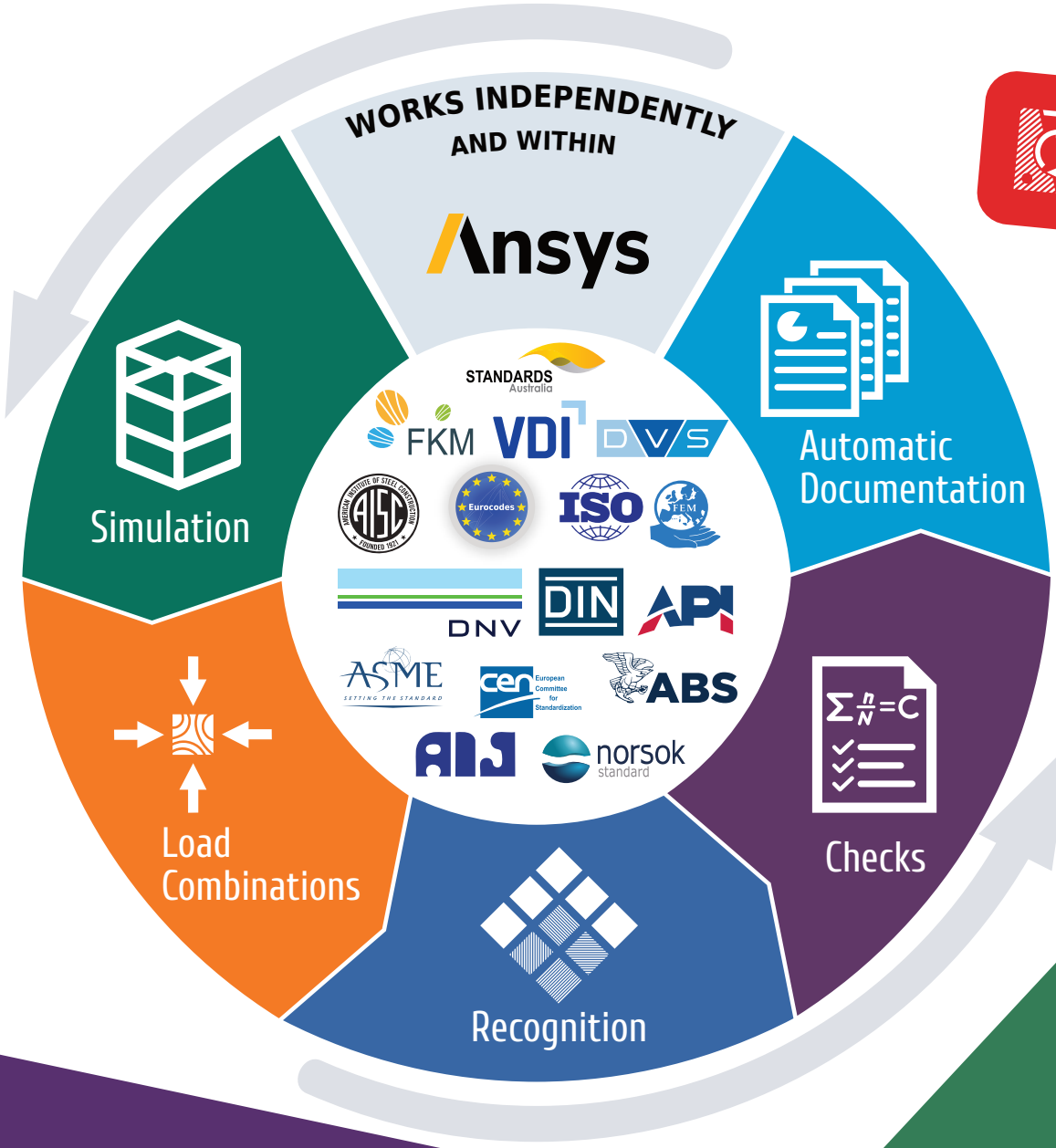
SDC VERIFIER



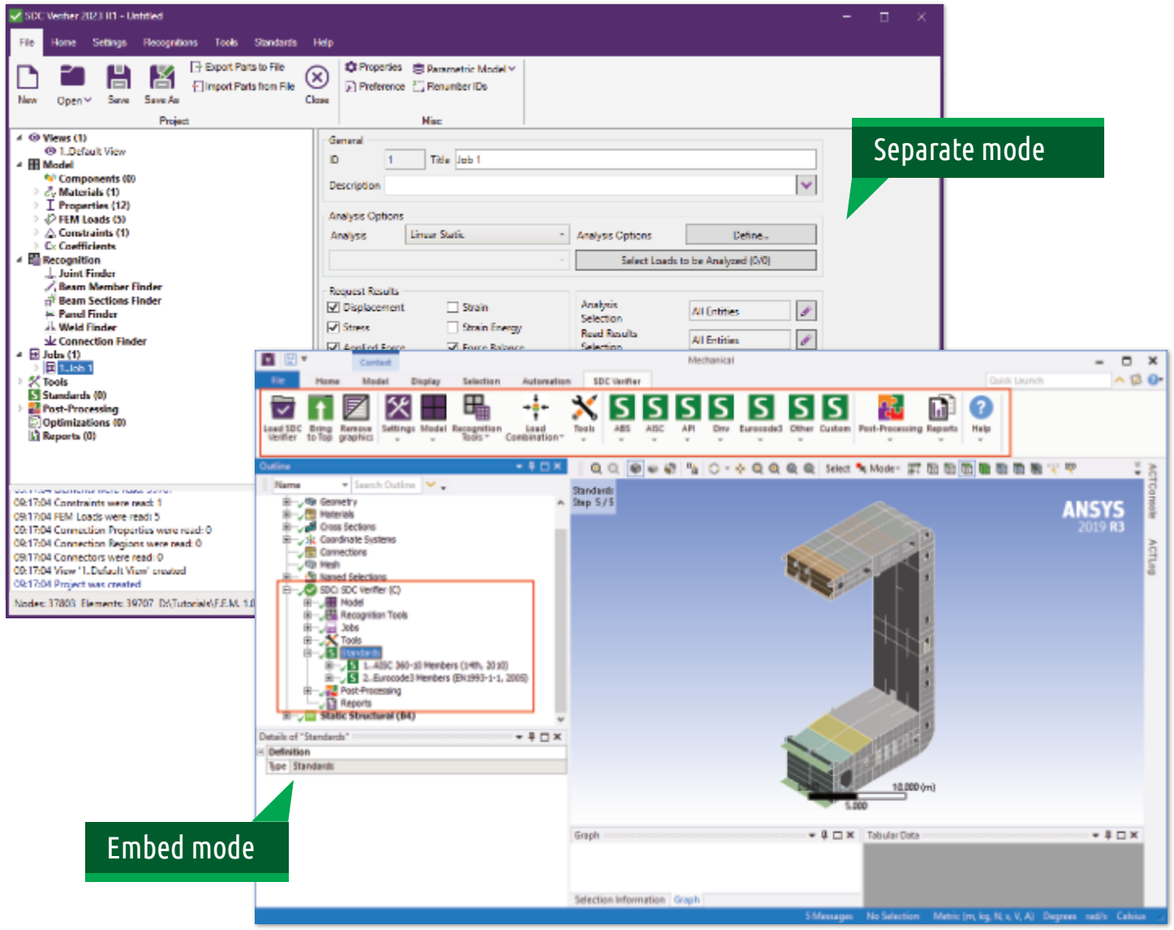

STRUCTURAL OPTIMIZATION

# STRUCTURAL VERIFICATION ACCORDING TO STANDARDS

ANSYS ADVANCED SOLUTION PARTNER

# SDC VERIFIER FOR ANSYS

**SDC Verifier** is the powerful, integrated in Workbench, extension for **Ansys** which automates verification of structures in accordance with different industries design and safety standards.




## 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



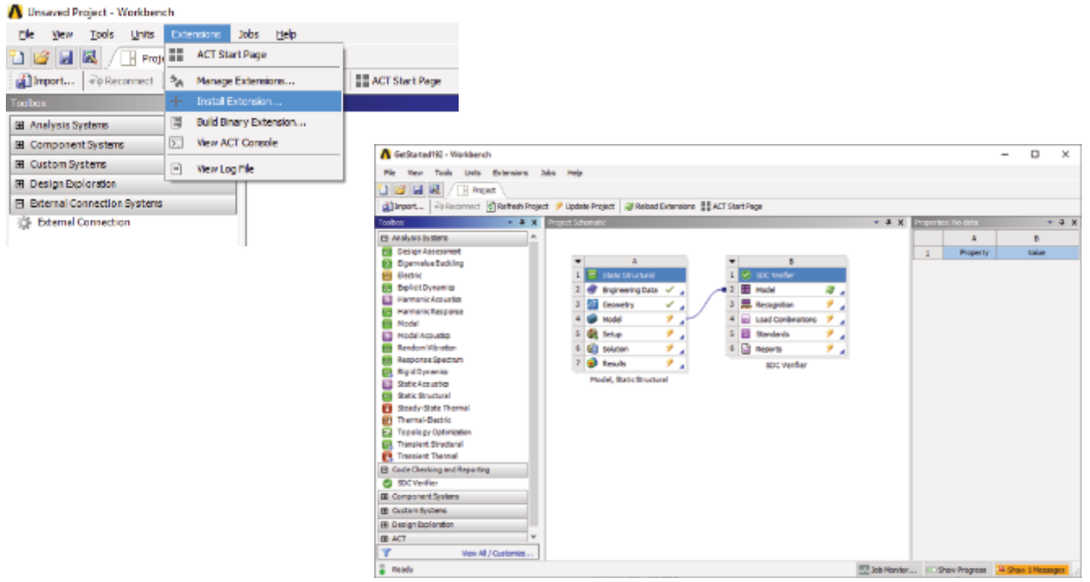
**Ansys** offers an advanced engineering analysis environment for simulation of complex engineering problems.

**SDC Verifier** together with Ansys 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 the report regeneration.

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.



