SDC VERIFIER

STRUCTURAL OPTIMIZATION

WORKS INDEPENDENTLY AND WITHIN

Ansys FEMAP Simcenter 3D

- Simulation
- Load Combinations
- Recognition
- Checks
- Automatic Documentation

STANDARDS Australia

FKM · VDI · DVS · AISC · Eurocodes · ISO · FEM · DNV · DIN · API · ASME · cen European Committee for Standardization · ABS · AIJ · norsok standard
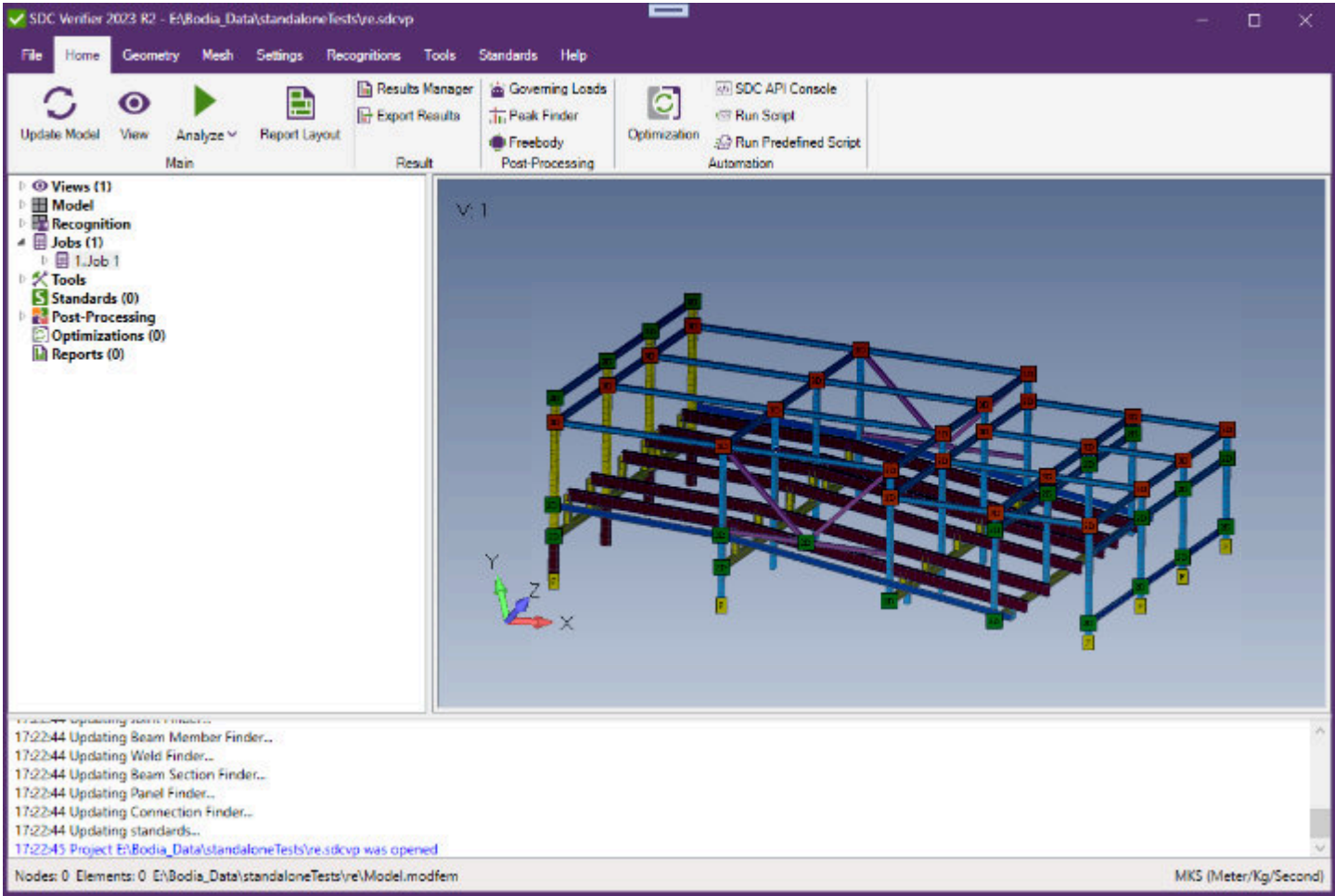
STRUCTURAL VERIFICATION ACCORDING TO STANDARDS

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 solver combined with the features of SDC Verifier allows engineers to cover simulation and verification with just a few clicks.

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.

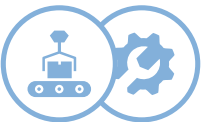## TAILOR MADE FOR THE FOLLOWING INDUSTRIES

