STRUCTURAL DESIGN OF STEEL CONNECTIONS AND JOINTS

IDEA StatiCa®

Calculate yesterday's estimates

WHAT WE DO

We develop software for structural engineers, fabricators, detailers and all others who perform or use structural analysis. Our development team researches, tests and applies new methods of analyzing behavior of structures and their members. Based on this, we create IDEA StatiCa – software that enables engineers to work faster, evaluate requirements of the national code thoroughly and use optimal amount of material. For us, creating software is a way to contribute to making every new construction around the world safer and cheaper.

IDEA StatiCa Steel

IDEA StatiCa Concrete and Prestressing

Calculate yesterday's estimates

PARTNERS

We build partnerships with key companies in the field and link IDEA StatiCa with their software. IDEA StatiCa is a part of a global workflow which improves productivity of structural engineers and fabricators.
We are AEC Solution Associate of Autodesk, a recommended 3rd party solution for Autodesk users. IDEA StatiCa works with Robot Structural Analysis, Advance Steel and Revit.
IDEA StatiCa has a strong synergy with Tekla Structures. We partnered up with Trimble to create a seamless link between Tekla Structures and IDEA StatiCa.

AUTODESK. Trimble.

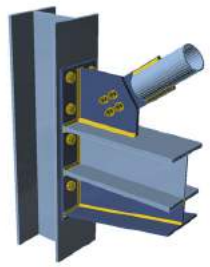
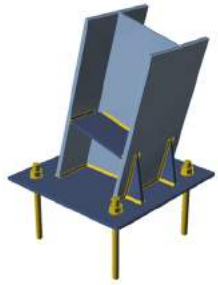
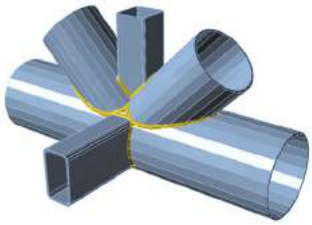
Other partners include Grafitec, Dlubal Software and MIDAS IT.

IDEA StatiCa® Team

Steel connection design – reinvented

IDEA StatiCa introduces a novel way to design and check all steel connections and joints. With it, engineers can break the limits of standard connection design tools to save time and optimize the material usage.
Clear pass/fail checks according to the code are available in minutes, as well as complete output reports.

IDEA StatiCa Connection

2D frames & trusses	Footings, anchoring	3D frames & trusses
		

IDEA StatiCa Connection can design all types of welded or bolted connections, base plates, footing and anchoring. It provides precise checks, results of strength, stiffness and buckling analysis of a steel joint. Bolts, welds and concrete blocks are checked according to the code. Templates for most-used connections are available as well as wide range of predefined hot rolled and sheet welded members.

ANY TOPOLOGY

No limits in how many connections there are in the joint, what is their type and how they are put together. Shape is defined by project requirements, not by software capabilities.

ANY LOADING

All forces are analyzed. The overall check of the joint takes into account interactions between all the beams and connections. Engineers stays on the safe side all the time.

IN MINUTES

The whole design and check process is kept short enough to be a part of everyday work of structural engineers and fabricators all around the world.

Work with data from other programs

IDEA StatiCa Connection

FEA software

Design your joint from scratch or build on geometry and loading imported from StaadPRO, SAP 2000, Robot SCIA Engineer and others, cutting design time even more

CAD software

Take advantage of integration with Tekla Structures and Advance Steel to provide workshop drawings and support manufacturing process

IDEA StatiCa®

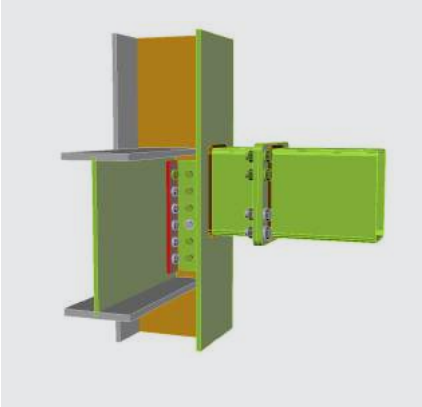
Changing the way how we calculate connections and joints in steel structures

Engineers typically design steel connections that follow prescribed building code requirements based on lab empirical testing, computational model verification and engineering judgment. However, many projects have situations where the connection design must be validated by a more comprehensive connection analysis. This can be very time-consuming and requires advanced software equipment, impacting profitability. A project-specific way of studying connection behavior is needed to ensure safety of the design while increasing productivity of the whole engineering process.