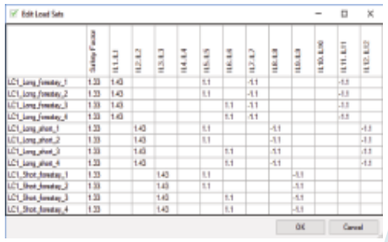
## ASK FOR A TRIAL AT

sdcverifier.com
sales@sdcverifier.com
+31 15 455 05 6[illegible]

# SDC VERIFIER WORKFLOW

FEA Simulation

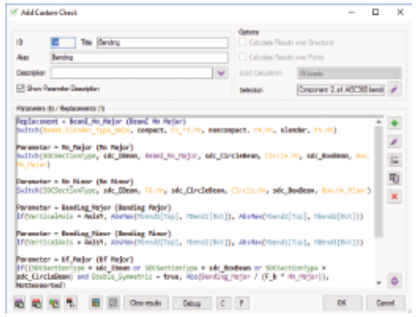

Reports



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

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)

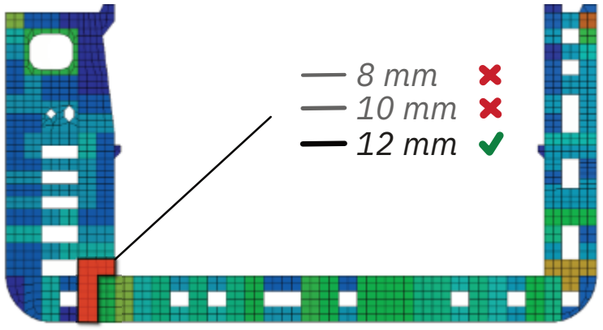
https://sdcverifier.com

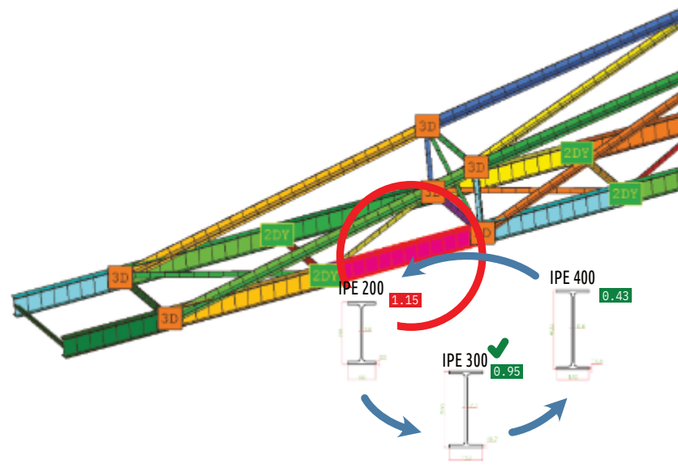


# DESIGN OPTIMIZATION

## SPECIFIC LOADS

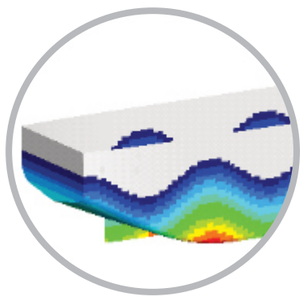
The **Optimization module** helps to take the best possible design decision acquired from code-checking results. Optimization can be based on Cross Section, Weld Type, Yield Stress, and Plate Thickness parameters.