OFFSHORE AND MARITIME
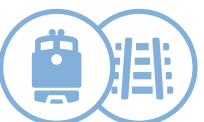
OIL AND GAS

HEAVY LIFTING

MACHINERY EQUIPMENT

RAILWAY

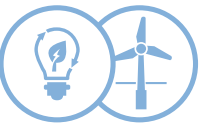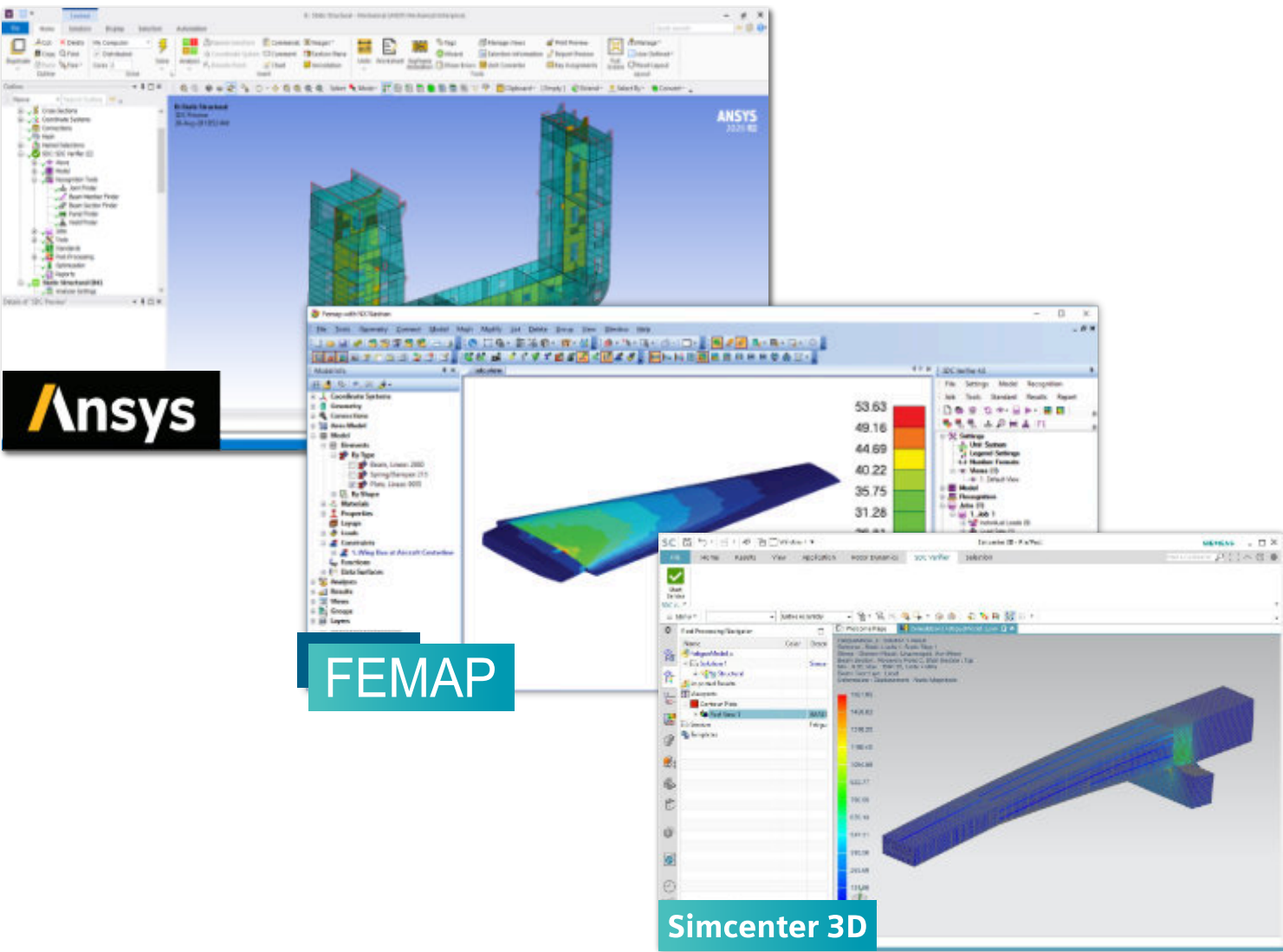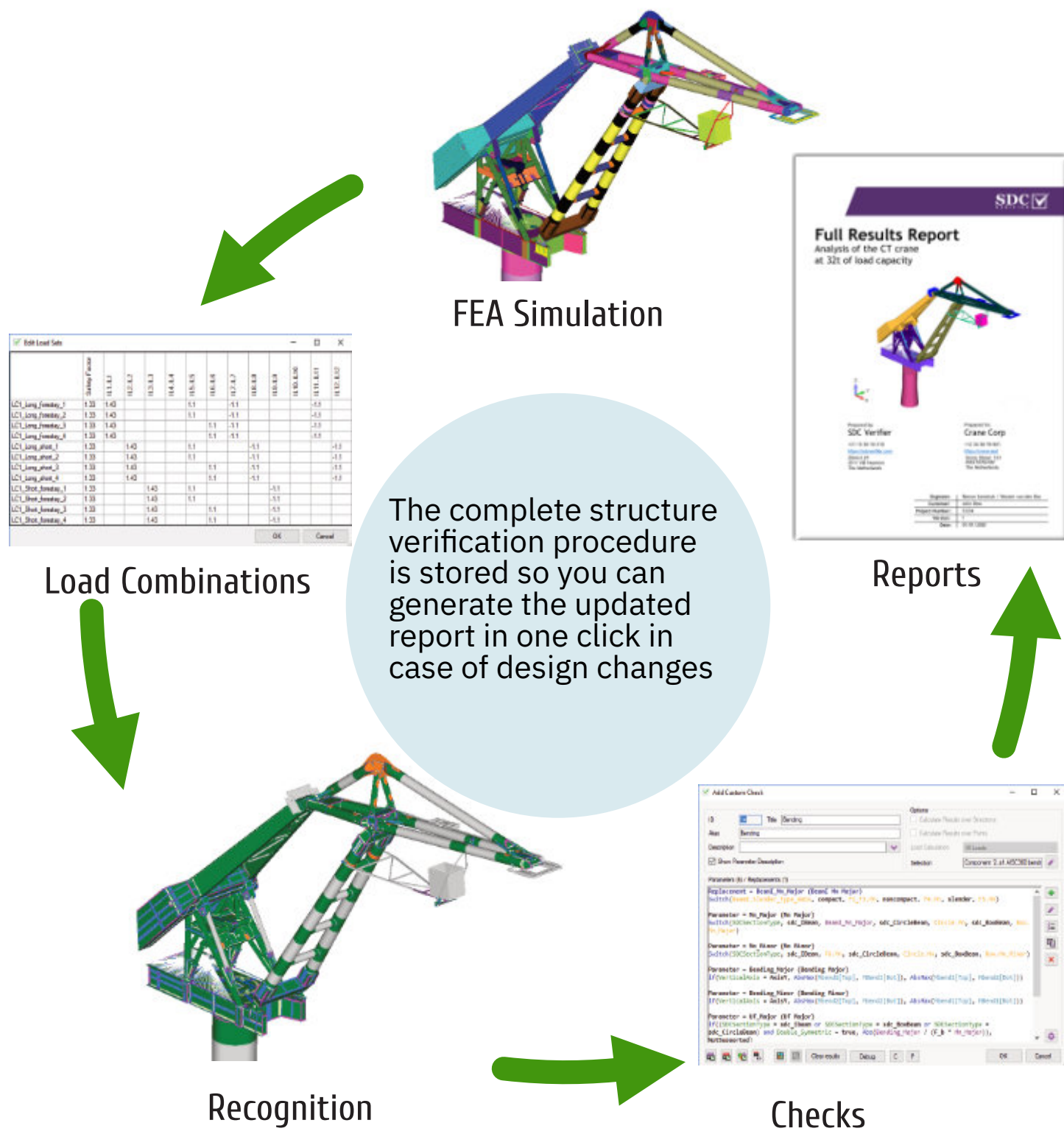CIVIL ENGINEERING

PIPES AND PETROCHEMICAL

AEROSPACE

RENEWABLE ENERGY

DEFENSE

FEA Simulation

Load Combinations

Reports

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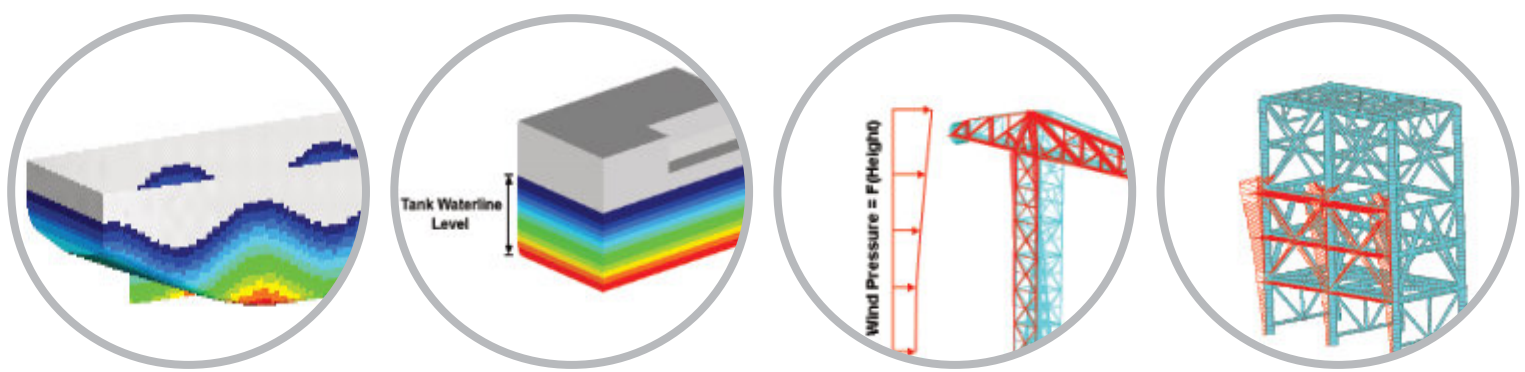
Recognition

Checks

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

IPE 200   1.15
IPE 400   0.43
IPE 300   0.95

— 8 mm ✗
— 10 mm ✗
— 12 mm ✓
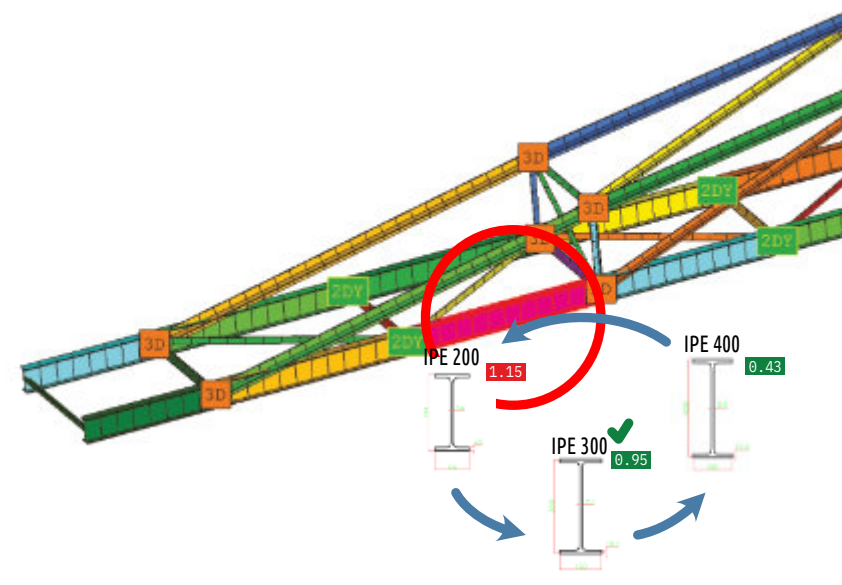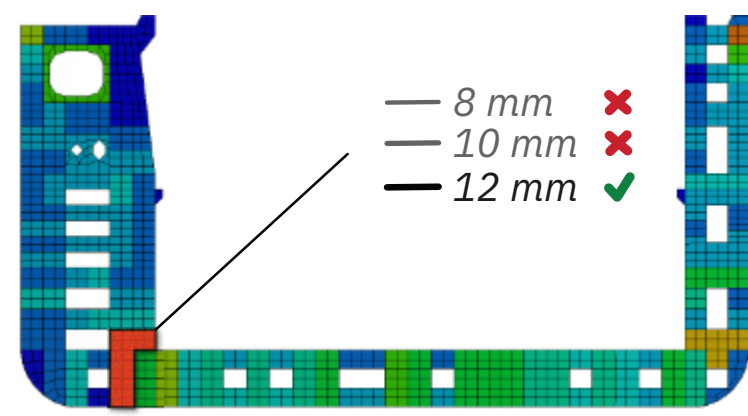
Optimization helps to automatically calculate various design input combinations and ensure cost-effectiveness by adjusting the existing model parts for specific terms of usage.

