SolidWorks WORLD 2010

Plant Design Using SolidWorks Together with Solution Partner Products and Other Standard Industry Tools

Dr. Vladimir Popov, CEO of SolidACE, Director, IN RE UAB
Andrej Jarmolajev, Technical Director, IN RE UAB

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About IN RE

CAD/CAM/CAE/PDM Systems provider
and CAD/CAE Software Developer in
Lithuania and Baltic's since 1996.
DS SolidWorks VAR since 2004

Authorized Training, Testing & Support Center

About IN RE

- Since 1997 - SRAC (COSMOS/M) authorized representative in Baltic's.
- Since 2002 - SolidWorks reseller in Lithuania.
- Since 2004 authorized SolidWorks Corp representative in Lithuania.
- 2005. IN RE staff members achieved Certified SolidWorks Professional and Certified SolidWorks Support Technican status.
- 2005. IN RE signed SolidWorks Research Association Agreement.
- 2006. IN RE staff members achieved Certified COSMOS Support Tech. – Core qualification.
- 2006. IN RE staff members achieved SolidWorks Certified Instructor qualification.
- 2007. IN RE received Authorized Training, Testing & Support Center status.

IN RE
Computer-Aided Engineering Services

UNIVERSAL COSMOS/M PARTNER

SolidWorks Authorized Reseller

SolidWorks COSMOSWorks Certified Support Provider Core

SolidWorks Authorized Training, Testing & Support Center

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About SolidACE

SolidACE

CAD/CAE Software Developer
for SolidWorks since 2008

DS SolidWorks Solution Partner

IN RE

CAD/CAM/CAE/PDM Systems provider
and CAD/CAE Software Developer in
Lithuania and Baltic's since 1996.
DS SolidWorks VAR since 2004

DS SolidWorks Authorized Training, Testing & Support Center

AMC BRIDGE
Reduced Overheads in Engineering

Software Development Services provider
for CAD/CAM/CAE/PDM since 1999.
Working for DS SolidWorks projects
since 2001

DS SolidWorks Solution Partner

About SolidACE

- November 7, 2008; **SolidACE, a new company developing computer aided design and engineering tools within the SolidWorks environment** for the Architectural, Building and Construction Engineering and Plant Engineering markets, was registered in Lithuania.
- SolidACE was created by experienced and dedicated **structural steelwork software professionals from IN RE and includes a development team in Dnepropetrovsk, Ukraine**, which brings many years of SolidWorks development expertise to the team.
- November, 2008. SolidACE signed **SolidWorks Research Association Agreement** for BuiltWorks development.
- January, 2009. SolidACE – **SolidWorks Solution Partner**
- November 9, 2009; **first commercial release of BuiltWorks 2010** is announced
- January 25, 2010; **BuiltWorks 2010 Release 1.1** is announced

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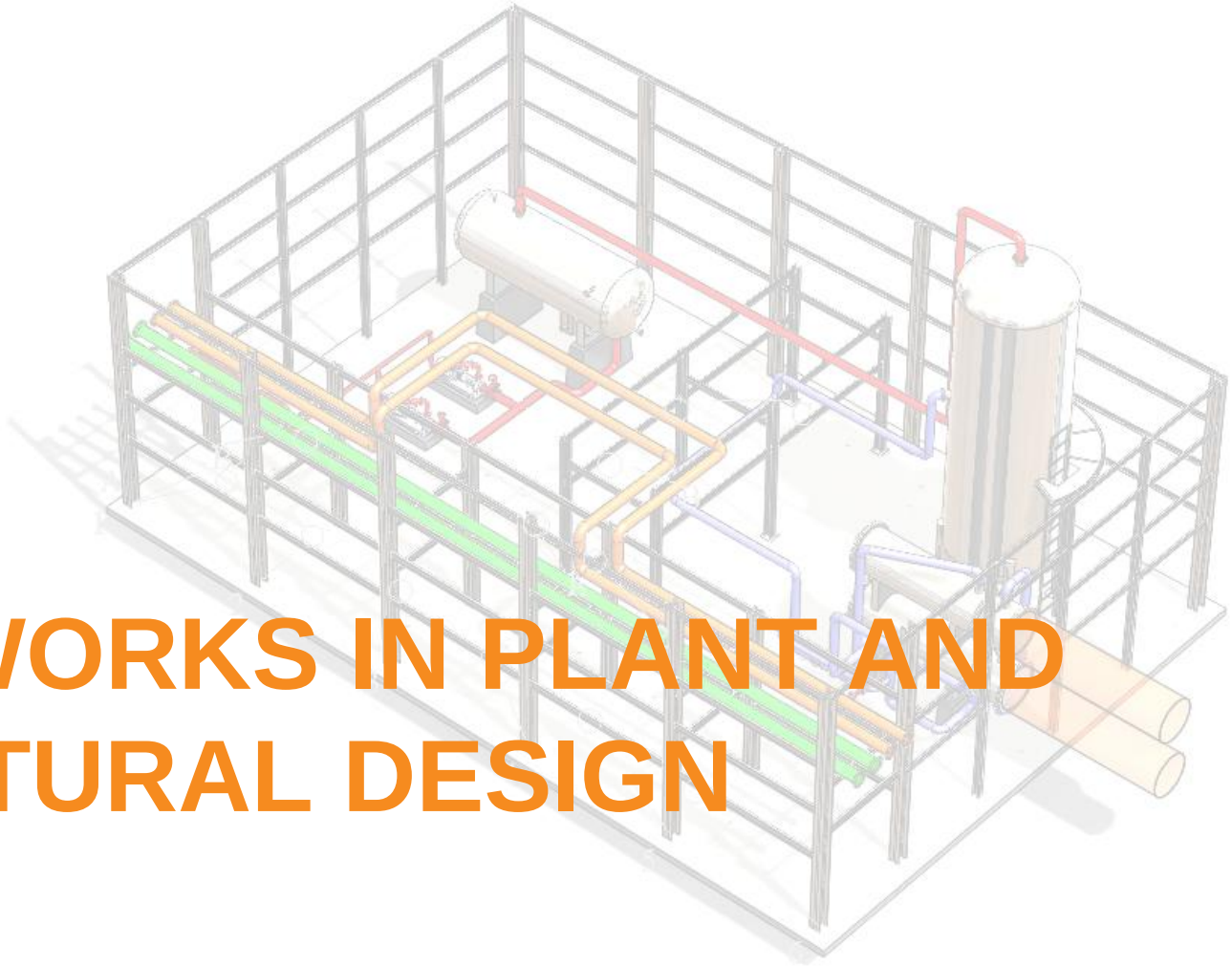
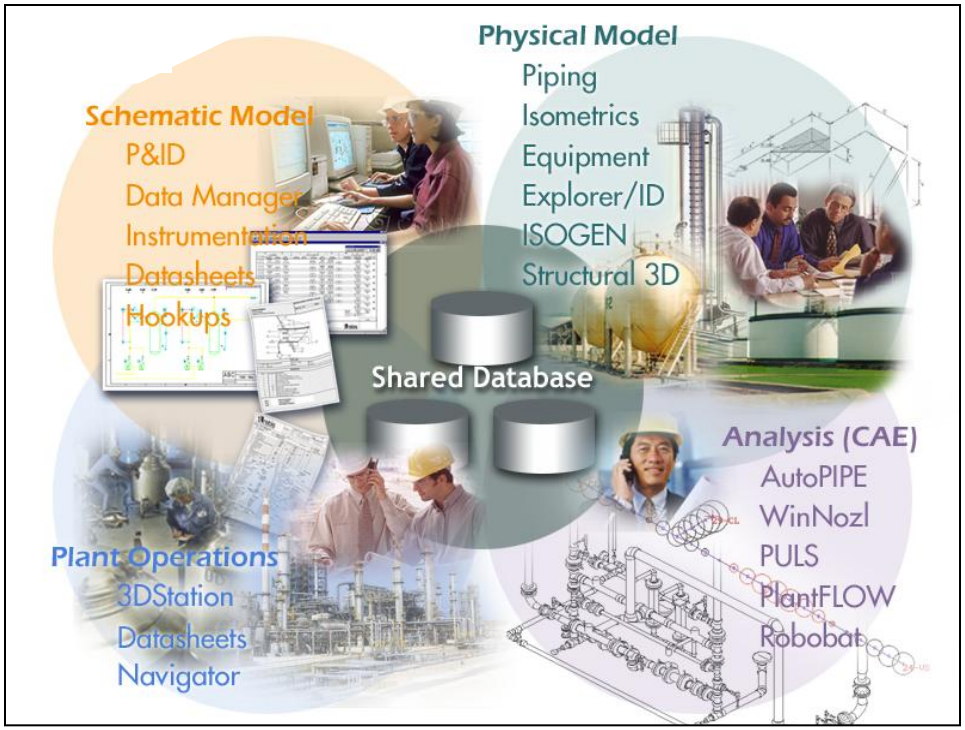


SOLIDWORKS IN PLANT AND STRUCTURAL DESIGN WORLD

Tasks for Plant Design

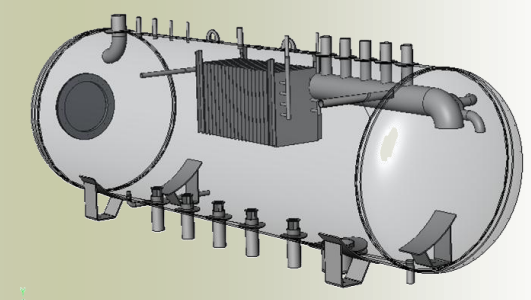
- An Industrial Plant facility is a multi disciplinary design task which includes
  - 2D Schematic Model Design
    - P&ID,
    - PFD,
    - Instrumentation,
    - Electrical, etc.
  - 3D plant Model Developing (Design & Analysis)
    - Equipment
    - Piping,
    - Structural,
    - Mechanical, etc. third level bullet
  - Operation process design
    - Construction simulation
    - Review
    - Maintenance & Support



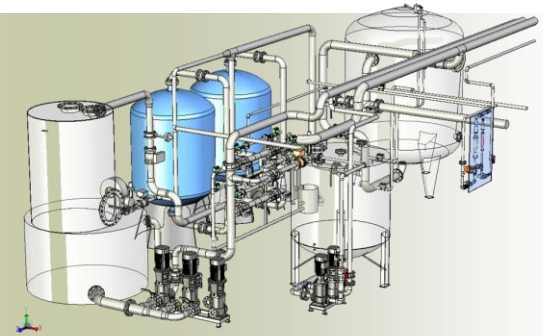
Taken from ***Bentley Systems*** presentation

Plant components

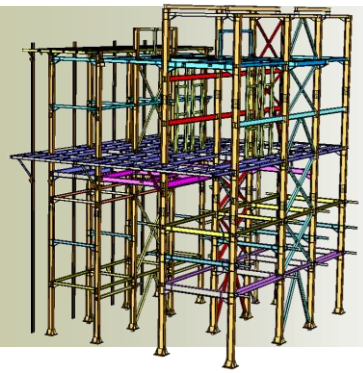
- Equipment and Mechanical parts
  - 3D Modeling
  - Drawings & B.O.M.
  - Stress Analysis
  - Flow & Heat transfer Analysis



- Piping System
  - Pipes, elbows, tees, reducers
  - Instruments and control systems
  - Supports, etc.



- Steel structures
  - Building frameworks
  - Pipeline trestles
  - Equipment supports
  - Service, staircases, handrails, etc.



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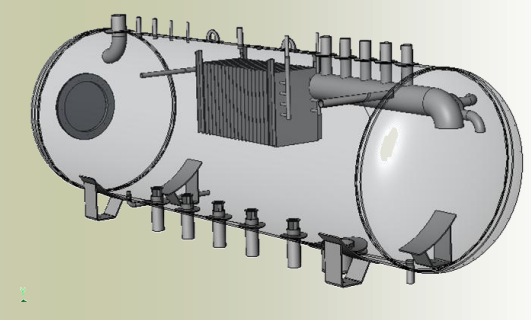
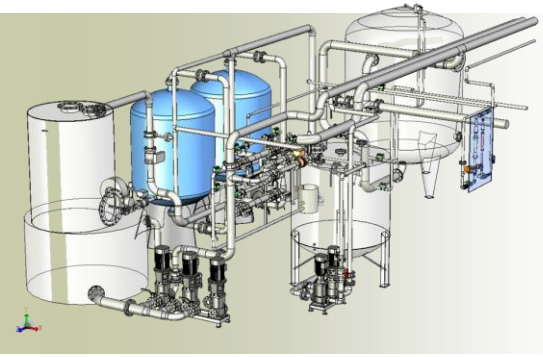
Plant components

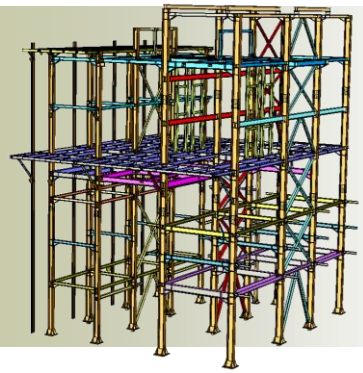
- Design of Equipment and Mechanical parts
  - 3D Modeling
  - Drawings & B.O.M.
  - Stress Analysis
  - Flow & Heat transfer Analysis



- Design of Piping System
  - 3D Modeling (Routing)
  - Drawings & B.O.M.
  - Stress & Flow Analysis
  - Data exchange with piping A&D systems



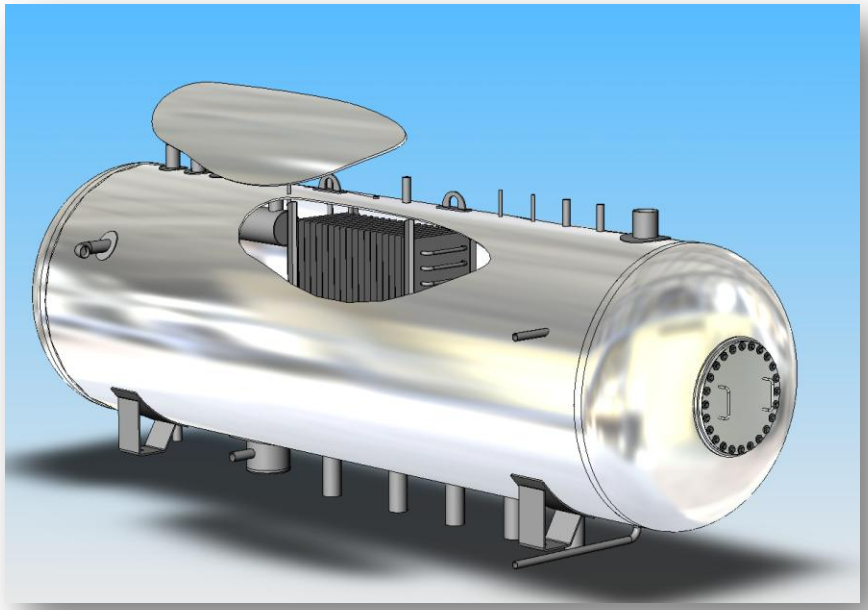
- Design of Steel structures
  - 3D Modeling
  - Drawings & B.O.M.
  - Connection detailing
  - Stress Analysis
  - Data exchange with structural A&D systems

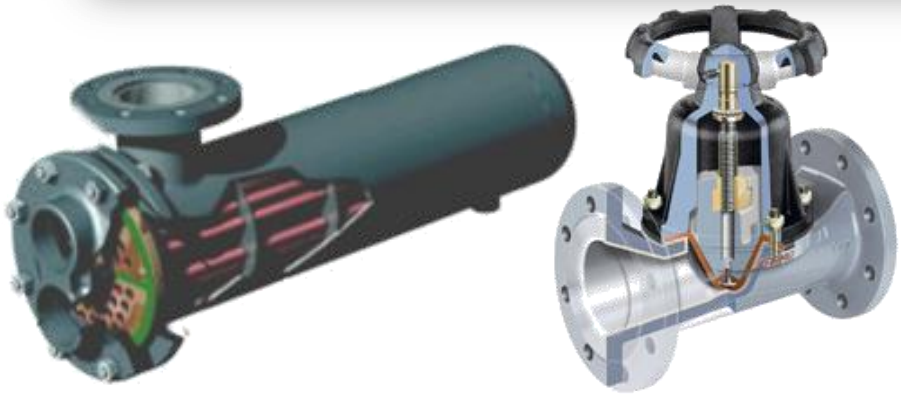


SOLIDWORKS FOR DESIGN OF EQUIPMENT AND MECHANICAL PART

SolidWorks for Equipment modeling

- SolidWorks allows the application of full scale layouts and detailed design of plant equipment and it's components:
  - Installation units and assemblies
  - Production tools and accessories
  - Process columns and towers
  - Tanks and vessels
  - Heat exchangers, boilers
  - Piping components
  - Pumps, valves, nozzles, fittings,
  - Devices and instruments
  - Supports and connections
  - Mechanical parts and elements