IDEA StatiCa Connection provides

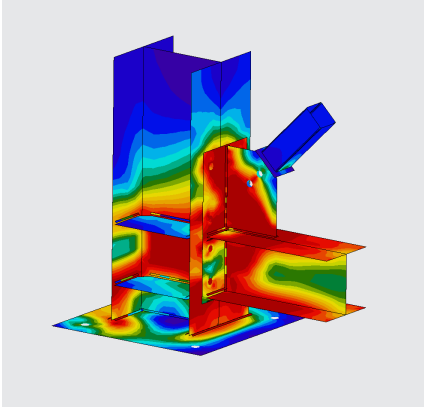
Overall check

According to various national design codes



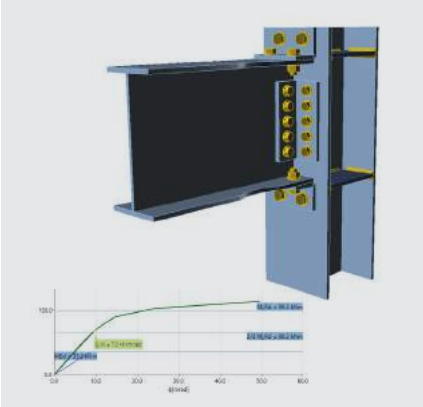
Stress/ strain analysis

FE model of steel joint is composed automatically



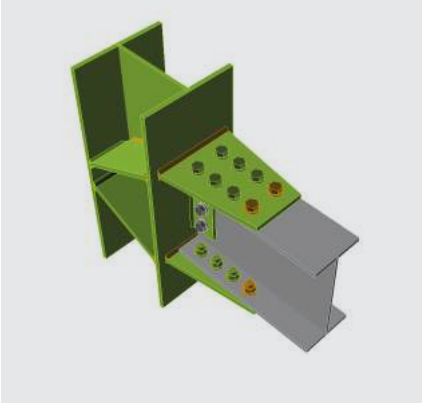
Stiffness analysis

Rotational or transversal stiffness of any connection



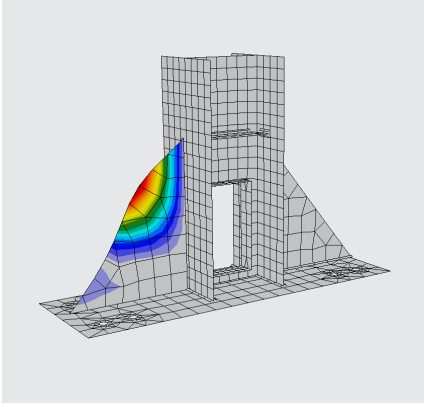
Member Capacity Design

Seismic check of non-dissipative connections



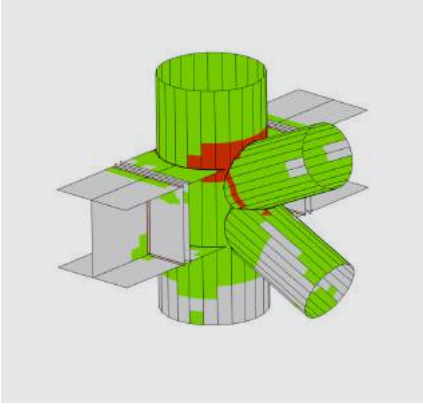
Buckling analysis

Local buckling effects and critical load factors



Design Joint Resistance

Maximal possible loads, reserve in joint capacity

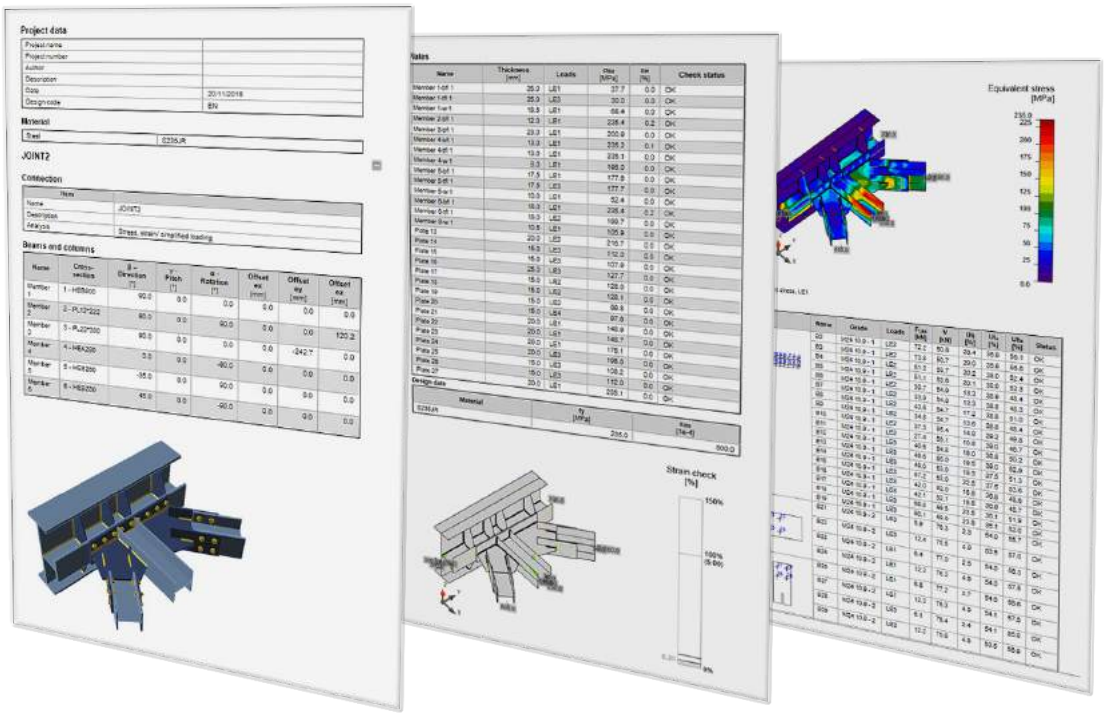


Story behind

IDEA StatiCa Connection is a result of a long-term R&D project of IDEA StatiCa team and two top technical universities. After 5 years of primary research and theoretical preparations, the first version of the application was coded in 24 months and released in May 2014. Since then, it has been improved consistently and marketed worldwide. We are happy to have over 1 000 licenses in 40 countries.
Key parts of the technology of IDEA StatiCa Connection is protected by a patent.

Output report

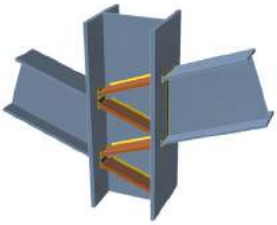
You can choose from three types of output reports – one line, 1 page and detailed. All checks according to selected code are displayed and referenced.



Validation and verification of results

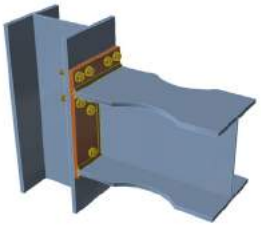
Together with technical universities, results of IDEA StatiCa Connection were examined. The first level of testing was to design and calculate typical joints described in design guides and compare results. The second level of testing was for non-standard connections and joints – an advanced FEA models were created in other programs and results compared. The third level of examination were live tests in university laboratories. For example, gradual loading of a footing until it was ripped from a concrete block.
This thorough examination confirmed accuracy and reliability of IDEA StatiCa Connection. All verification and validation studies are published and available to the engineering public. Our new approach to steel connection design has already been presented on tens of international conferences and meetings of regulatory bodies all around the world. We are happy to see its wide acceptance amongst academics, structural engineers, fabricators, code-checkers and other industry professionals.