SDC Verifier automates the application of the specific loads:

IMPLEMENTED STANDARDS

STANDARDS Australia
AS 3990 (1993)

AIJ (2005 Edition, 2017)

DIN 15018

NORSOK N004

AISC 89, 2010, 2022

F.E.M. 1.001

DNV 1995 & 2010

ISO 19902 (2007 & 2020)

ASME VIII (Div2, 2010)
ASME B31.8-2018

Eurocode 3 (EN 1993)

API 2A RP

EN 13001

ABS 2004 & 2014

VDI 2230 Bolts

FKM (5th edition, 2003; 6th edition, 2012)

DVS 1608 (2010), DVS 1612 (2014)

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 – apply force and pressure based on wave parameters (height, length, crest, amplitude, etc.).

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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)*, **EN 13001** *(Cranes General Design, 2018)*

AIJ (2017)

EN 13001

Norsok N004

AS 3990 (1993)

AISC 89 & 2010 AISC 360-22

API RP 2A RP

ISO 19902 (2007, 2020)

Eurocode 3

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:

Maximum Deflection

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.
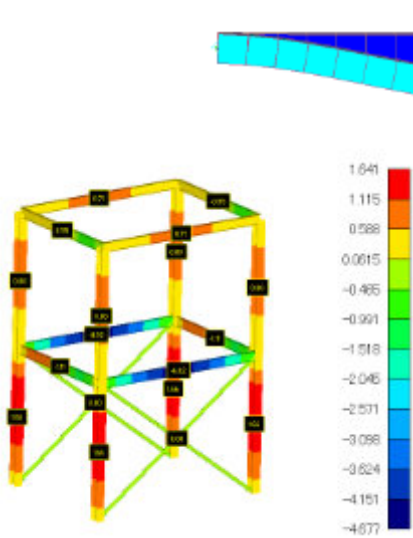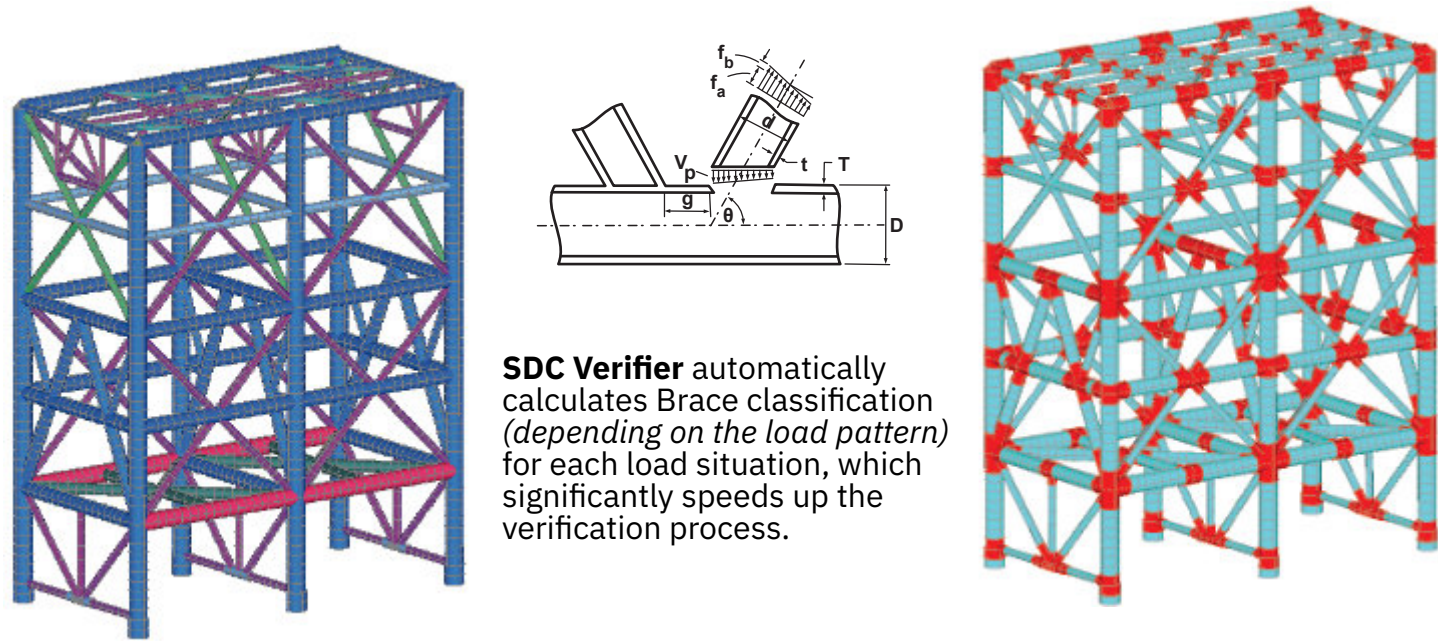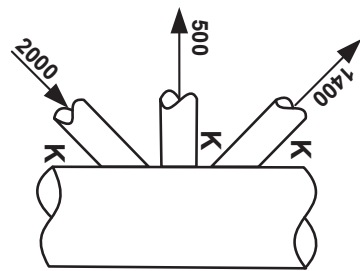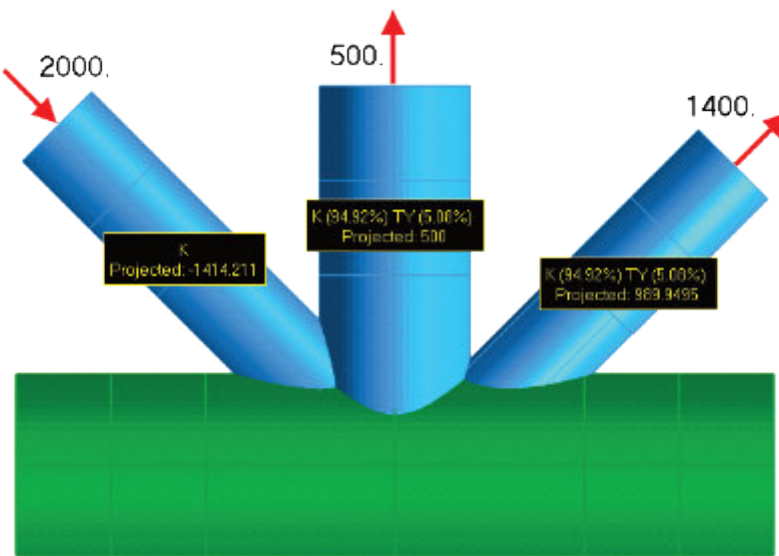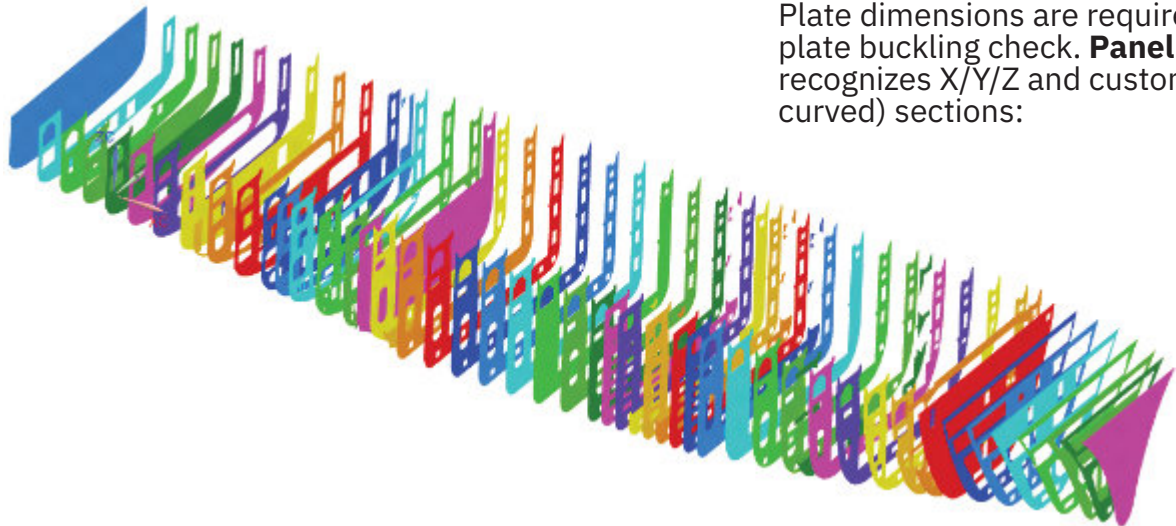
JOINT CHECK

