updates impact to the original design.

The optimization module allows the best design decision to be made
for the structure by calculating different combinations of design inputs.

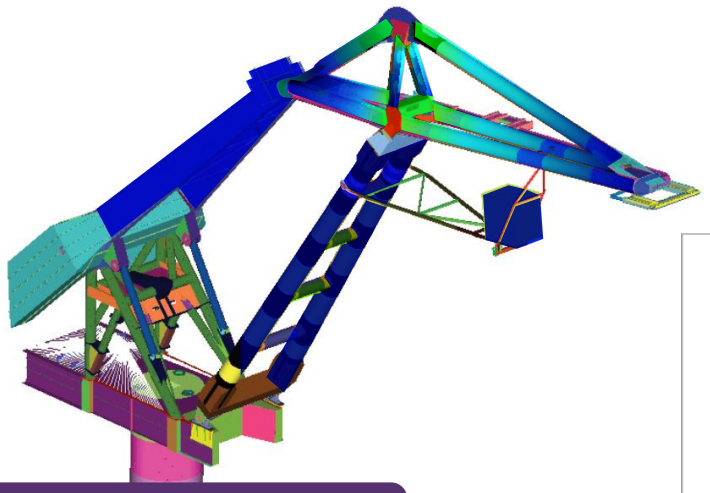
In addition SDC Verifier has an open API to help automate interaction with software.



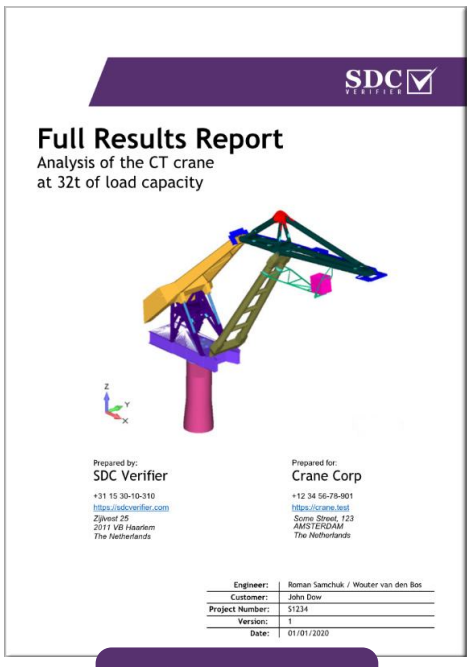




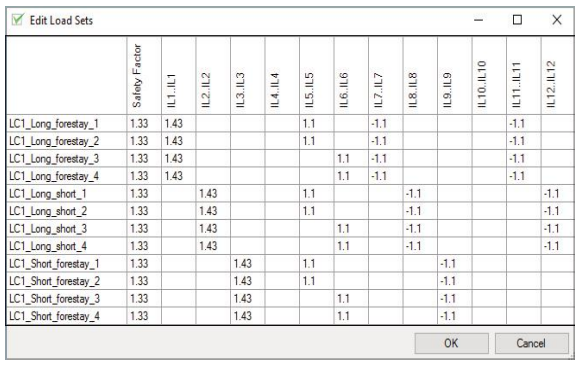
SDC VERIFIER WORKFLOW



FEA Simulation



Reports

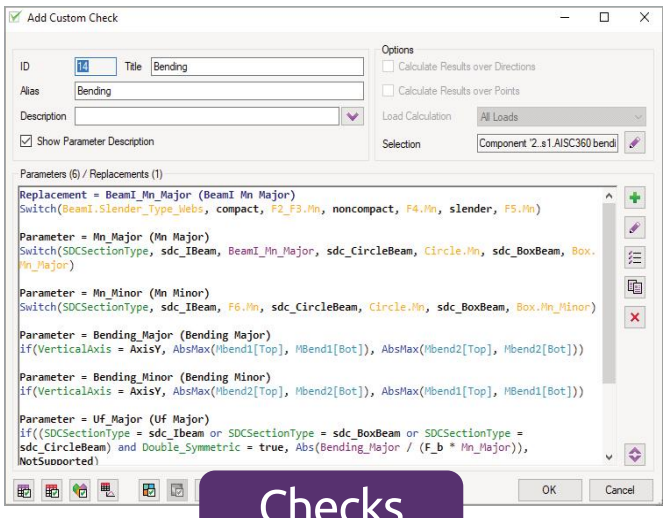


	Safety Factor	IL1..IL1	IL2..IL2	IL3..IL3	IL4..IL4	IL5..IL5	IL6..IL6	IL7..IL7	IL8..IL8	IL9..IL9	IL10..IL10	IL11..IL11	IL12..IL12
LC1_Long_forestay_1	1.33	1.43				1.1		-1.1				-1.1	
LC1_Long_forestay_2	1.33	1.43				1.1		-1.1				-1.1	
LC1_Long_forestay_3	1.33	1.43					1.1	-1.1				-1.1	
LC1_Long_forestay_4	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			

Load Combinations

The complete structure verification procedure is stored so you can generate the updated report in one click in case of design changes

Recognition



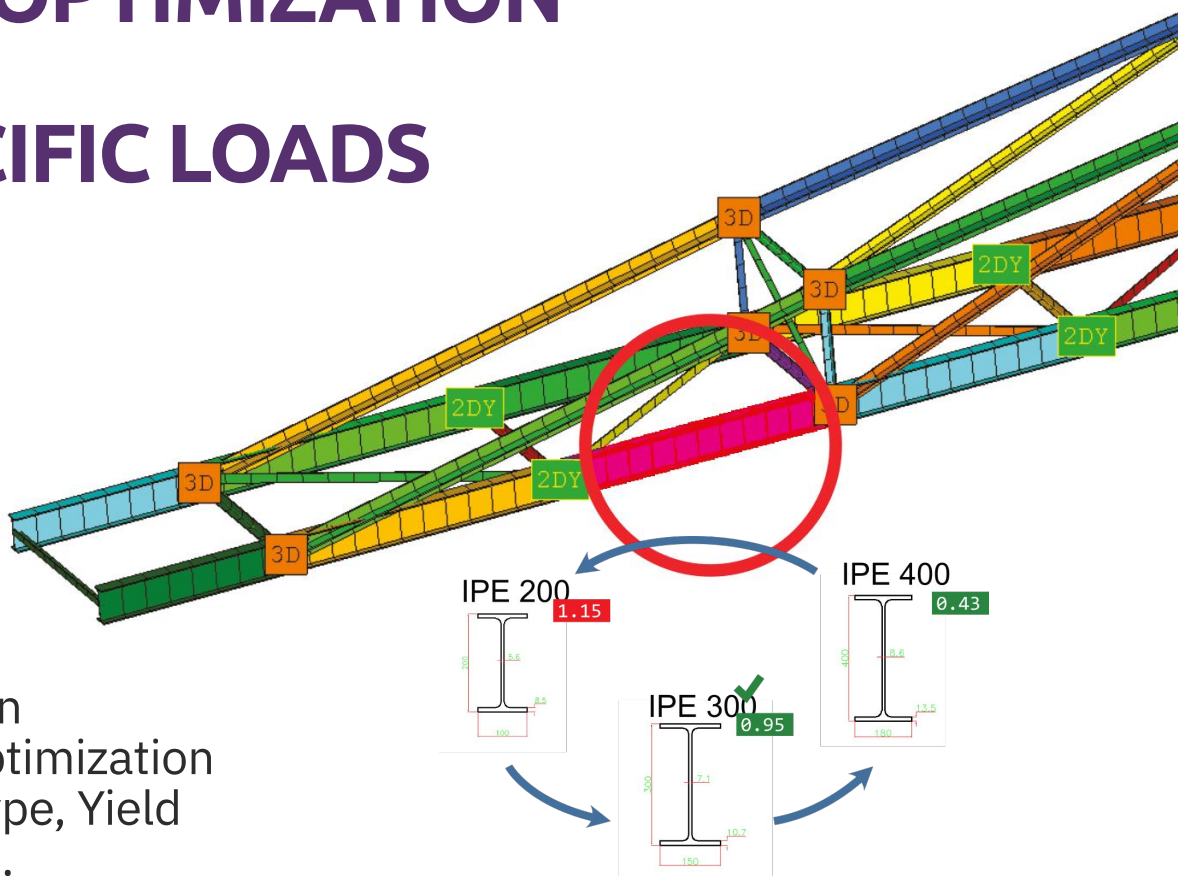
Checks

IMPLEMENTED STANDARDS

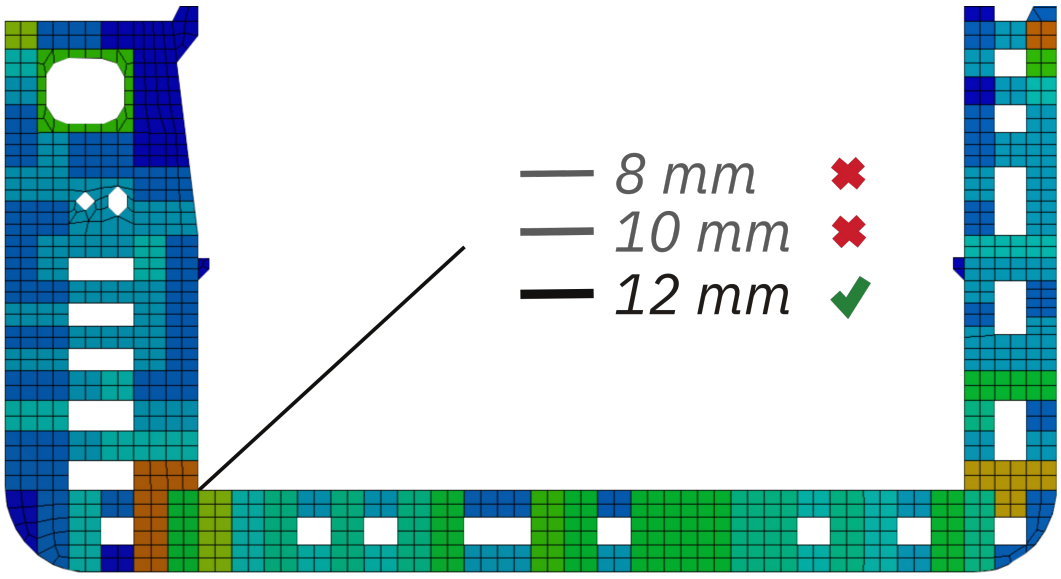
40+ standards are available in the library. Check the full list on our website **sdcverifier.com**

DESIGN OPTIMIZATION

SPECIFIC LOADS

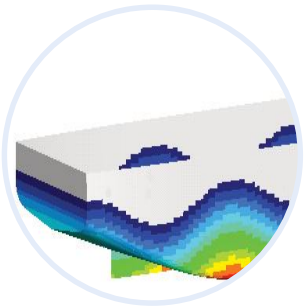


The **Optimization module** helps to take the best possible design decision acquired from codechecking results. Optimization can be based on Cross Section, Weld Type, Yield Stress, and Plate Thickness parameters.



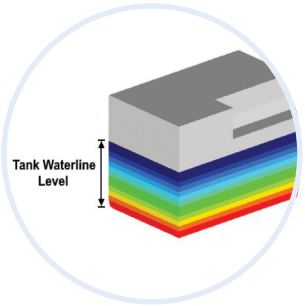
Optimization helps to automatically calculate various design input combinations and ensure cost-effectiveness by adjusting the existing model parts for specific terms of usage.