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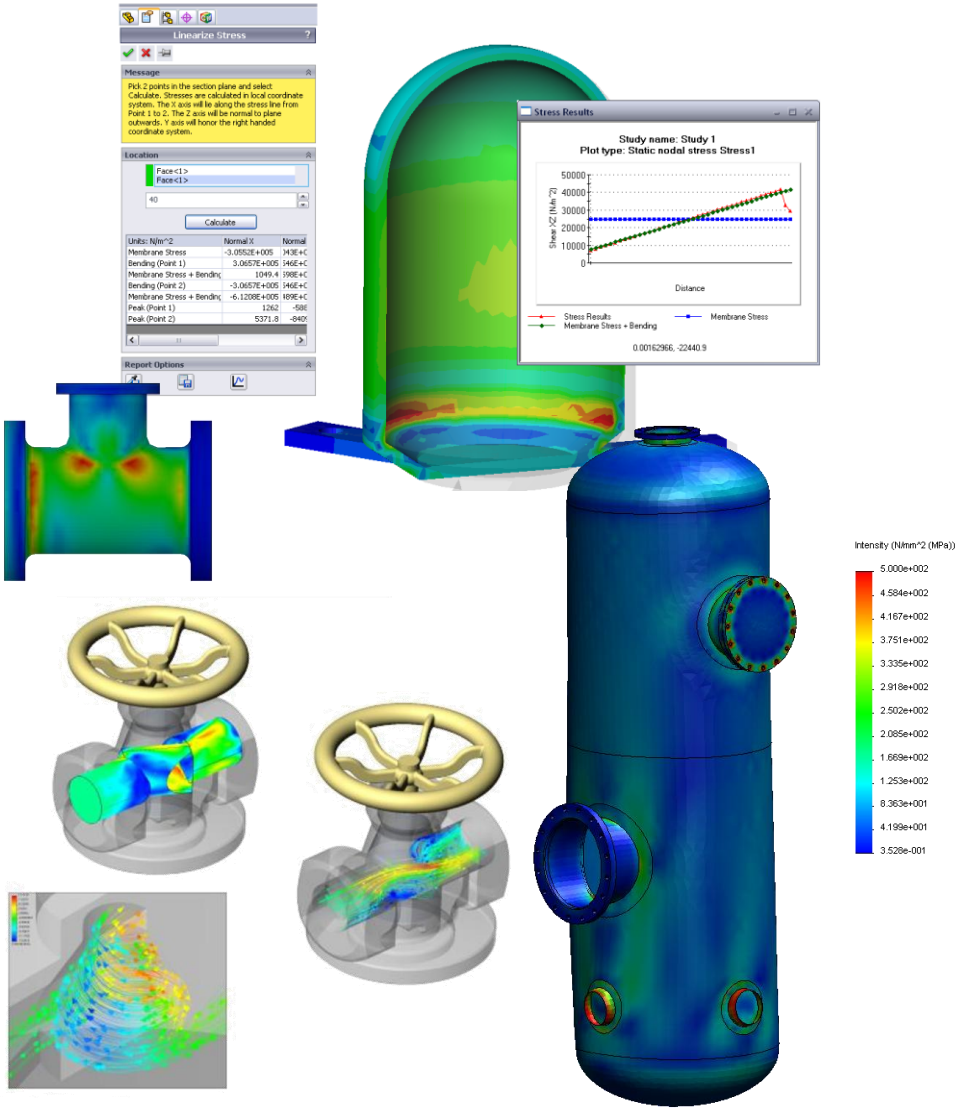
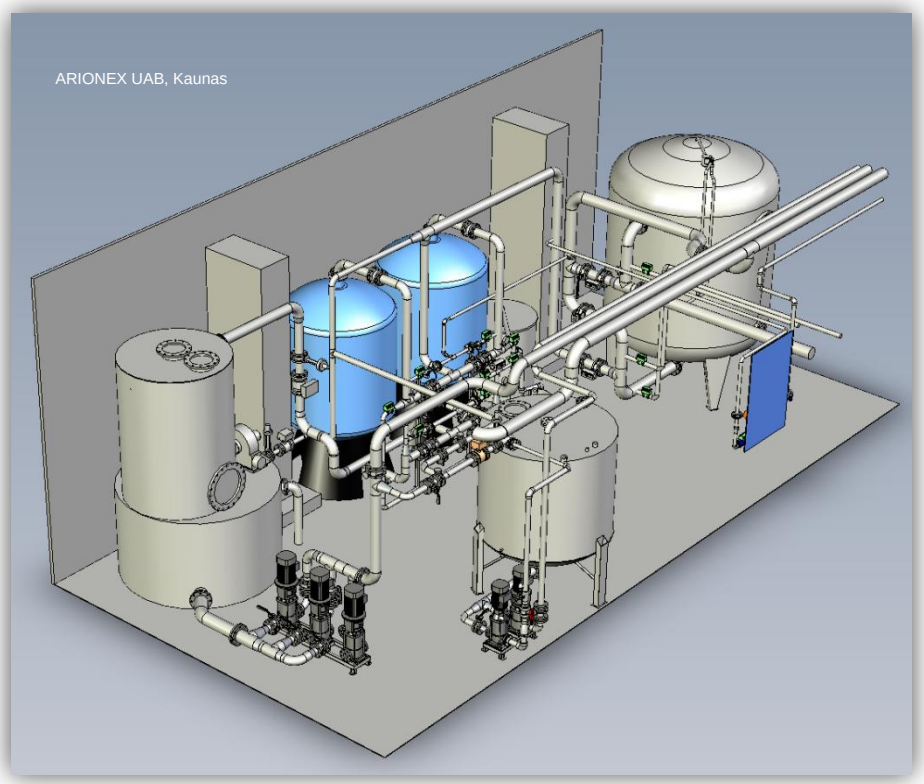
SolidWorks Simulation tools for equipment Analysis

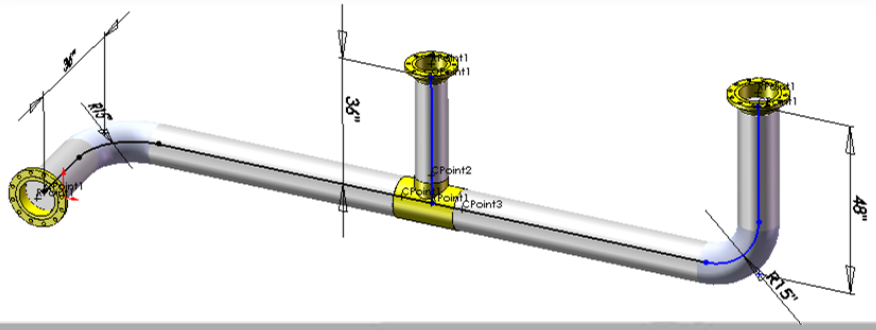
- General FEM based Analysis of the equipment and it's components
  - Stress – strain
  - Buckling
  - Fatigue
  - Nonlinear
  - Heat transfer
- Pressure vessels - code based design
  - ASME codes – 'stress-linearing'
  - Stress combinations of stress results
- Flow and Heat transfer Analysis for process



SolidWorks Routing – part of SolidWorks Premium

- SolidWorks Routing - Piping
- Module allows pipeline routing based on specification rules:
  - Mixture of bends or elbows
  - Focus on pipeline systems and small facility design
  - Piping assemblies from Design Library
  - Auto-route segments
  - Content per DIN, ISO, and ANSI standards
  - Easy custom library creation
  - Bend table for Manufacturing





SolidWorks future success in Plant industry

- Successful application of SolidWorks in Plant industry depends not only on how effective, powerful and flexible are modeling, routing, and drawing tools, but also how the information created in SolidWorks and SolidWorks add-ins can be translated to CAD/CAE systems from PLANT industry.
- SolidWorks has really excellent kit of neutral exchange formats, but they are more typical for MECHANICAL (Equipment) rather then for PLANT industry generally.
- Let's take a look how SolidWorks can be integrated with PLANT applications using standard PLANT exchange formats.

.step ✓ .x_t ✓

.sat ✓

.vda ✓ .iges ✓

.cis/2 ? .sdnf ?

.dstv ? .pcf ✓

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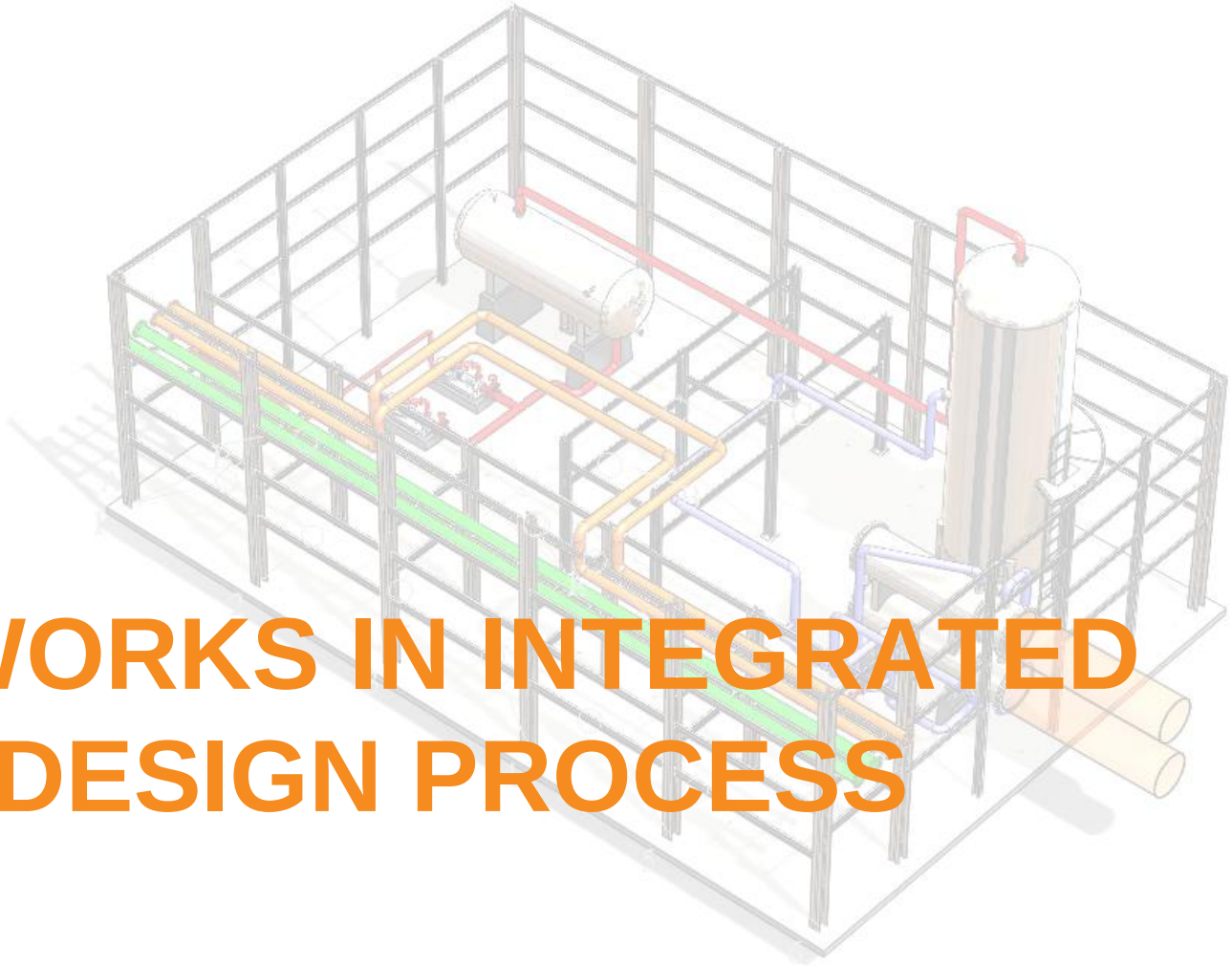

SOLIDWORKS IN INTEGRATED PIPING DESIGN PROCESS

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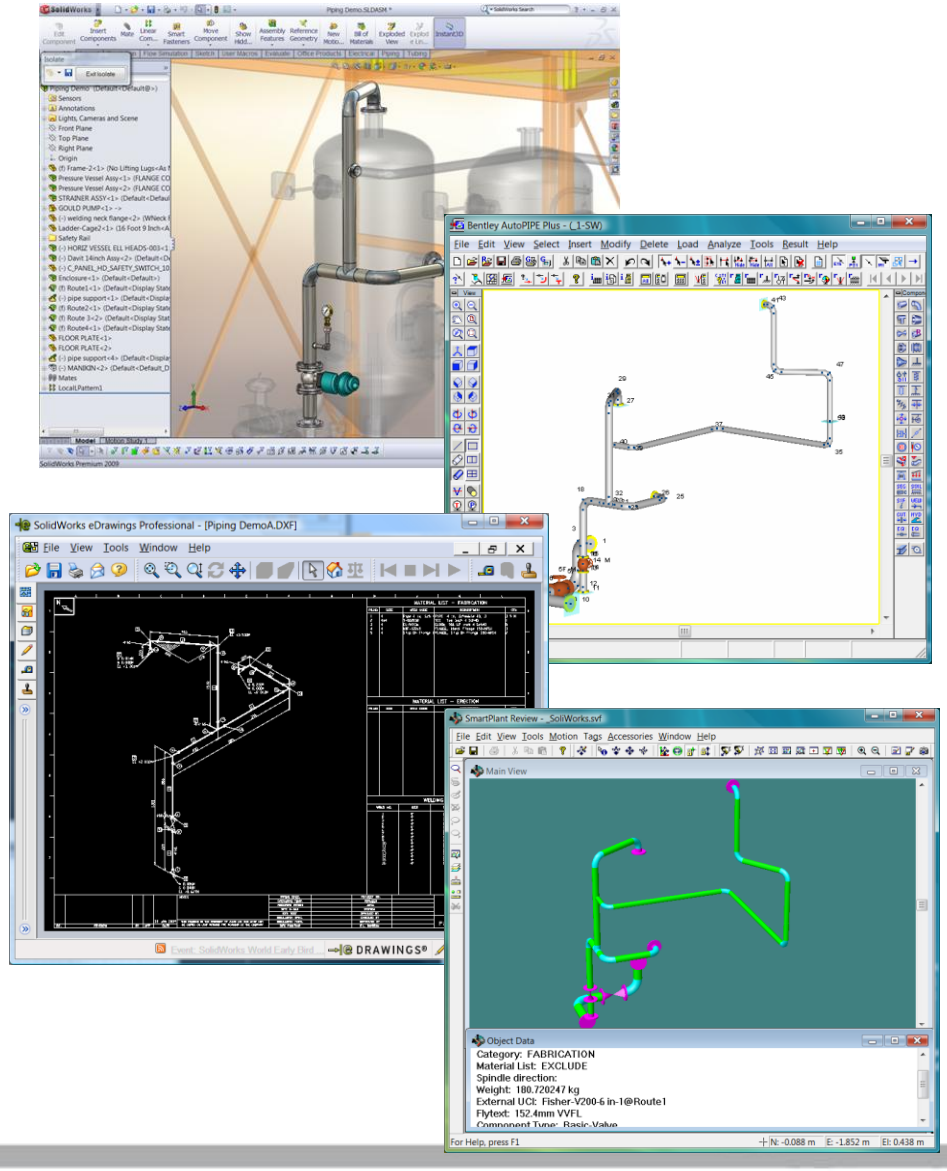
SolidWorks success in piping industry

- One of the key point of SolidWorks popularity in PLANT area is the level of integration with PLANT industry standard applications
- The is major requirement coming from EPC's and O/O's companies is to establish continuous design workflow of piping systems
  - Modeling, Analysis, Generation of ISOGEN, Design Review
- Such integration level could be established by specific data exchange formats which support piping geometry and intellectual information transfer through the different PLANT applications



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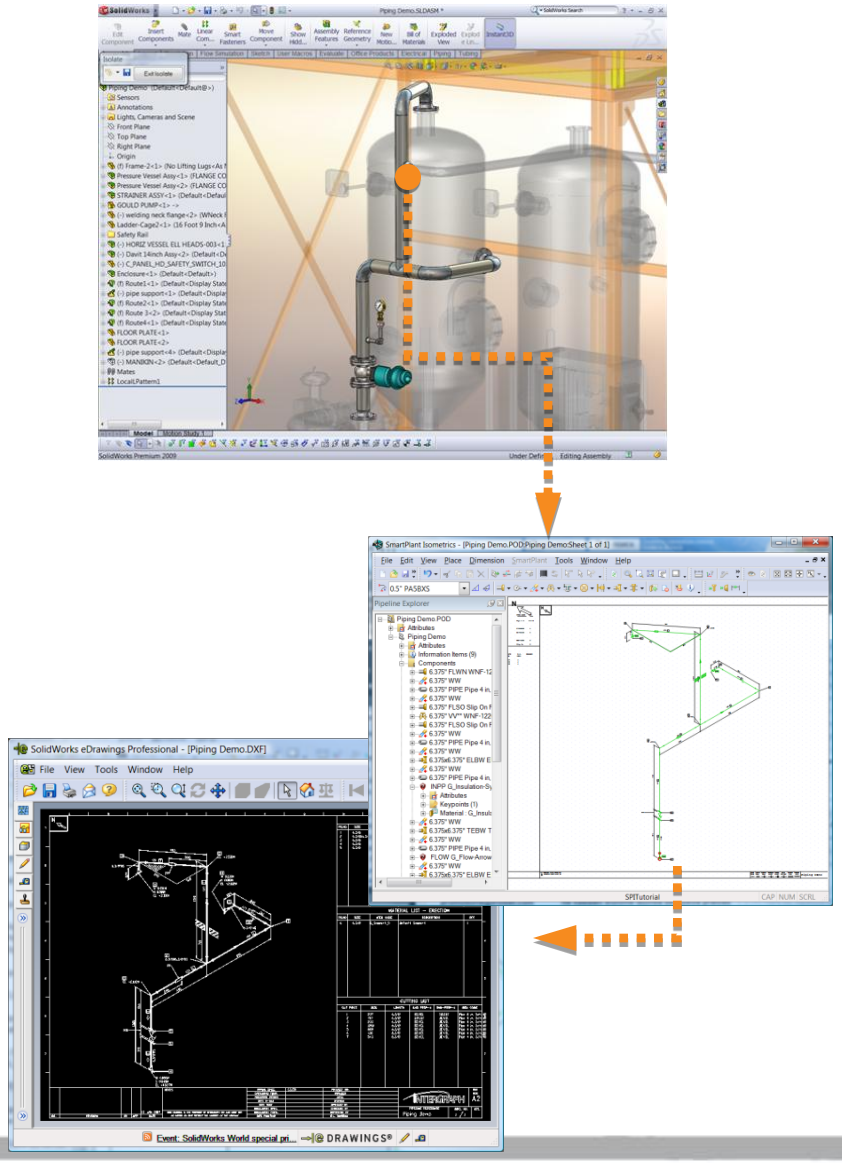
SolidWorks suscess in piping industry

- PCF – “de facto” industry standart for pipe exchange data. 80% of all plant design projects rely on Alias/Intergraph technology for their automated piping isometric production (www.alias.co.uk).
- Using PCF file you can exchange data with:
  - Pipe Stress Analysis Software like ***Bentley AutoPIPE***, ***CEASER II*** (now Intergraph!), ***ROHR2*** and others;
  - Plant Design and Review Software like ***SmartPlant 3D, PDMS, AutoPLANT, CADWorx*** (now Intergraph!) and others;
  - Piping fabrication software like ***SPOOLGEN***.