Joint Finder tool is used to verify tubular joints 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.
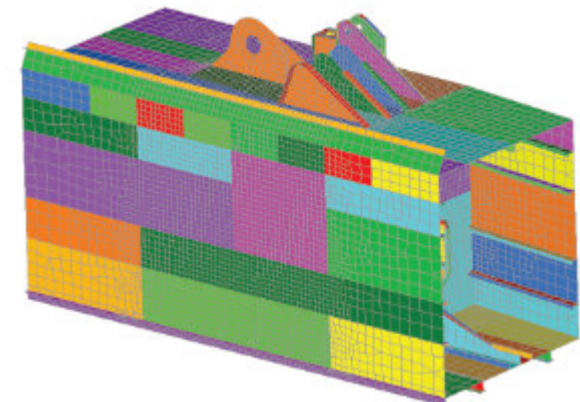

Connection ID	Brace Number	Joint Type
1	#1 (ElemID = 27)	K
	#2 (ElemID = 13)	K (94.92%) TY (8.08%)
	#3 (ElemID = 19)	K (94.92%) TY (8.08%)

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** and **Eurocode 3** rules:

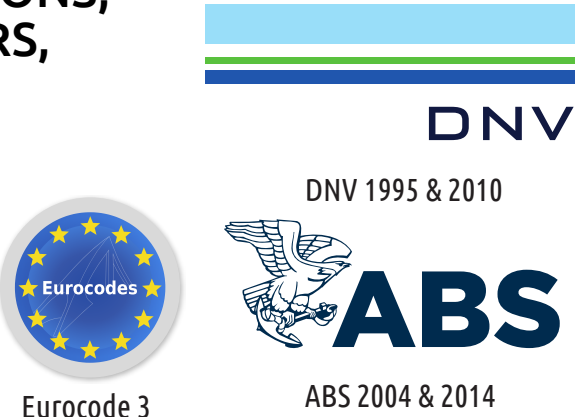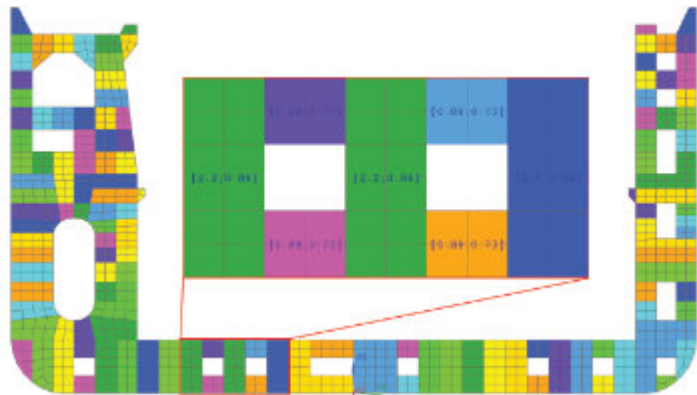

DNV 1995 & 2010

Eurocode 3

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(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

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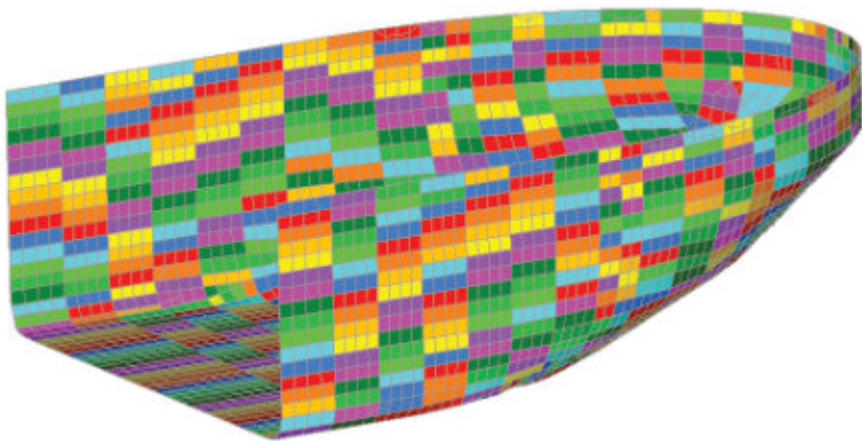
Stiffened Panel Finder — recognizes sections, panels, plates, stiffeners and girders and their dimensions automatically. This tool is an advanced version of the Panel Finder.
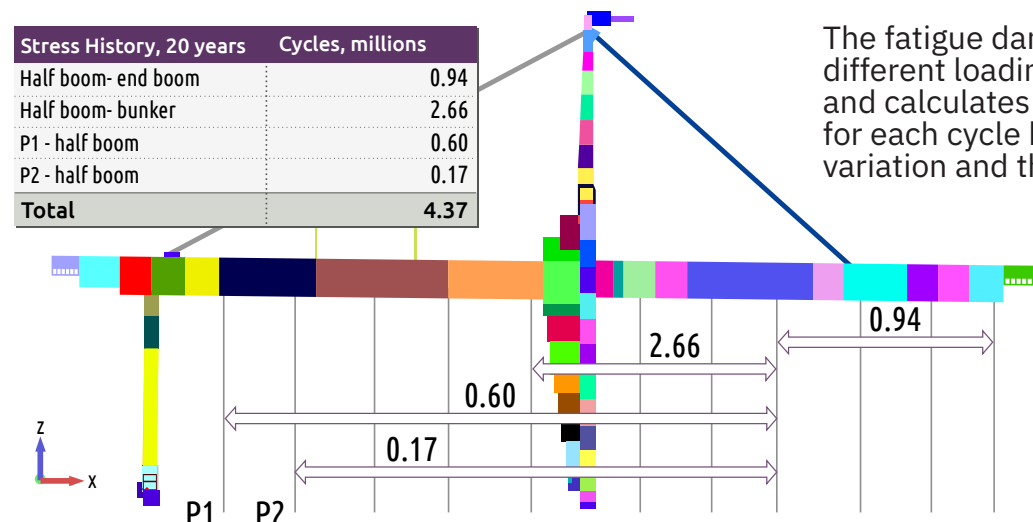

