AUTODESK **UNIVERSITY** 2015

ES9599

Involve Analysis from Predesign Through to Documentation Phase in Your BIM Process

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Autodesk

Learning Objectives

- Learn how to perform load takedown with Gravity Analysis for Revit
- Learn how to analyse your Revit model in the cloud to evaluate early stage design
- Learn how to build up detailed structural analysis models with Revit and Robot Structural Analysis
- Learn how structural analysis can be introduced in the early stage of your BIM design process

Description

This class is intended for structural engineers/technicians and contractors who struggle with the on-time delivery of accurate structural analysis results. It's a daily challenge for structural engineers to make the right decisions on structural geometry based on limited project data. Being competitive in structural design means early delivery of building construction documentation. In this session you will learn how to perform early-stage analysis on your structural models in Revit in order to define the right foundation design. You will discover how to detect structural problems in your predesign stage of your Building Information Modelling (BIM) process using cloud analysis in Revit with the Structural Analysis toolkit. Find out how to share your analysis conclusions with the other stakeholders of the project. Finally, we will evaluate the predesign decisions with comprehensive detailed analysis of your structural model in Robot Structural Analysis.

Your AU Experts

Working as a Structural Technical Specialist for the Northern European region at Autodesk, ***Dieter Vermeulen*** *is specialized in the products of the structural solutions portfolio. Within that domain he supports the channel partners and customers with workflow solutions, especially - but not limited to - for structural engineering.*

With Revit, RSA and Dynamo as his sidekicks, he is offering BIM workflow solutions covering the building process from design over analysis to fabrication for steel and concrete constructions.

Dieter has over 15 years of experience in the structural engineering business and started his career in 2000 at Jacobs Engineering as Structural Engineer. Since 2008 he became active in the Autodesk channel and worked as a Sr. BIM Implementation Manager for a Value Added Reseller in Belgium.

Twitter www.twitter.com/BIM4Struc
LinkedIn www.linkedin.com/in/dietervermeulen
WordPress personal blog www.revitbeyondbim.wordpress.com
Typepad team blog www.autodesk.typepad.com/bimtoolbox/

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Introduction

Autodesk offers a portfolio of software tools that help structural engineering teams take on today's project challenges. The extended Autodesk portfolio of products helps make it easier for structural engineers to more closely coordinate project documentation with extended team members.

The Autodesk structural engineering portfolio of products provides benefits to structural engineers, including:

- The ability to design and document structural engineering projects with more efficiency and accuracy
- Powerful tools that enable simulation and analysis of structural systems for building projects
- Tools to help optimize structural engineering workflows from design to fabrication

Various market forces are driving industry trends affecting structural engineering companies, including:

- **Building Information Modelling:** BIM provides structural engineers with a competitive advantage by enabling the design, analysis, and optimization of structural systems designs before they are built. As owners, contractors, and designers continue to adopt BIM at a rapid pace, the demand for structural engineering firms who have embraced BIM workflows increases, helping those firms gain a competitive advantage
- **Decreasing new construction spend:** The global decline in new construction spend is creating an opportunity to assess and improve efficiencies in existing building stock through renovation and retrofit projects.
- **More efficient designs:** As building owners increasingly demand buildings that are energy efficient and designs that adhere to more stringent structural design codes, building teams can turn to software solutions to create more efficient structural designs.

What are your most critical business issues?

- **Increased project requirements with decreased budgets?** Project designs are becoming more increasingly complex. How will your business rise to the challenge of managing these types of projects when project teams and budgets are smaller?
- **Finding new business in today's competitive economy?** With fewer new construction projects in our current competitive economy, how will you differentiate yourself from the competition?
- **Too much time is spent on inefficient tasks and disconnected workflows?** With reduced resources and greater project requirements, how can you maximize your efficiency with current staffing levels? Does your engineering staff spend too much time on disjointed workflows resulting in less efficiency and re-work due to poor coordination of structural design and analysis?

Issues facing your business

- Coordinating documentation on every stage of designing process (modelling, analysis, and fabrication) using non-interoperable software is difficult and time consuming.
- Analysis and calculations of large, complicated or unusually shaped structures takes too much time, especially in generating reliable, good-quality meshing of the panels.
- Because of the need for various analysis capabilities on a single project, engineers have been using multiple structural analysis models for different applications, instead of using one single model for one analysis solution.

Autodesk Robot Structural Analysis Professional offers a smoother workflow and interoperability with Autodesk Revit.

The software is versatile enough for simple frame or complex finite element analysis (FEA), steel, and reinforced concrete design.

Autodesk Robot Structural Analysis Professional provides support for performing different types of analysis on your structural model. This means you only have to create your model once and can analyse it in multiple ways. The software includes support for both steel and concrete frames. The software allows the simple and effective analysis of many types of nonlinearity, such as P-delta analysis; tension/compression members; and supports, cables, and plastic hinges. It also enables you to explore the response of your structures to dynamic loading such as harmonic frequencies and earthquakes.

Inefficient structural workflows that affect your business

Let's take a more in-depth look at some different types of inefficient structural workflows that could affect your business.

- Incorporating analysis results back into structural designs can be tedious and prone to mistakes. Often multiple structural applications are used for this workflow and it is difficult to ensure that the feedback from analysis gets properly coordinated and included with design updates.
- Transferring final design drawings to the fabrication process is often time consuming and it is difficult to ensure fabrication drawings reflect the true design intent which can be costly.
- Lack of support for local conditions and code requirements can make it difficult to get designs approved. This can also lead to decreased confidence in structural engineering designs if teams are unsure if they are in compliance with local codes.

With Autodesk Robot Structural Analysis Professional, structural engineering professionals can capitalize on interoperability with bidirectional links between Autodesk Revit and Advance Steel, enhancing the BIM workflow. With the powerful combination of Autodesk Revit and Autodesk Robot Structural Analysis, design updates can be more quickly analysed, and the analysis results can be more easily incorporated into the structural model, enhancing the integrity between design and analysis.

In addition, structural engineers can efficiently transfer drawings from structural analysis and design to fabrication drawings. Create structural models and perform structural analysis and design within Autodesk Robot Structural Analysis, and more smoothly transfer the model and results to Revit and Advance Steel to generate fabrication drawings.

Before Getting started

Some important remarks, before you start reading this handout.

- For better understanding of this handout, a basic knowledge of Revit and Robot Structural Analysis is advised.
- A comprehensive list of learning resources is listed at the end of this handout.
- All the instructions are recorded into structured video captures. The video recordings are embedded in the presentation and organized in a logical way of use in the presented workflow.

Used software

To perform the whole process several software is used:

- **Autodesk® Revit 2016**
  Used for the design of the full steel and reinforced concrete structure
  More info on : http://www.autodesk.com/products/revit-family/overview

- **Autodesk® Robot™ Structural Analysis 2016**
  Used for the structural analysis of steel and concrete structures
  More info on: http://www.autodesk.com/products/robot-structural-analysis/overview

- **Results Connect**
  Results Connect is an application that allows designers and engineers using Autodesk Robot Structural Analysis to seamlessly access data and results with Microsoft Office Excel.
  More info on: https://knowledge.autodesk.com/support/robot-structural-analysis-products/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/RSAPRO-WhatsNew/files/GUID-A8E4D3BD-FD44-4189-85B2-85B35705C704-htm.html

- **Structural Analysis Toolkit 2016**
  Add-In for Revit which is used for integrating the Revit analytical model with Robot Structural Analysis and making connection with the Autodesk 360 Cloud Analysis tools.
  More info on:
  https://apps.autodesk.com/RVT/en/Detail/Index?id=appstore.exchange.autodesk.com%3astructuralanalysistoolkit20151427698407_windows64%3aen

- **SOFiSTiK Reinforcement Generation 2016**
  Add-In for Revit which reads analysis results directly from the Revit Results Packages and generates reinforcement in Revit meeting the required reinforcement.
  More info on:
  https://apps.autodesk.com/RVT/en/Detail/Index?id=appstore.exchange.autodesk.com%3alabssofistikreinforcementgeneration20141436539200143937103 4_windows64%3aen

Project Description

In the next chapters we will have a deeper look in how Revit and Robot Structural Analysis will help us optimize your structural engineering workflow.