Any topology – manufacturing operations

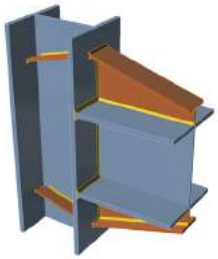


Stiffeners

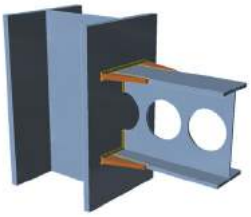
Circular end plate, stiffeners



Irregullar bolt group, flange notches

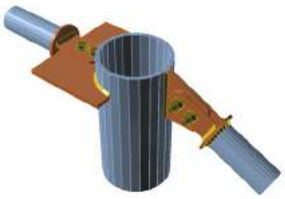


Double haunches

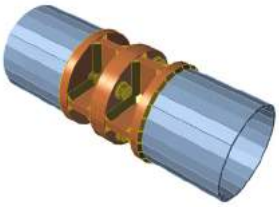


Flange haunches, openings

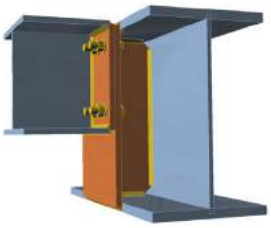
Connecting plates, notches



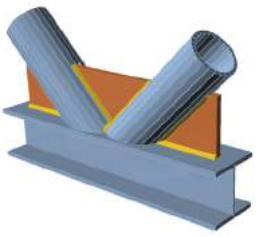
Connecting plates, cuts



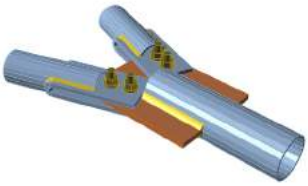
Plates, bolt grid, cuts



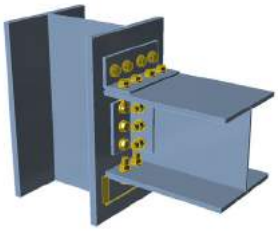
Shifted end plate



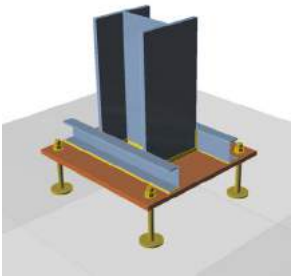
Cuts, notches



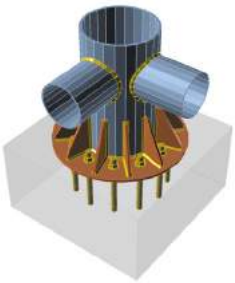
Stiffening members, bolt grids



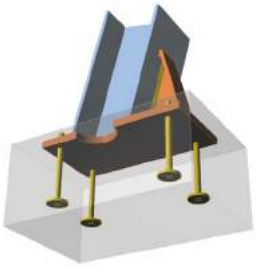
Bolted or welded cleats



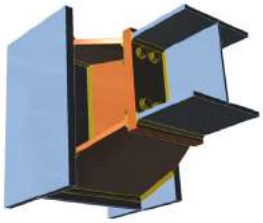
Base plate, stiffening members



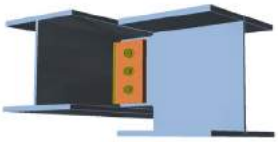
Base plate, stiffeners, cuts



Base plate, haunch, notch, washers

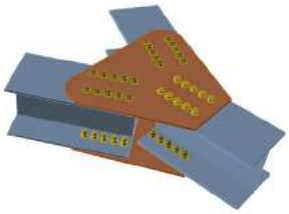


Stub



Fin plate

Overlaps, contact of plates



Splice plates

Beam support (contact), webdoubler

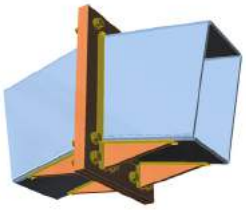
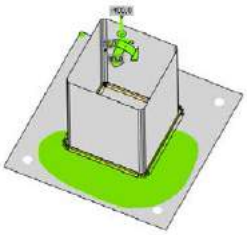


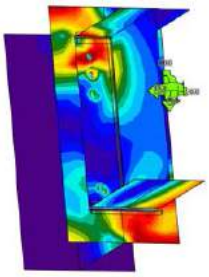
Plate to plate, ribs

Any loading – all internal forces from 3D global analysis



Base plate – N, My, Mz

3D loaded joint



End plate – My, Mz, Vy, Vz

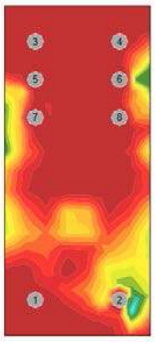
3D simulation of a steel joint

Steel joint is composed from plates, welds, bolts, contacts and can be anchored into concrete block. FEA model is generated automatically.

Plates

Model is composed from steel plates – both parts of steel members and stiffening plates. Real shape of plates is kept. Each plate is meshed independently. Equivalent strain is checked.

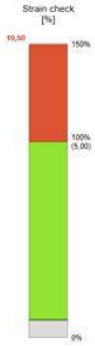
3D model



Equivalent stress

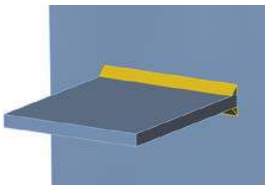
Equivalent strain

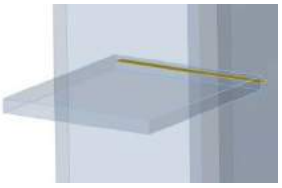
Overall check

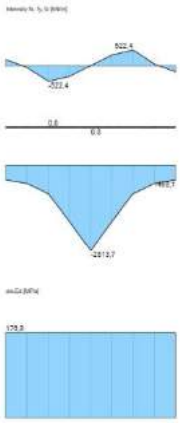


Welds

Welds are modeled as constrains between plates. Forces in each weld are evaluated. Stress in weld is checked according EN/AISC.







Welds (Average stress)

Name	Edge	Throat th. [mm]	Length [mm]	Load case	$\sigma_{w,Ed}$ [MPa]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	UI [%]	Check status
C-bfl 1	B-bfl 1	◢5,0◣	120	LE1	176,8	-88,4	0,0	88,4	49.1	OK

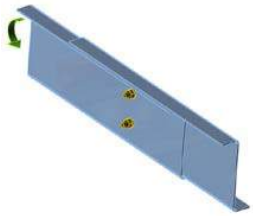
Design data

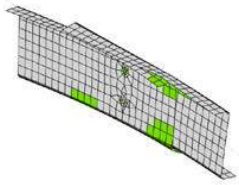
	β_w [-]	$\sigma_{w,Rd}$ [MPa]	$0.9\ \sigma_{w,Rd}$ [MPa]
S 235	0,80	360,0	259,2

Solid view and transparent view of welds. Calculated stress in weld. Output table with results.

Contacts

Contacts appear in places where two plates are in touch. They take 100% of the pressure but do not act in tension at all.