In the figure below, panels, simple stiffeners (marked in blue) and girders or stiffeners supporting also other stiffeners (marked in red) are plotted.
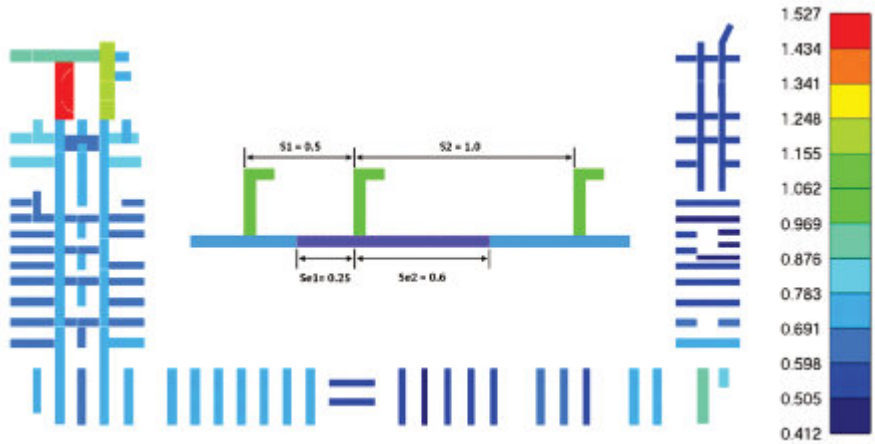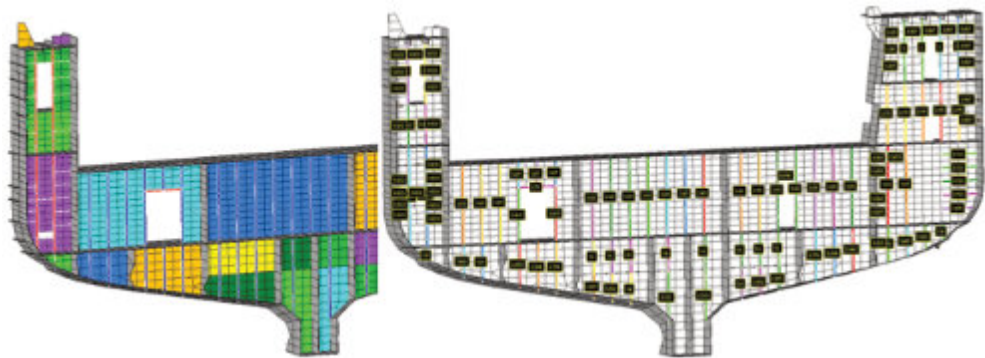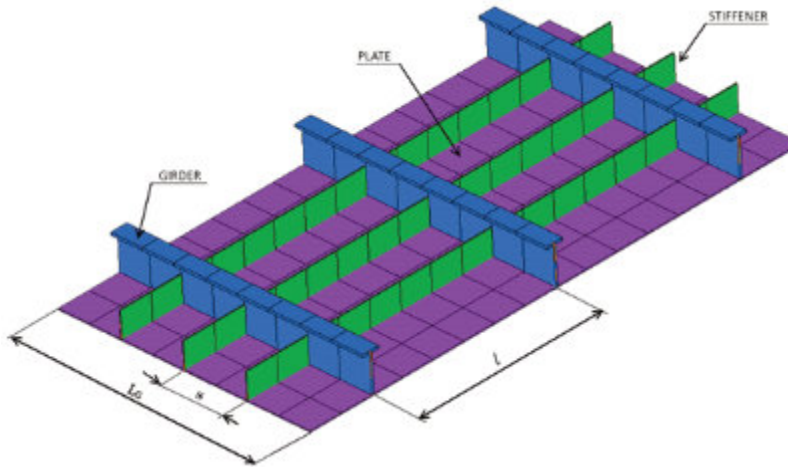
Effective Width — calculates the plate effective width for every load situation. The Effective width is used in the stiffener buckling check according to DNV-RP-C201 2010.

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# 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 S-N 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, 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

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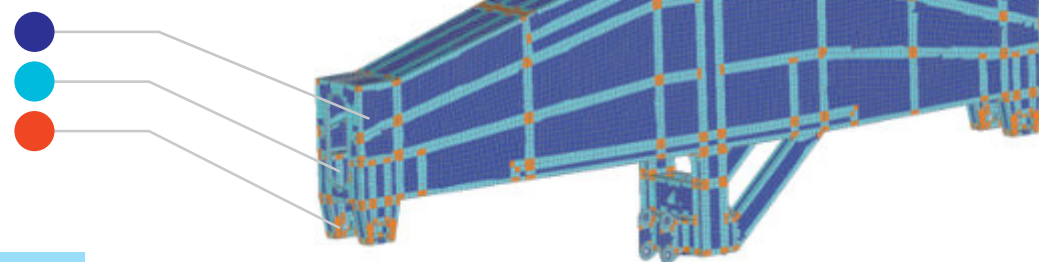
SDC Verifier performs a weld strength check according to **DNV-OS-C101/C201, Eurocode 3**.

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

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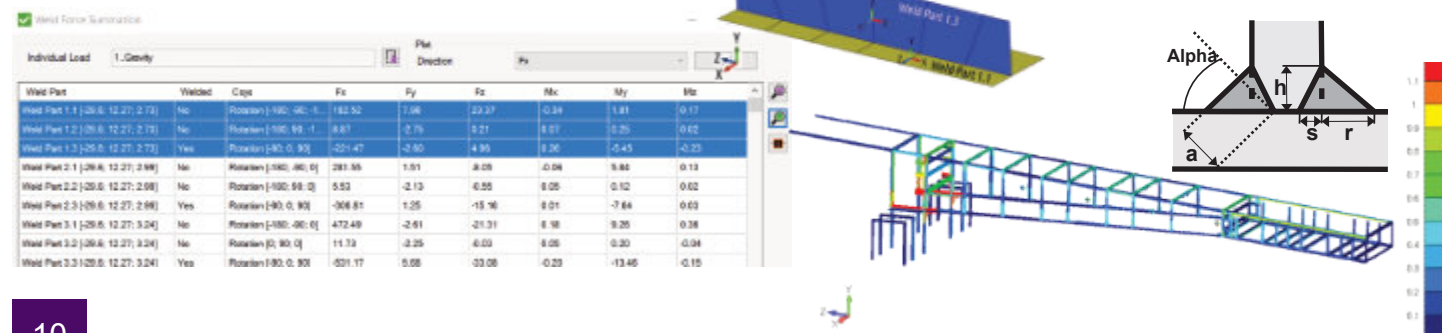
WELD CLASSIFICATION

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.
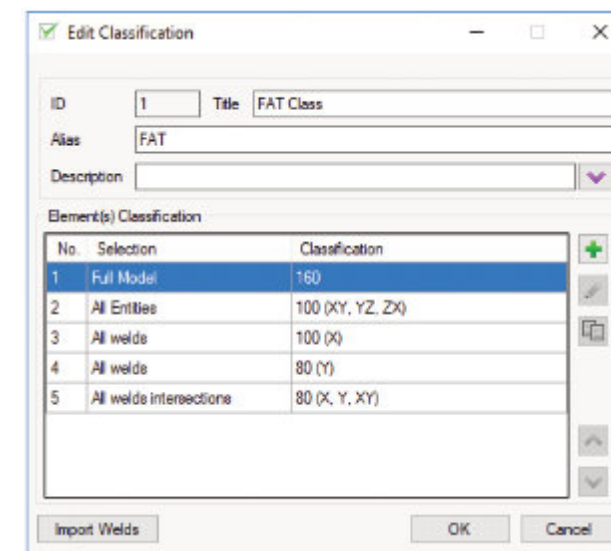
| Detailed Category	Constructional detail	
100		
80		
80		
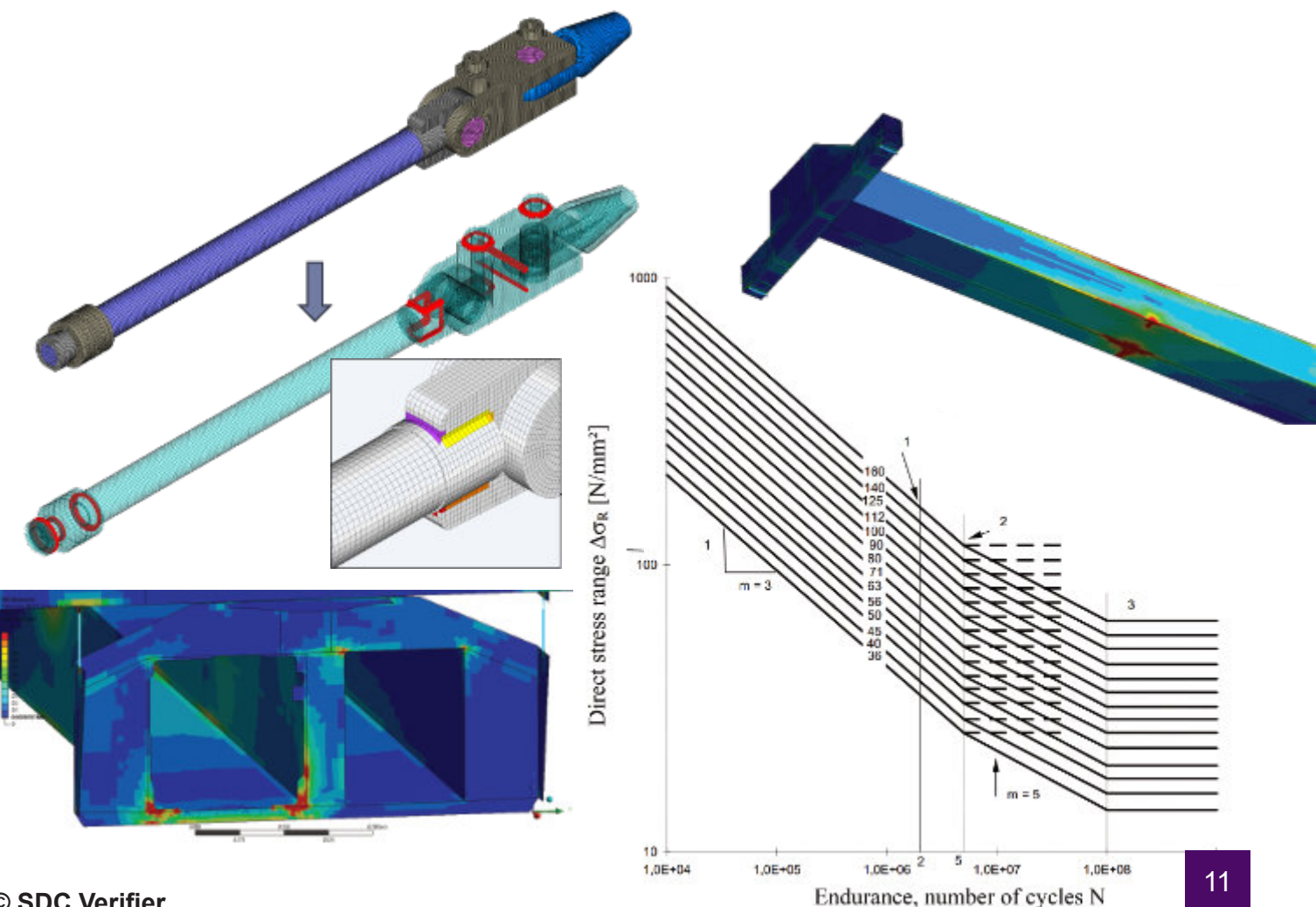
© SDC Verifier