SDC Verifier automates the application of the specific loads:



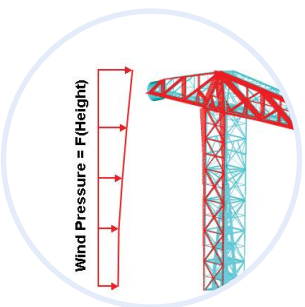
Buoyancy

a water pressure acting on a construction (e.g. ship hull), including wave parameters.



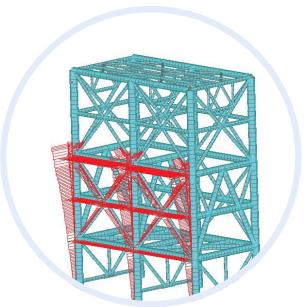
Tank Ballast

fluid level based on a mass content transferred into a pressure level on a tank surface.



Wind

height dependent pressure applied to the model taking into account the element area exposed to the wind direction.



Wave and current loads

a water pressure acting on a construction (e.g. ship hull), including wave parameters.

MEMBER CHECKS. BUCKLING LENGTH RECOGNITION. DEFLECTION CHECK

SDC Verifier implements the following standards for checking large (offshore) lattice structures:

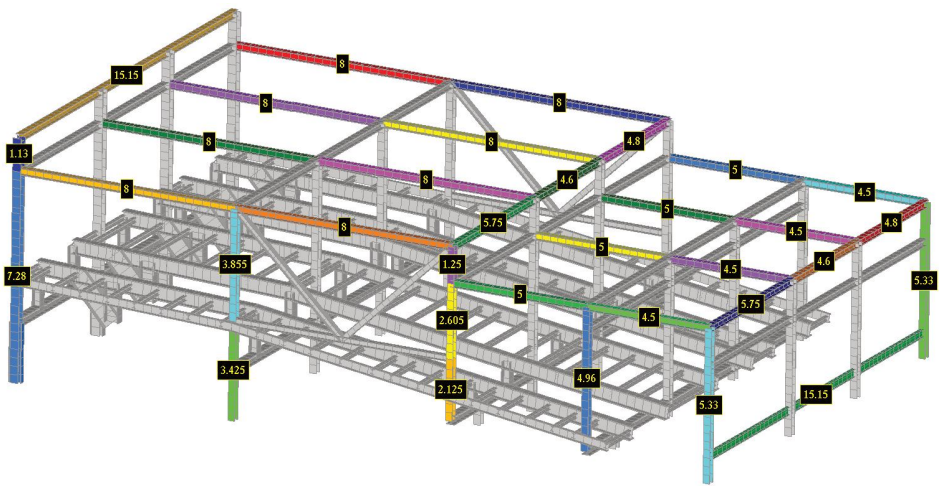
AISC/ANSI 360-10 and **AISC 360-22** (Specification for Structural Steel Buildings), **API RP 2A** (Planning, Designing, and Constructing Fixed Offshore Platforms — Working Stress Design), **Eurocode 3** (Design of steel structures), **ISO 19902 (2007, 2020)** (Petroleum and natural gas industries — Fixed steel offshore structures) and **Norsok N-004** (Design of steel structures), **AS 3990, AS 4100.**

AIJ (2017)

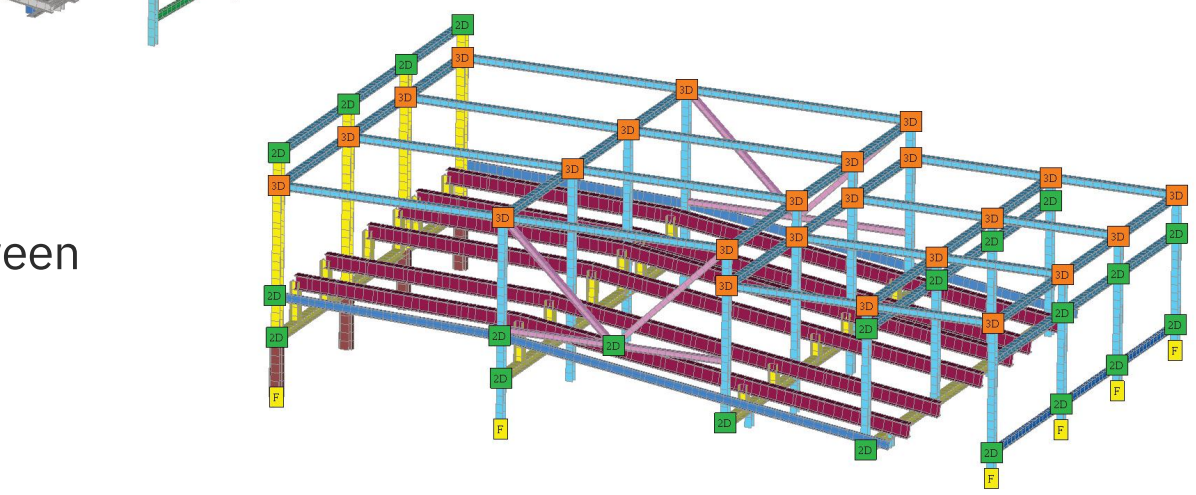
AS 3990, AS 4100

AISC 89 & 2010
AISC 360-22

API RP 2A RP

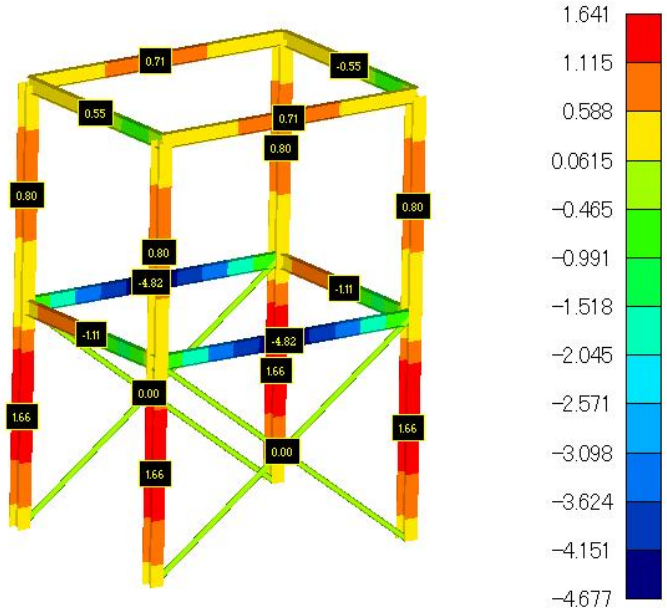


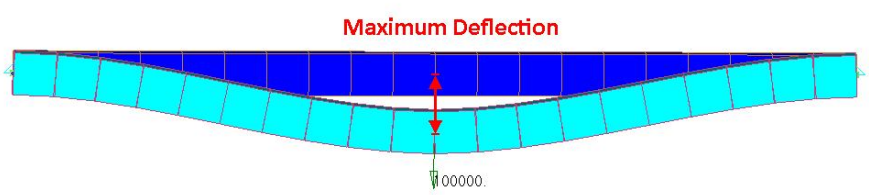
Beam Member Finder tool automatically detects beam members (buckling) lengths for 3 directions (Y, Z and torsional).



SDC Verifier calculates the **Buckling length** between the Joints, regardless of the model mesh.

The deflection of members is one of the checks that should be performed for serviceability limit state design. With the help of the **Beam Member Finder** tool SDC Verifier automatically detects beam member lengths:





SDC Verifier contains all the necessary tools to quickly perform the **deflection check**.

The automatic beam member recognition, result transformation, and the usage of the envelope results of a load group reduce the calculation and post-processing time significantly.

JOINT CHECK

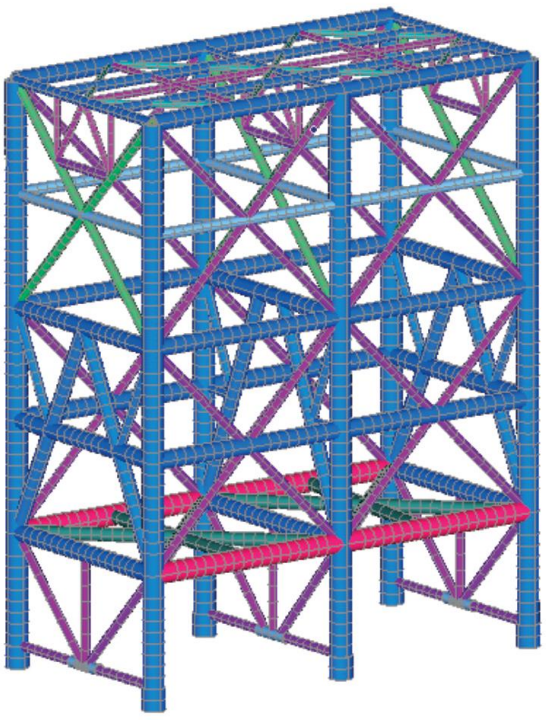
Norsok N004

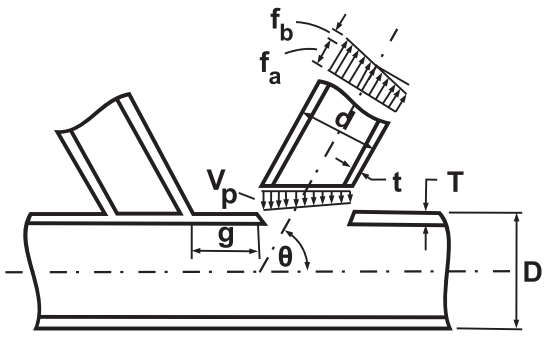
AS 3990 (1993)

ISO 19902 (2007, 2020)