The project used here, is a fictive project made by our Autodesk EMEA NE Technical Sales Team, called "Millennium Project". The structure shown below is part of the "Millennium Railway Station" and represents a mixed steel / concrete structure with several floor types used.

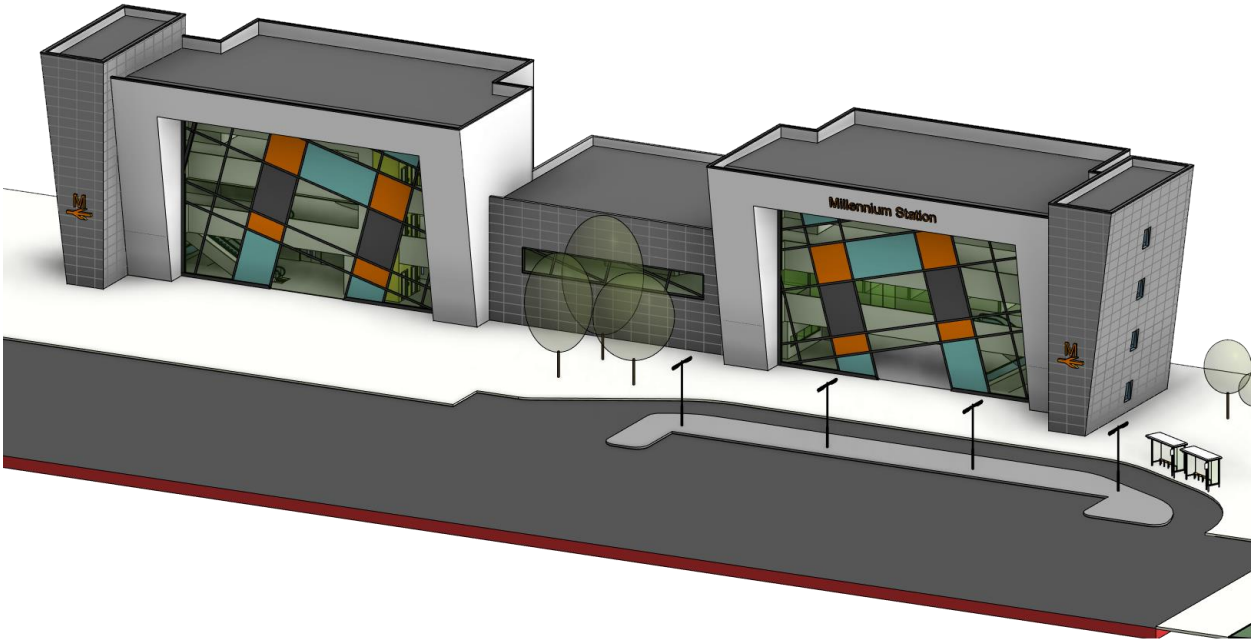


FIG. 1 - MILLENNIUM RAILWAY STATION - ARCHITECTURAL MODEL

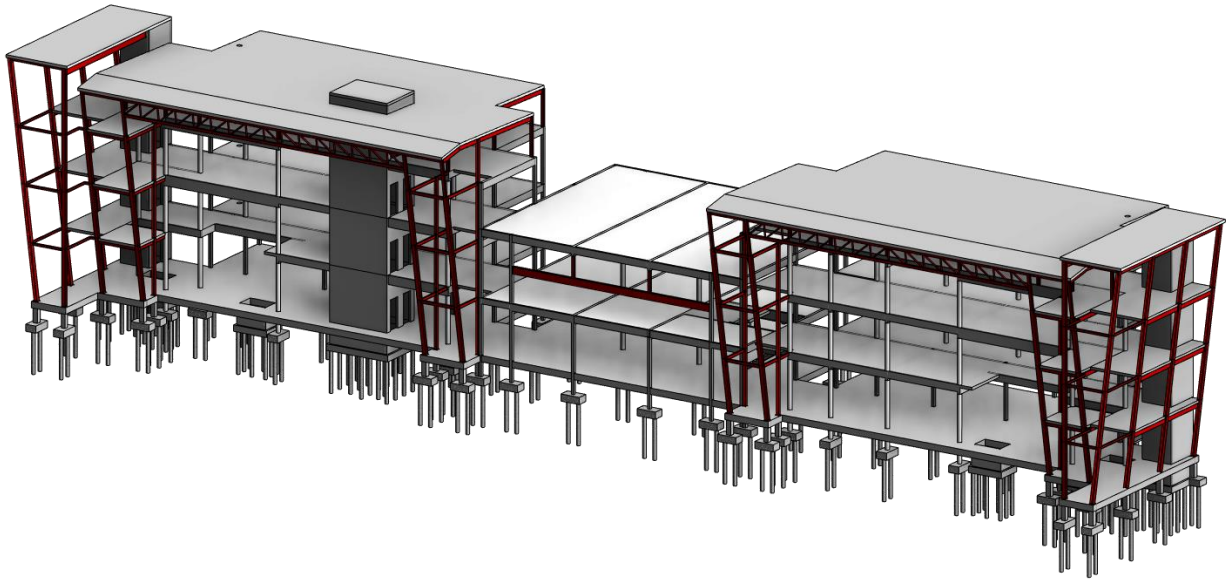


FIG. 2 - MILLENNIUM RAILWAY STATION - STRUCTURAL MODEL

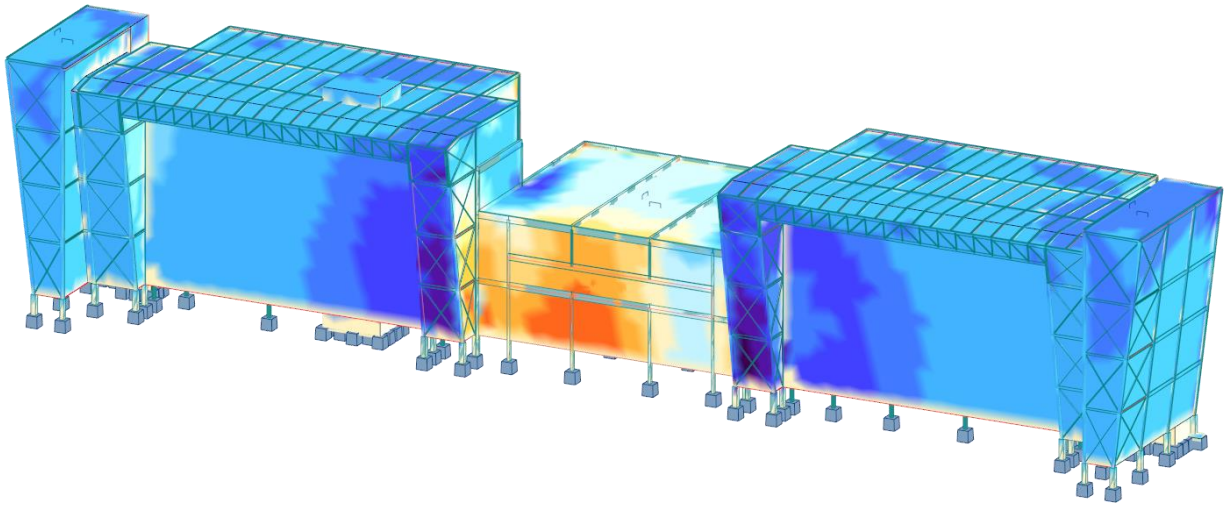
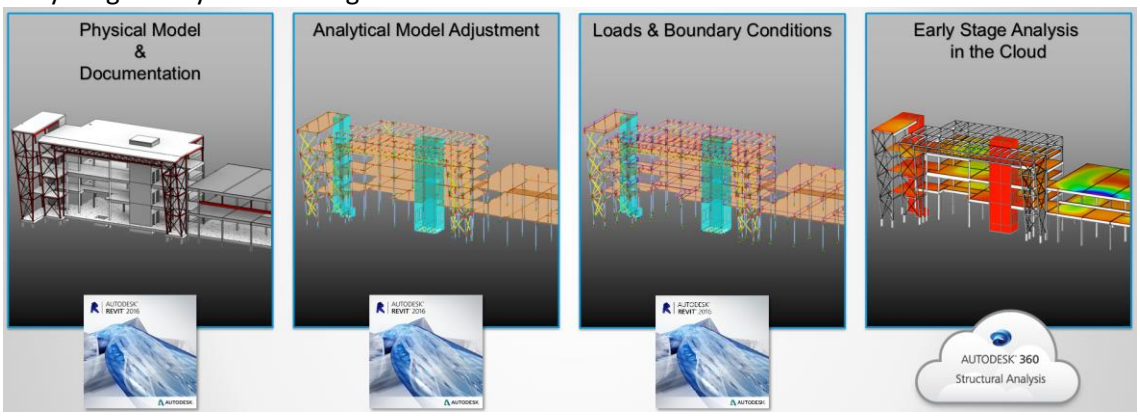