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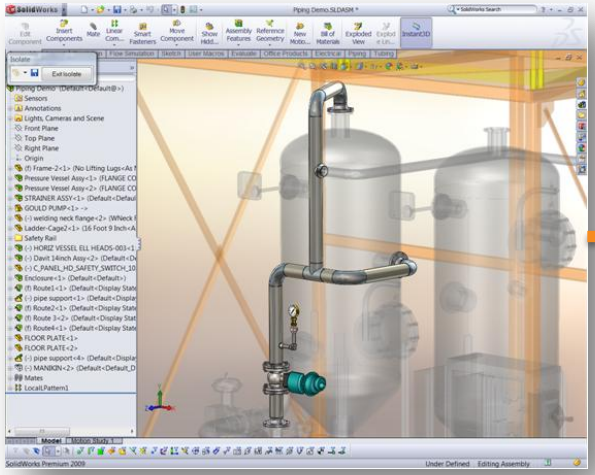
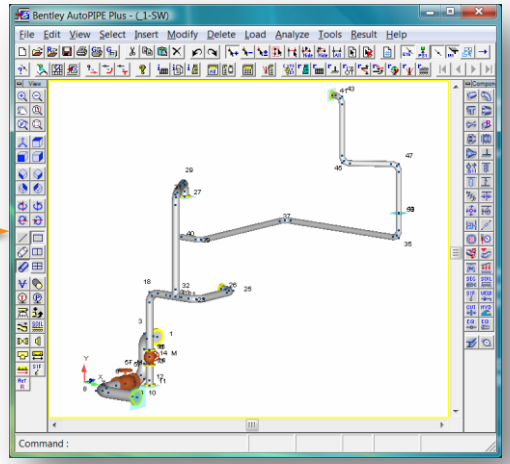
SolidWorks success in piping industry



SolidWorks Routing

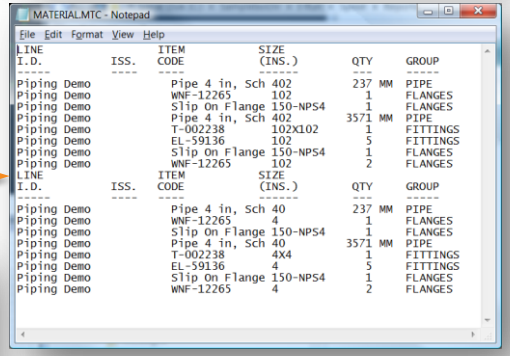
PCF

CAE

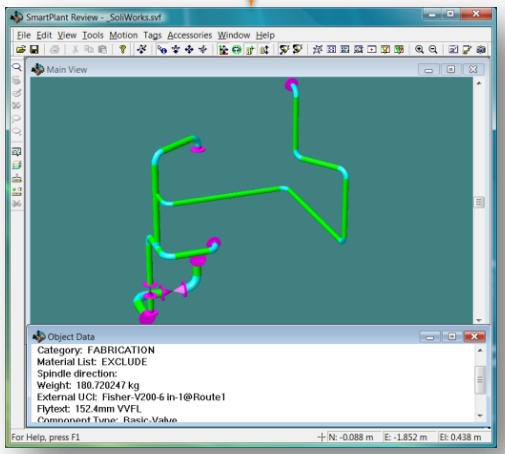


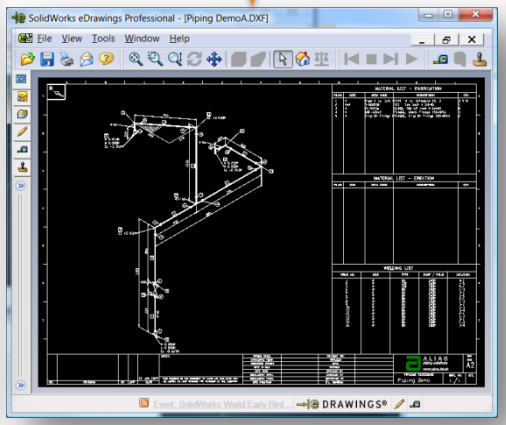
Automate drawing

BOM



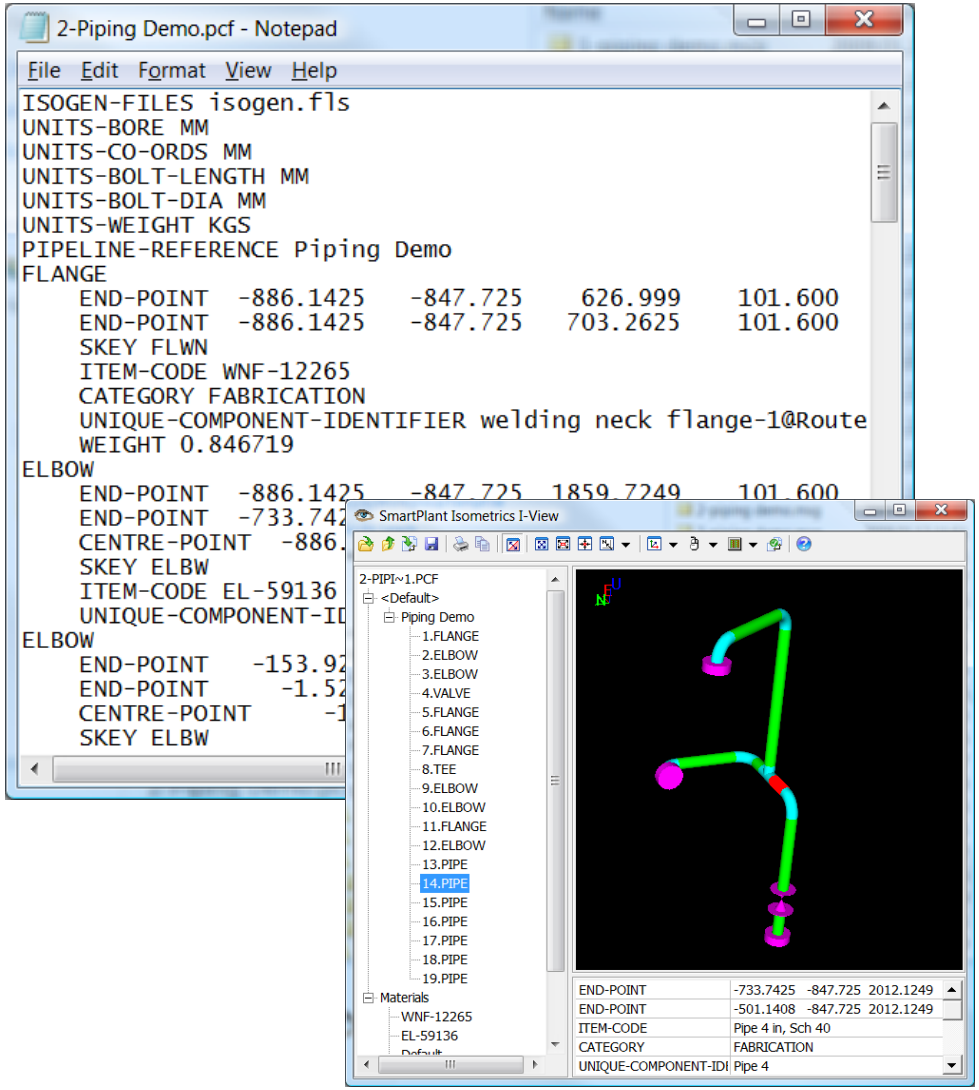
Review





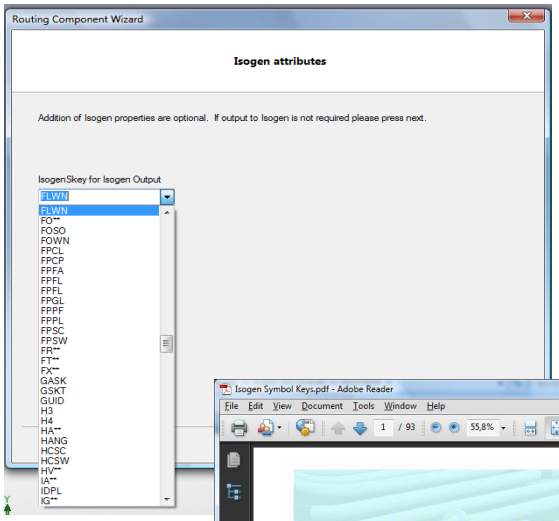
What is PCF in Plant Design?

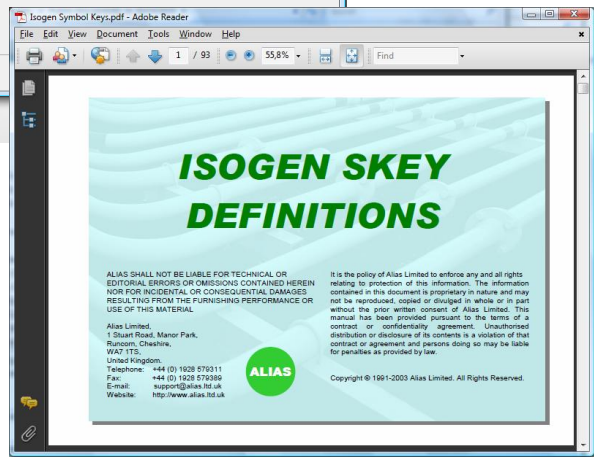
- PCF – Piping component file:
  - Industry standard piping data exchange format
  - Based on ISOGEN standard
  - This is a simple text file
  - Can be represented in 3D using ***SmartPlant Isometrics I-View***, including element attributes

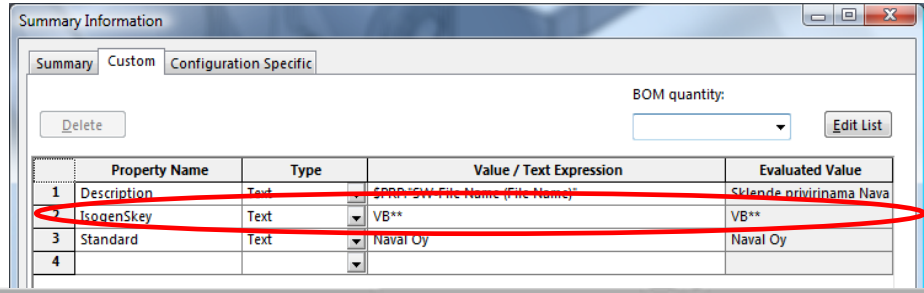


SolidWorks Routing PCF support

- To generate PCF file:
  - Select ‘Export pipe/tube data’
    - PCF file is stored with the SolidWorks assembly file
  - Define **CPont** – connection point;
  - Define **RPoint** – routing point;
  - For many of components define **Vertical axis** and/or **Axis of Rotation**
  - Define **IsogenSkey** properties
- More information about Isogen settings can be learned from any ISOGEN based solutions documentation (I-Run, SmartPlant Isometrics)

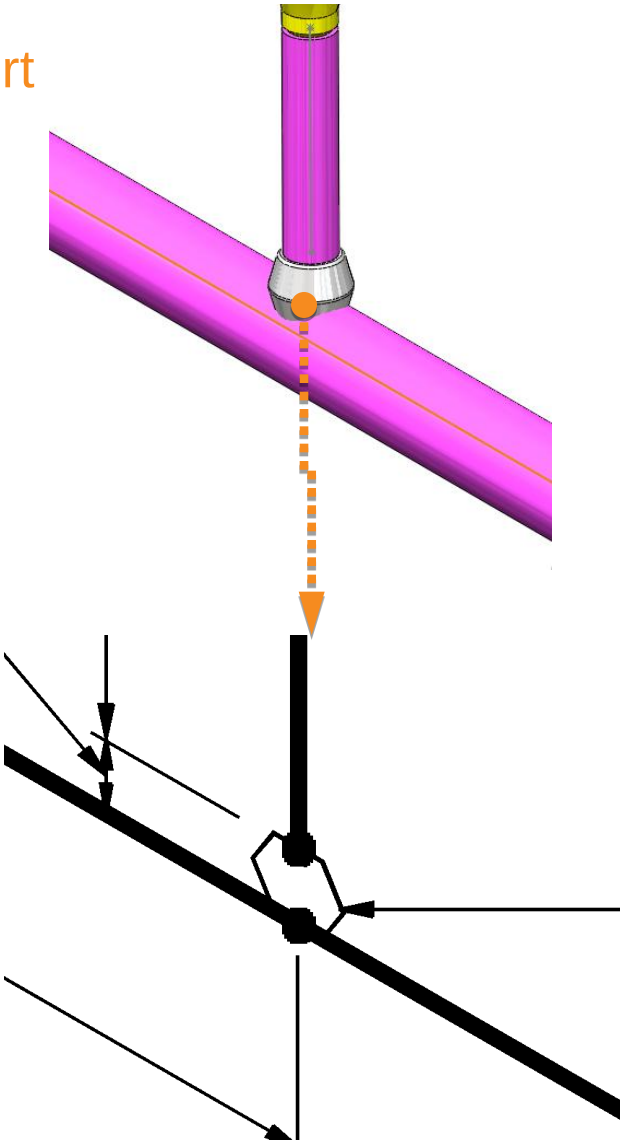






SolidWorks Routing PCF support

- Every release of SolidWorks improves PCF support (for ex. SolidWorks 2010 now supports O-Lets),
  - … but full support of all components is not available
- If you need just to transfer information to cutting machines, you have that possibility
- But if your task is to transfer data to piping analysis and other plant design systems PCF generated by SolidWorks is not enough
- Using SolidWorks Routing there is no way to add miscellaneous components like
  - supports, spindle directions, heat tracing, bolts, flow arrows, wall/floor symbols and etc.
- … to ISOGEN PCF file.