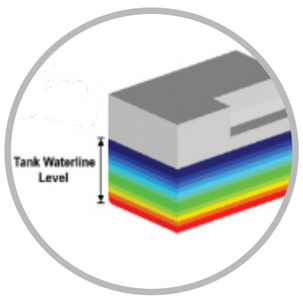




Optimization helps to automatically calculate various design input combinations and ensure cost-effectiveness by adjusting the existing model parts for specific terms of usage.

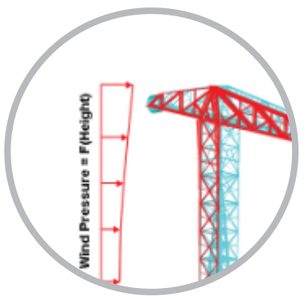
SDC Verifier automates the application of the specific loads:



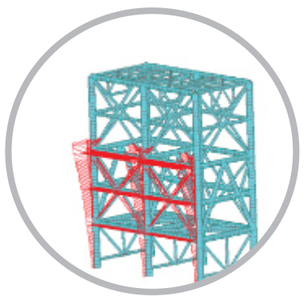
**Buoyancy** – a water pressure acting on a construction (e.g. ship hull), including wave parameters.




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

# MEMBER CHECKS. BUCKLING LENGTH RECOGNITION. DEFLECTION CHECK

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

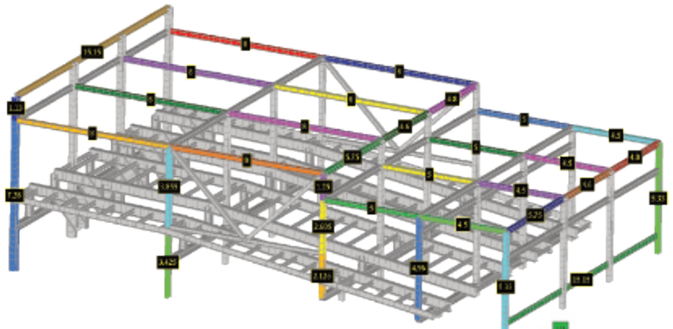
**AISC/ANSI 360-10** and **AISC 360-22** *(Specification for Structural Steel Buildings)*, **API RP 2A** *(Planning, Designing, and Constructing Fixed Offshore Platforms — Working Stress Design)*, **Eurocode 3** *(Design of steel structures)*, **ISO 19902 (2007, 2020)** *(Petroleum and natural gas industries — Fixed steel offshore structures)* and **Norsok N-004** *(Design of steel structures)*, **EN 13001** *(Cranes General Design, 2018)*

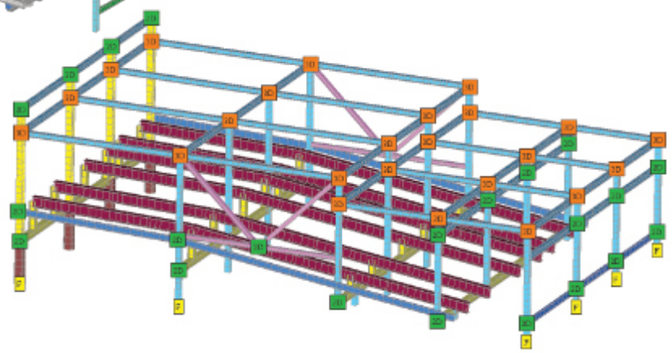
AIJ (2017)

EN 13001

AISC 89 & 2010
AISC 360-22

API RP 2A RP

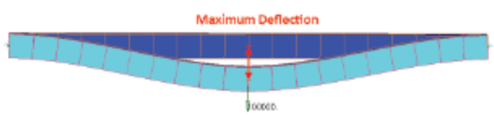


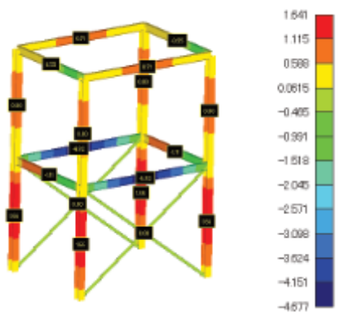


SDC Verifier calculates the **Buckling length** between the Joints, regardless of the model mesh.

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

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

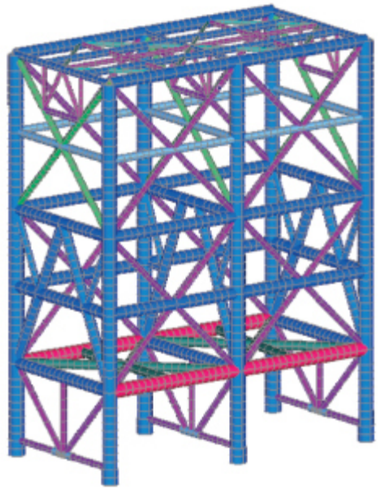
Norsok N004

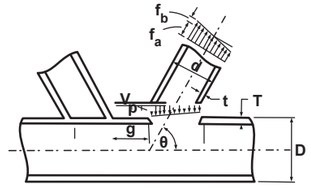
AS 3990 (1993)

ISO 19902
(2007, 2020)