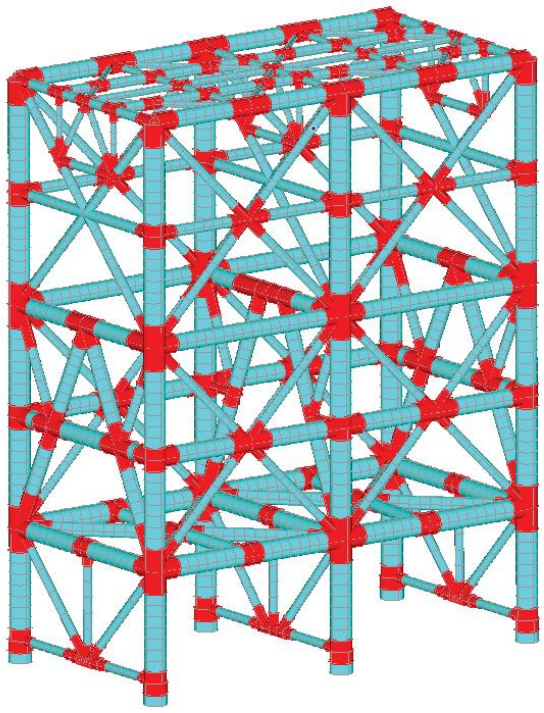
Eurocode 3

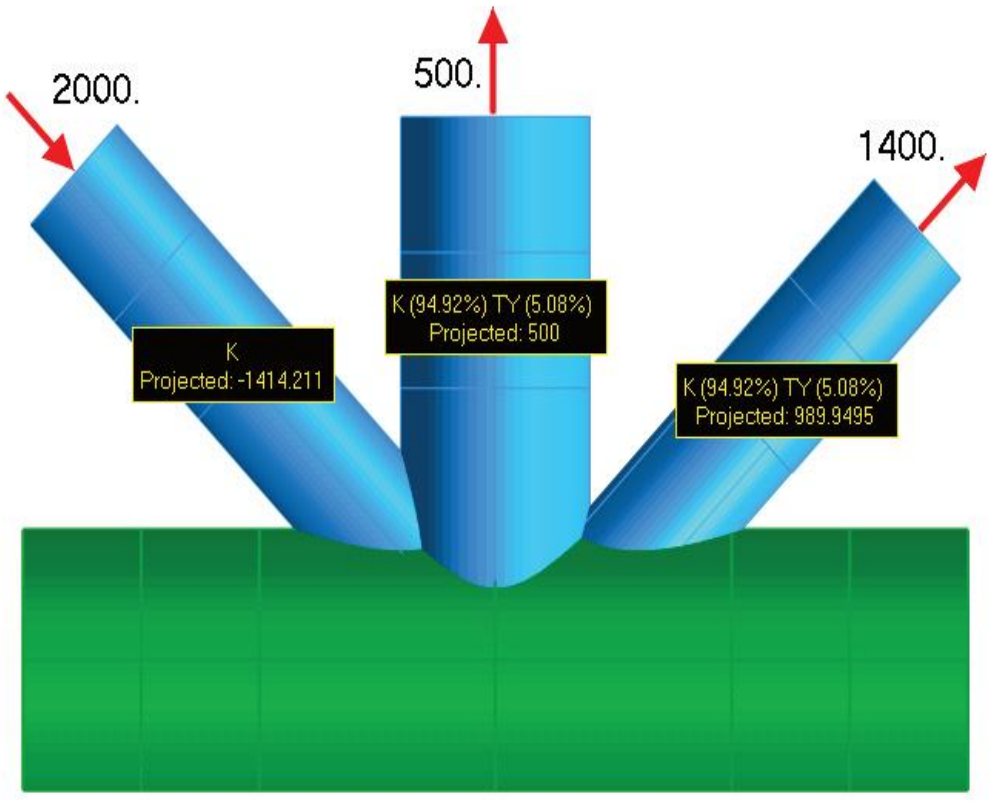
Joint Finder tool is used to verify joints and connections according to **API RP 2A, Eurocode 3, ISO 19902 (2007, 2020),** and **Norsok N-004** standards

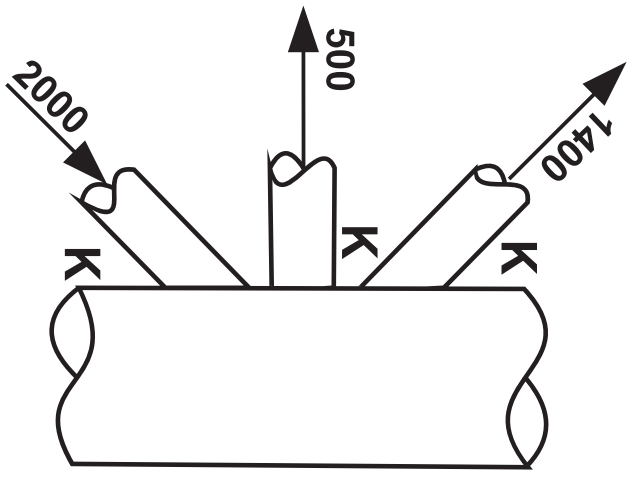




SDC Verifier automatically calculates Brace classification (depending on the load pattern) for each load situation, which significantly speeds up the verification process.







Connection ID	Brace Number	Joint Type
1	#1 (ElemID = 27)	K
2	#2 (ElemID = 13)	K (94.92%) TY (8.08%)
3	#3 (ElemID = 19)	K (94.92%) TY (8.08%)

AUTOMATIC DETECTION OF SECTIONS, PANELS, PLATE FIELDS, STIFFENERS, AND GIRDERS

Plate buckling strength is an important aspect of offshore steel construction design. Each plate should be checked as it influences the strength and stability of the whole construction. In SDC Verifier plates can be checked against buckling according to the **ABS 2004/2014, DNV RP-C201 2010, BV NR615** and **Eurocode 3** rules:

Eurocode 3

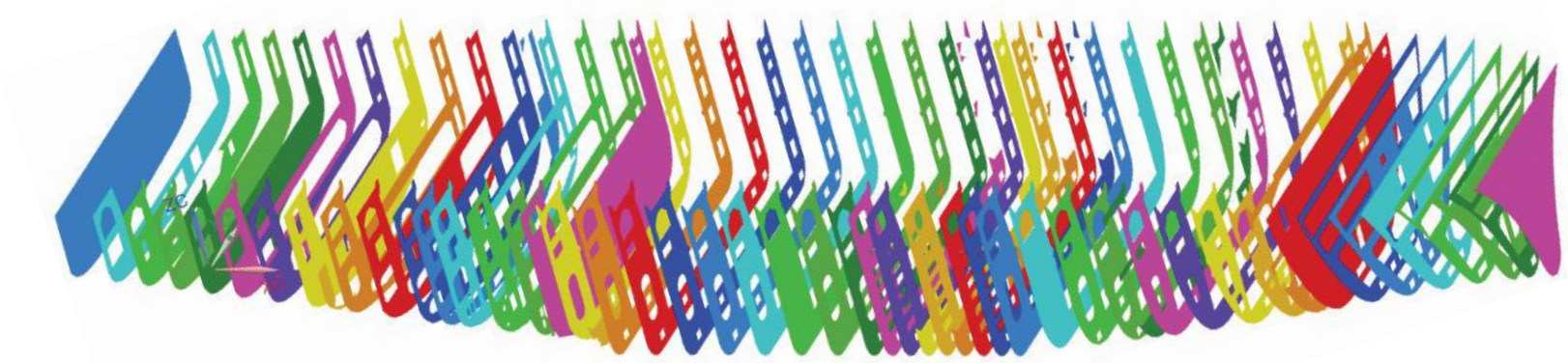
BV

DNV 1995 & 2010

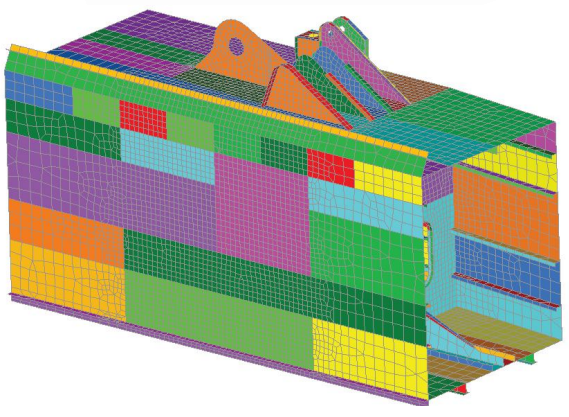
ABS 2004 & 2014

Plate dimensions are required to perform a plate buckling check.

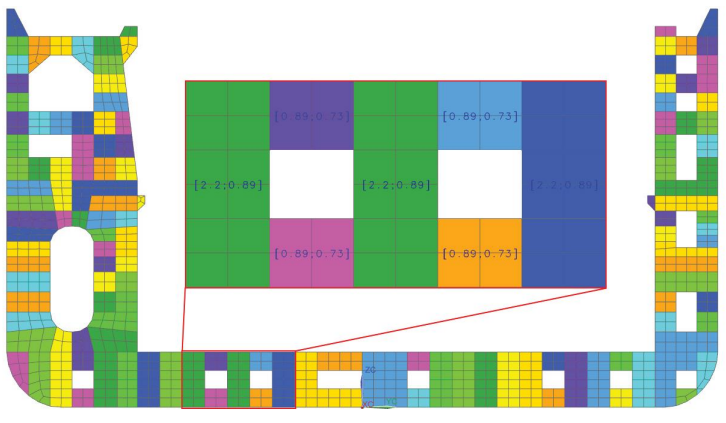
Panel Finder recognizes X/Y/Z and custom (inclined and curved) sections:



The recognition is based on the mesh connectivity and can be performed on any structure using plate (shell) elements:



Plates with their dimensions are recognized automatically for each section:



The results can be presented over sections (frames/longitudinals/decks). Those above the limit are highlighted in red:

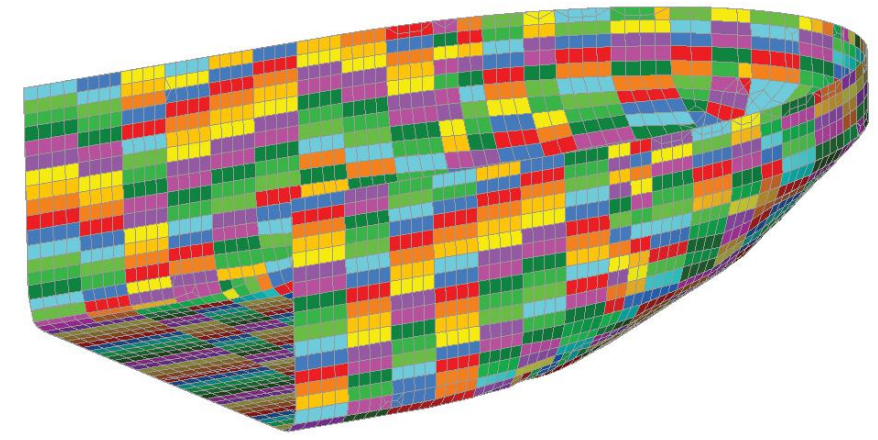
Buckling (L S2, 5 Sections)

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		

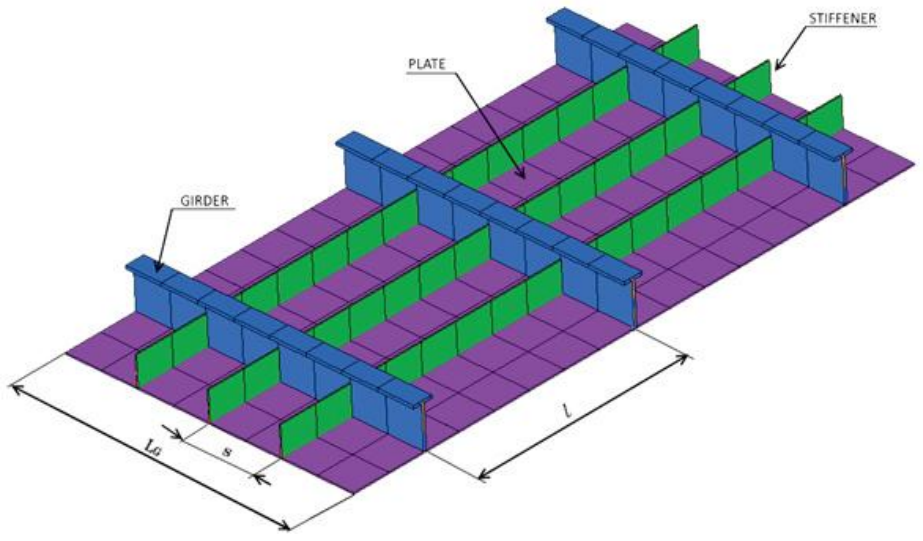
Section Title	Stress X in plate direction	Stress Y in plate direction	Stress XY in plate direction	Equivalent Stress	Stress XY in plate direction	Stress XY in plate direction
1..Section X 1 (X = 70) [MaxID = 86]	-62.0e+6	-38.3e+6	-38.4e+6	85.8e+6	0.952	0.976
1..Section X 1 (X = 71.68) [MaxID = 10]	-7.2e+6	-31.6e+6	-8.1e+6	31.9e+6	0.335	0.579
1..Section X 1 (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