FIG. 3 – MILLENNIUM RAILWAY STATION - STRUCTURAL ANALYSIS MODEL

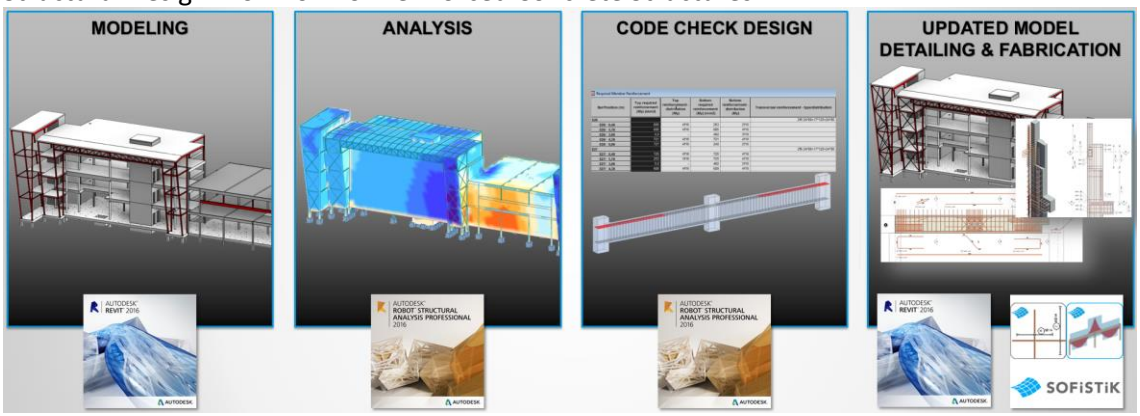
Workflow Description

In this class we will apply the next workflows

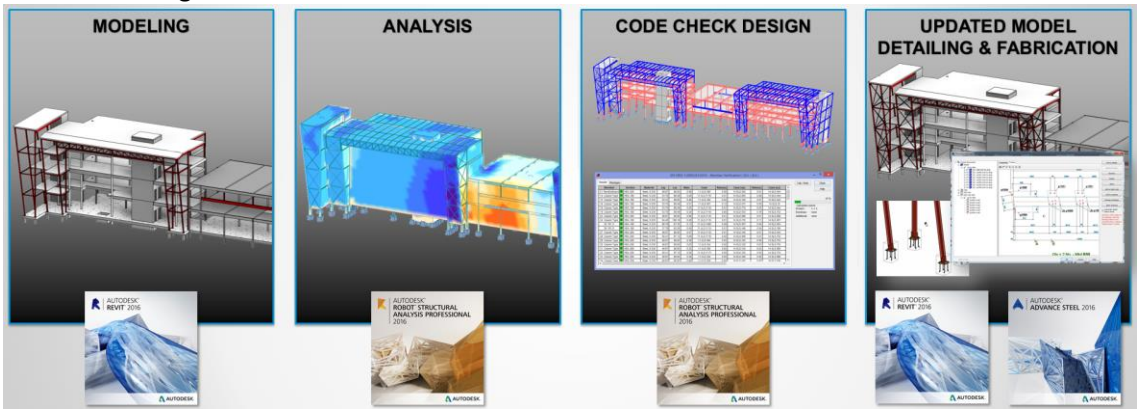
- Early Stage Analysis and Design Workflow



- Structural Design Workflow for Reinforced Concrete Structures



- Structural Design Workflow for Steel Structures



In the next chapters these workflows are described more in depth.

Preparing the model – Setting up the analytical model in Revit

Before making a cloud analysis you need to set up the physical model in Revit. If you use the right structural objects (Structural Framing, Structural Column, Wall, Floor, Structural Foundation), then the analytical model is built up simultaneously.