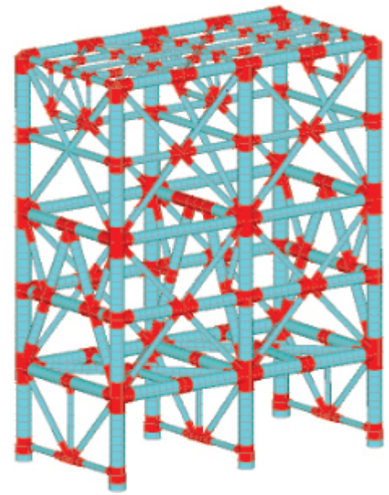
Eurocode 3

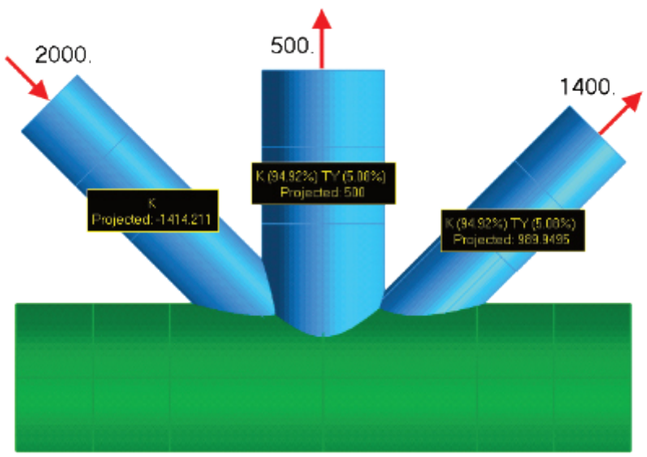
**Joint Finder** tool is used to verify tubular joints according to **API RP 2A, Eurocode 3, ISO 19902 (2007, 2020),** and **Norsok N-004** standards.

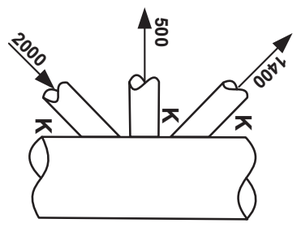





**SDC Verifier** automatically calculates Brace classification *(depending on the load pattern)* for each load situation, which significantly speeds up the verification process.






| 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

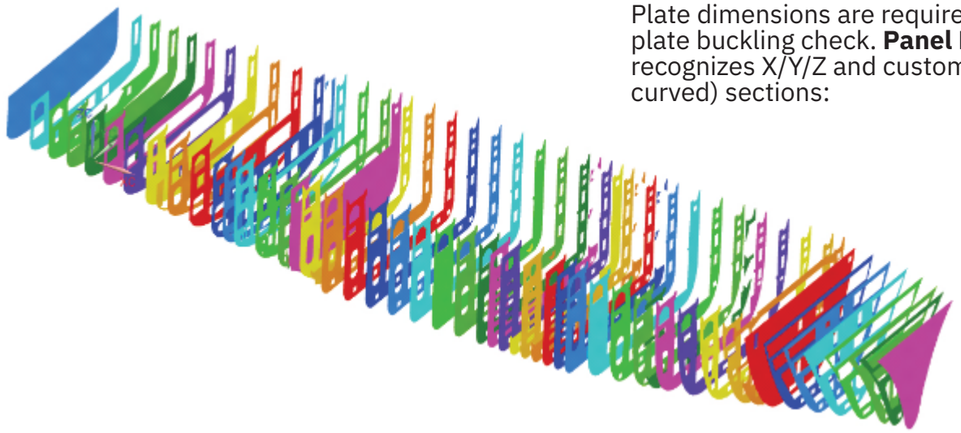
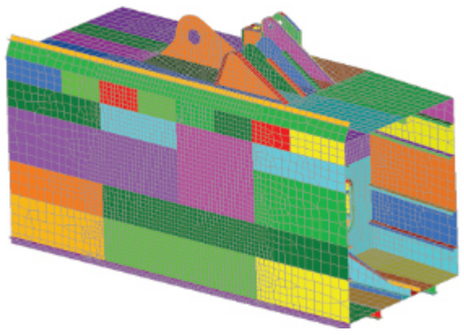
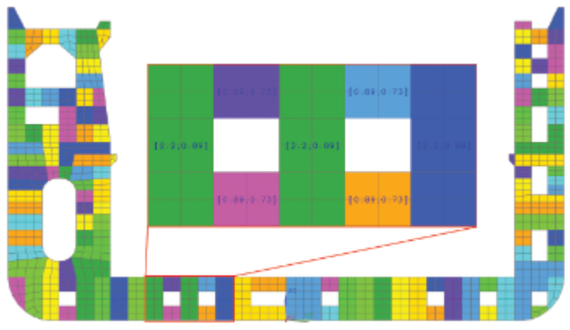


Plate dimensions are required to perform a plate buckling check. **Panel Finder** recognizes X/Y/Z and custom (inclined and curved) sections:

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 |

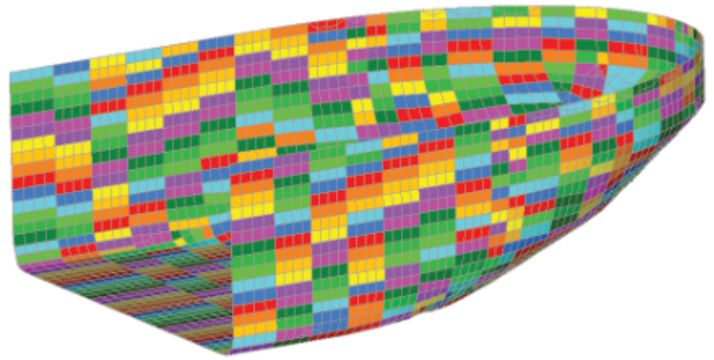




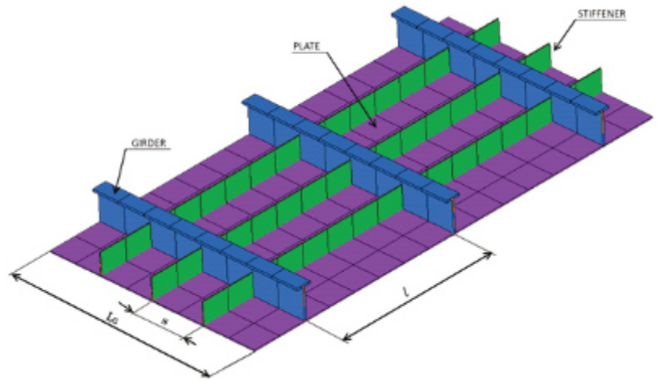


# PLATE BUCKLING AND STIFFENER BUCKLING CHECKS

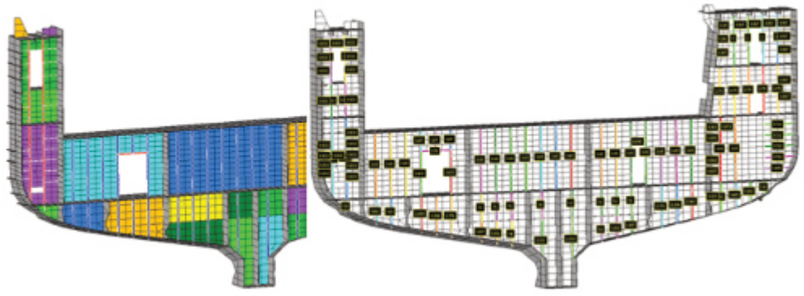
Colored plots with labels *(dimensions)* make it easy to preview the results of the tool. The following plot presents buckling plates on a part of the hull *(curved section)*.