PLATE BUCKLING AND STIFFENER BUCKLING CHECKS

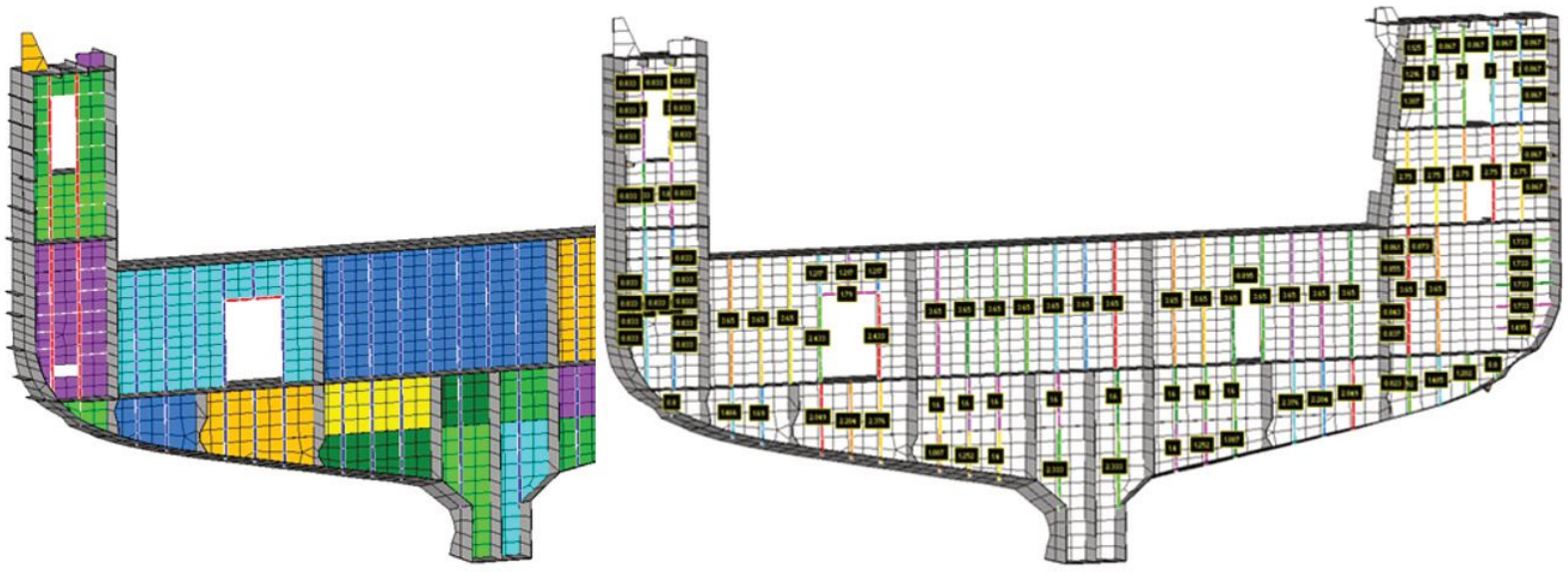
Colored plots with labels (dimensions) make it easy to preview the results of the tool. The following plot presents buckling plates on a part of the hull (curved section).

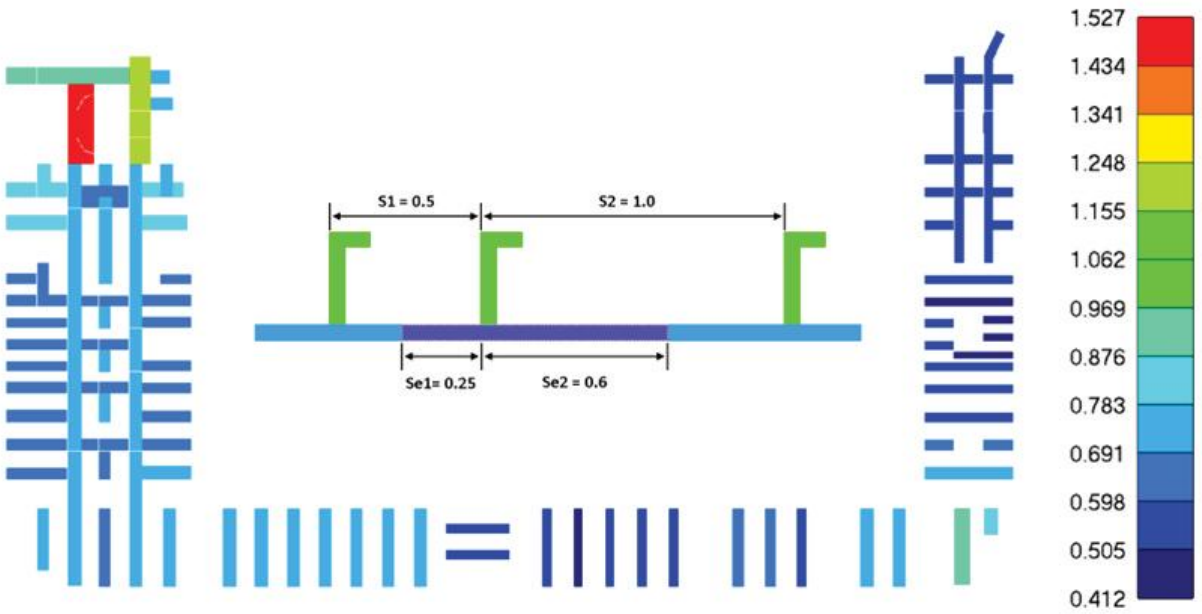


Stiffened Panel Finder — recognizes sections, panels, plates, stiffeners and girders and their dimensions automatically. This tool is an advanced version of the Panel Finder.



In the figure below, panels, simple stiffeners (marked in blue) and girders or stiffeners supporting also other stiffeners (marked in red) are plotted.





Effective Width — calculates the plate effective width for every load situation. The Effective width is used in the stiffener buckling check according to DNV-RP-C201 2010.

AUTOMATIC WELDS RECOGNITION. FATIGUE CHECKS AND WELD STRENGTH

Fatigue is a progressive structural damage of materials under the cyclic loading. SDC Verifier implements the following standards (based on the SN curves):

Eurocode 3 (Design of steel structures), **F.E.M 1.001** (Rules for the Design of Hoisting Appliances), **DIN 15018** (Cranes. Steel structures. Verification and analyses), **FKM** (Analytical strength assessment (5th, 6th revised edition, 2003)), **EN 13001** (Cranes General Design, 2018).

FKM (5th and 6th edition)

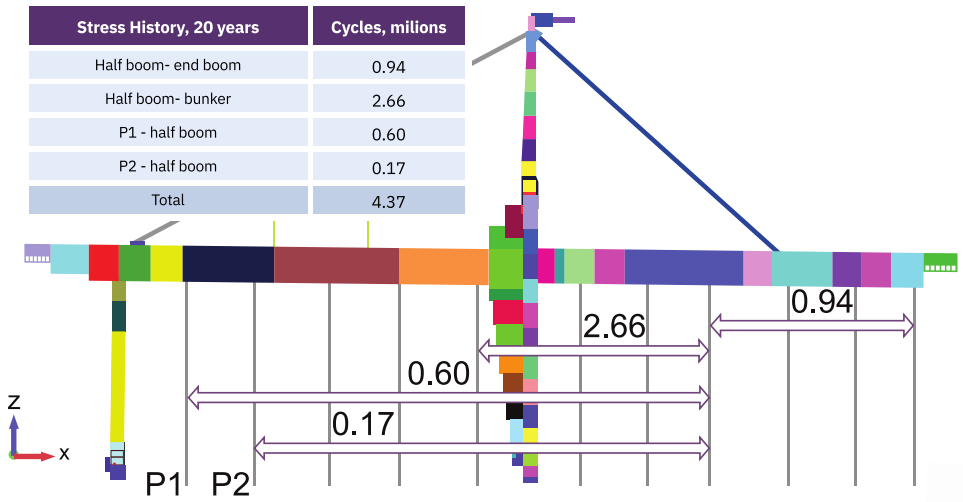
DIN 15018

EN 13001

Eurocode 3

F.E.M 1.001

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



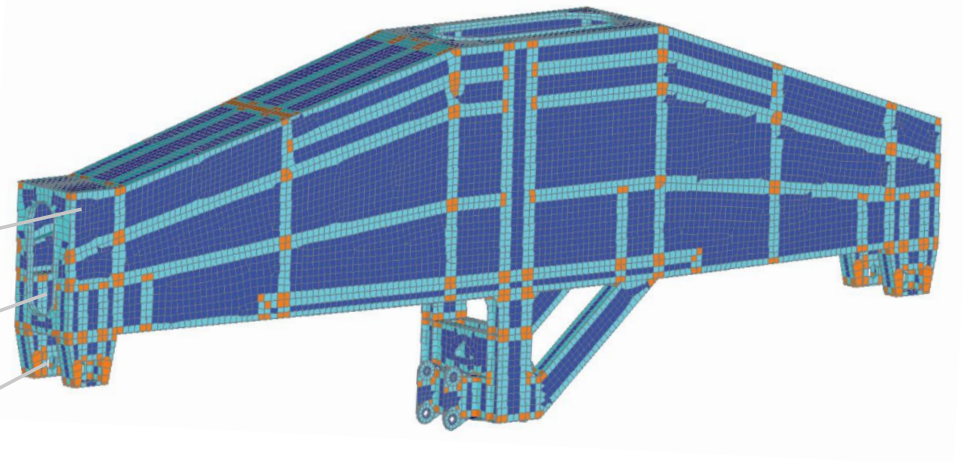
The fatigue damage method is based on different loading patterns (stress history) and calculates fatigue life consumption for each cycle based on the stress variation and the number of load cycles

SDC Verifier tool **Weld Finder** detects automatically:

non-welds

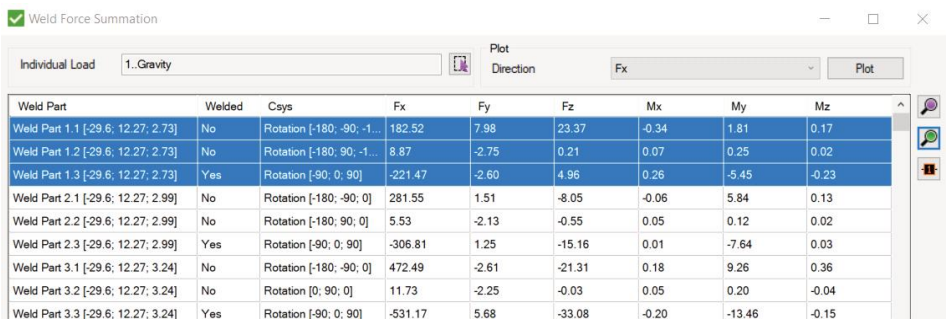
welds

crossing welds



SDC Verifier performs a weld strength check according to **DNV-OS-C101/C201, Eurocode 3**.