Preparing a full calculation report is one of the most time-consuming 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:
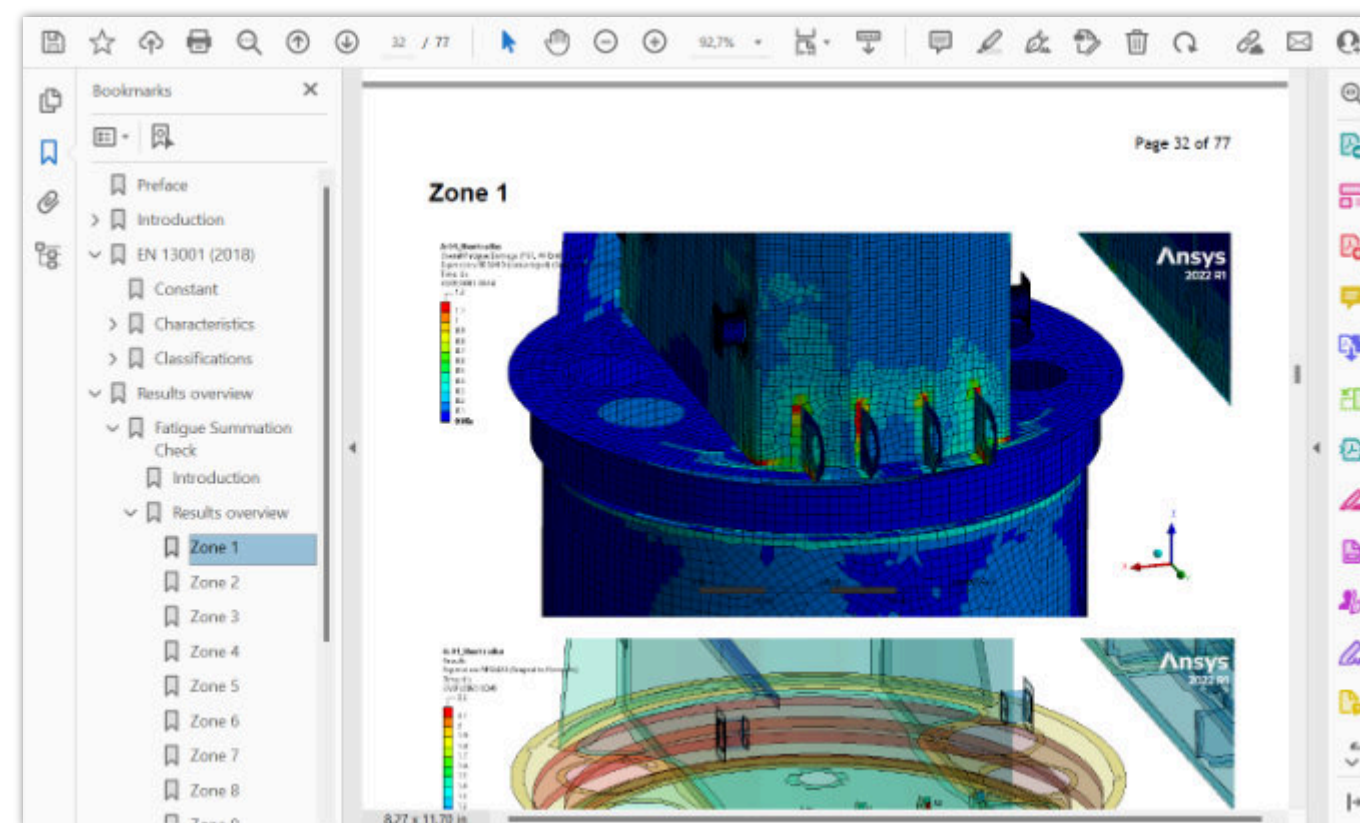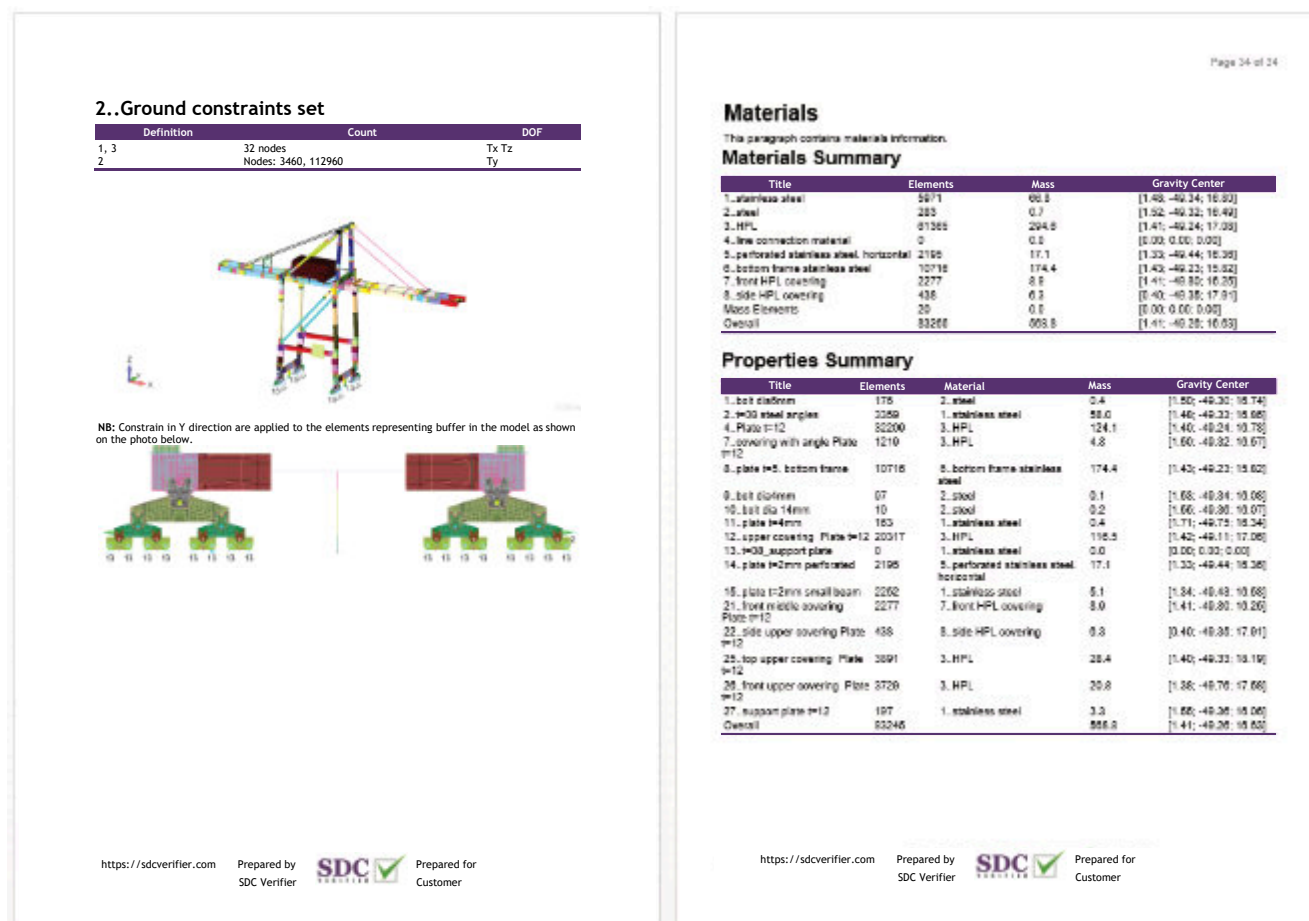