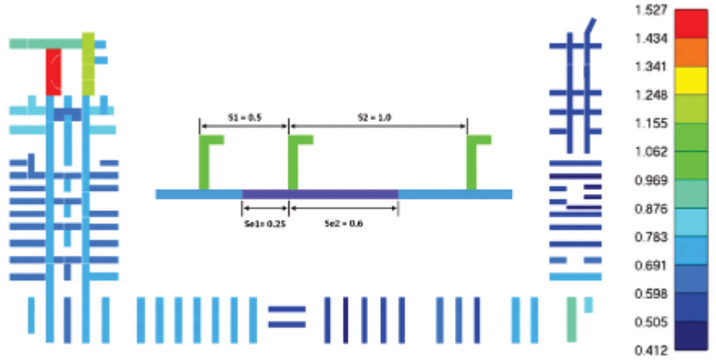


**Stiffened Panel Finder** — recognizes sections, panels, plates, stiffeners and girders and their dimensions automatically. This tool is an advanced version of the Panel Finder.




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.

# 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)

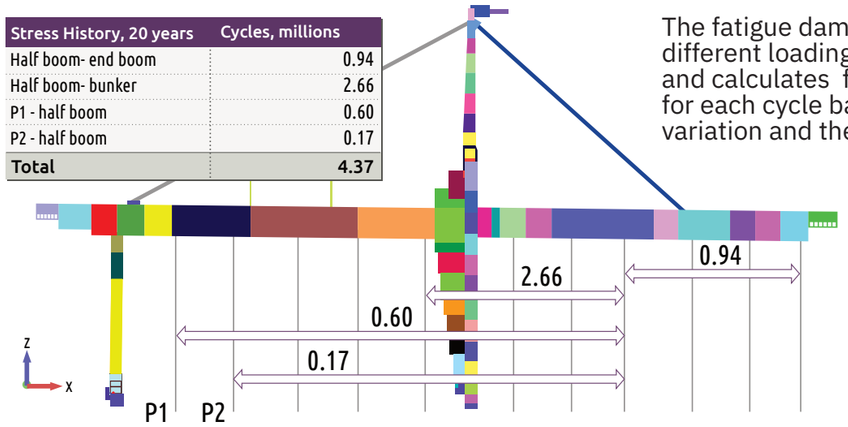
DIN 15018

EN 13001

Eurocode 3

F.E.M 1.001

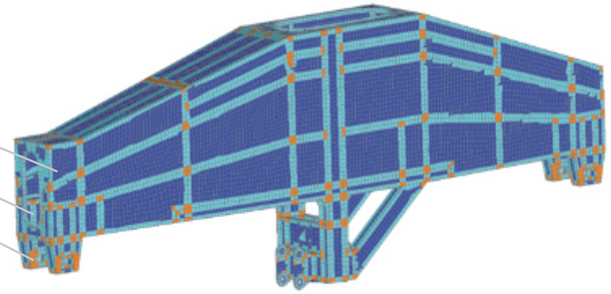
| Stress History, 20 years | Cycles, millions |
|---|---|
| Half boom- end boom | 0.94 |
| Half boom- bunker | 2.66 |
| P1 - half boom | 0.60 |
| P2 - half boom | 0.17 |
| **Total** | 4.37 |




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.

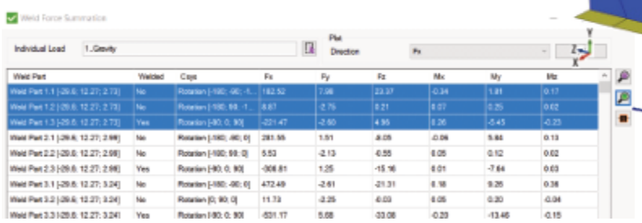
SDC Verifier tool **Weld Finder** detects automatically:

- non-welds
- welds
- crossing welds

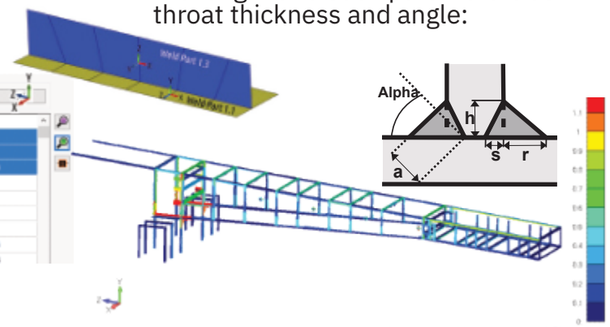


SDC Verifier performs a weld strength check according to **DNV-OS-C101/C201, Eurocode 3**.

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:






https://sdcverifier.com

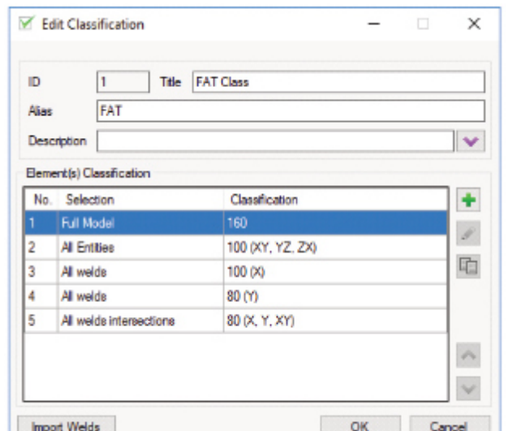
# WELD CLASSIFICATION

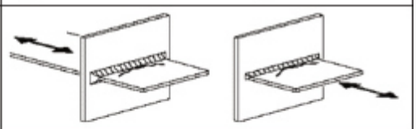
DVS 1608 (2010), DVS 1612 (2014)

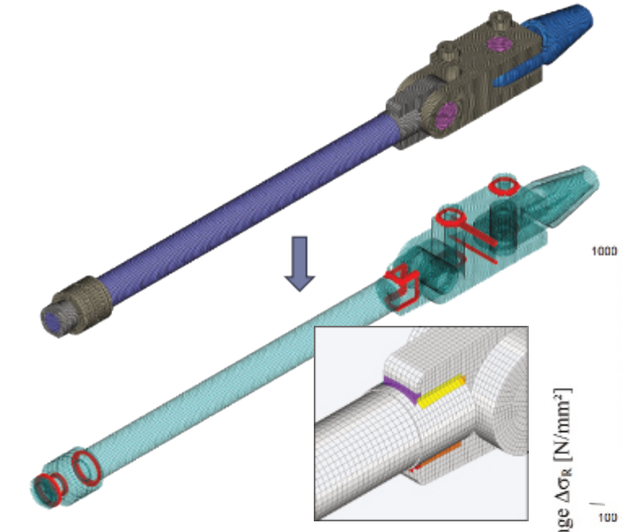
**DVS 1608** *(Design and strength assessment of welded structures from aluminum alloys in railway applications)* – Aluminium Fatigue Check.