The forces/moments of each element of the weld are summarized into the local weld coordinate system:


Weld Force Summation

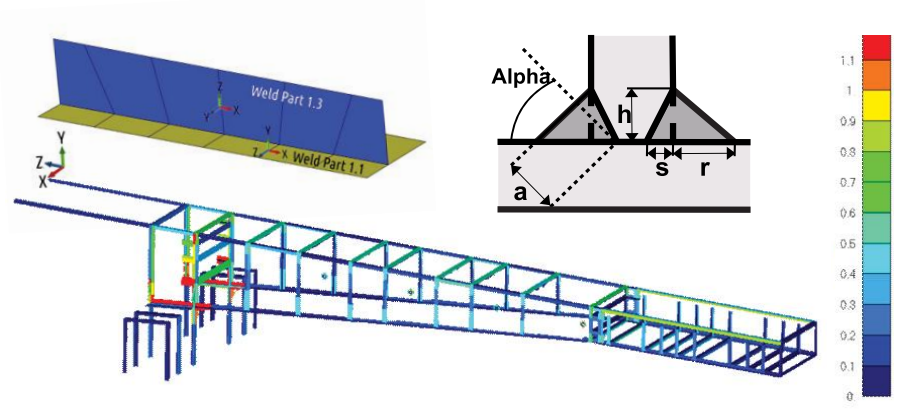
Individual Load: 1..Gravity

Plot Direction: Fx

Plot

Weld Part	Welded	Csys	Fx	Fy	Fz	Mx	My	Mz
Weld Part 1.1 [-29.6; 12.27; 2.73]	No	Rotation [-180; -90; -1...	182.52	7.98	23.37	-0.34	1.81	0.17
Weld Part 1.2 [-29.6; 12.27; 2.73]	No	Rotation [-180; 90; -1...	8.87	-2.75	0.21	0.07	0.25	0.02
Weld Part 1.3 [-29.6; 12.27; 2.73]	Yes	Rotation [-90; 0; 90]	-221.47	-2.60	4.96	0.26	-5.45	-0.23
Weld Part 2.1 [-29.6; 12.27; 2.99]	No	Rotation [-180; -90; 0]	281.55	1.51	-8.05	-0.06	5.84	0.13
Weld Part 2.2 [-29.6; 12.27; 2.99]	No	Rotation [-180; 90; 0]	5.53	-2.13	-0.55	0.05	0.12	0.02
Weld Part 2.3 [-29.6; 12.27; 2.99]	Yes	Rotation [-90; 0; 90]	-306.81	1.25	-15.16	0.01	-7.64	0.03
Weld Part 3.1 [-29.6; 12.27; 3.24]	No	Rotation [-180; -90; 0]	472.49	-2.61	-21.31	0.18	9.26	0.36
Weld Part 3.2 [-29.6; 12.27; 3.24]	No	Rotation [0; 90; 0]	11.73	-2.25	-0.03	0.05	0.20	-0.04
Weld Part 3.3 [-29.6; 12.27; 3.24]	Yes	Rotation [-90; 0; 90]	-531.17	5.68	-33.08	-0.20	-13.46	-0.15

The load on the total weld is compared to the capacity based on the length and such parameters as throat thickness and angle:



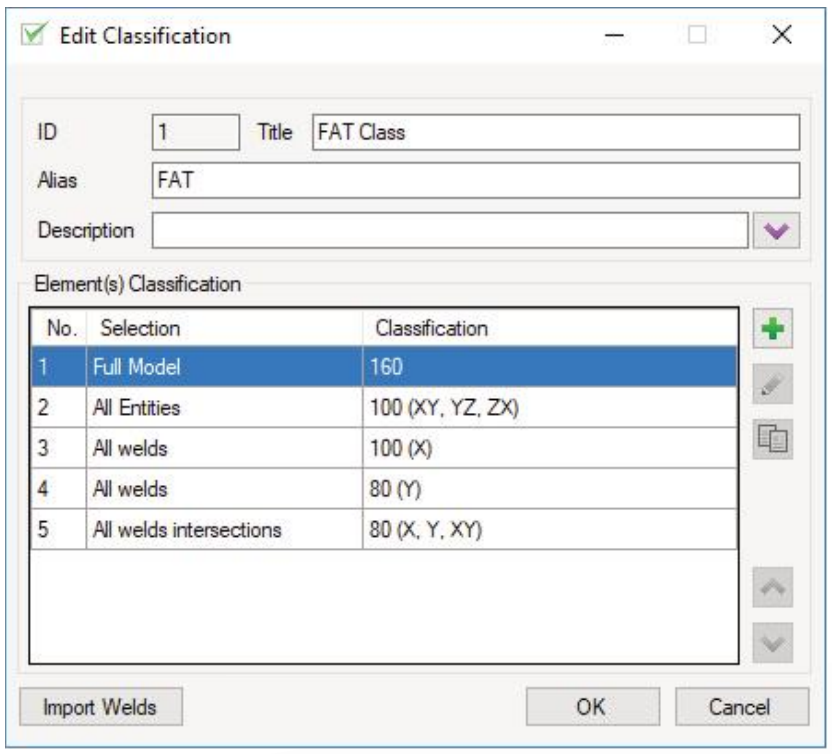
WELD CLASSIFICATION

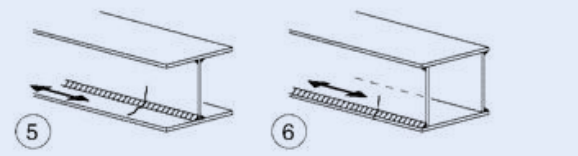
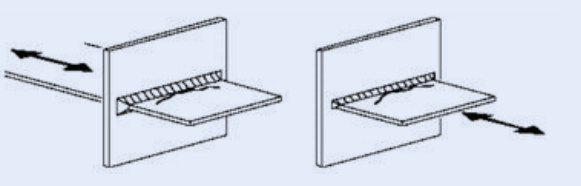
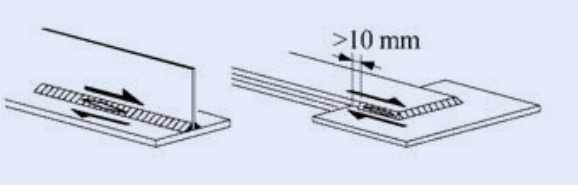
DVS 1608 (2010), DVS 1612 (2014)

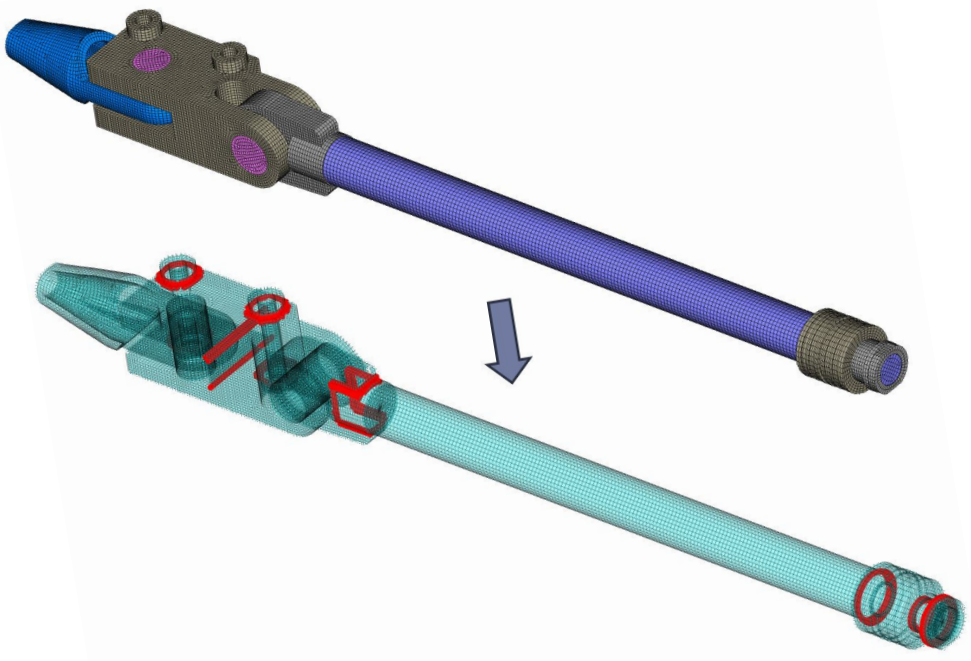
DVS 1608 (Design and strength assessment of welded structures from aluminum alloys in railway applications) – Aluminium Fatigue Check.

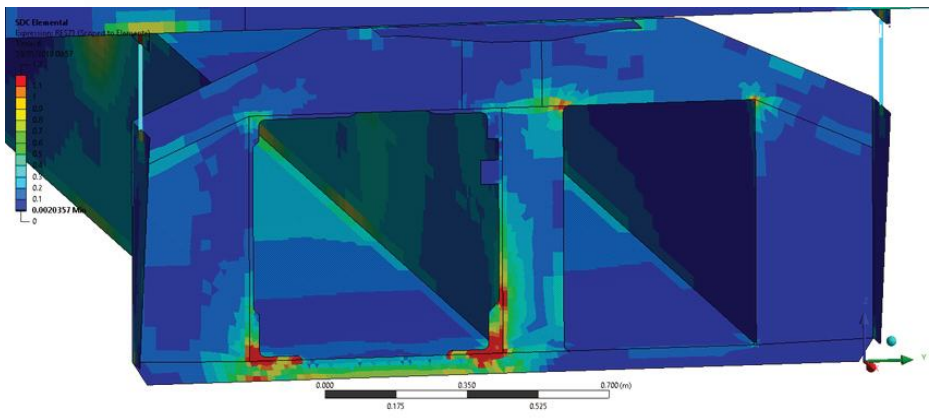
DVS 1612 (Design and endurance strength analysis of steel welded joints in rail-vehicle construction) – Steel Fatigue Check and Static Stress Check.

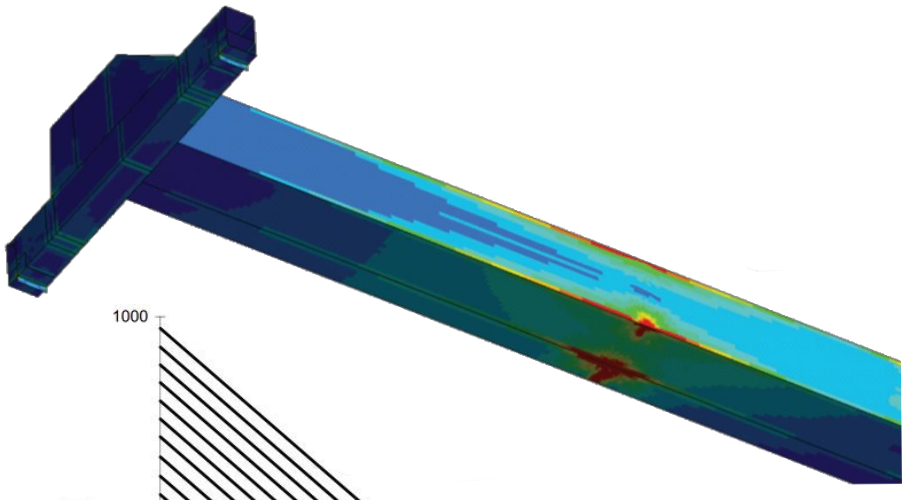
The notch group classification or fatigue strength of the welds depends on the quality and the stress direction, along the weld (X), perpendicular to the weld (Y) and the shear (XY). Stresses are converted into weld direction automatically by the weld finder.