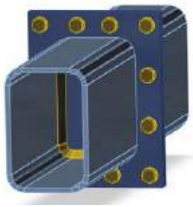




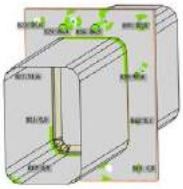
Contacts between web and flanges of 2 overlapped Z sections

Bolts

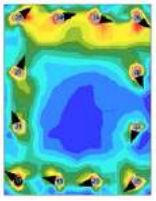
Standard or preloaded bolts are nonlinear springs taking tension and shear.



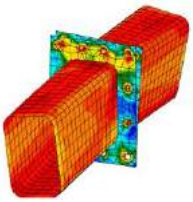
3D model



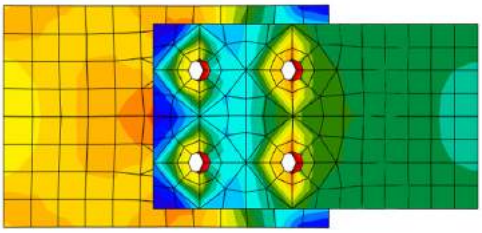
Tension forces



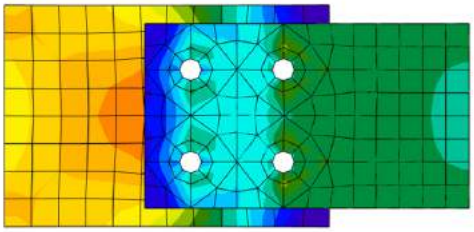
Shear forces



Deformed shape



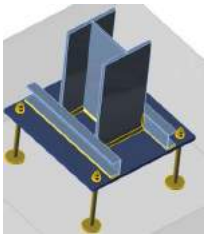
Standard bolts - Force transfer by bearing



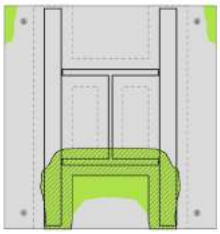
Preloaded bolts - Force transfer by friction between members

Concrete block

Steel structure can be anchored into concrete block. Base plate is in contact with concrete. Tension is taken by anchors, shear by bolts, friction or shear iron.



3D model

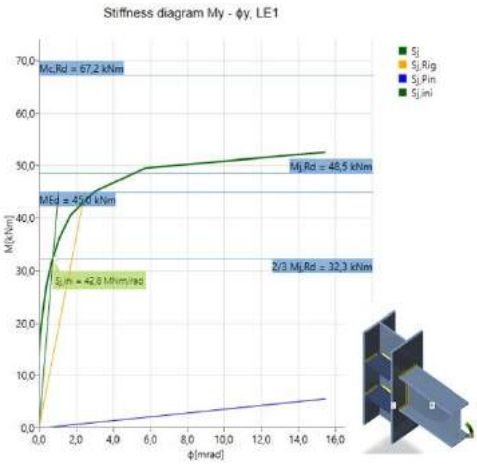


Contact stress area

Break-out cones

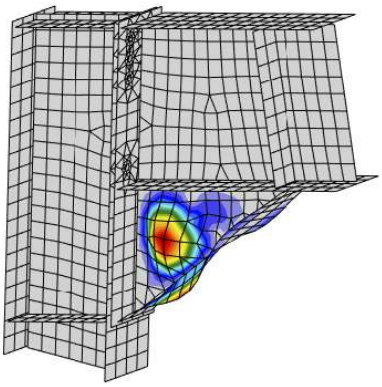
Stiffness analysis

Stiffness of any connected member is analyzed. Connection is classified and moment/rotation diagram gives clear view about its capacity.



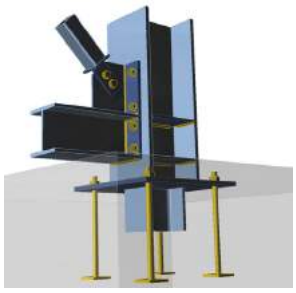
Buckling analysis

Local buckling can determine safety design of the joint. Software shows the level of safety and point out the weakest part of joint.