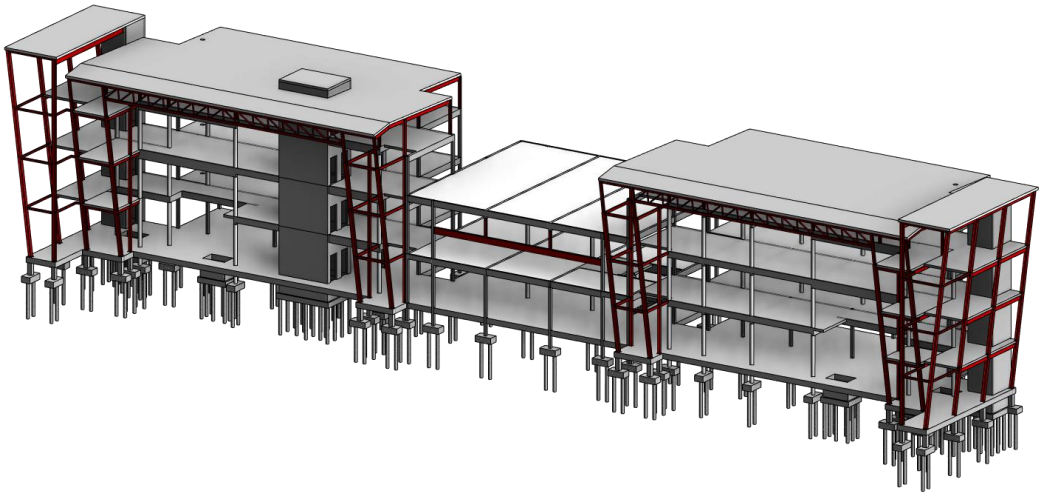


FIG. 4 - PHYSICAL MODEL IN REVIT

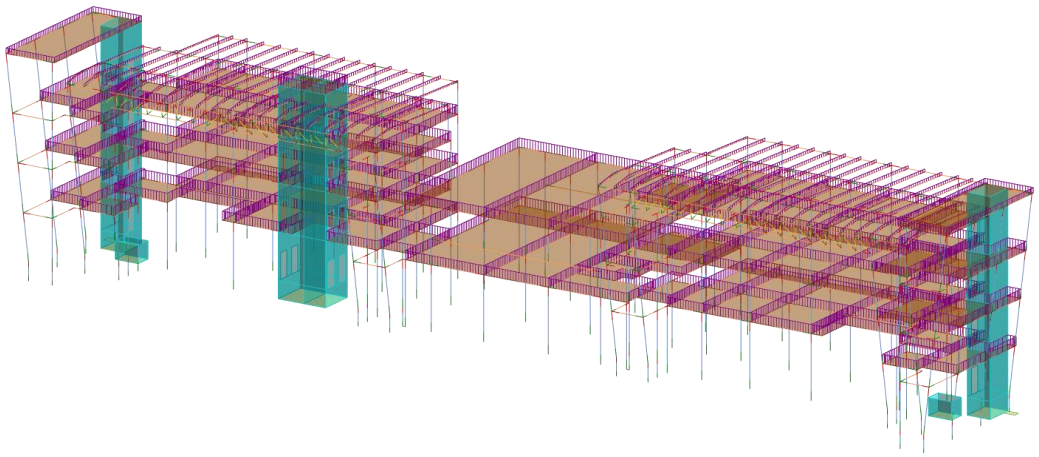


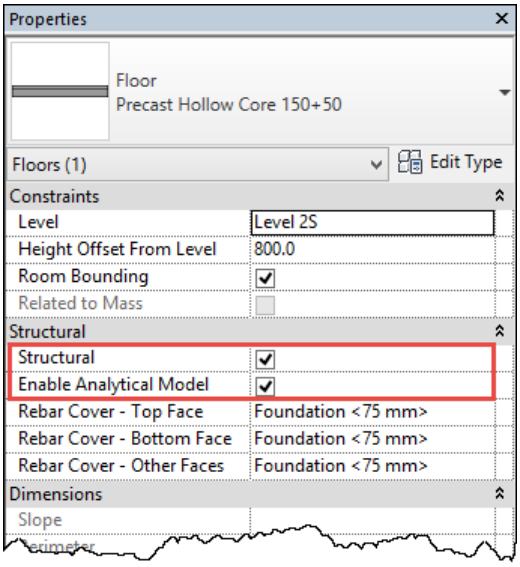
FIG. 5 - ANALYTICAL MODEL IN REVIT

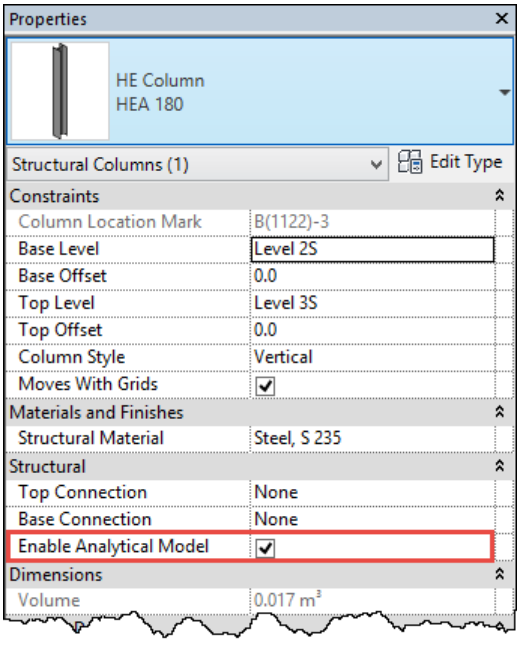
Some rules to take into account when you want to set up a decent analytical model

- First, it is important that you use a good working method for building up your structural model. “BIM Protocols” are quite common in communication between architects and engineers. It could be useful setting this up between the structural engineer and structural designer as well.

- General information on the use of an analytical model can be found on this link: http://help.autodesk.com/view/RVT/2016/ENU/?guid=GUID-264F079B-0134-4C34-A753-B4561C30F300

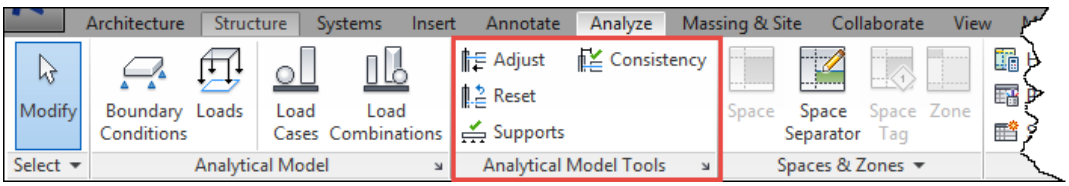
- Make sure that the *Analytical model* is enabled for all elements you want to include in the analysis.





- The analytical model should also be consistent and the elements need to be connected in the right way.
  A list of possible problems you can face, is included in the *02 Railway Station - Structure - 01 Analytical Model.rvt* file in the datasets. Open the view *00 Problem assignments* to see them.

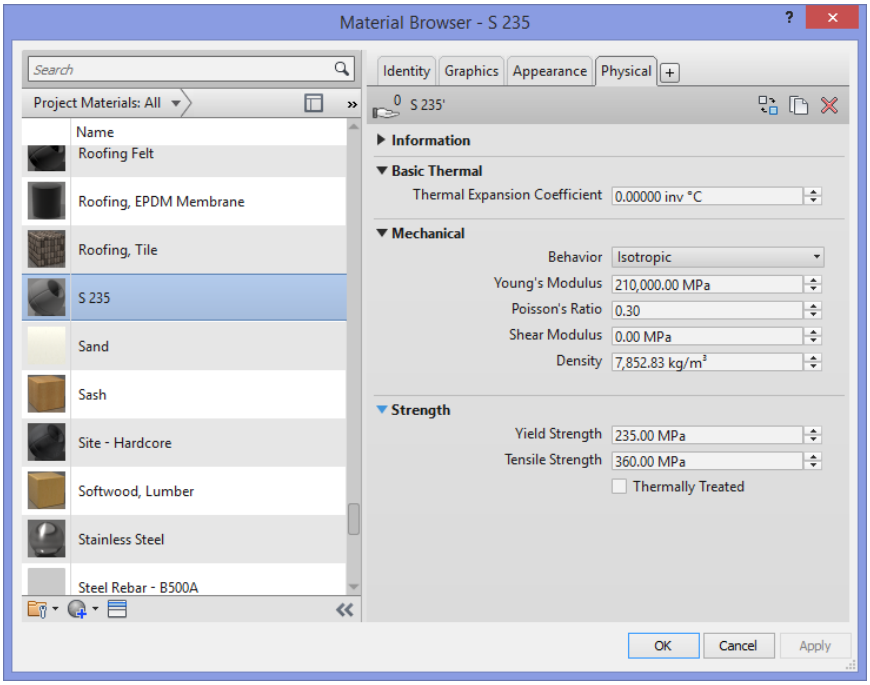
  The *Analytical Model* tools in Revit make it possible to make the necessary corrections.



- Adding *Loads* is necessary for executing cloud analysis. For detailed analysis with RSA, this can be an advantage, but not obligatory.

- Make sure the structural foundations are used as supports. In case not, add *Supports* manually with the *Analytical Model* tools.

- Include Physical assets in the materials you assign to the objects.



Hands-On

More information can be found on the Autodesk Knowledge Network:
The Structural Analytical Model

Instructions on how to change the analytical model are shown on the embedded videos in the class presentation.