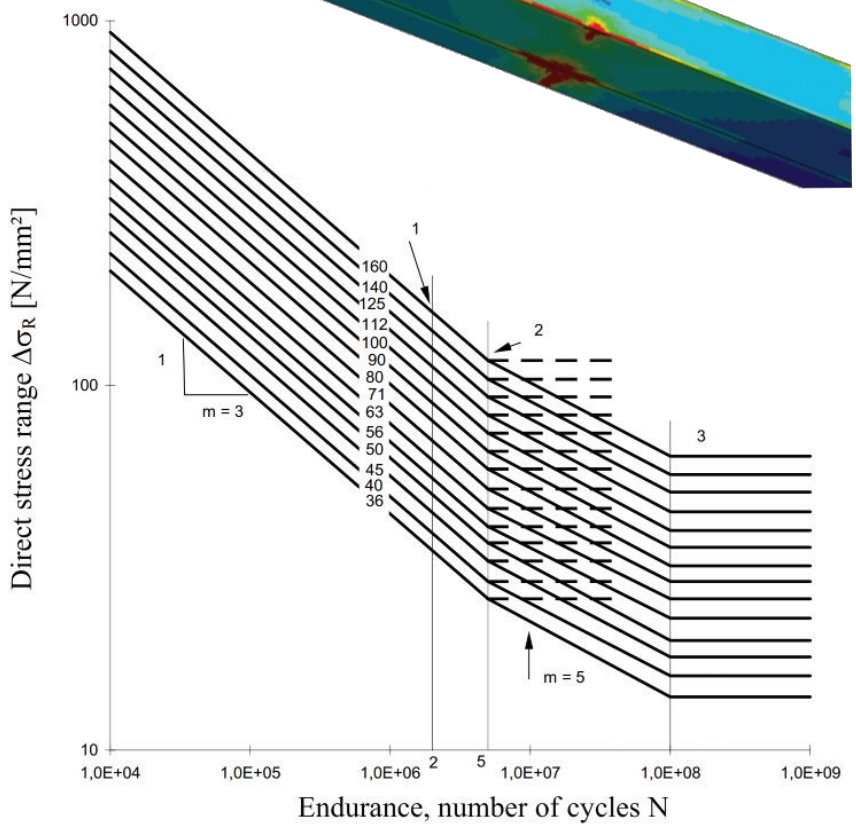


Detailed Category	Construction Detail
100	
100	
100	





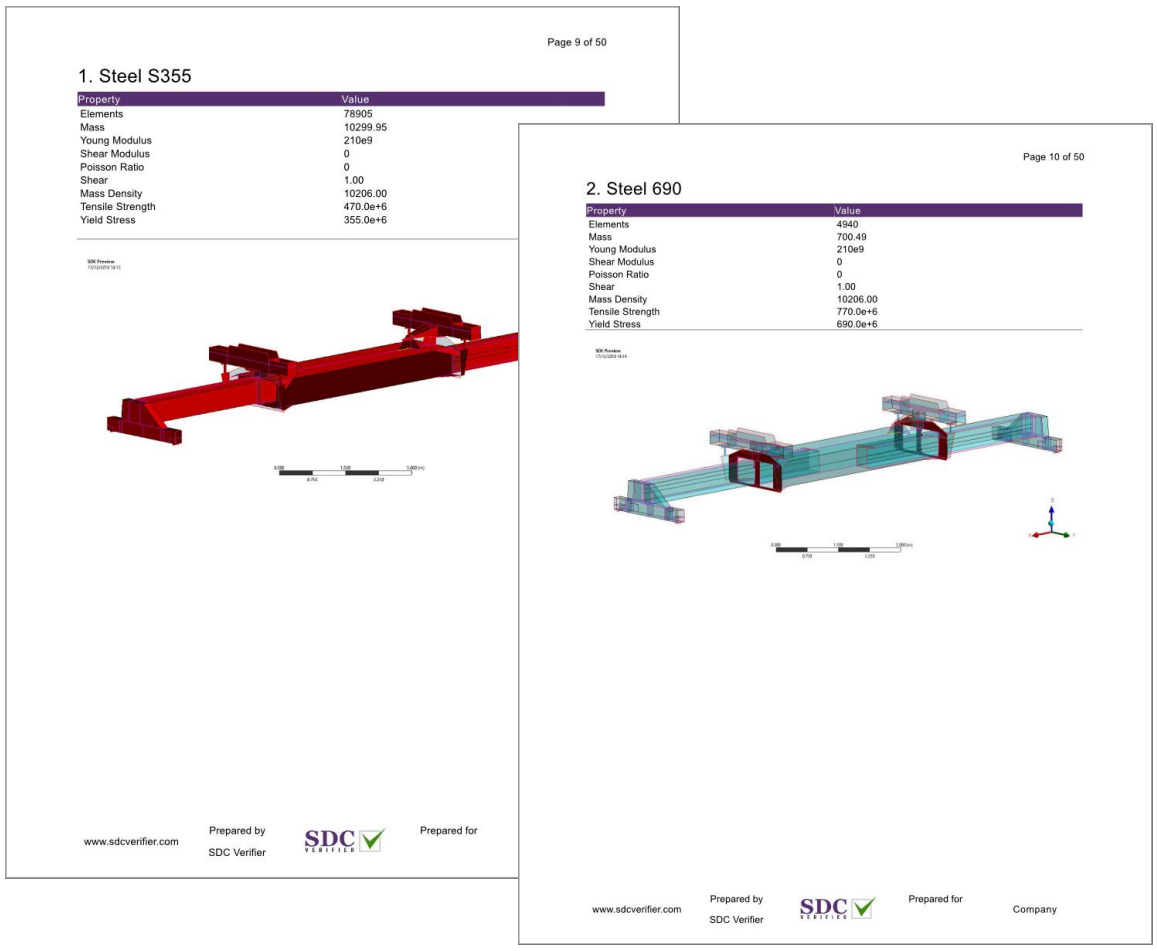




REPORT. MODEL SETUP

Preparing a full calculation report is one of the most timeconsuming parts of the project. From project to project, an engineer repeats the same routine to create a calculation report. With SDC Verifier, the process of report generation is done automatically, reducing time expenses.

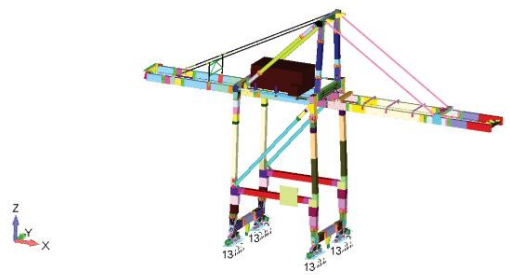
Materials and properties data (including mass overview) are described. Elements related to material/property are highlighted:



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

2..Ground constraints set

Definition	Count	DOF
1, 3	32 nodes	Tx Tz
2	Nodes: 3460, 112960	Ty



NB: Constrain in Y direction are applied to the elements representing buffer in the model as shown on the photo below.

Materials

This paragraph contains materials information.

Materials Summary

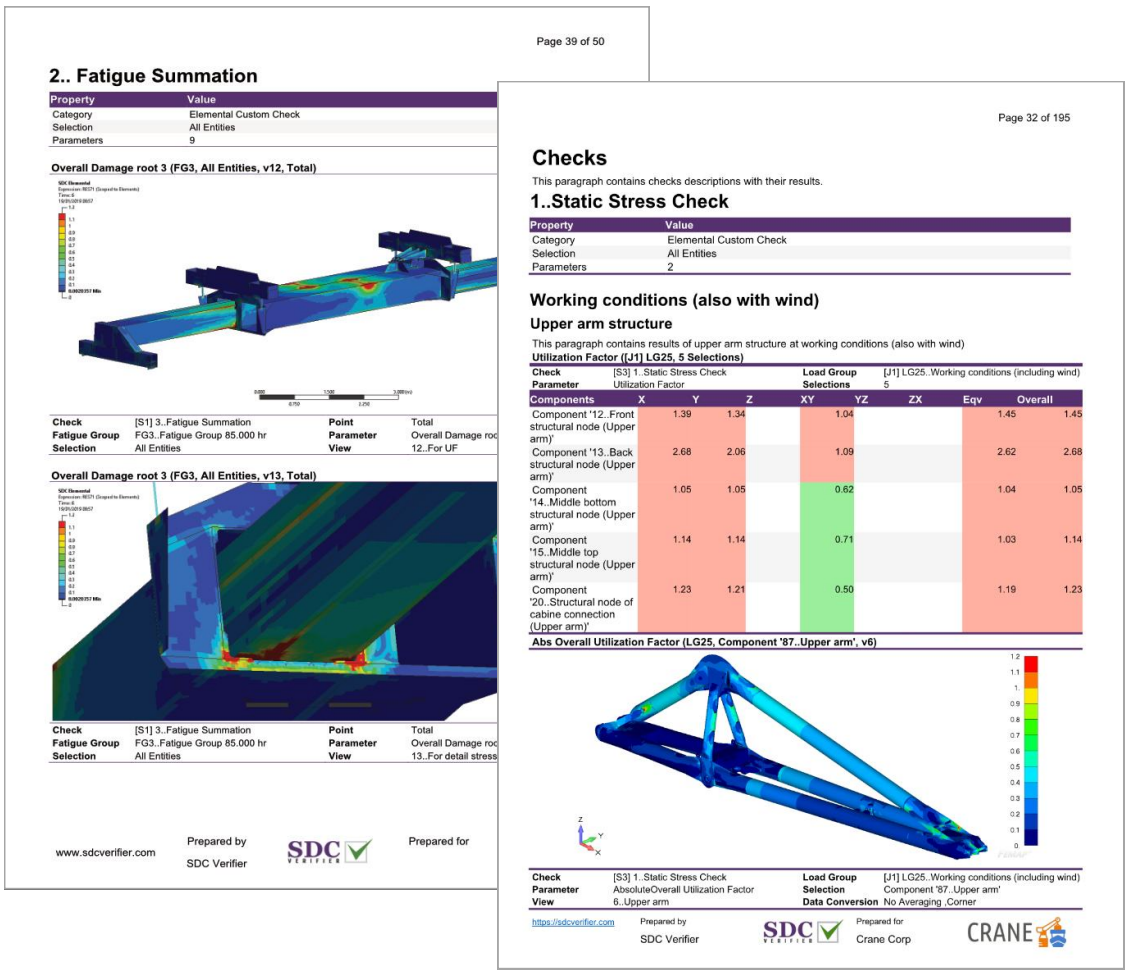
Title	Elements	Mass	Gravity Center
1..stainless steel	5971	66.8	[1.48; -49.34; 16.80]
2..steel	283	0.7	[1.52; -49.32; 16.49]
3..HPL	61365	294.6	[1.41; -49.24; 17.08]
4..line connection material	0	0.0	[0.00; 0.00; 0.00]
5..perforated stainless steel. horizontal	2195	17.1	[1.33; -49.44; 16.36]
6..bottom frame stainless steel	10716	174.4	[1.43; -49.23; 15.82]
7..front HPL covering	2277	8.9	[1.41; -49.80; 16.25]
8..side HPL covering	438	6.3	[0.40; -49.35; 17.91]
Mass Elements	20	0.0	[0.00; 0.00; 0.00]
Overall	83265	568.8	[1.41; -49.26; 16.63]