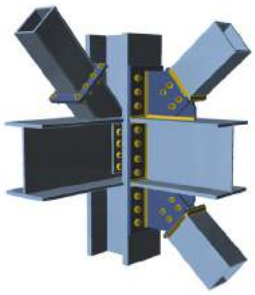


Designed by IDEA StatiCa Connection

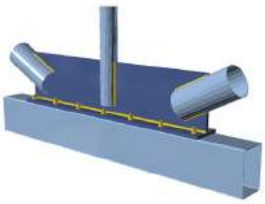
Stadium roof



Warehouse

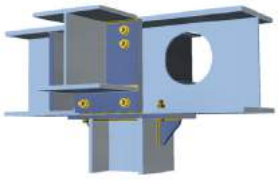


Industry hall

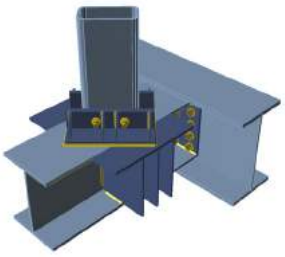


Pedestrian Bridge

Power plant

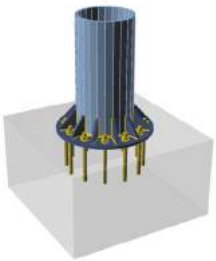


Stadium roof



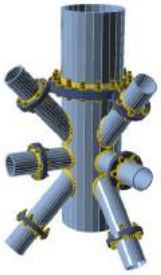
Crane support structure

Congress centre

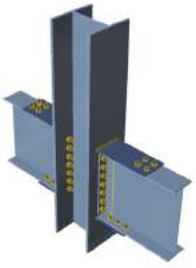


Lightning column

Facade secondary structure



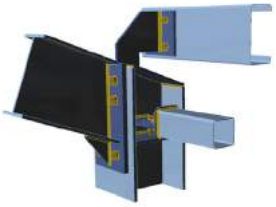
Broadcast tower



Congress centre

Designed by IDEA StatiCa Connection

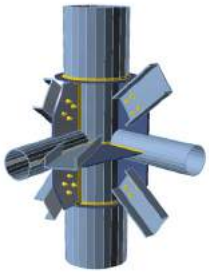
Shopping mall



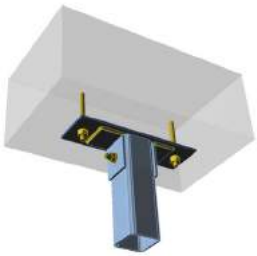
Warehouse

Shopping mall

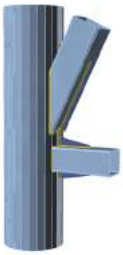
Tower mast



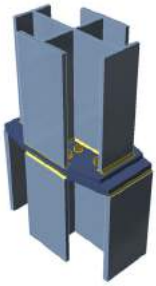
Off-shore struct



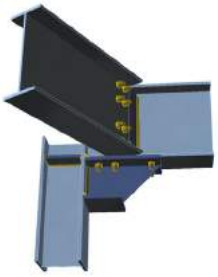
Canopy



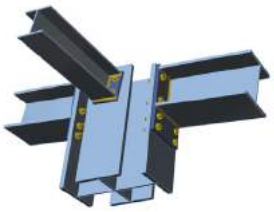
Facade secondary structure



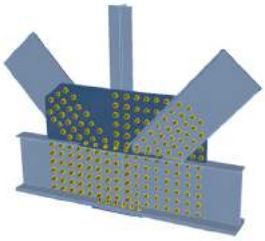
Shopping mall



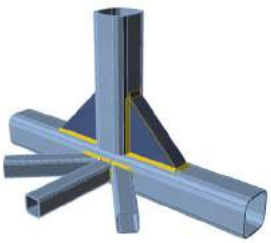
Industry hall



Theatre roof



Railway bridge



Airport Service Bridge

Working with other programs

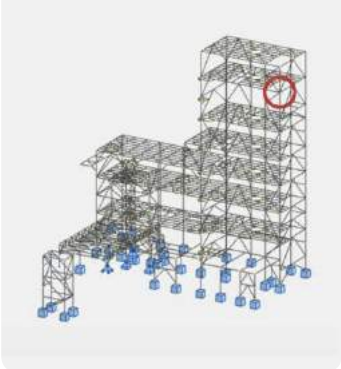
IDEA StatiCa Connection is not just a standalone program where we define geometry, loads and other inputs by himself. It has BIM interface which enables importing steel joints and connections (including loads) from other programs.

FEA programs

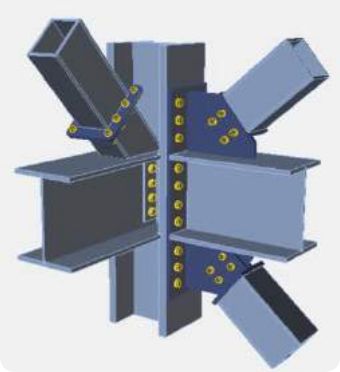
Save time by importing geometry and loading from StaadPRO, SAP 2000, Robot Structural Analysis, SCIA Engineer, RFEM, AxisVM and ConSteel and go right into design and check.

Workflow in Robot Structural Analysis:

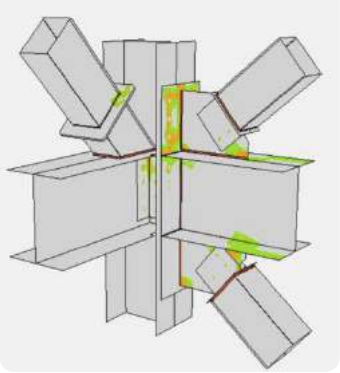
Node selection in RSA



Design of connection



Check EN/AISC

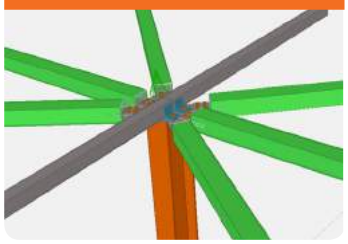


CAD programs

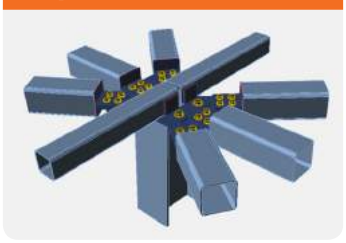
Click on "IDEA" icon in Tekla Structures or run command "Concheck" in Advance Steel to instantly export geometry of a selected joint into a new project in IDEA StatiCa Connection. Input loading and go into design and check.