DATASETS

02 Railway Station - Structure - 01 Analytical Model.rvt

Early Stage Analysis and Design

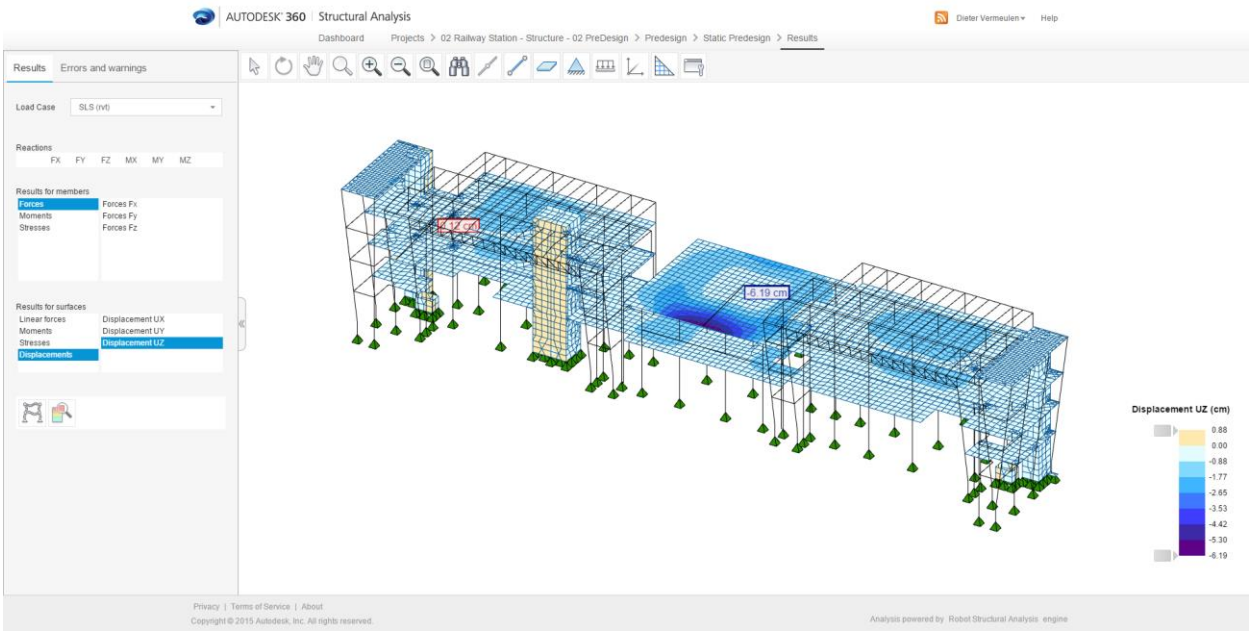
In some cases you need the analysis results of a conceptual structure early in the design process, i.e. in case of making decisions of the foundation types to use in the project.

A solution for this is **Structural Analysis in Revit**. Structural Analysis for Autodesk Revit lets you perform cloud-based structural analysis of a Revit analytical model. You can explore analysis results in the Revit project and on the Autodesk® 360 Structural Analysis website.

To prepare Revit analytical models for analysis, you need to install the Structural Analysis Toolkit for Autodesk Revit on the computer with Revit installed. After a model has been prepared, you can submit the analysis from Revit or from the Autodesk® 360 Structural Analysis website.

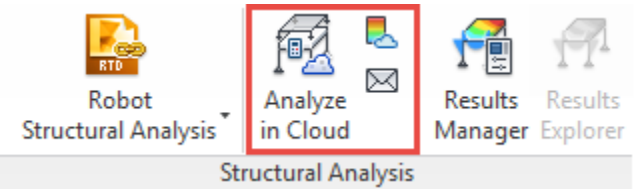
The Structural Analysis for Autodesk Revit add-in uses the Autodesk® Robot™ Structural Analysis Professional engine.

With this toolkit you can send the Revit analytical model to the **Autodesk 360 Structural Analysis** service and perform analysis like *Gravity Analysis* or *Static Analysis*.



To send the analytical model to the Autodesk 360 service, the *Structural Analysis Toolkit* needs to be installed.

The tools can be accessed on the *Analyze* tab in Revit.



With *Analyze in Cloud* the analytical model is checked and then sent to the Autodesk 360 service. Therefore a valid Autodesk ID is needed and you need to have cloud credits available.

You access the results through http://structuralanalysis.360.autodesk.com

These results can be shared with other stakeholders by either share them the cloud design, either download the results in Revit, with the *Results Manager*.

Hands-On

More information can be found on the Autodesk Knowledge Network:
Using Structural Analysis for Autodesk Revit

Instructions on how to perform cloud analysis are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Structure - 02 PreDesign.rvt

Send the analytical model to RSA for detailed analysis

When you need to perform a detailed analysis, you can send the Revit analytical model to Robot Structural Analysis.

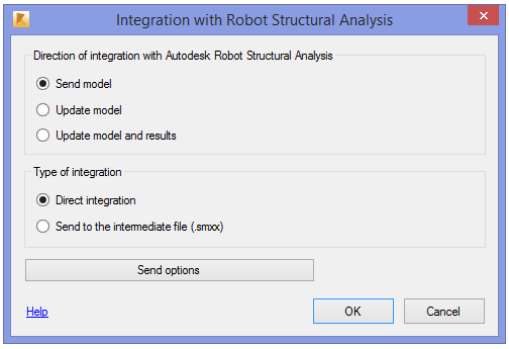
The Integration with Robot Structural Analysis or Integration with Revit Structure link is a tool which allows bidirectional data exchange between Autodesk Robot Structural Analysis Professional (RSA) and Autodesk Revit Structure (Revit).

With this tool you can:

- transfer a structure model from Revit to RSA or from RSA to Revit
- update a structure model in one program after making changes in the model in another program
- transfer the results of static analysis and required reinforcement calculated in Robot to the Revit model.

This tool allows you to work on a part of large structure models. You can load a whole structure in one program, select a part of it and transfer this part to another program.

Also, you can save your model to the intermediate file (SMXX) and open it in RSA or in Revit. You can use the SMXX file to exchange data between programs on different computers.



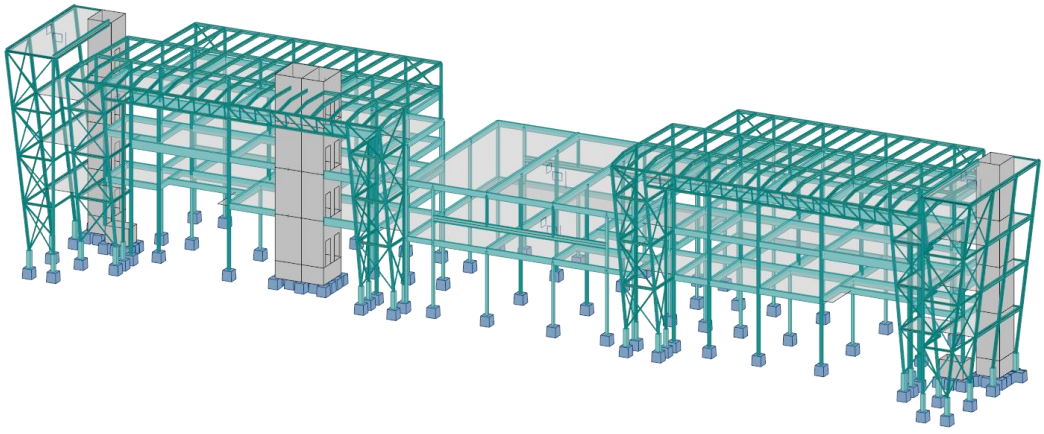


FIG. 6 - ANALYSIS MODEL IN ROBOT STRUCTURAL ANALYSIS AFTER INTEGRATION WITH REVIT

Hands-On

More information can be found on the Autodesk Knowledge Network:
Revit - RSA Integration

Instructions on how to send the Revit analytical model to Robot Structural Analysis are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Structure - 02 PreDesign.rvt

Start model:
02 Railway Station - Analysis - 01 Start.rtd

Setting up the analysis model in Robot Structural Analysis

Depending on which additional analytical elements are modelled in Revit (i.e. bar end releases, supports, loads …), you need to set up the "simulation" or "analysis" model in Robot Structural Analysis for detailed analysis.