Properties Summary

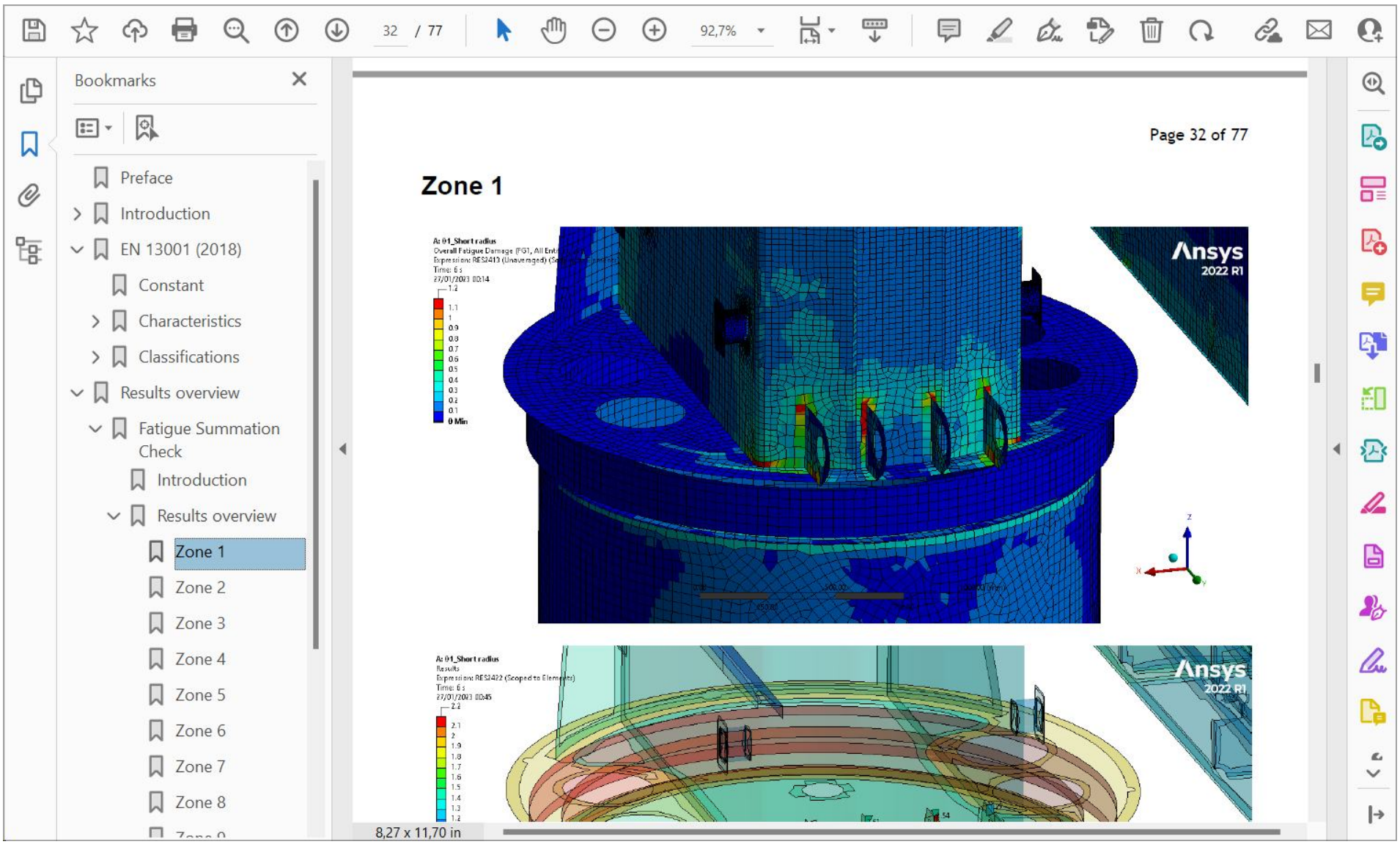
Title	Elements	Material	Mass	Gravity Center
1..bolt dia6mm	176	2..steel	0.4	[1.50; -49.30; 16.74]
2..t=08 steel angles	3359	1..stainless steel	58.0	[1.48; -49.33; 16.86]
4..Plate t=12	32209	3..HPL	124.1	[1.40; -49.24; 16.78]
7..covering with angle Plate t=12	1219	3..HPL	4.8	[1.50; -49.32; 16.57]
8..plate t=5. bottom frame	10716	6..bottom frame stainless steel	174.4	[1.43; -49.23; 15.82]
9..bolt dia4mm	97	2..steel	0.1	[1.53; -49.34; 16.08]
10..bolt dia 14mm	10	2..steel	0.2	[1.55; -49.36; 16.07]
11..plate t=4mm	163	1..stainless steel	0.4	[1.71; -49.75; 16.34]
12..upper covering Plate t=12	20317	3..HPL	116.5	[1.42; -49.11; 17.06]
13..t=08_support plate	0	1..stainless steel	0.0	[0.00; 0.00; 0.00]
14..plate t=2mm perforated	2195	5..perforated stainless steel. horizontal	17.1	[1.33; -49.44; 16.36]
15..plate t=2mm small beam	2252	1..stainless steel	5.1	[1.34; -49.43; 16.58]
21..front middle covering Plate t=12	2277	7..front HPL covering	8.9	[1.41; -49.80; 16.25]
22..side upper covering Plate t=12	438	8..side HPL covering	6.3	[0.40; -49.35; 17.91]
25..top upper covering Plate t=12	3891	3..HPL	28.4	[1.40; -49.33; 18.19]
26..front upper covering Plate t=12	3729	3..HPL	20.8	[1.38; -49.76; 17.58]
27..support plate t=12	197	1..stainless steel	3.3	[1.55; -49.36; 16.06]
Overall	83245		568.8	[1.41; -49.26; 16.63]

REPORT. RESULTS

Results contain plots and tables. Detailed results for each entity, extreme results on selection, and advanced tables to compare load results are shown:



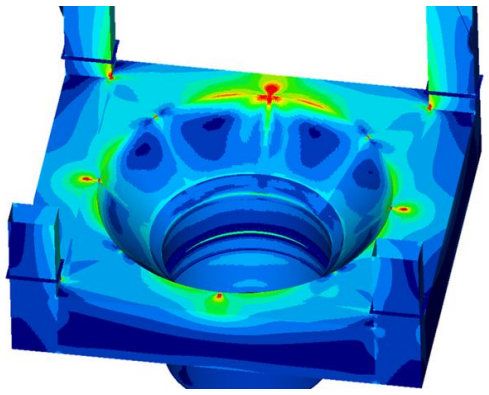
A complete setup with headings and bookmarks enables a quick navigation through the reports.

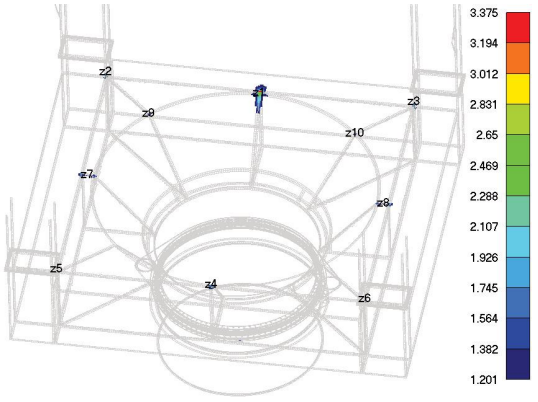


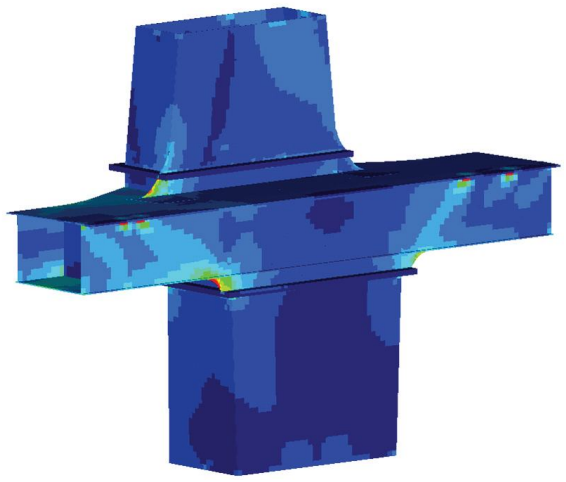
With Report Designer, you can control the report's structure and easily preview and modify it. A variety of tools helps to create a huge amount of plots and tables quickly.

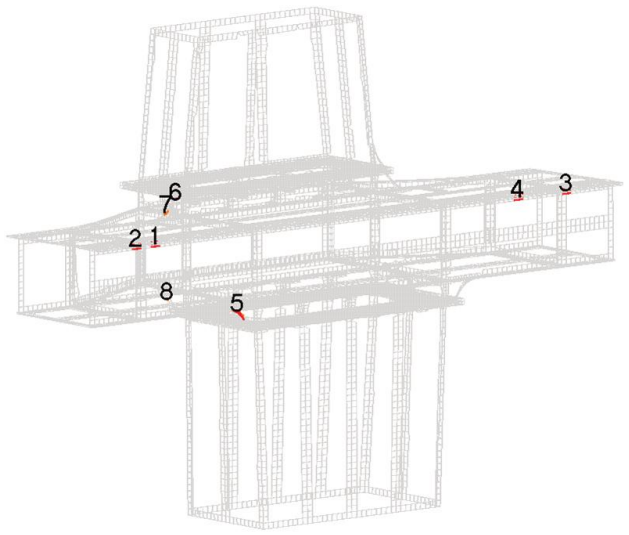
POST-PROCESSING TOOLS

Peak Finder finds all peak zones based on output results and presents them using a special plot and a summary table.
The peaks for both simple FEA results, such as stresses, strains, or displacements, and all available results of SDC Verifier checks (Fatigue, Beam Buckling, etc.) can be found.









Zone	Value	Zone	Value
Zone 1 (Elements: 2)	1.45	Zone 5 (Elements: 15)	1.41
Zone 2 (Elements: 2)	1.44	Zone 6 (Elements: 1)	1.21
Zone 3 (Elements: 2)	1.43	Zone 7 (Elements: 3)	1.09
Zone 4 (Elements: 2)	1.42	Zone 8 (Elements: 1)	1.01

Governing loads tool extracts the critical loads out of a large group of load combinations. Save time focusing on important situations instead of checking each and every.