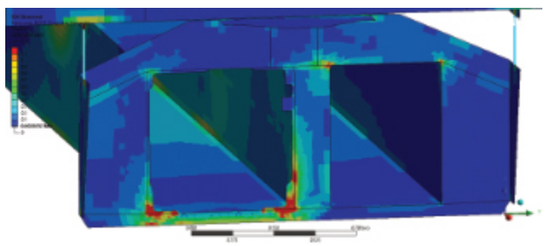
**DVS 1612** *(Design and endurance strength analysis of steel welded joints in rail-vehicle construction)* – Steel Fatigue Check and Static Stress Check.

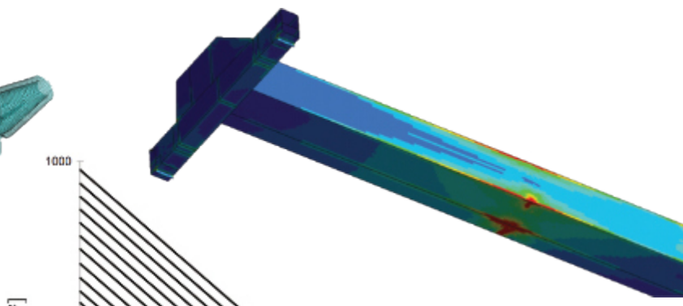
The notch group classification or fatigue strength of the welds depends on the quality and the stress direction, along the weld (X), perpendicular to the weld (Y) and the shear (XY). Stresses are converted into weld direction automatically by the weld finder.




| Detailed Category | Constructional detail |
|---|---|
| 100 |  |
| 80 |  |
| 80 |  |



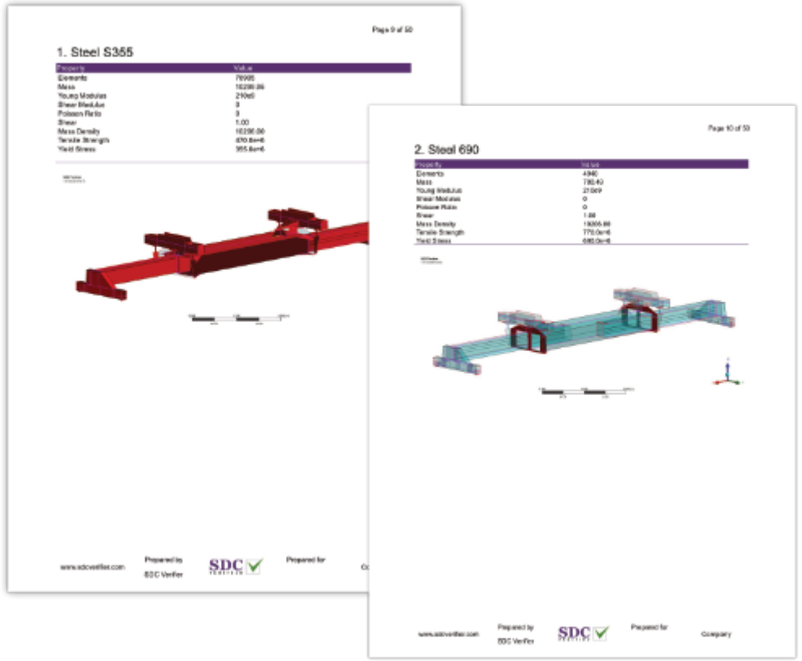




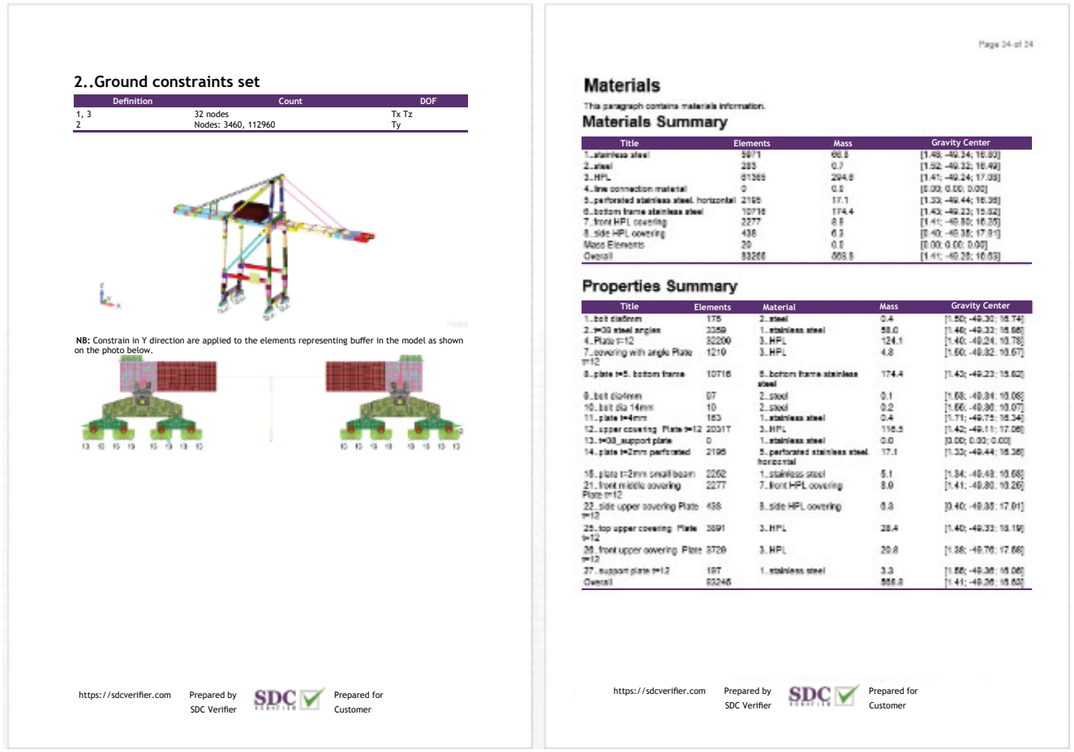
# REPORT. MODEL SETUP

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:

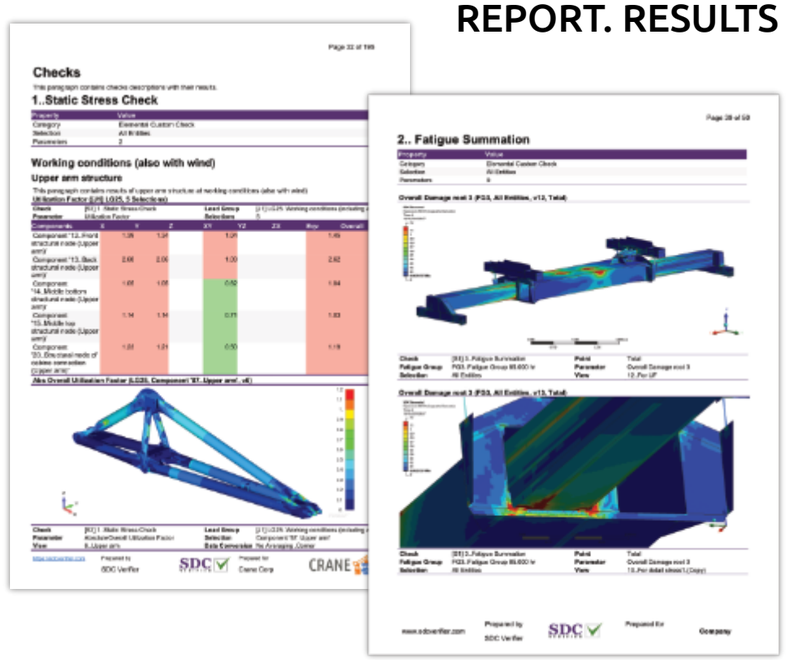



Description of applied loads and constrains, mass overview over materials/ properties/groups:

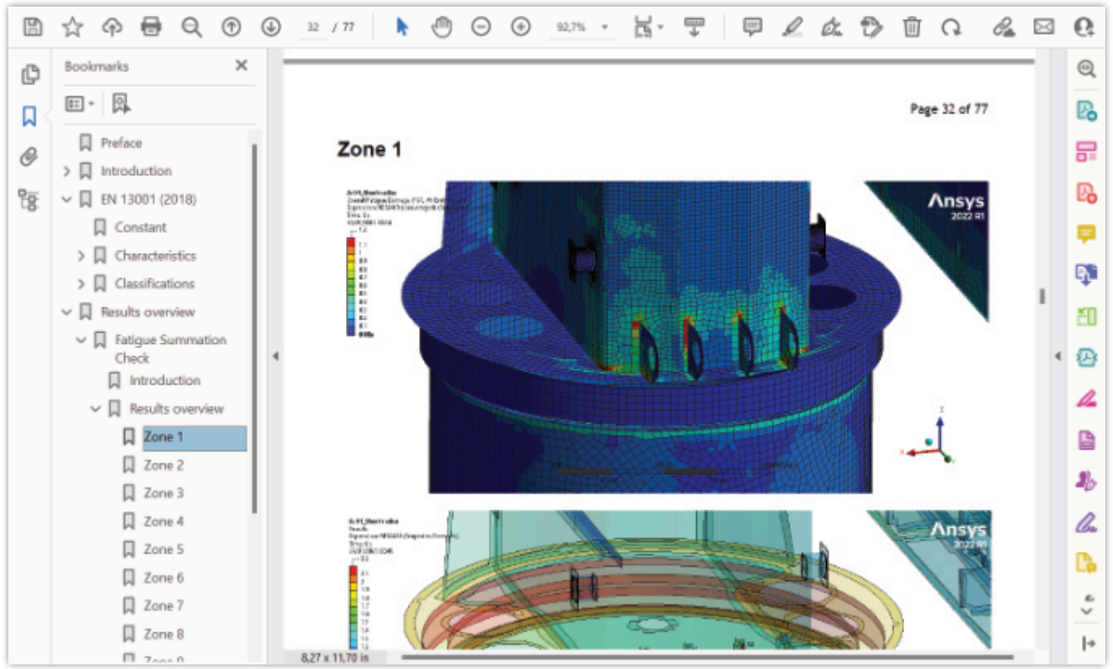



# REPORT. RESULTS

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



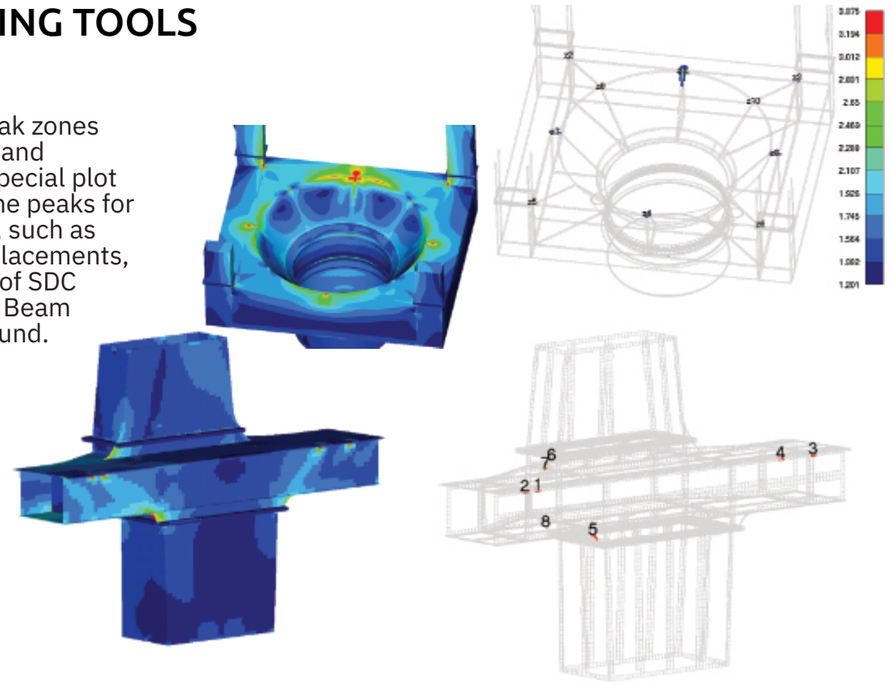

A complete setup with headings and bookmarks enables a quick navigation through the reports.