Basically you need the follow the next general steps:

1. Add additional structural elements (i.e. wind bracings, cladding …)

2. Add boundary conditions like supports, releases, advanced properties for tension only members, behaviour to the FE panels (Panel Calculation Model)…

3. Add load cases, load definitions and load combinations.
   In this particular case, the Automatic Wind Load Simulation (CFD) tools are used.

4. Run the analysis.

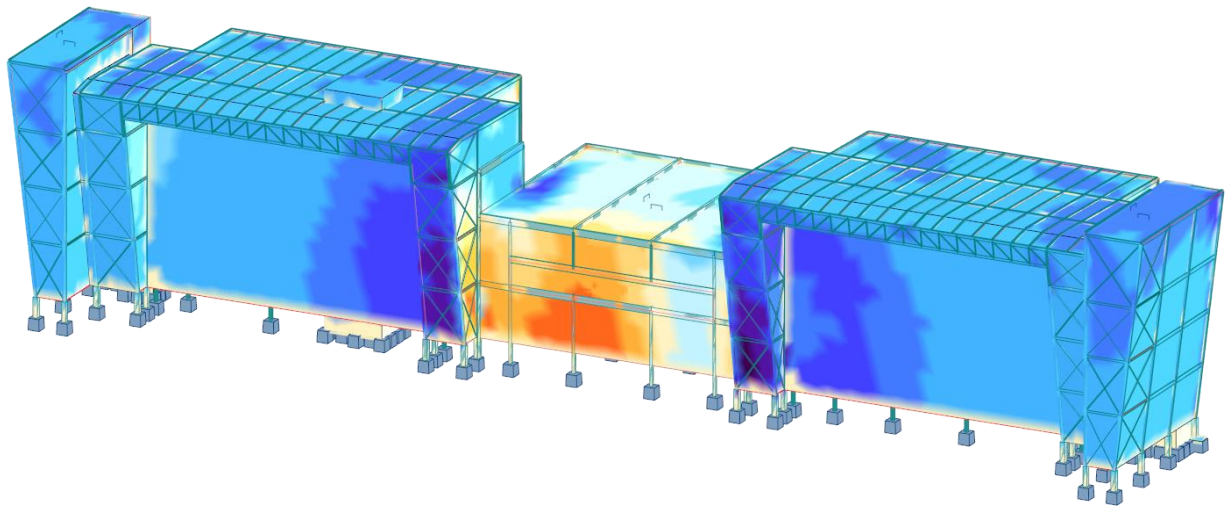
5. Interpret the results.

This won't be explained in this handout as this would take us to far away from the subject.

A good guide for this could be this class from Ken Marsh at AU 2014.

http://au.autodesk.com/au-online/classes-on-demand/class-catalog/2014/robot-structural-analysis-professional/se6881-l#chapter=-1

Or you could get one of his books about Robot Structural Analysis here:
http://www.marshapi.com/robot-essentials.html



Hands-On

More information can be found on the Autodesk Knowledge Network:
Getting started with Robot Structural Analysis

Instructions on how to send the Revit analytical model to Robot Structural Analysis are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Analysis - 01 Start.rtd
Finalized model:
02 Railway Station - Analysis - 02 Results.rtd

Analyze Results in Excel with Results Connect

Microsoft Excel is still the most used tool by engineers for analysis purposes. Sometimes you want to perform specific a specific post-processing of the analysis results in your custom made Excel worksheet. With Results Connect the engineer gets live access to the results database in the Robot Structural Analysis model and can make his own spreadsheet based calculations on the results.

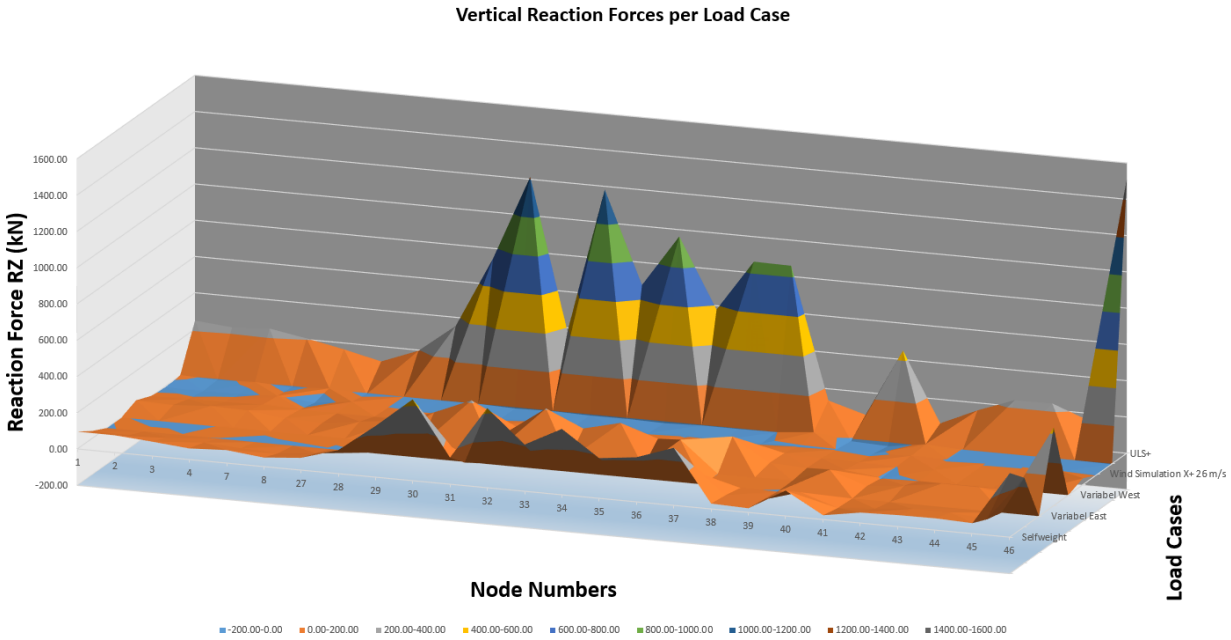


FIG. 7 – POST-PROCESSING RESULTS IN EXCEL

Hands-On

More information can be found on the Autodesk Knowledge Network:
Using Results Connect

Instructions on how to work with Results Connect are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Analysis - 02 Results.rtd

Start document:
02 Railway Station - Reaction Forces_start.xlsx

Finalized document:
02 Railway Station - Reaction Forces.xlsx

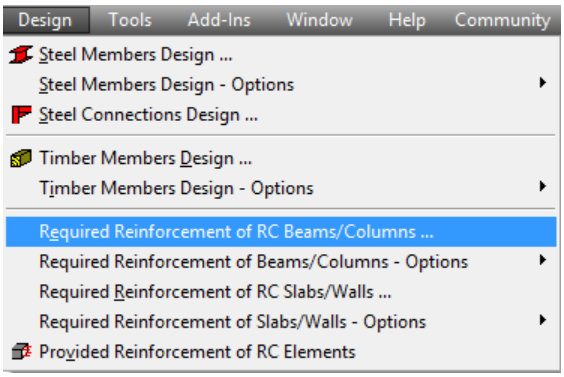
Code check design of Reinforced Concrete Elements