Only 8 load cases are defined as critical for this model and selected criteria, which will dramatically speed up the further verification process

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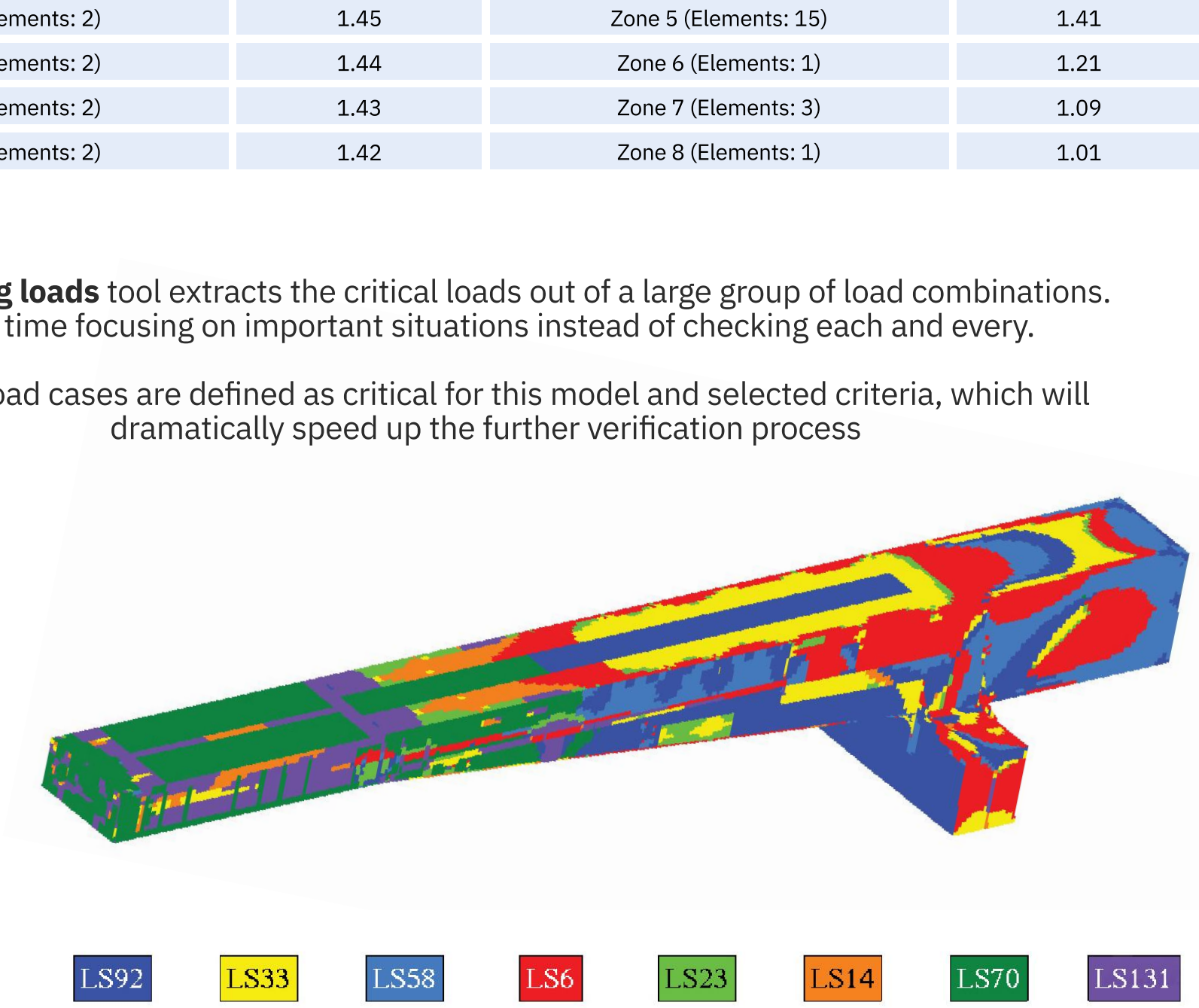
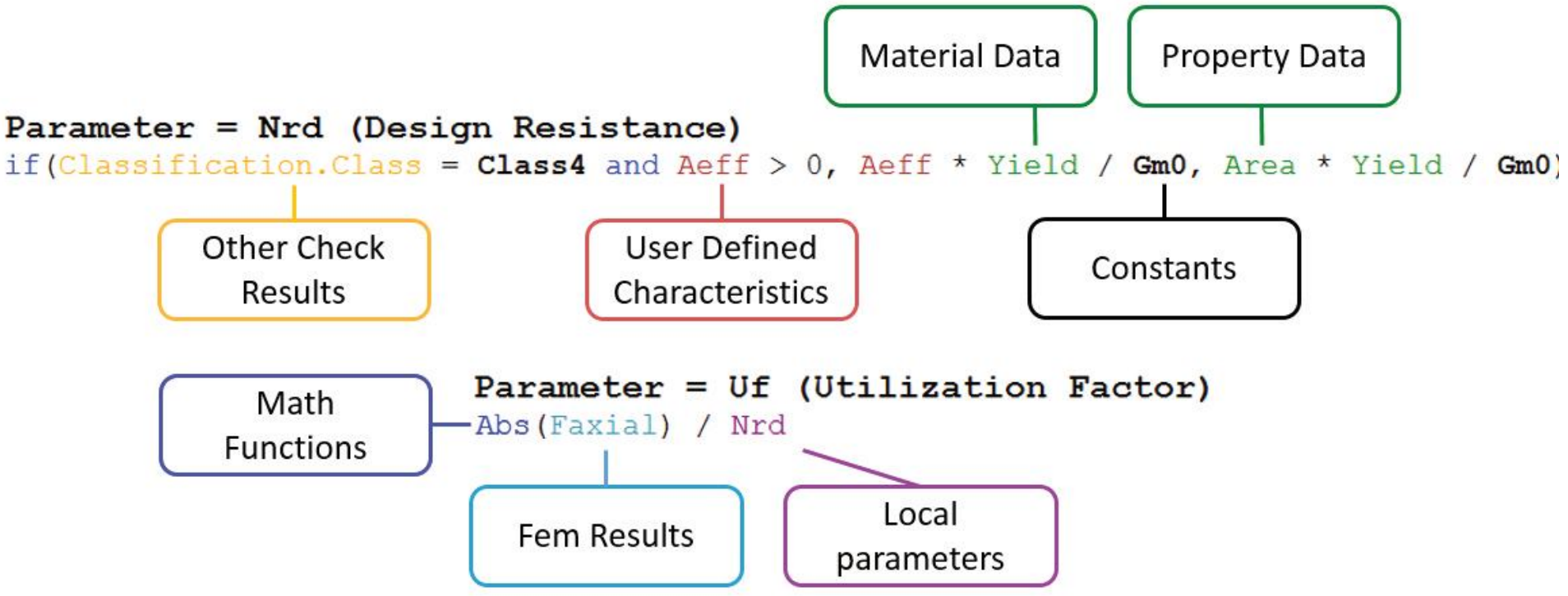
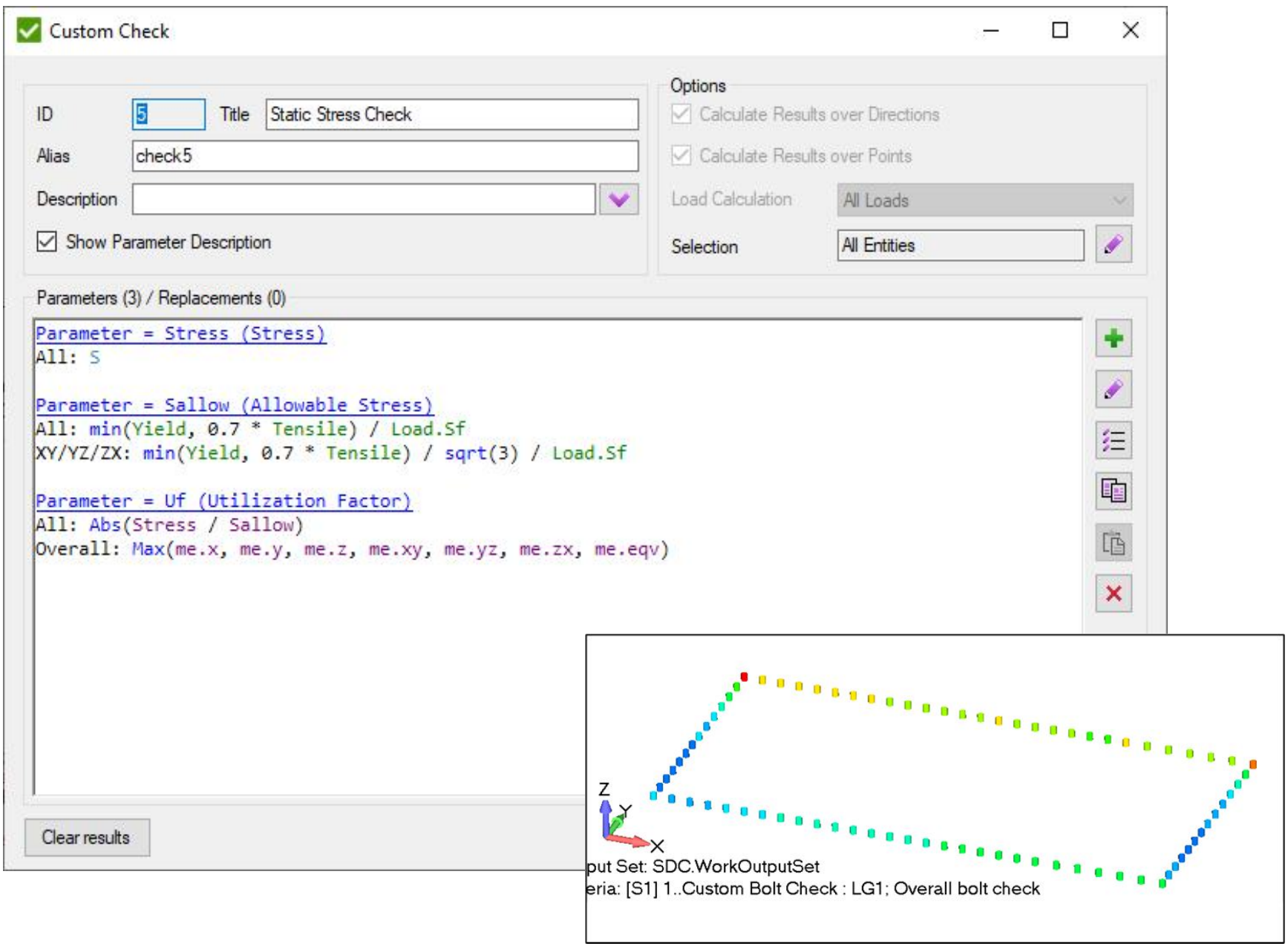


CUSTOMIZED CHECKS

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

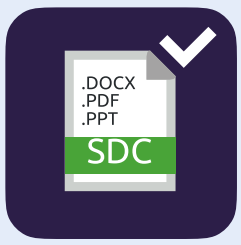


The following example demonstrates a verification of bolted connections. The Axial Force of bolts is compared with the bolt design resistance:



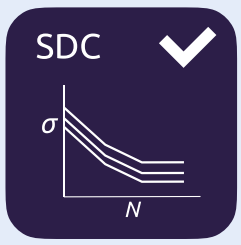
EXTENSIBLE MODULES

Acquire only some modules if you need specific features of the software



SDC Reporting and SPDM

Weld Check



Fatigue

Bolt Check

Plate & Stiffener

Beam Member and Joint

Beam Member Check

Eurocode 3 Beam Member

FKM App

AISC Beam Member

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The Netherlands,
Haarlem Zijlvest 25, 2011 VB

+31 15 455 05 65

sdcverifier.com

support@sdcverifier.com