Results contain plots and tables. Detailed results for each entity, extreme results on selection, and advanced tables to compare load results are shown:
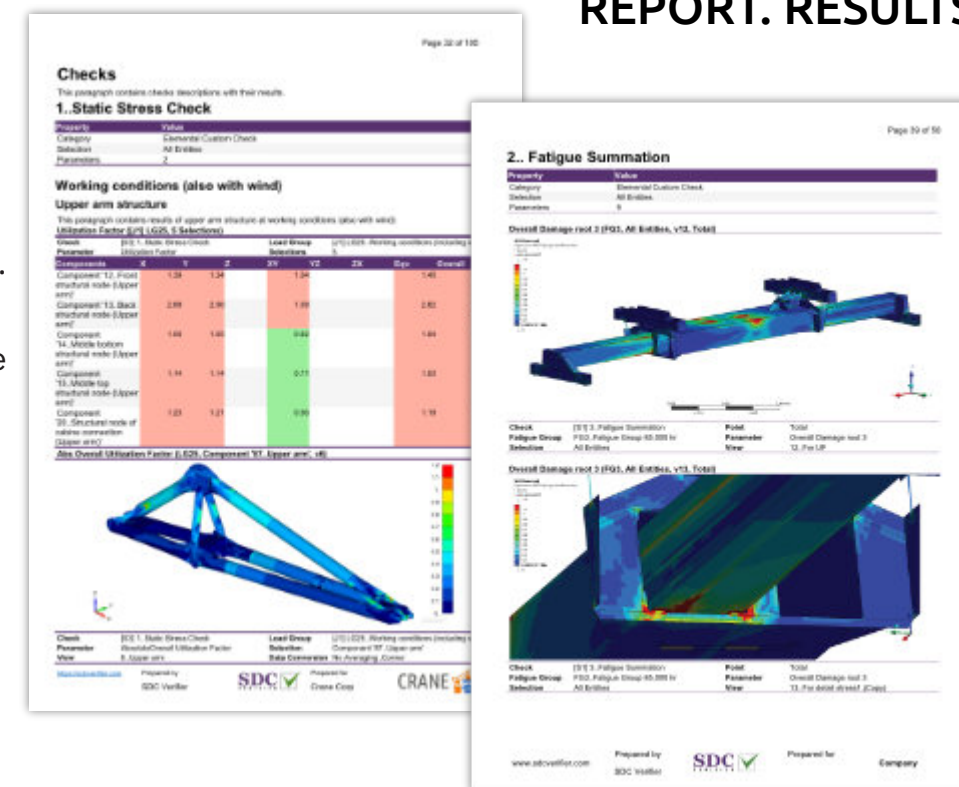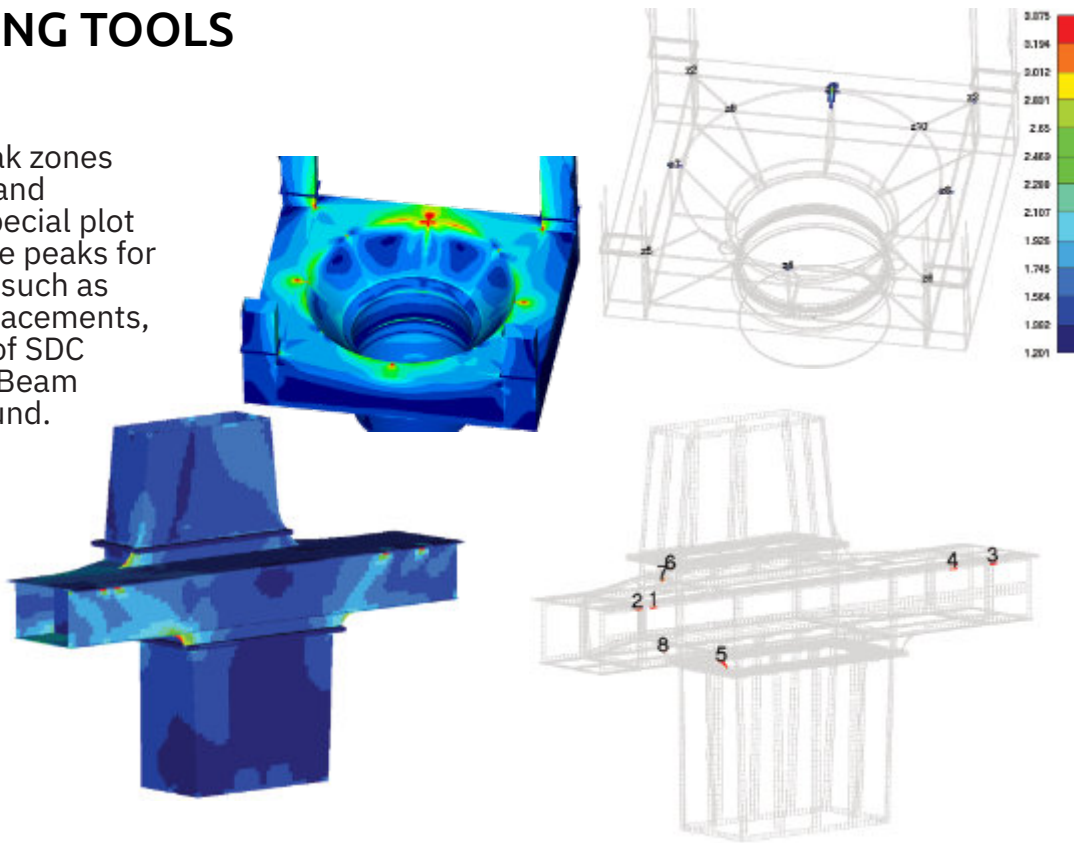

A complete setup with headings and bookmarks enables a quick navigation through the reports.