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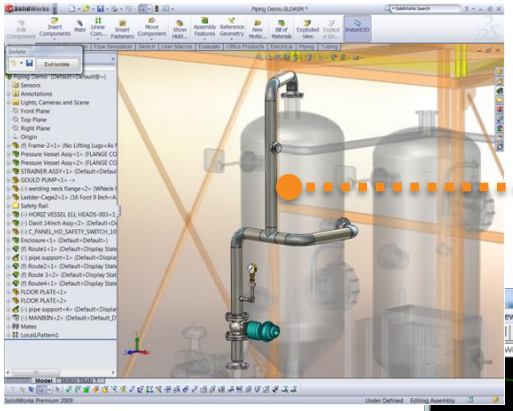
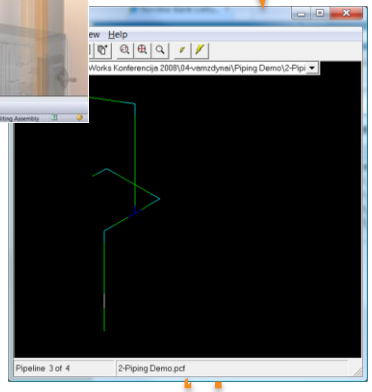
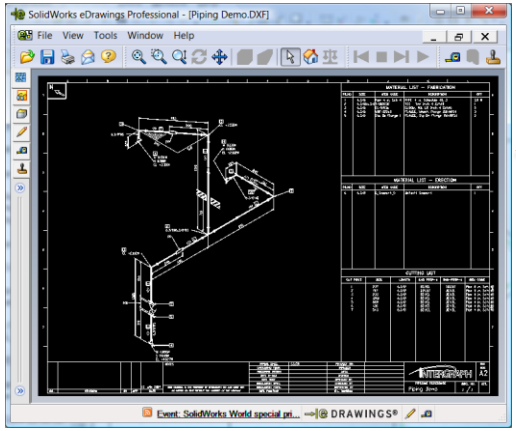
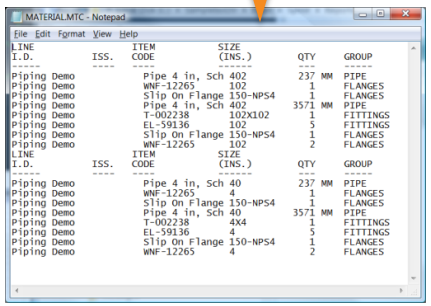
Two ways to generate ISOGEN drawings of pipeline

- Use **ALIAS I-Run** to generate ISOGEN drawings
  - Transfer piping data to I-Run for review
  - Generate as is ISOGEN drawing



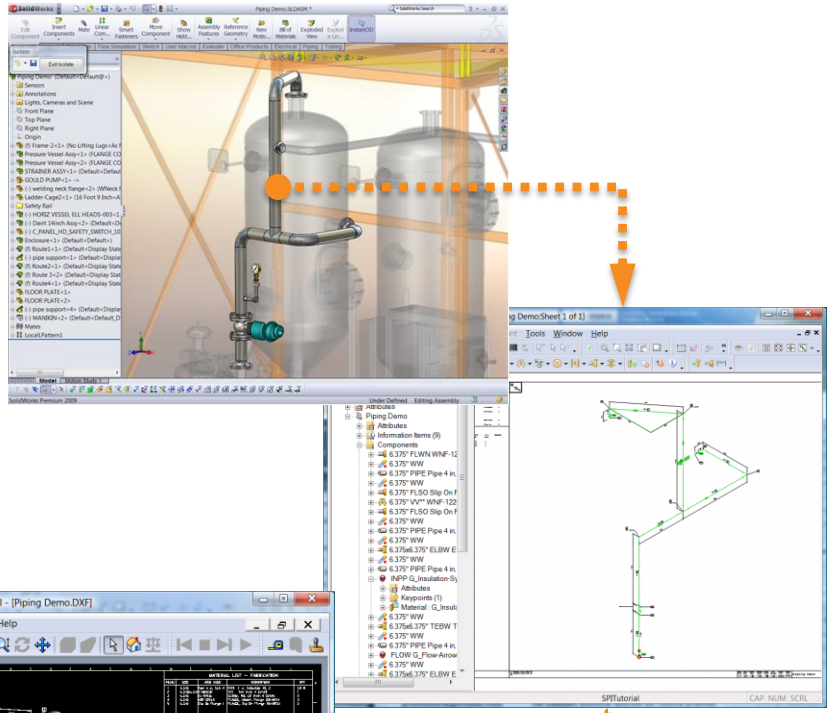


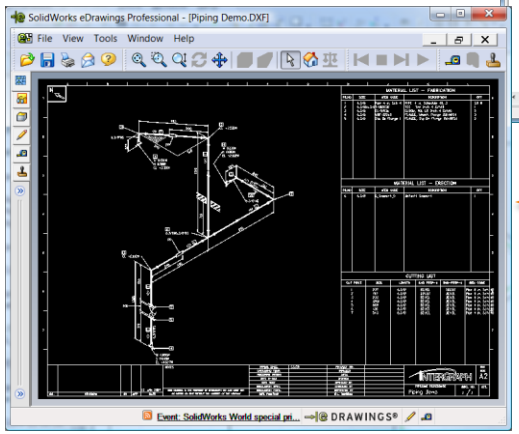




Two ways to generate ISOGEN drawings of pipeline

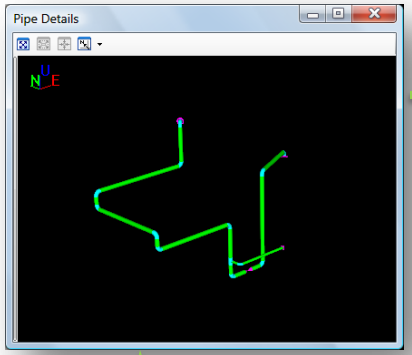
- Use **ALIAS I-Run** to generate ISOGEN drawings
  - Transfer piping data to I-Run for review
  - Generate as is ISOGEN drawing
- Use **SmartPlant Isometrics** to add additional information and generate ISOGEN drawings
  - Transfer piping data to SmartPlant Isometrics to
  - Add necessary information to PCF file then
  - Generate complete ISOGEN drawing for different pipeline representing style:
    - Spool;
    - Weld;
    - Pipe-cut;
    - Overview, check, etc…



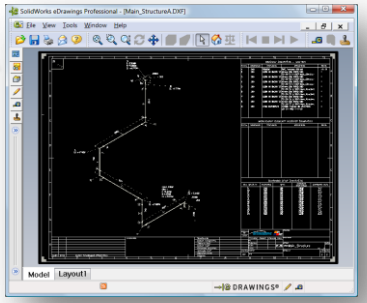


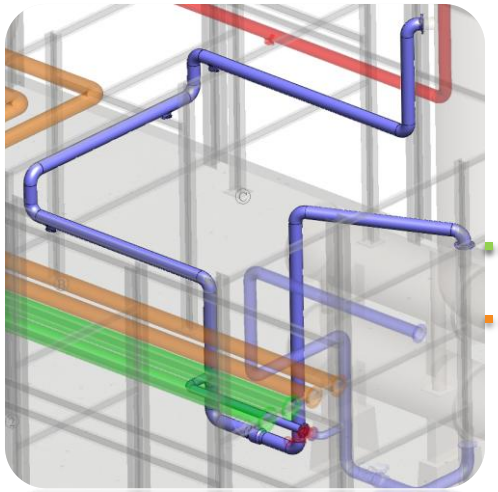
SolidWorks Routing PCF support

Alias I-Run

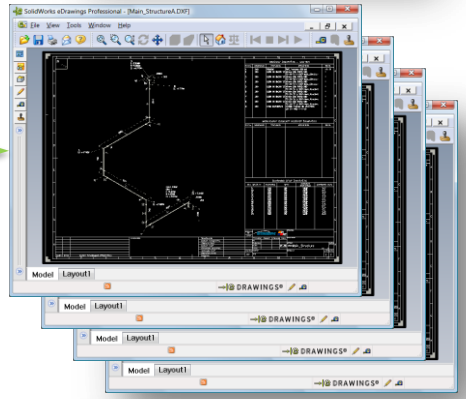


Cut-list





SolidWorks Routing



Spool

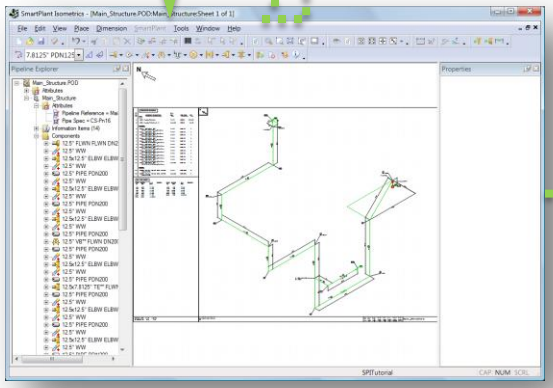
Erection

Overview

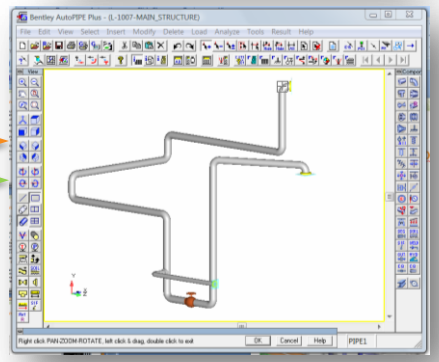
Weld-Box

System

Check



SmartPlant Isometrics/
Spoolgen



Analysis (AutoPIPE, CEASER II)

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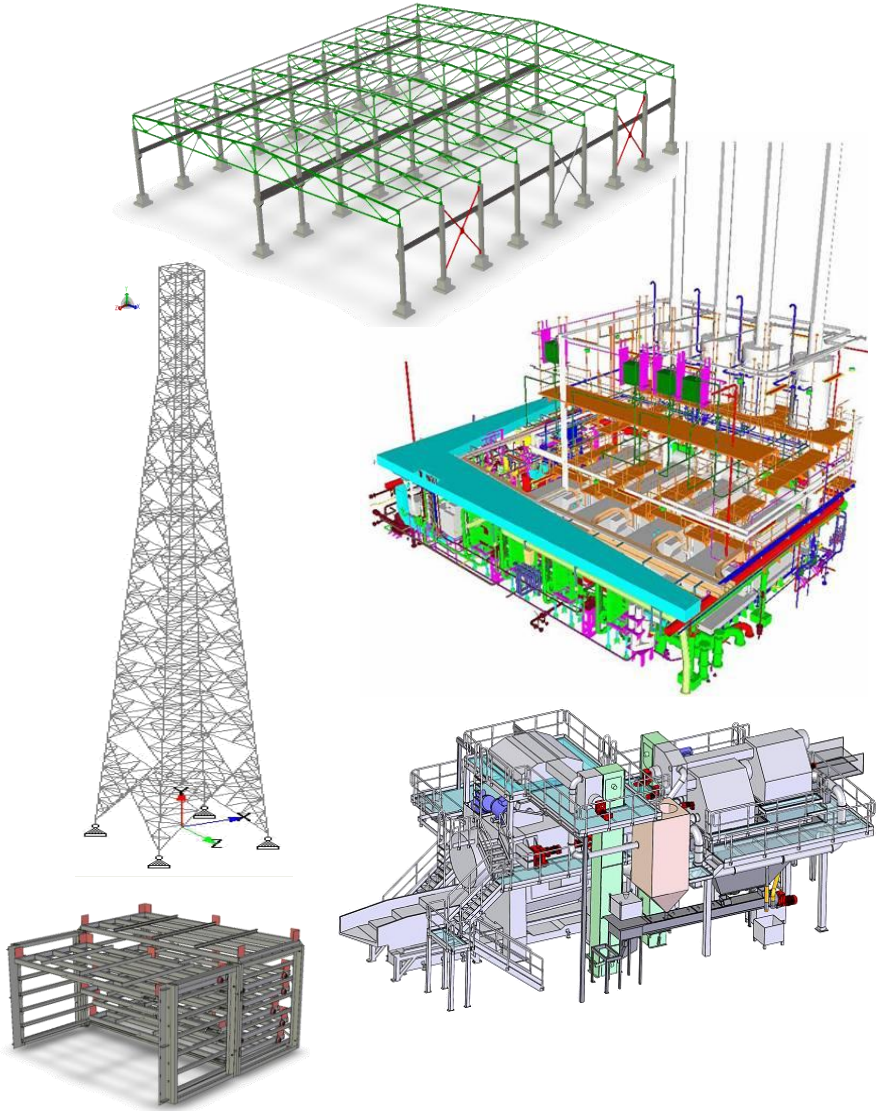
SOLIDWORKS IN INTEGRATED STRUCTURAL STEEL DESIGN PROCESS

SolidWorks WORLD 2010

SolidWorks application for steelwork design

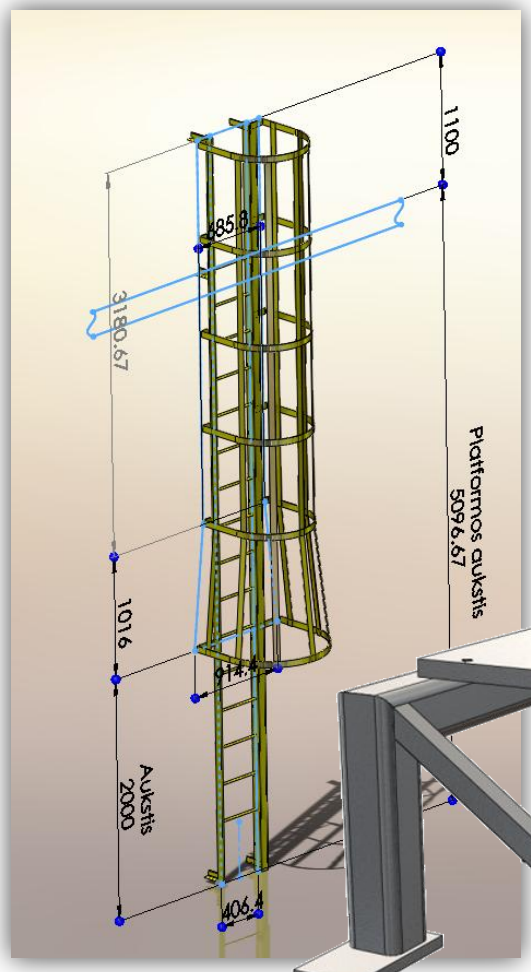
Steelwork for Industrial Facilities

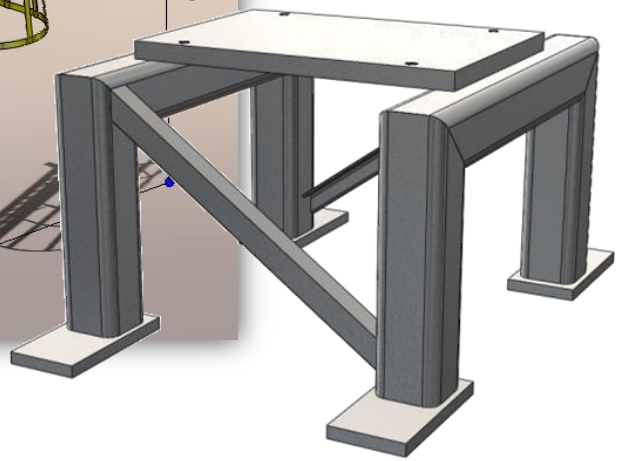
- Building frameworks
- Pipelines trestles
- Equipment bearing and supports
- Operating platforms
- Floor girders and grillages
- Roof structures, trusses, lattice girders, ledgers, purling
- Facades
- Wells, staircases and handrails



SolidWorks standart functionality

- SolidWorks has embedded tools for the design of welded frame structures (Weldment)
- Weldment features in Part allow the creation of frame elements (beams, columns, trusses) quickly working in the same file.
- Using SolidWorks Weldment it is available to make detailed model and produce design documentation for second level structures like
  - Pipelines small trestles
  - Equipment bearing and supports structures
  - Small maintenances platforms
  - Staircases and handrails
  - Trusses
  - Containers, etc…



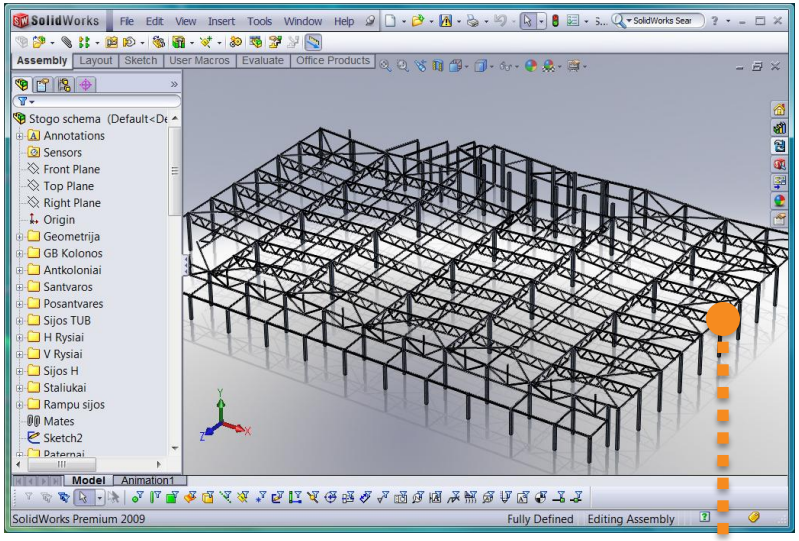


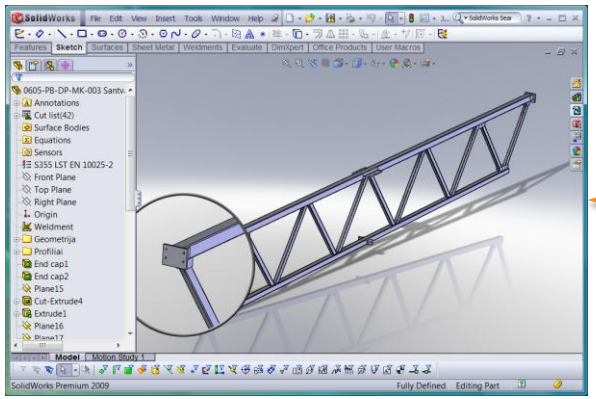
SolidWorks standart functionality limitations

- All that structures are
  - Mostly welded
  - Not require analysis and design by Code Check requirements
- Working with main structures like buildings, frameworks, operating platforms Weldment tools are limited
  - Model is more schematic rather than detailed (for main equipment sitting, adjustment visualization)
  - No easy way to get detailed drawings or BOM

SolidWorks standart functionality limitations

- Big models of structural frameworks require have to be build in Assembly mode:
  - To create big model
  - Use multiplied elements
  - Create connection details
  - Generate detailed drawings and reports
- Link to Structural analysis and design (A&D), (not just FEA).
- SolidWorks Weldment can not support such requirements.
  - There are still a lot of “hand” work no automation.
  - Not possible to be linked to A&D Software





