DESIGN OF STRUCTURAL STEEL JOINTS AND CONNECTIONS
WHAT WE DO

We develop software for structural engineers, fabricators, consultants 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 and Advance Steel. Revit link is coming.

IDEA StatiCa has a strong synergy with Tekla Structures. We partnered up with Trimble to create a seamless link between these two programs. The largest distributor of Tekla Structures worldwide, company Construsoft, resells IDEA StatiCa in several EU countries and Latin America.

Other partners include Dlubal Software, MIDAS IT and InterCAD.

FUN FACTS ABOUT IDEA STATICA

- There are 800 licenses of IDEA StatiCa in 30 countries worldwide.
- IDEA StatiCa was the first to launch cloud-based structural analysis service. It has over 3 000 registered users.
- Together with Microsoft, HUAWEI, Dell and others, we are in the TOP 100 companies in the Czech Republic.
- Our CEO and CTO were in the finals of EY’s awards “Entrepreneur of the year 2015”.
- We have 25 people in the team who already coded over 6 million lines of IDEA StatiCa.
- Resellers in 20 countries around the world, BIM links to 12 engineering programs.
Steel connection design - reinvented

IDEA StatiCa introduces a novel way to design and check structural connections and joints. Engineers can deal with challenges of residential, industrial, off-shore and other steel structures. Clear pass/fail checks according to EC/AISC are available in minutes, as well as complete output reports.

IDEA StatiCa Connection

<table>
<thead>
<tr>
<th>2D frames &amp; trusses</th>
<th>Footings, anchoring</th>
<th>3D frames &amp; trusses</th>
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</table>

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 EC/AISC. 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 Robot, SAP 2000, SCIA Engineer, RFEM, AxisVM, ConSteel and others, cutting design time even more

**CAD software**
Take advantage of integration into Tekla Structures and Advance Steel to provide workshop drawings and support manufacturing process

Calculate yesterday’s estimates
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**

<table>
<thead>
<tr>
<th>Stress analysis</th>
<th>Buckling analysis</th>
<th>Stiffness analysis</th>
<th>Overall check</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Stress analysis" /></td>
<td><img src="image2.png" alt="Buckling analysis" /></td>
<td><img src="image3.png" alt="Stiffness analysis" /></td>
<td><img src="image4.png" alt="Overall check" /></td>
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</table>

**Key features**

- Welded/bolted connections, base plate, footing, anchoring
- Joints with various numbers of beams in multiple directions and loads
- Analysis model created according to manufacturing operations used – cuts, plates, stiffeners, ribs, openings, cleats, welds, bolts etc.
- Automatic generation of joint’s FE model, user does not handle with FEA
- Efficient FEA solver delivers result faster than current methods
- More than 90% of calculations is national-code independent
- Calculation of internal stress/forces in joints based on elastic/plastic FE analysis
- Clear information about behavior of the joint/connection
- Stiffness analysis of any kind of connection
- Local buckling analysis of steel joint, critical load factor
**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 400 licenses in 30 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 Eurocode or AISC 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
- Irregular 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), web doubler

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](image1)
![Equivalent stress](image2)
![Equivalent strain](image3)
![Overall check](image4)

**Welds**

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

![Solid view and transparent view of welds. Calculated stress in weld. Output table with results.](image5)

**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](image6)
**Bolts**

Bolts are nonlinear springs taking tension and shear.

![3D model](image1)
![Tension forces](image2)
![Shear forces](image3)
![Deformed shape](image4)

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**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](image5)
![Contact stress area](image6)
![Break-out cones](image7)

**Stiffness analysis**

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

![Stiffness diagram](image8)

**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 user defines 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 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.

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

*Ideal elastic/plastic material diagram*  *Live testing of the new CBFEM method*
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

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:
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 80% of the connection design time on 20% 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.

Get your 14-day trial at our website

Or contact one of our resellers in Netherlands, UK, Spain, Germany, Switzerland, Italy, Latin America, Poland, Portugal, Greece, Singapore, Belgium, Romania, Hungary and other countries.