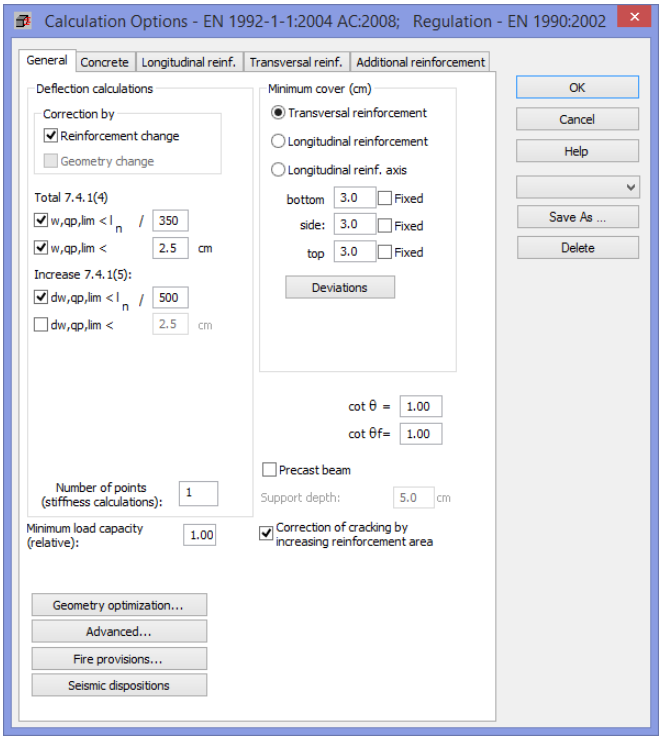
When the results have been evaluated it is time to perform a Code Check design for the Reinforced Concrete elements (RC Members).

Robot Structural Analysis offers two possibilities for the design of RC structure members:

- calculation of the required (theoretical) reinforcement area needed for the RC member
- generation of the provided (real) reinforcement for the RC member.

In this case, the required reinforcement results will be used later in Revit for detailed reinforcement design.





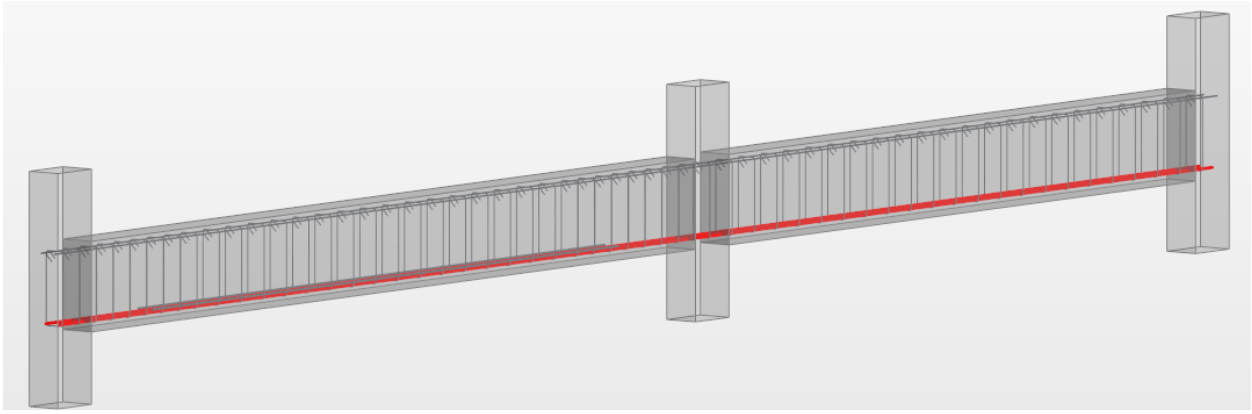


FIG. 8 - PROVIDED REINFORCEMENT IN RC ELEMENTS

Hands-On

More information can be found on the Autodesk Knowledge Network:
Reinforced Concrete Design

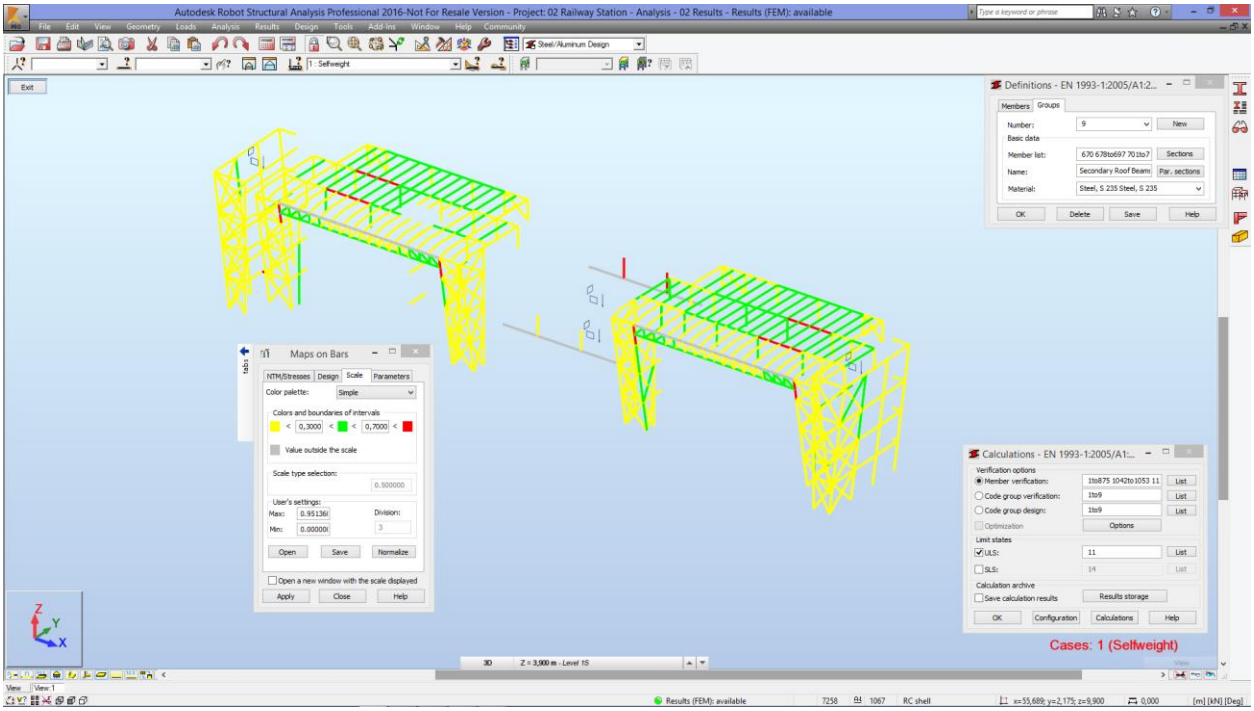
Instructions on how to perform code check design on RC Members are shown on the embedded videos in the class presentation.

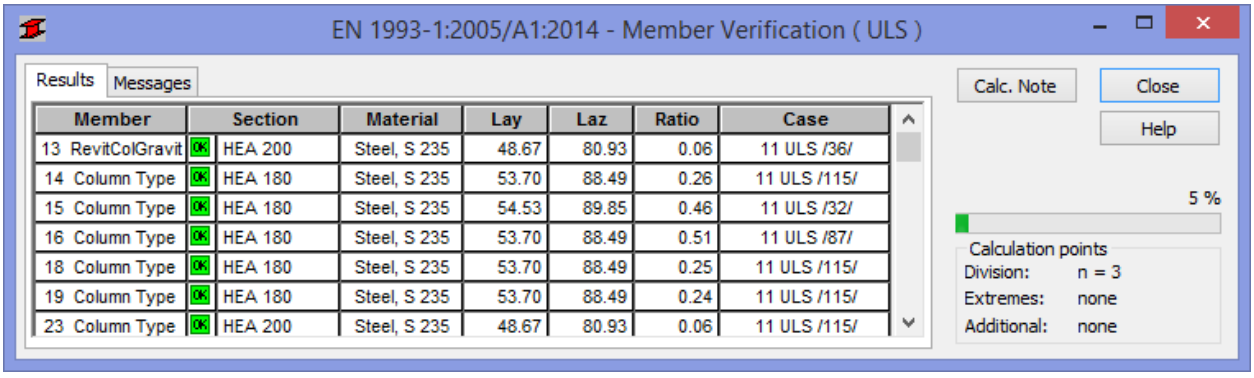
DATASETS

Start model:
02 Railway Station - Analysis - 02 Results.rtd
Finalized model:
02 Railway Station - Analysis - 03 Optimized.rtd

Code check design of Steel Structures

The structure also contains steel elements. In the initial design in Revit, they were estimated on thumb rules or based on the cloud analysis results. In this step we will take the steel model and perform a code check verification and optimization on the single elements. The post-processing of the global model results consists of verifying the internal stresses with the code requirements, and optionally change the cross-sections of the steel members.