2 biggest SolidWorks standard functionality limitations

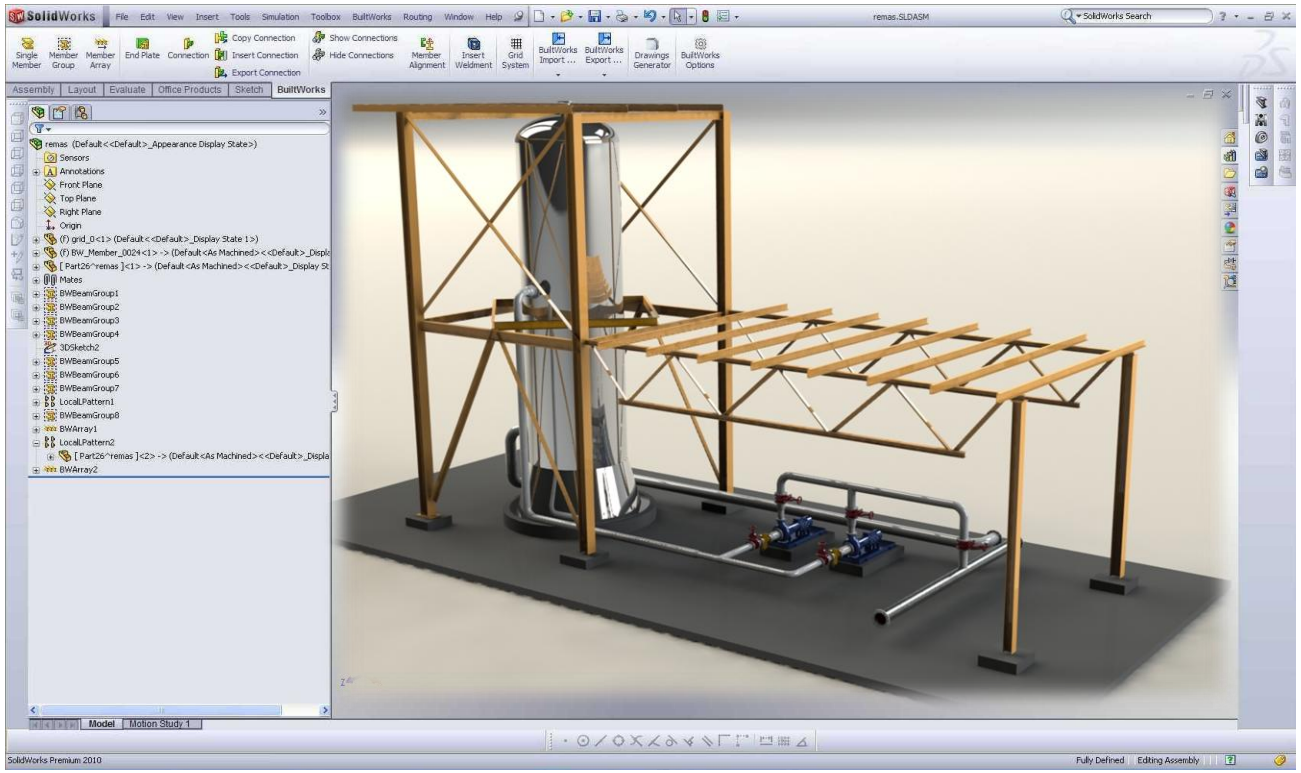
- There are two main direction to improve SolidWork productivity in Structural area

1. To maintain modeling of large structures in Assembly mode working with Weldments and other Structural Elements
   - Add modeling capabilities for Structural Steel area in Assembly mode at the general arrangement stage
   - Add modeling capabilities for Structural Steel area at the connection detailing stage
   - Support drawing generation conforming to Building and Structural Standards
2. Integrate SolidWorks to Plant and Structural CAD/CAM/CAE/ world
   - Aveva PDMS, Intergraph SmartPlant 3D, PDS, Bentley AutoPLANT, etc.
   - TEKLA, ProSteel, StruCad, ProSteel, Bentley Structural, etc.
   - Bentley STAAD.Pro, RAM Structural Systems, etc.

SolidWorks WORLD 2010

BuiltWorks 2010 for SolidWorks 2010

- BuiltWorks is a software application for real-time steel design within the native SolidWorks environment, providing tools for 3D solid parametric modeling, analysis and design, connection detailing and automated generation of both drawings and BOMs



BuiltWorks

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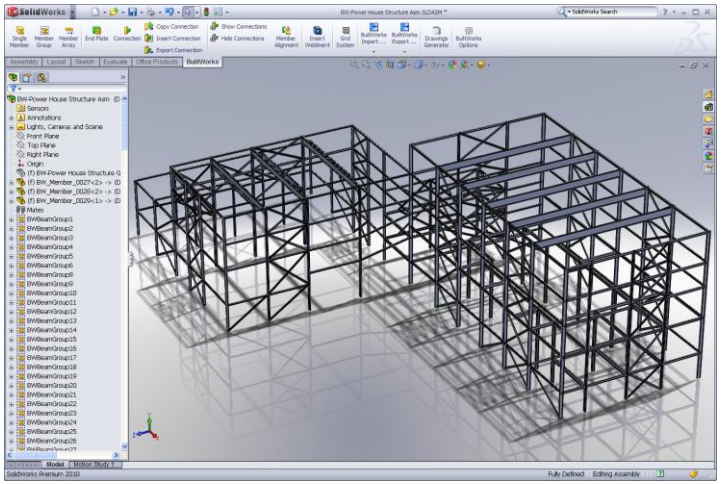
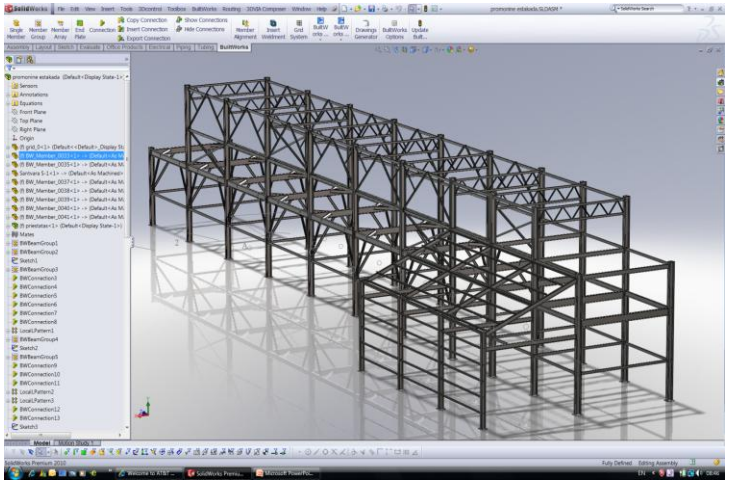
BuiltWorks application areas

- Developed to meet the Architectural, Engineering, Construction and Plant (Process & Power) industries requirements for high performance flexible and versatile design tools
- Capable of maintaining an intelligent and true solid model-based, SolidWorks, architecture that enables the user to create an 3D real-world simulated structure containing all the information required for the general and detailed design, fabrication and erection of steelwork structures
- Flexible to enable external best of breed vertical market products to be linked to SolidWorks and hence creating an open environment





BuiltWorks General Concept

- Modeling and Detailing tools
  - Parametric, physical 3D model of Structural framework within SW environment
  - Connections detailing: alignment, cutting, endplates, bolted connections
  - Structural general arrangement and detailed drawings and BOM
- Analysis tools
  - SW Simulation (COSMOS) for FEM Analysis
  - Bi-directional link to/from structural analysis package:
    - STAAD.Pro/ SCAD Office, LIRA, …
  - Direct export/import to/from structural analysis package through STD format
- Integration tools
  - Translators to other plant, structural or steel detailing and fabrication applications:
    - SDNF, CIS/2, IFC import/export
    - DSTV NC export

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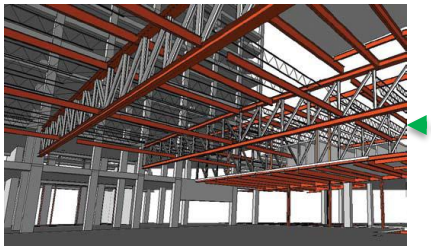
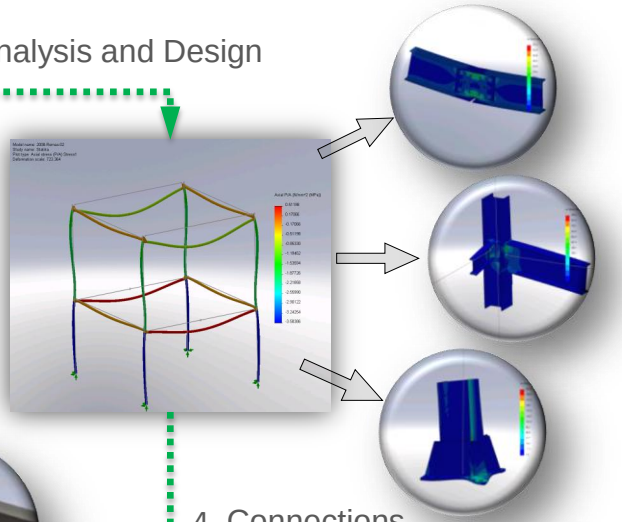
Product Philosophy

7. Import/export via SDNF formats to Building Design Systems

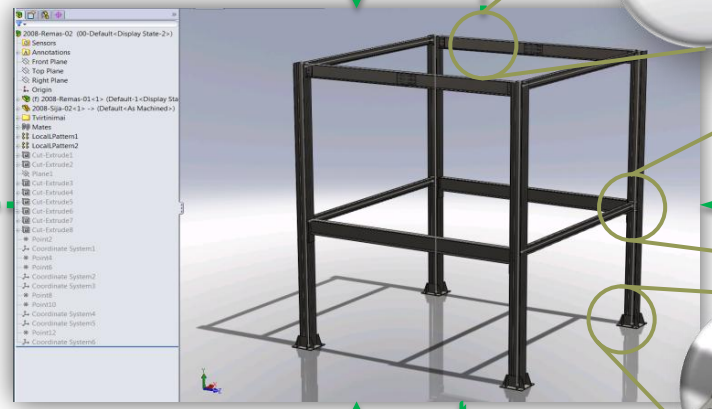


2. Analysis and Design



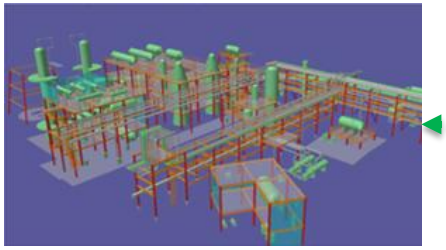
3. Connection Detailing

1. 3D Solid Parametric Modeling



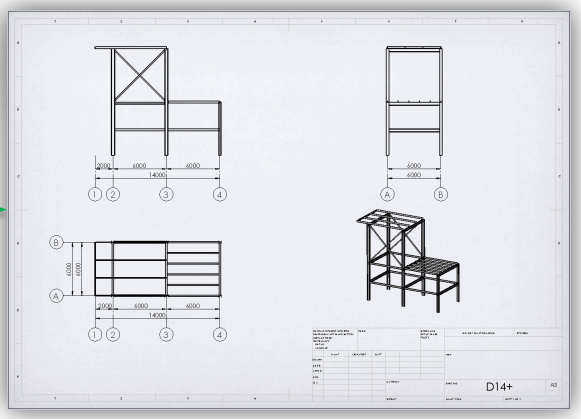
8. Export NC data in DSTV formats

4. Connections Analysis and Design



7. Import/export via SDNF formats to Industrial Plant Design Systems

6. Drawings & BOM



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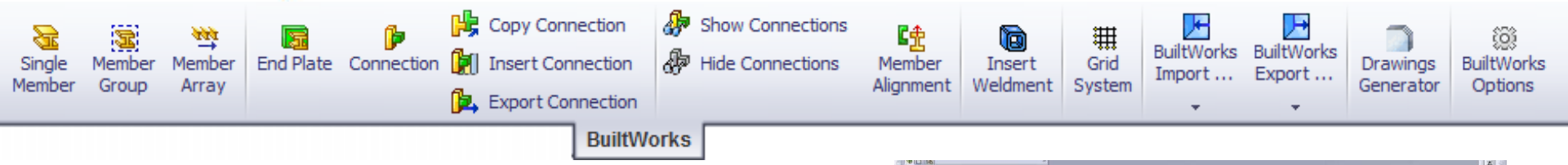
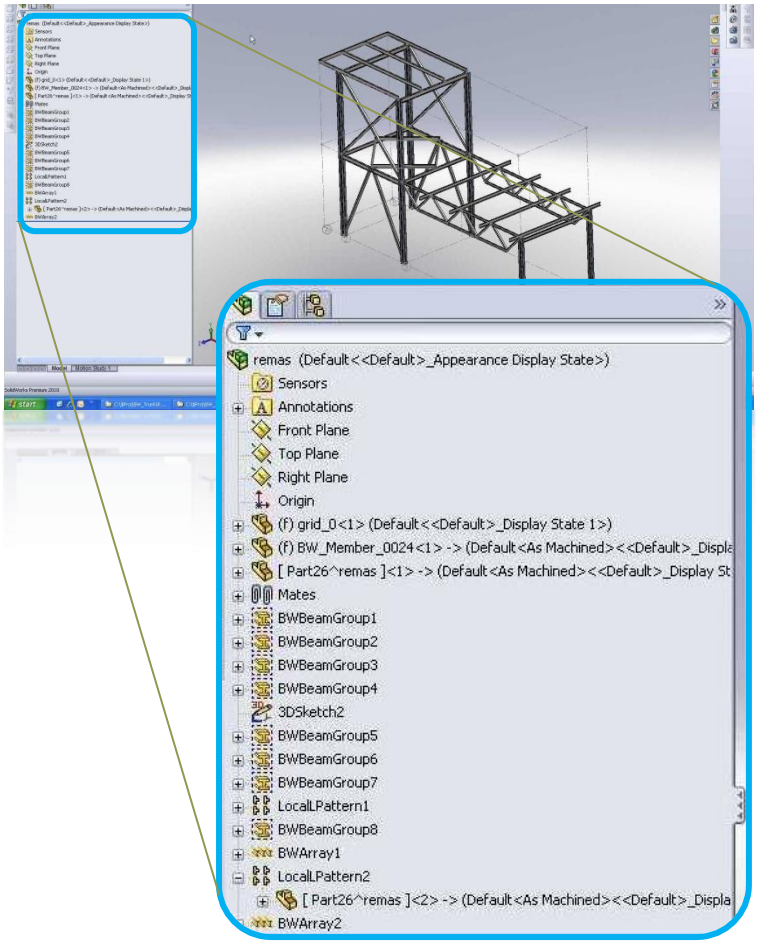
General



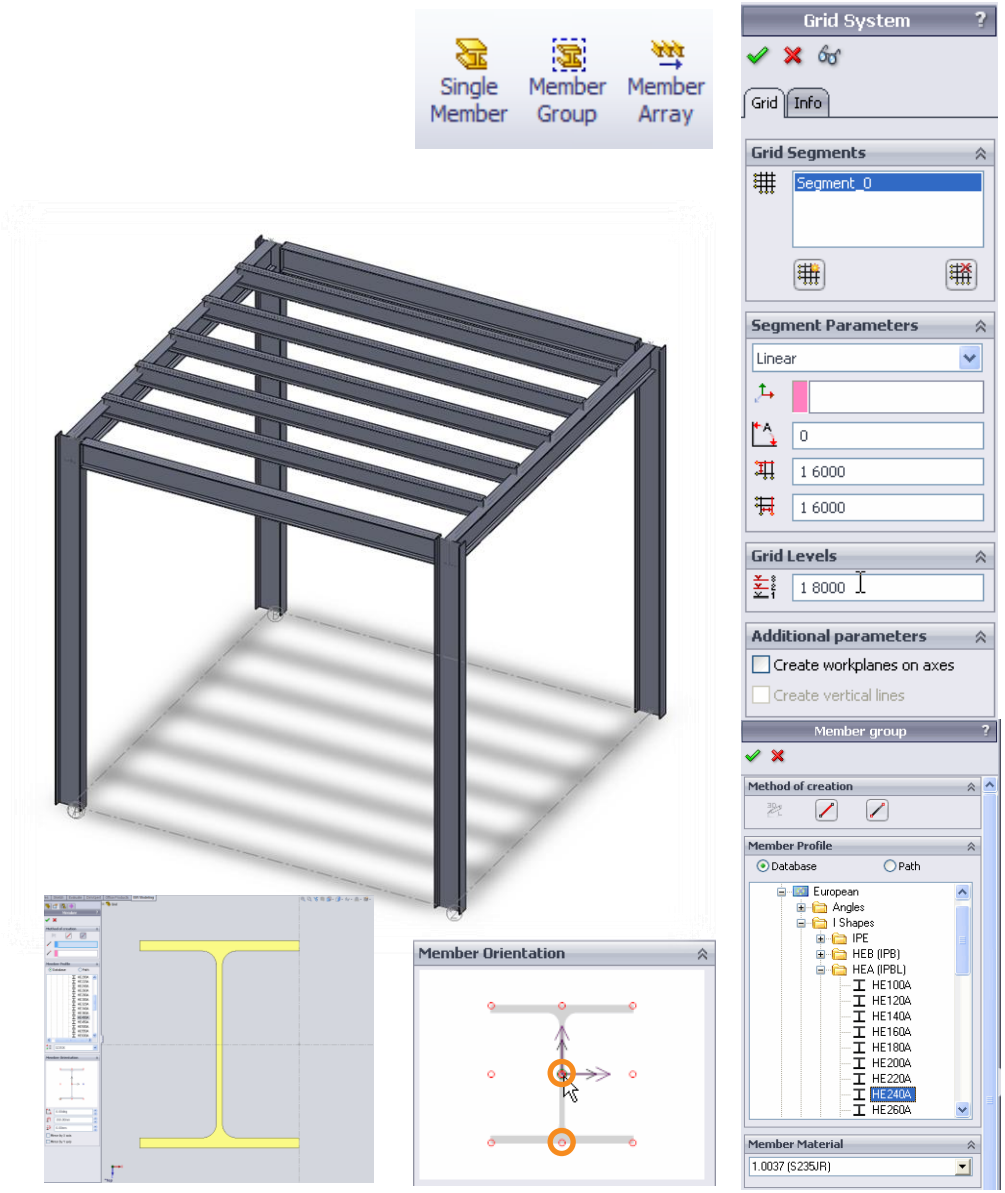
- Integrated workflow within SolidWorks environment.
  - Common data model, common task context menu, intuitive user interface
- Native SolidWorks and embedded BuiltWorks modelling tools to manipulate with
  - SolidWorks Structural elements (Weldment) in Assembly context mode
  - BuiltWorks members (intellectual structural objects) both in Assembly and Part context
- Feature based modelling technology
  - Model history is consistently written to a SolidWorks Feature tree which stores all information about structural elements and details, as well as their relations and attributes