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.

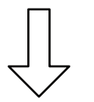


| Zone | Value | Zone | Value |
|---|---|---|---|
| Zone 1 (Elements: 2) | 1.45 | Zone 5 (Elements: 15) | 1.41 |
| Zone 2 (Elements: 2) | 1.44 | Zone 6 (Elements: 1) | 1.21 |
| Zone 3 (Elements: 2) | 1.43 | Zone 7 (Elements: 3) | 1.09 |
| Zone 4 (Elements: 2) | 1.42 | Zone 8 (Elements: 1) | 1.01 |

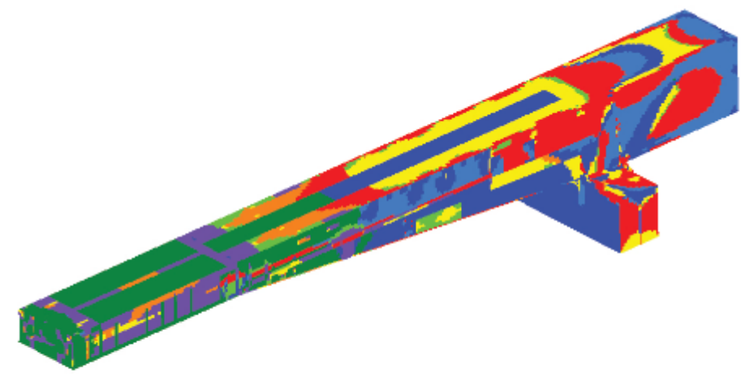
**Governing loads** tool extracts the critical loads out of a large group of load combinations. Save time focusing on important situations instead of checking each and every.

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

132



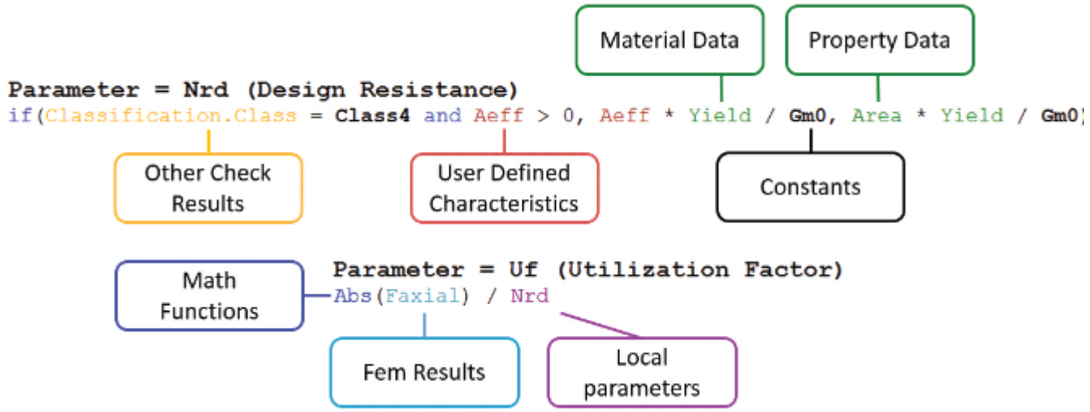
8



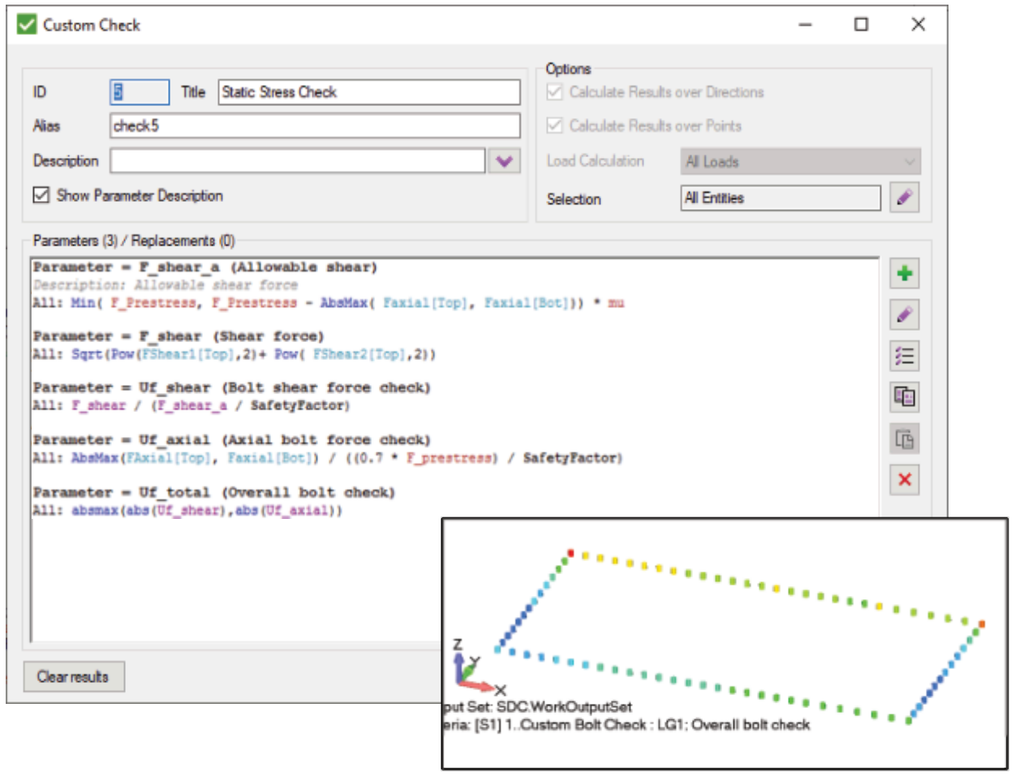
LS92 LS33 LS58 LS6 LS23 LS14 LS70 LS131

# 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 Buckling**


**Beam Member and Joint Checks**


**Beam Member Check**


**Eurocode 3 Beam Member**


**FKM App**


**AISC Beam Member**

## ASK FOR A TRIAL AT sdcverifier.com

SDC VERIFIER

The Netherlands,
Haarlem Zijlvest 25, 2011 VB
+31 15 455 05 65
https://sdcverifier.com
support@sdcverifier.com