Workflow in Tekla Structures:

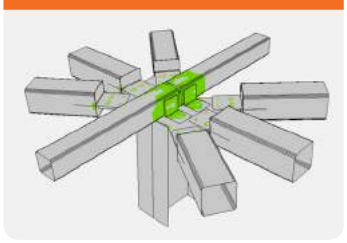
Node selection in TS



Input of load effects



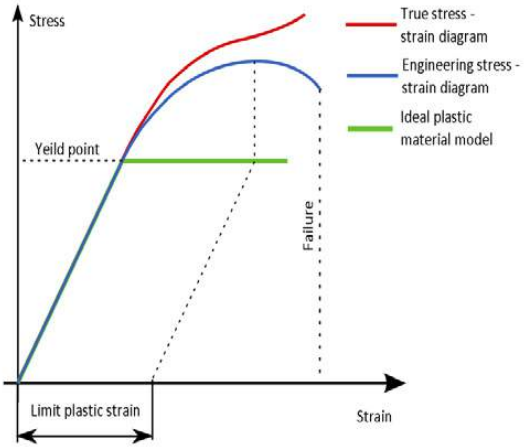
Check EN/AISC



BIM links to leading software solutions on the market enable structural engineers and fabricators quickly check feasibility of the design in any stage of the project. Moreover, you have a powerful tool for optimizing your design.

R&D background

IDEA StatiCa Connection is a result of a long-term research and development project with roots back in the 90s when our CEO Lubomír Šabatka started examining the topic with one of the leading academics worldwide in the field of steel structures – Professor František Wald.
After years of preparation, the research team was put together from IDEA StatiCa developers and academic staff from two technical universities in the Czech Republic – Czech Technical University in Prague (Prof. František Wald & team) and Brno Technical University (Prof. Miroslav Bajer & team). We put together long-term experience with development of component method (CM), practical experience with design of steel structures and proven professional experience with finite-element and software development. Over 30 people took part in this project with over 1,5 mil. EUR of costs incurred in research, development, validation and verification of this new approach.



Ideal elastic/plastic material diagram

Live testing of the new CBFEM method

We created a new method for analysis and check of steel joints of general shapes and loading. It is called Component-Based Finite element model (CBFEM) and differs from all current methods by being:

GENERAL

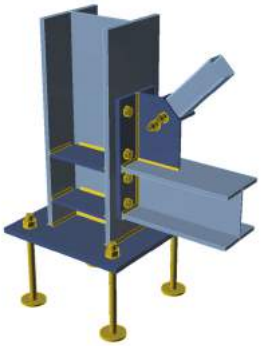
it is useable for all joints, anchors and details used by structural engineers and fabricators

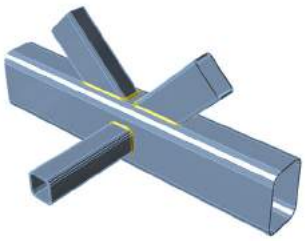
SIMPLE AND FAST

it provides results in time comparable with currently existing methods and tools

COMPREHENSIVE

engineers get information about joint behavior, stress, strain and reserves of individual components and overall safety and reliability

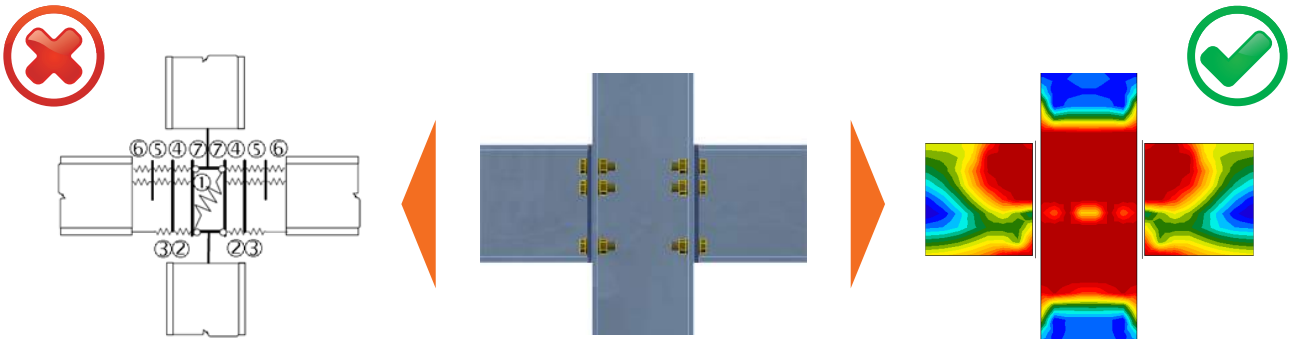




How CBFEM works

We combine two well-known and trusted methods used by engineers all around the world – finite element method and component method:

- Joint is divided into components
- All steel plates are modeled by finite element method assuming ideal elastic-plastic material
- Bolts, welds and concrete blocks are modeled as nonlinear springs
- Finite element model is used for analyzing internal forces in each of the components
- Plates are checked for limit plastic strain – 5% acc. to EC3
- Each component is checked according to specific formulas defined by the national code, similarly as when using component method



Component model *Bolted joint* *CBFEM model*

Validation and verification

Results of all tests performed to confirm safety and reliability of CBFEM method and IDEA StatiCa Connection are published and available. Visit our website to examine them. Professor Wald and his team are also publishing a book devoted to structural steel connections design using CBFEM method:

Benchmark cases for advanced design of structural steel connections

Improving daily work of engineers

IDEA StatiCa Connection can design steel joints and connections of any topology and loaded in all directions. It keeps the whole analysis-design-check process in minutes. This opens a possibility for structural engineers and fabricators around the world to increase productivity of designing steel joints and connections.

BE SAFE

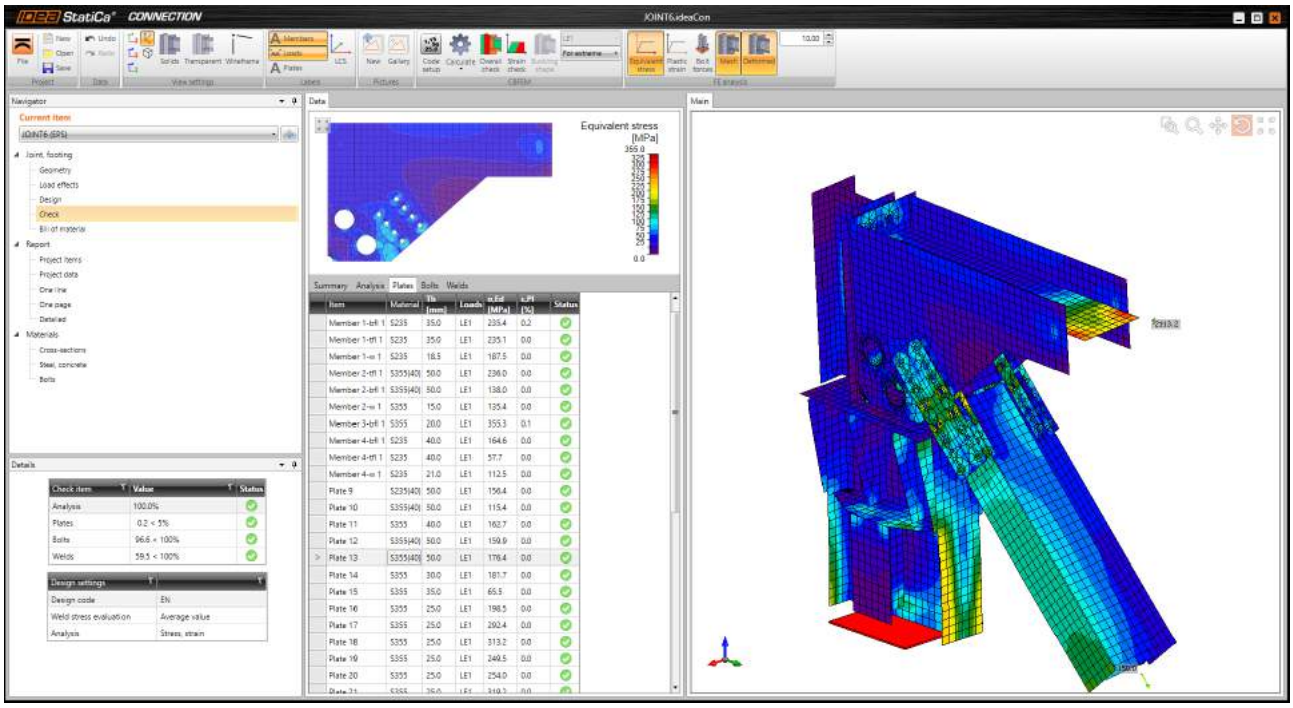
Stay on the safe-side with all checks according to selected national codes at hand at any time.

SAVE TIME

Engineers spend 70% of the connection design time on 30% non-standard cases. Do them in minutes as well.

OPTIMIZE

Know exactly how much material is needed in the joint and take advantage of it.



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