SolidWorks WORLD 2010

Modeling

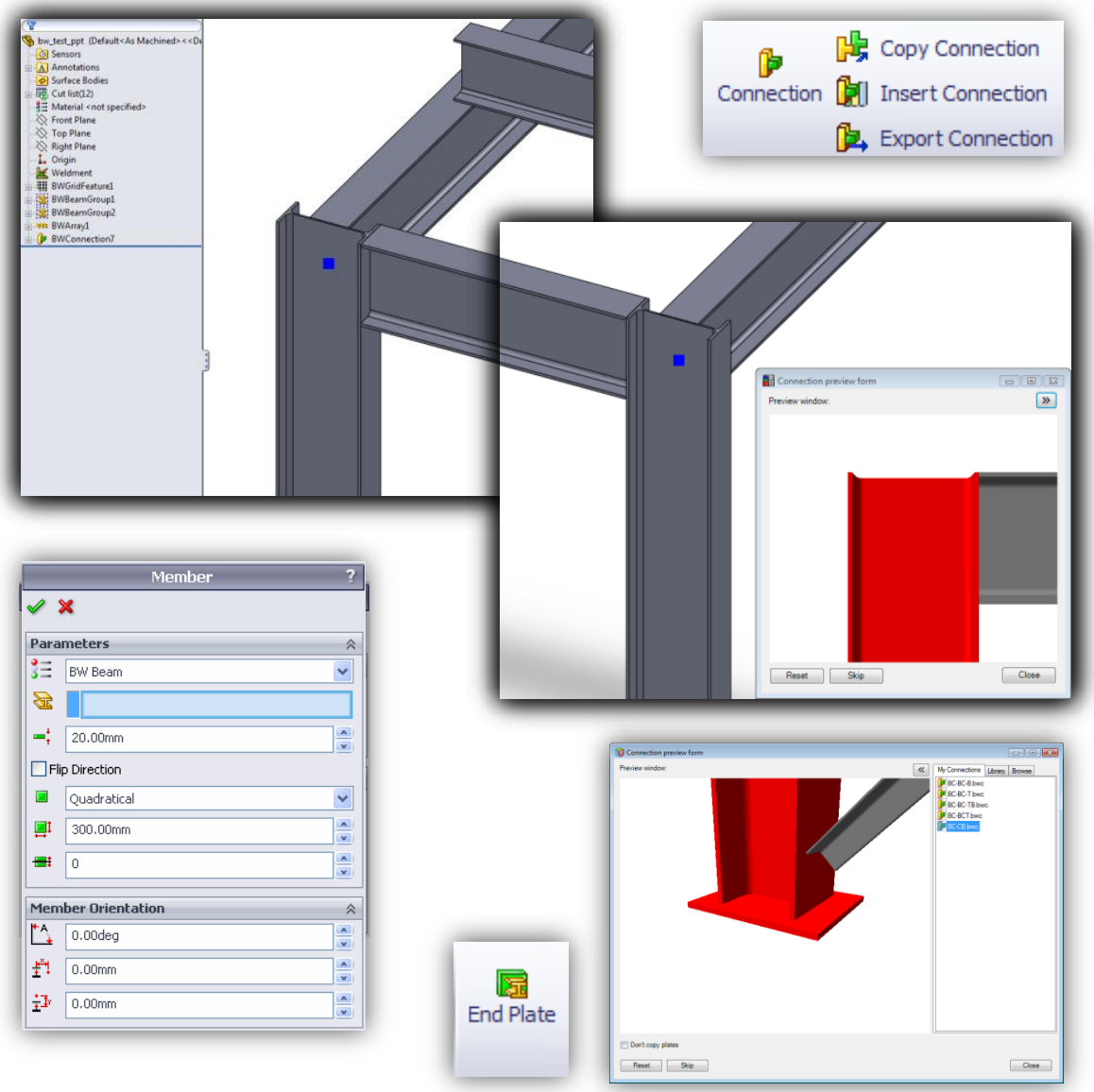
- **BuiltWorks** members are placed, per user's choice, in the context of a parametric wire frame sketch, building grid axes or existing nodes and elements and these are linked by association to the 3D representation
- **BuiltWorks** has extended International standard libraries of steel sections and materials available while, in addition, the user can create and store elements of arbitrary shapes and parametric sections which can accommodate for curved and tapered members.



SolidWorks WORLD 2010

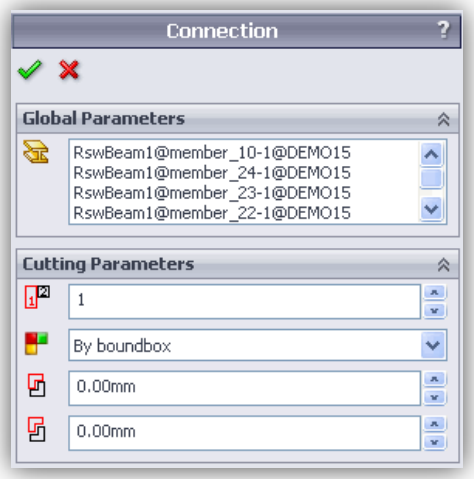
Detailing

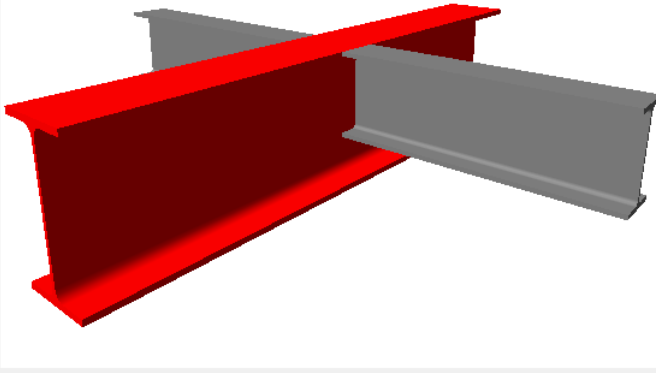
- **BuiltWorks** has connection modelling engine that provides flexible and intuitive tools for free connections detailing
  - Relations by chosen priority
  - Joining and cutting
  - Placing of connection plates and stiffeners
  - Placing of fasteners and weld lines
  - Copying of connection within the model space
  - Saving connection models to the library
  - Using connection models from the library



Detailing
Intersections and cuttings

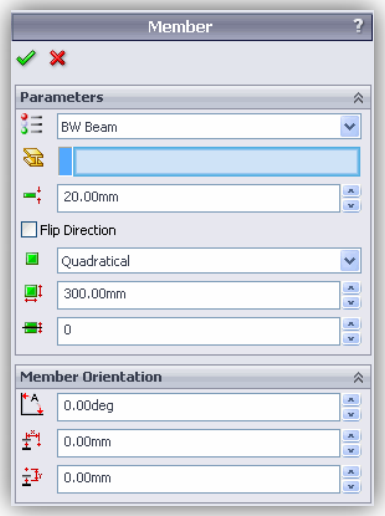
- Special features establishing priorities for intersected members
  - “Who cuts who”
- Special features for setting rules on connections cutting by intersection shape:
  - by normal
  - by bounding box
  - by plane
  - by master profile
  - by user profile
  - by lower priority
  - by intersection
  - by selected body (plane, face)
- Member’s shortening
- Clearance (gap) between members

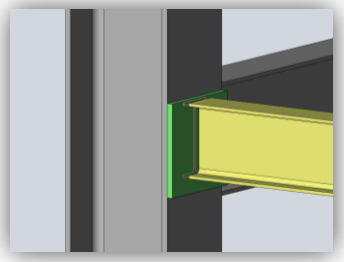


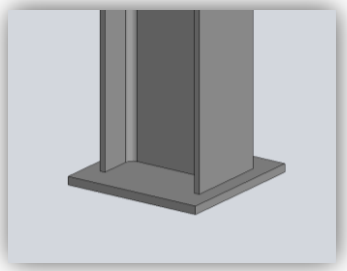


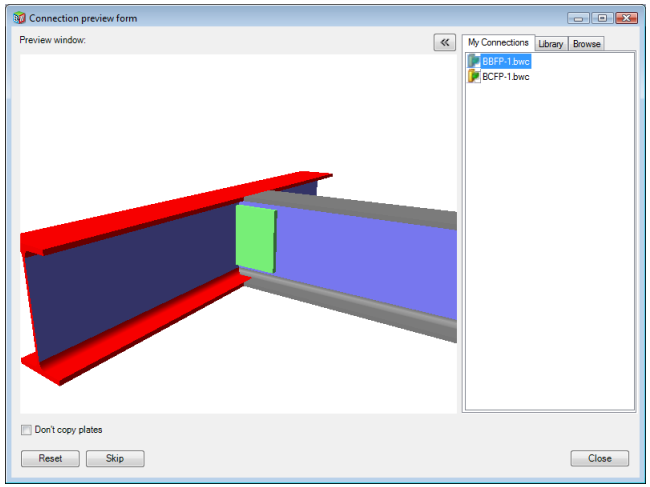
Detailing
Placing of connection plates

- Generation and placing of connection plates, short plates, angles and other standard shapes
  - End plates:
    - Standard shapes, user shape
  - Free plates (fin plates, stiffeners, etc)
    - Standard shapes, user shape
  - Angle cleats
  - Bearing brackets, angles
- Placing and positioning features
    - On member face
    - On member end
    - Face to face
    - Edge to face
    - Using SolidWorks mates
    - Using BuiltWorks mates



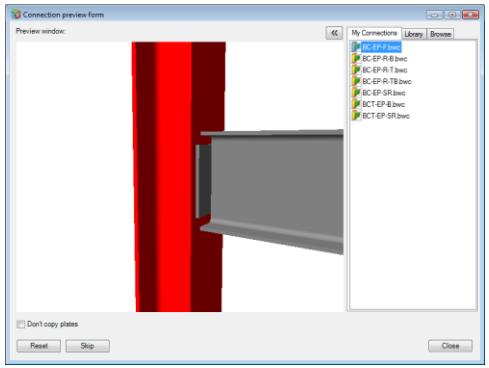


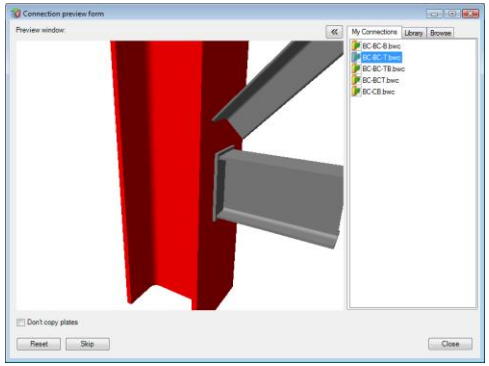


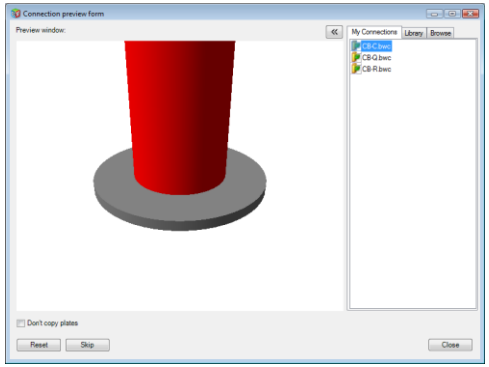


Detailing
Copying of connection. Connection library

- Preview window to manage selections and copying rules
- Copying of connections:
  - Copying of connections within the model
  - Copying of connections to the library
  - Copying of features:
    - SolidWorks features
    - Cutting
    - Connection plates
    - Fasteners
- Connection library
  - Project connection library
  - Standard connection libraries
  - User (free) connection libraries



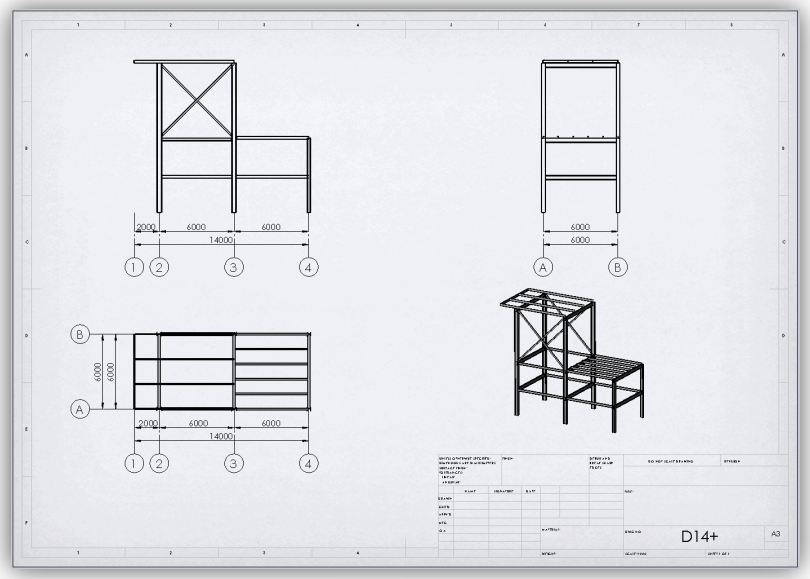


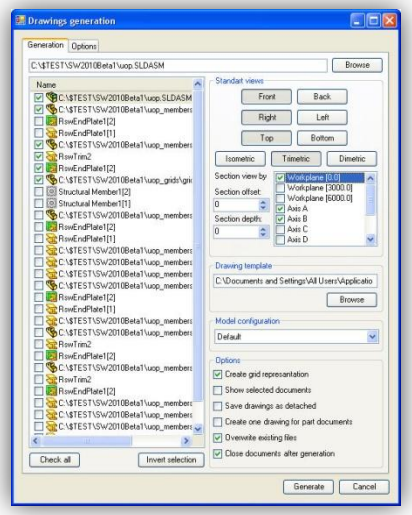


SolidWorks WORLD 2010

Drawings

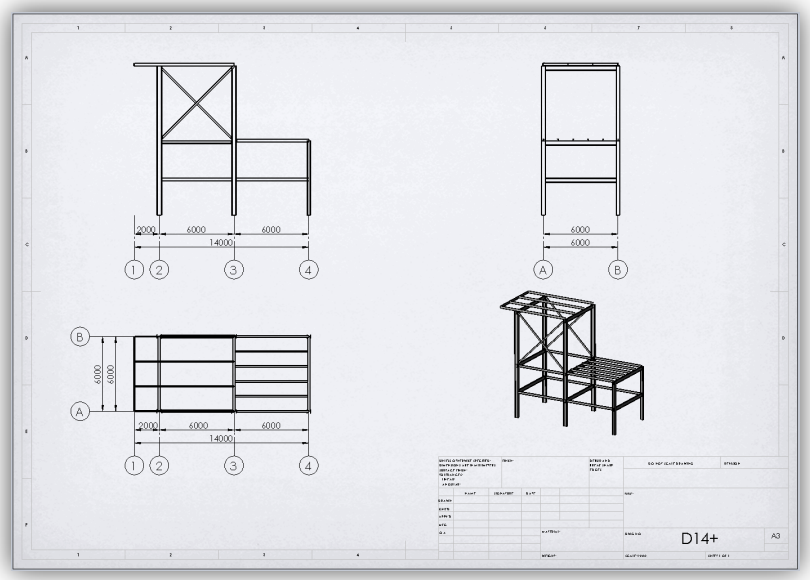
- BuiltWorks allows automatic generation of design stage general arrangement drawings, detailed fabrication drawings of steel assemblies as well as component workshop drawings.
  - Generation of standard building views from 3D model:
    - Plans and Elevations
    - Sections
    - Isometric views
  - Combined views in one drawing page:
    - Assembly views
    - Assembly & assembly components views
  - Generation of Grid representation object
    - Axis lines with named balloons
    - Dimensions between axis
    - General dimension line