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.
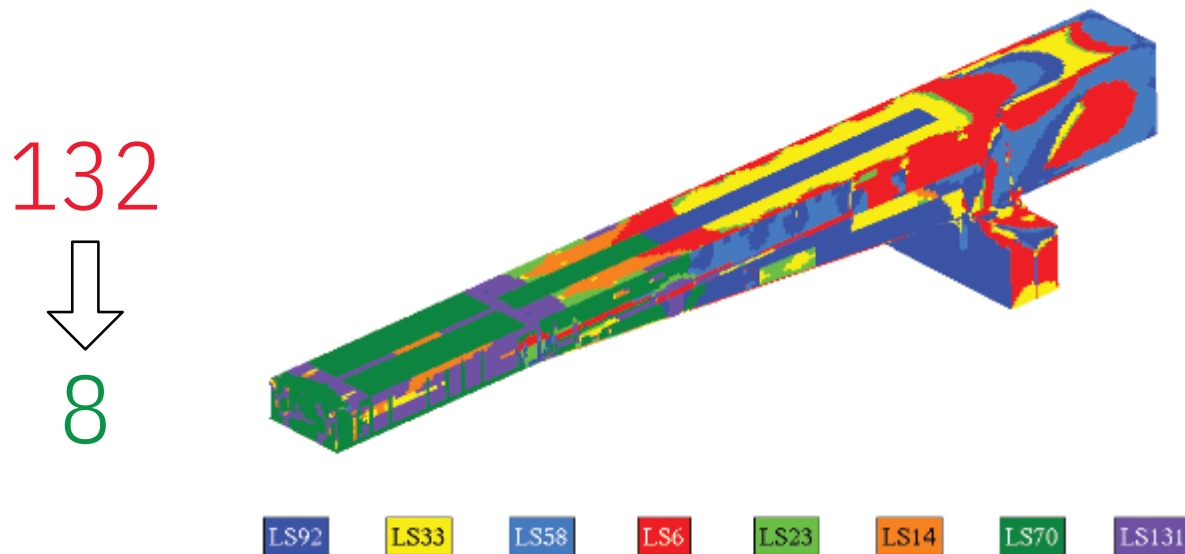
Peak Finder finds all peak zones based on output results and presents them using a special plot and a summary table. The peaks for both simple FEA results, such as stresses, strains, or displacements, and all available results of SDC Verifier checks (Fatigue, Beam Buckling, etc.) can be found.
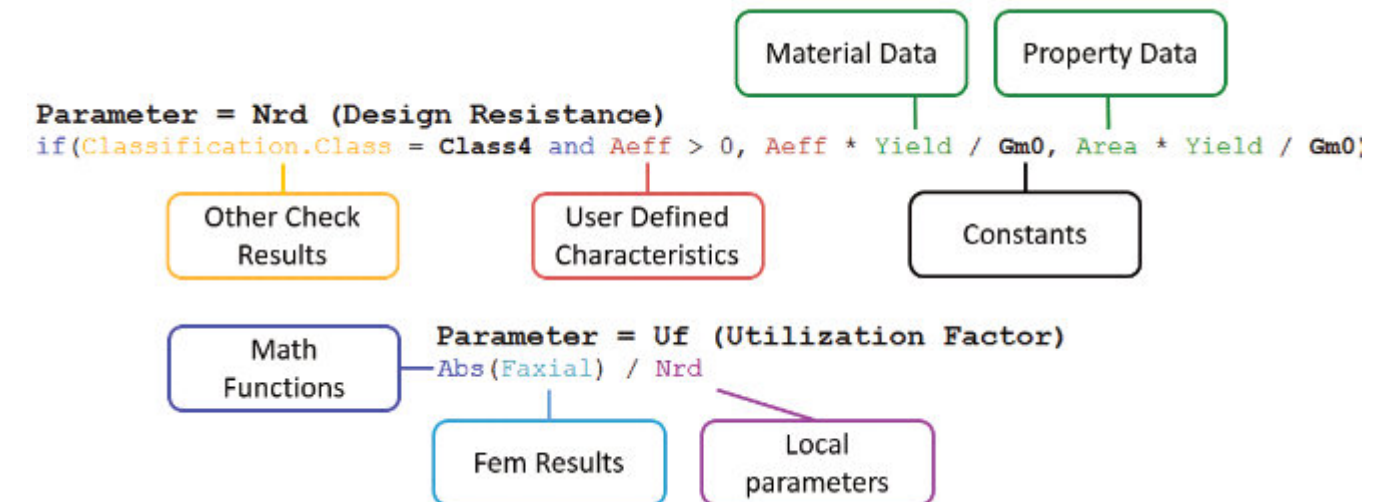
The checks in SDC Verifier are fully customizable. With the help of the formula editor, user-defined formulas can be created based on results, model properties and recognized dimensions.

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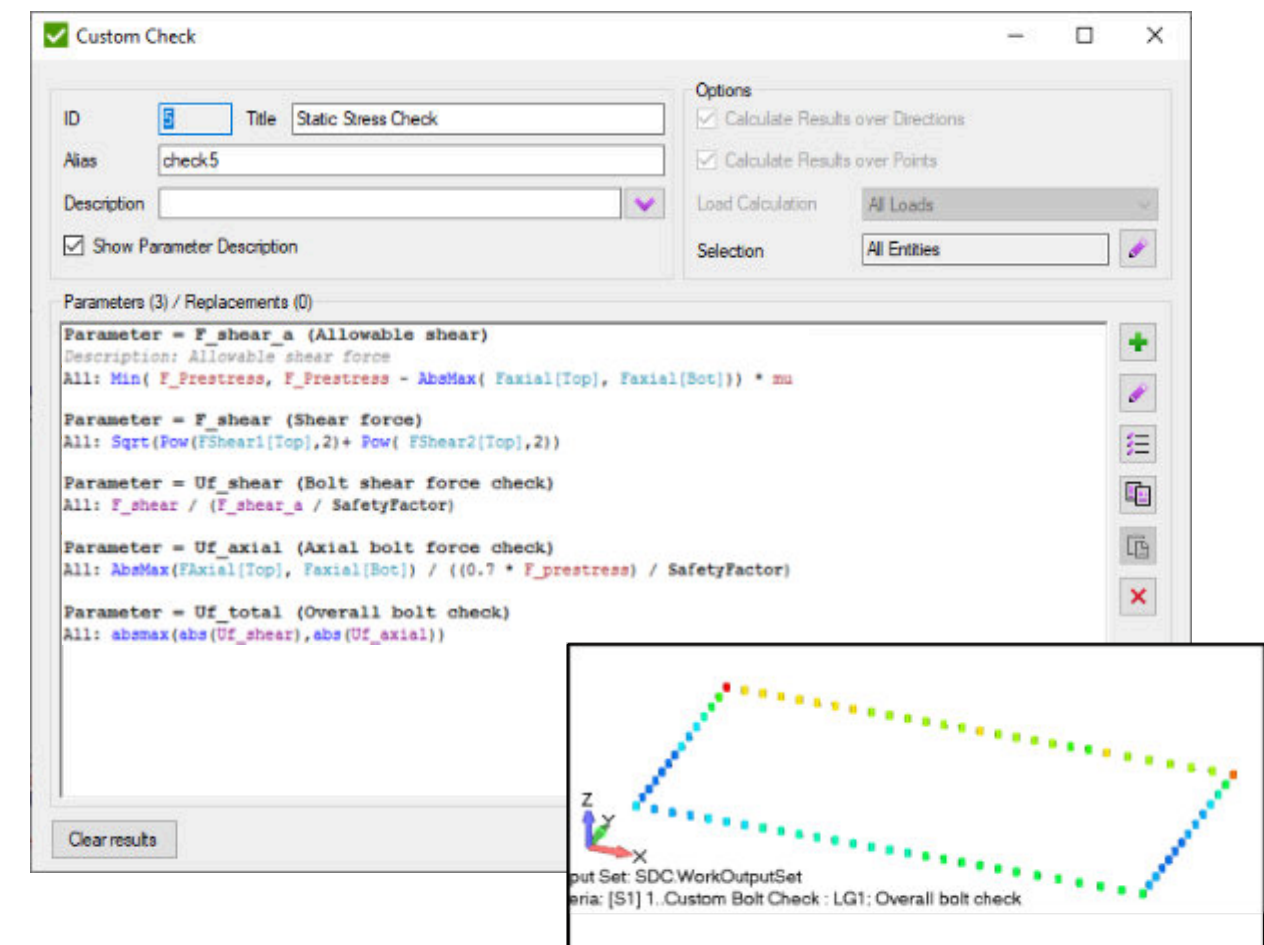
Only 8 load cases are defined as critical for this model and selected criteria, which will dramatically speed up the further verification process.

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

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EXTENSIBLE MODULES

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

SDC Reporting and SPDM
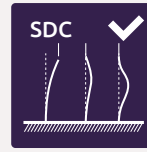
Weld Check

Fatigue

Bolt Check

Plate & Stiffener Buckling

Beam Member and Joint Checks

Beam Member Check

Eurocode 3 Beam Member

FKM App

AISC Beam Member

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