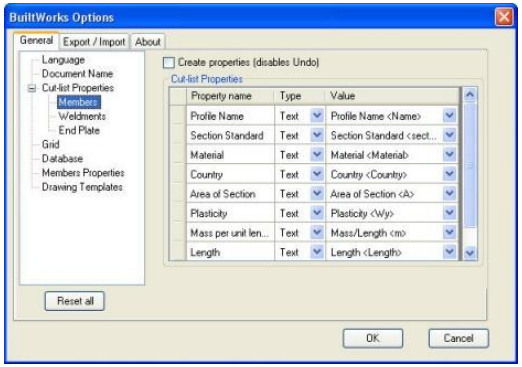




Bill of Materials (BOM)

- BuiltWorks provides the user with a versatile tool that can report practically anything that is included in the model. BuiltWorks creates bills of material (BOM), construction lists and specifications from the general model of the building.
  - Generation of Cut list properties by any Structural member (section) data available from database
  - Cut list Properties for specifications (BOM)
    - for BW Structural Members
    - for Weldments created from Database
    - for connection plates

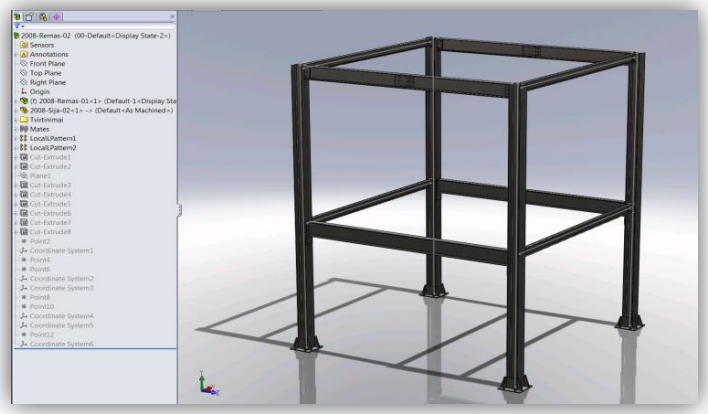


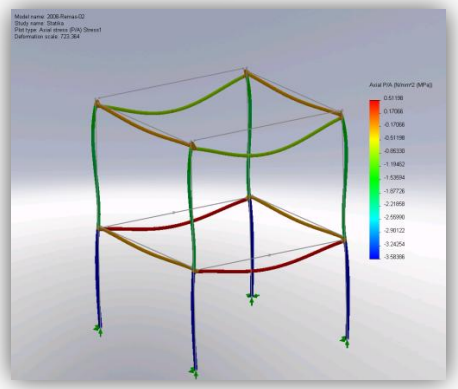


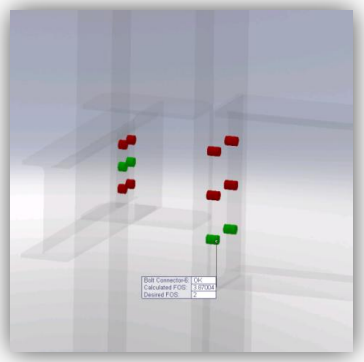
SolidWorks WORLD 2010

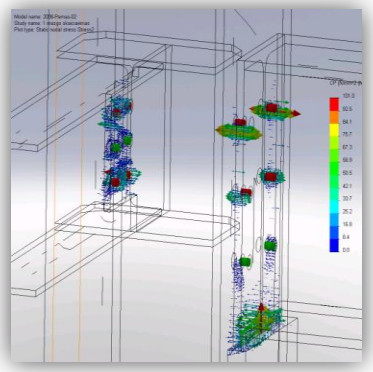
Analysis

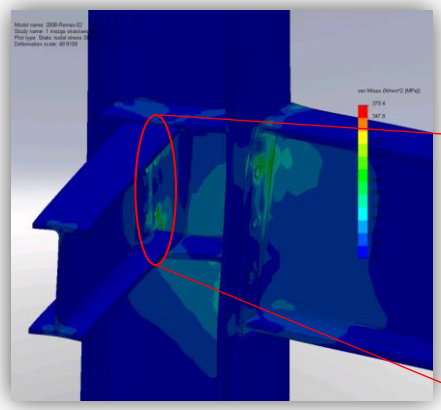
- Really seamless links to SolidWorks Simulation environment for FEA analysis
- All the true physical parameters from SolidWorks are read and automatically transferred to SolidWorks Simulation analysis Model

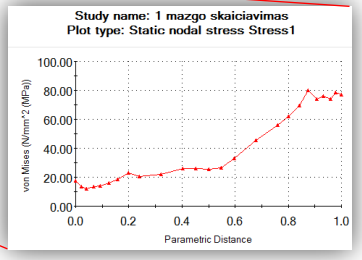






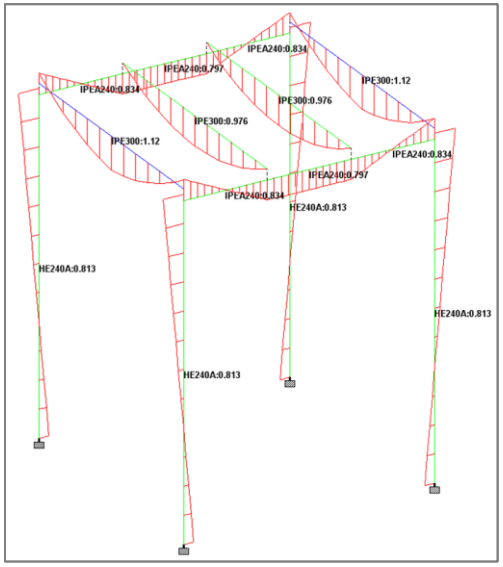


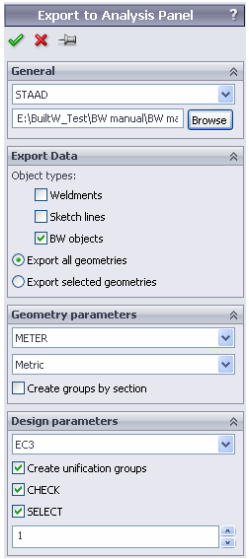


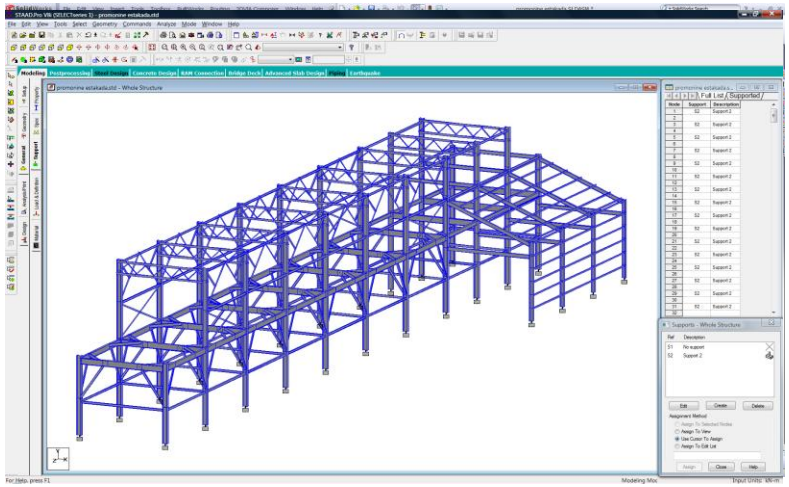


Analysis

- Really seamless links from the SolidWorks environment to leading third-party structural Analysis and Design systems like STAAD.Pro, RAM, SCAD, LIRA is available.
  - BuiltWorks generates STAAD.Pro analysis model directly from SolidWorks physical model
  - All the true geometry and physical parameters from SolidWorks are read and automatically transferred to STAAD.Pro analysis model
    - Model geometry
    - Cross-section data, including B-angle
    - Materials
    - Offsets of connections
    - Member groups
    - Code Check necessary data

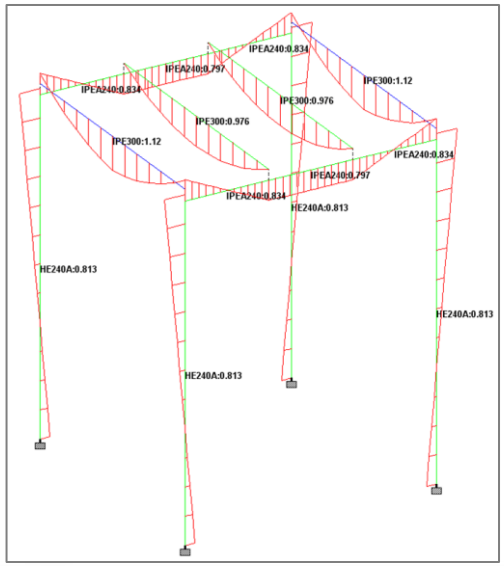


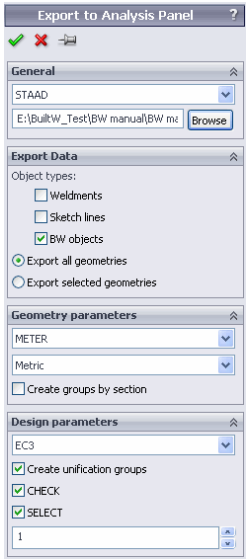


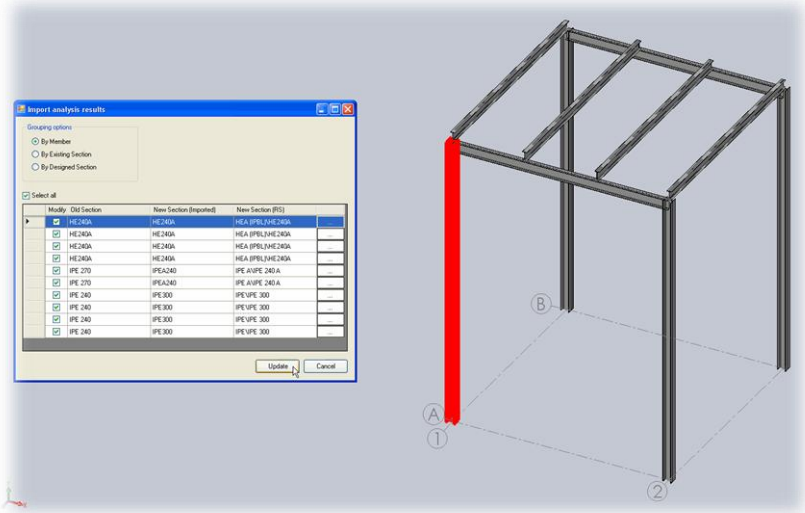


Analysis

- After structural analysis and design of the model is performed, results for sections received during code check are automatically transferred and assigned to the elements of the structural model
- The elements are updated in accordance with the parametric model links
  - Facilities to manage updateable sections
    - Accept section update
    - Skip update of section
- Import of Analysis model from Structural Analysis Software STAAD.Pro for future modelling and detailing







Translators
Export/Import of SDNF format, export of DSTV NC

- BuiltWorks can read and save data in popular industrial formats, including SDNF and DSTV NC.
- SDNF format ensures integration of the data between SolidWorks and Plant Design and other CAD systems including those steel detailing
  - Export/import of SolidWorks model to/from SDNF data file
    - Export/import of SolidWorks part model to SDNF
    - Export/import of SolidWorks assembly model to SDNF
- DSTV NC standard allows steel manufacturers to use models or drawings generated in digital machine-tool control applications.
  - Export of SolidWorks model to DSTV NC data file
    - export of SolidWorks part model to SDNF
    - export of SolidWorks assembly model to SDNF

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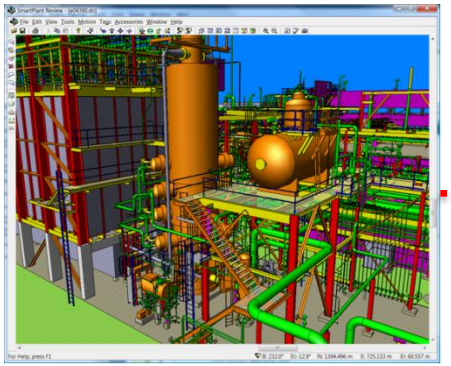
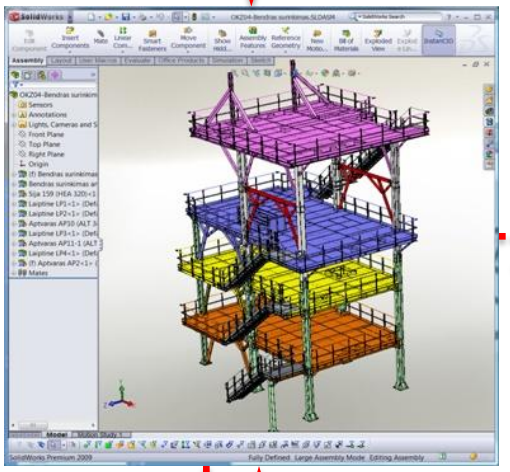
Integration with Plant and Structural CAD, A&D Systems

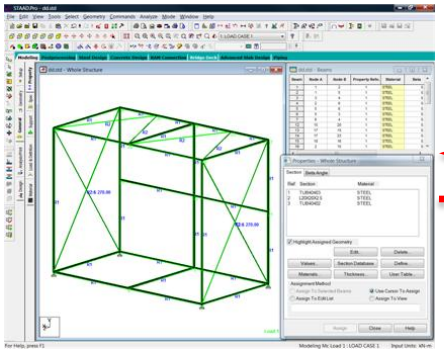


Import structural general arrangement model via SDNF and CIS/2 formats from Intergraph PDS, SmartPlant, AVEVA PDMS, Bentley AutoPlant, Plant Space

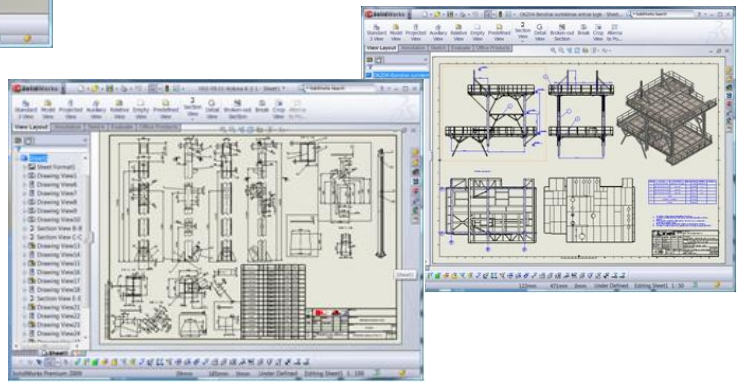


Export NC data in DSTV formats

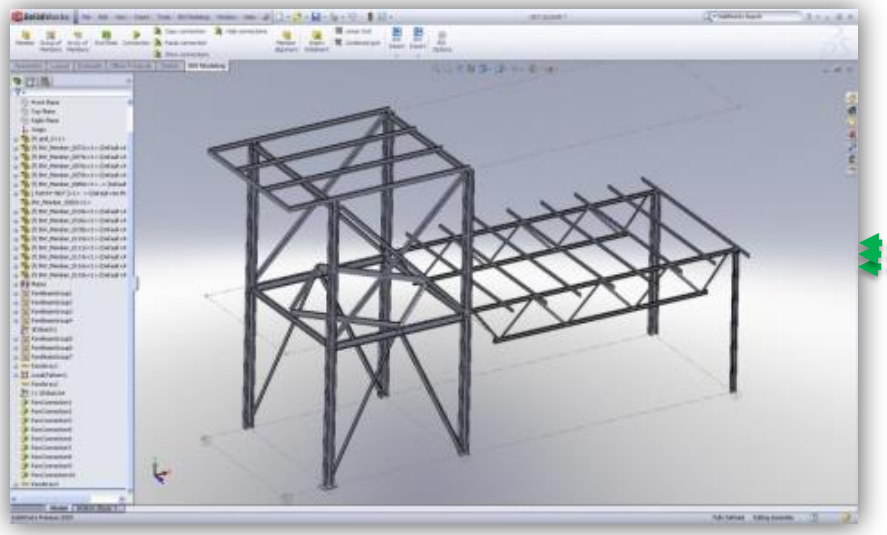
Create general arrangement & shop drawings in SolidWorks

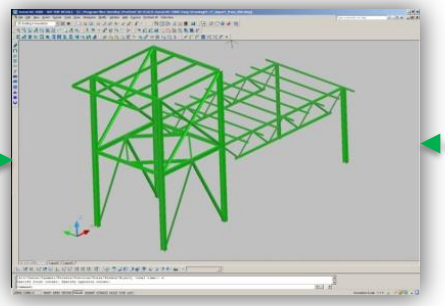


Bi-directional link to structural design software: STAAD.Pro, RAM, Lira, SCAD, …

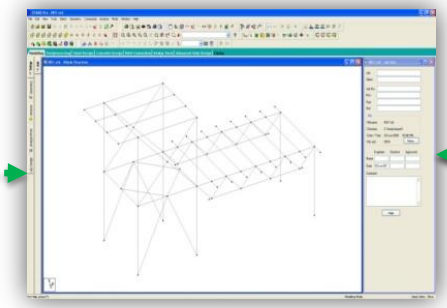


Translators
Export/Import of SDNF format

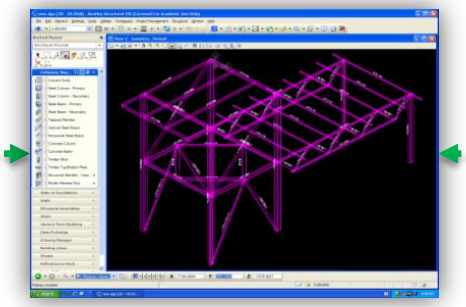




Bentley ProSteel

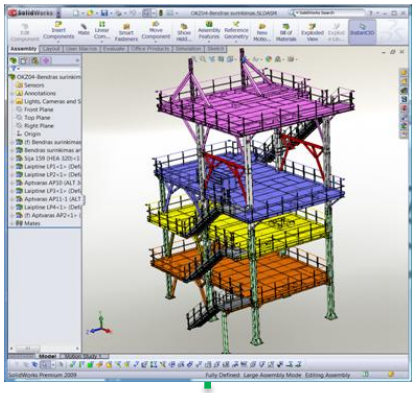


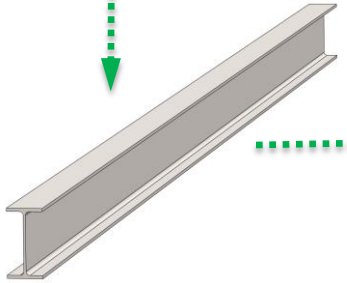
STAAD.Pro



Bentley Structural

Translators
Export/Import of of DSTV NC





BWBeam1.nc - Notepad

File Edit Format View Help

```
BWBeam1.nc ** Name of member

1
IPE 160
I
4500     **Length
160      **Profile Height
82       **Profile Width
7.4      **Flange Thickness
5        **Web Thickness
9        **Radius
15.8     **Weight by meter
0        **Painting surface by meter
0        **Web Start Cut
0        **Web End Cut
0        **Flange Start Cut
0        **Flange End Cut
PR
  11.5 -72.5999999046 9 90.0000000000003
  2.5 -63.5999999046
  2.5 -63.5999999046
  2.5 63.5999999046
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  -2.5 63.5999999046
  -2.5 63.5999999046
```

Export NC data in DSTV formats

INDUSTRY INTEGRATION

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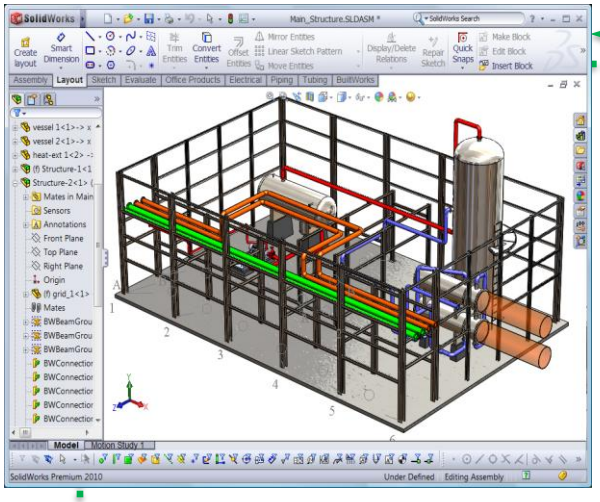
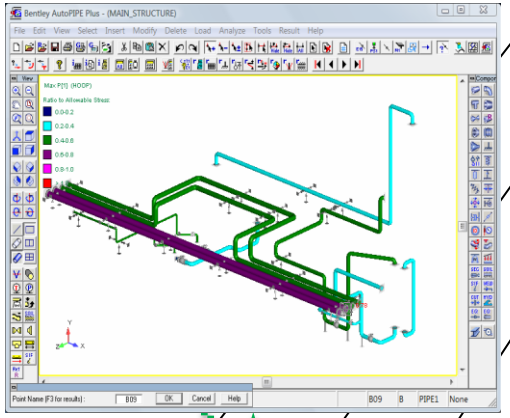
Integration with Piping and Structural A&D systems

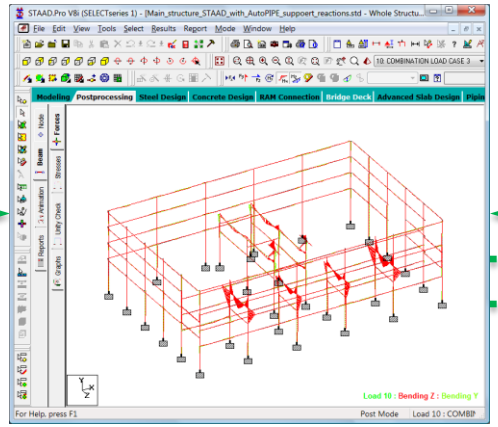


Export of pipeline data to AutoPIPE in PCF format

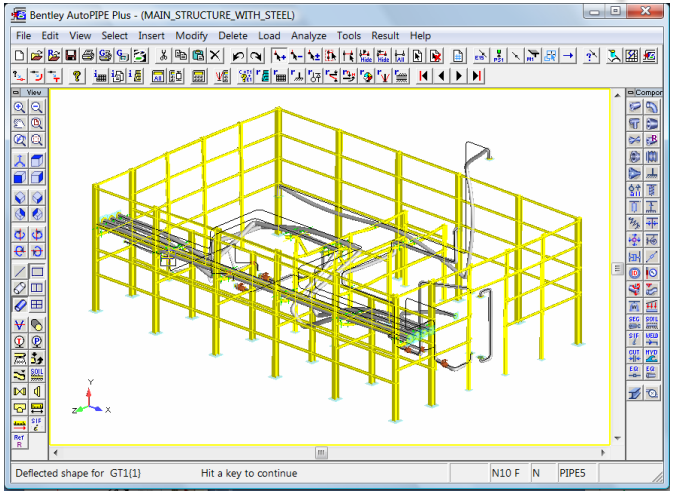


Import of AutoPipe result data to SolidWorks

- Export support data to structural analysis
- Export structural model to pipe analysis
- Final analysis of structural-piping system

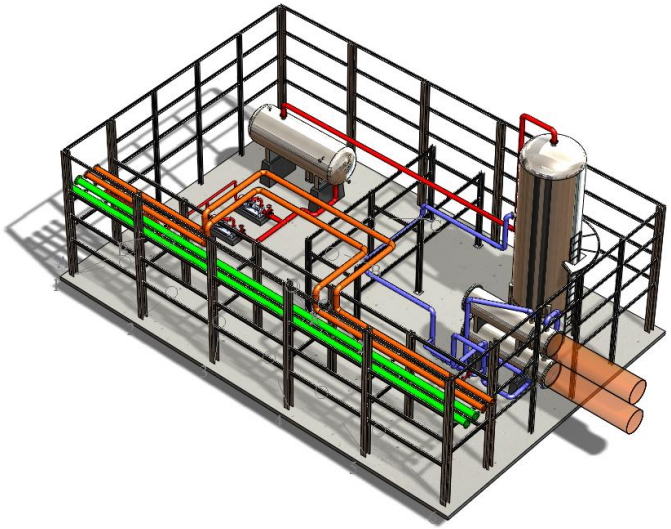


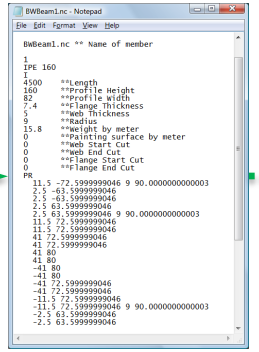
Export SolidWorks structural data to STAAD.Pro in STD format

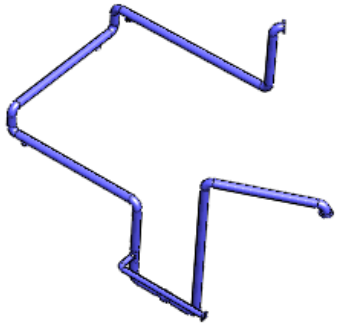


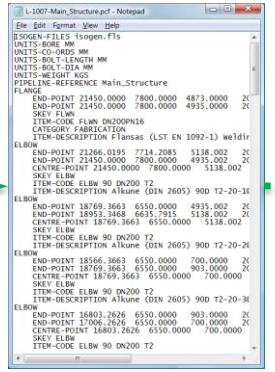
SolidWorks WORLD 2010

Integration in Piping and Stuctural manufacturing





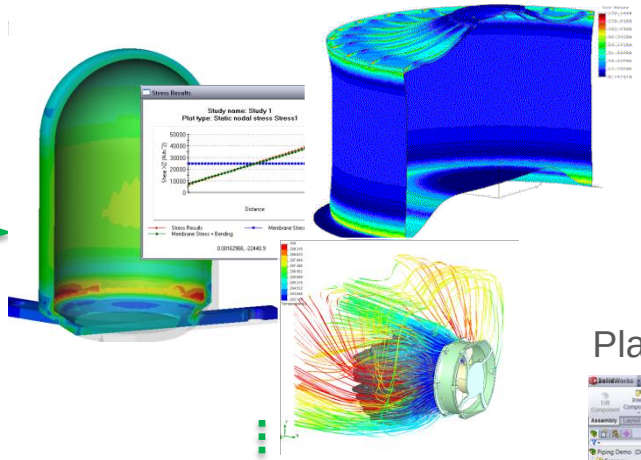




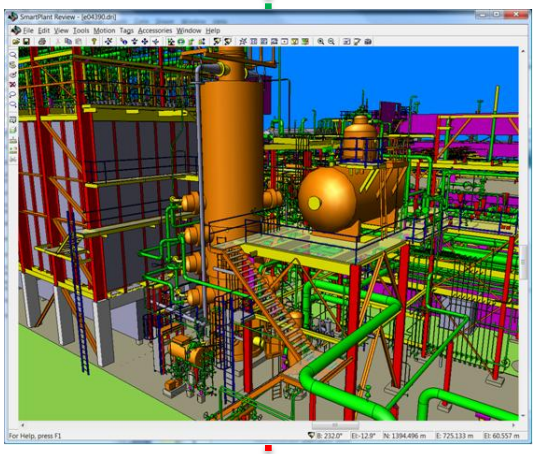
SolidWorks WORLD 2010

Integration with Equipment A&D

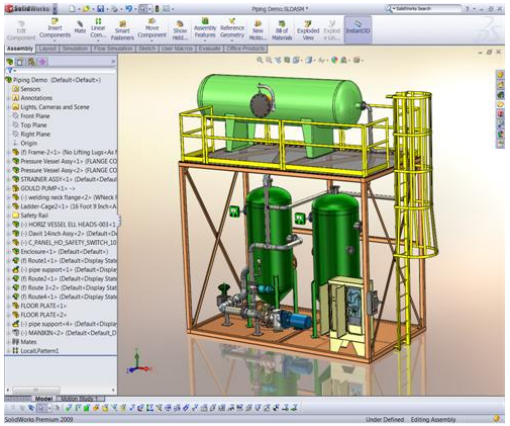
Design Equipment using SW Simulation FEA (COSMOS Works, FlowWorks), and Code Based options (ASME codes)

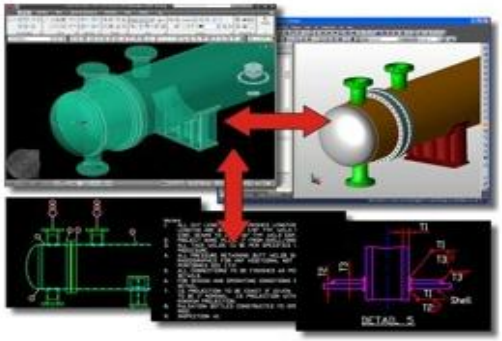


Plant Information Model



Plant Physical Model



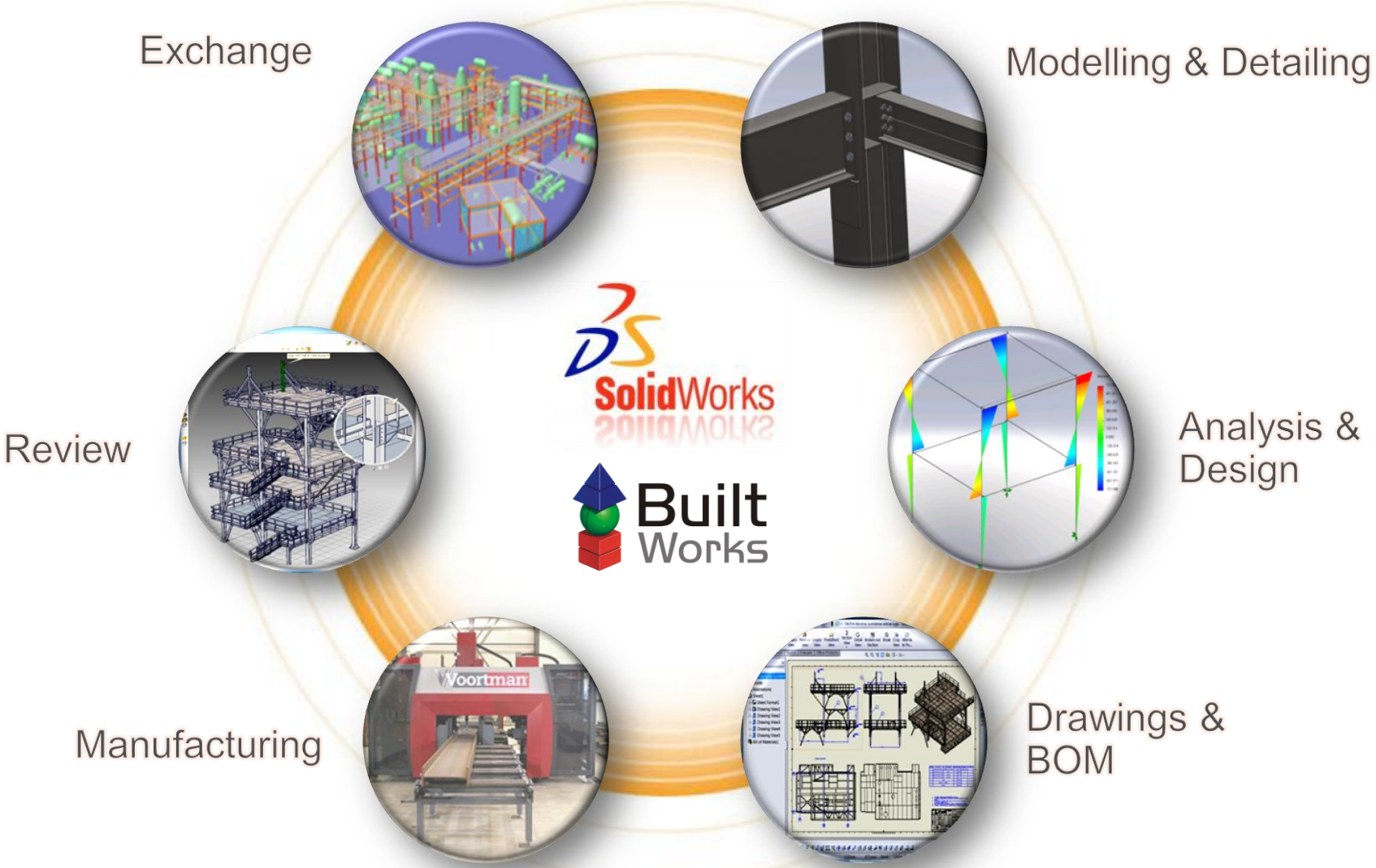


Code based A&D of equipment

COADE ENGINEERING SOFTWARE

SolidWorks WORLD 2010

BuiltWorks design circle within the SolidWorks environment



below:

SolidWorks WORLD 2010

Calendar of SolidACE events at SWW2010

Date and Time	Event	Location
Mon., Feb. 1 through Wed., Feb. 3	Exhibiting BuiltWorks 2010 at Partner Pavilion	Exhibit Hall A, SolidACE booth #733
Mon., Feb. 1, 4:30 – 6:00 p.m.	Technical Training Session "**Plant Design Using SolidWorks Together with Solution Partner Products and Other Standard Industry Tools**", *Dr. Vladimir Popov, CEO of SolidACE* *Andrey Yarmolaev, Technical Director, IN RE UAB*	Convention Center Level 2, Room: 204A
Tue., Feb. 2, 4:30 – 6:00 p.m.	Technical Training Session "**Structural Steel Design using SolidWorks and Solution Partner Products**", *Eric Leafquist, Product Manager, DS SolidWorks Corp.* Co-presenter: *Dr. Vladimir Popov, CEO of SolidACE*	Convention Center Level 3, Room: 304A/B
Wed., Feb. 3, 12:00 – 1:30 p.m.	BuiltWorks 2010 from SolidACE – Short Live Demo Session for SolidWorks VARs and TTMs	GoldKey Ballroom I, Marrion Hotel 15
Thu., Feb. 4, 8:30 a.m. - 1:30 p.m.	BuiltWorks 2010 from SolidACE – Extensive Post-Conference Training Session for registered SolidWorks users.	Hilton Hotel, 4th Floor, Conference Room

SolidWorks WORLD 2010

Locate SolidACE booth #733 at Partner Pavilion

SolidWorks WORLD 2010

SolidACE, UAB

www.solidace.com

IN RE, UAB

www.inre.lt

Lukiskiu str. 3, VI floor

LT-01106 Vilnius,

LITHUANIA

THANK YOU, Q & A