Member		Section	Material	Lay	Laz	Ratio	Case
13 RevitColGravit	OK	HEA 200	Steel, S 235	48.67	80.93	0.06	11 ULS /36/
14 Column Type	OK	HEA 180	Steel, S 235	53.70	88.49	0.26	11 ULS /115/
15 Column Type	OK	HEA 180	Steel, S 235	54.53	89.85	0.46	11 ULS /32/
16 Column Type	OK	HEA 180	Steel, S 235	53.70	88.49	0.51	11 ULS /87/
18 Column Type	OK	HEA 180	Steel, S 235	53.70	88.49	0.25	11 ULS /115/
19 Column Type	OK	HEA 180	Steel, S 235	53.70	88.49	0.24	11 ULS /115/
23 Column Type	OK	HEA 200	Steel, S 235	48.67	80.93	0.06	11 ULS /115/

FIG. 9 - CODE CHECK DESIGN ON STEEL MEMBERS

Hands-On

More information can be found on the Autodesk Knowledge Network:
Steel Design

Instructions on how to perform code check design on Steel Members are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Analysis - 02 Results.rtd
Finalized model:
02 Railway Station - Analysis - 03 Optimized.rtd

Update model changes from RSA to Revit

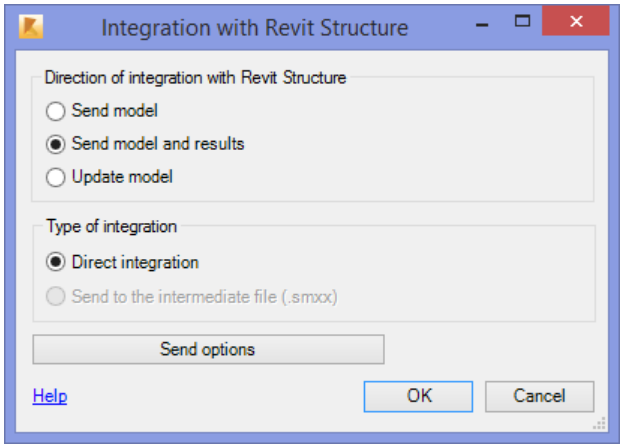
The simulation model that was initially born out of the transfer from Revit to RSA has been further developed now:

- by adding and modifying elements in the structure.
- results for stresses, deformation and required reinforcement are saved in the simulation model.
- an optimization of the steel structure has led to some changes in the cross-sections of steel members.

In a structural engineering workflow people tend to exchange information about model changes on an inefficient way (i.e. PDF mark-ups, long review meetings, even on paper). With the Structural Analysis Toolkit it is possible to import the modified RSA model back into the Revit design model.

The update involves transfer of the next items:

- additional modelled elements in RSA are imported in Revit in the right category
- results for forces, stresses and deformations can be stored in the Revit Results Packages
- results for required reinforcement for RC Member can be imported in the Revit Results Packages



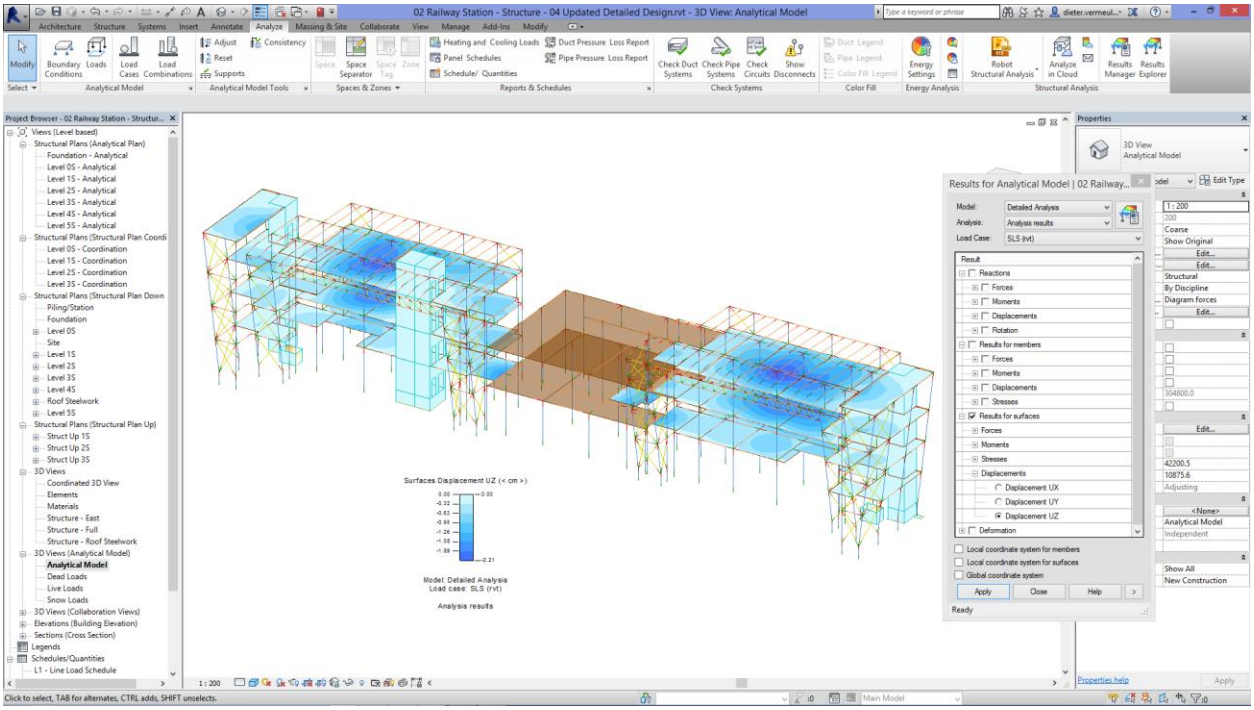


FIG. 10 – DEFORMATION RESULTS IN REVIT AFTER MODEL UPDATE

Hands-On

More information can be found on the Autodesk Knowledge Network:
Revit - RSA Integration

Instructions on how to update the Revit model with the changes made in RSA are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Analysis - 03 Optimized.rtd

Start model:
02 Railway Station - Structure - 02 PreDesign.rvt

Finalized model:
02 Railway Station - Structure - 03 Optimized Design.rvt

Reinforced Concrete detailing based on results

With the update of the RSA model to Revit it is also possible to store the results for “required reinforcement of RC elements” into the Revit Results Packages.

SOFiSTiK Reinforcement Generation automatically generates a 3D rebar model in Revit based on computed analysis and design results that are stored in the Revit Results Packages. The rebar model provides an automatically generated proposition of reinforcement layout which fulfils the reinforcement requirement and which can be freely modified. Design requirements from construction codes and company standards can be controlled by user-defined rules similar to the approach used in expert systems. Visualization of existing reinforcement vs. required reinforcement provides a clear indication whether adequate reinforcement has been provided.

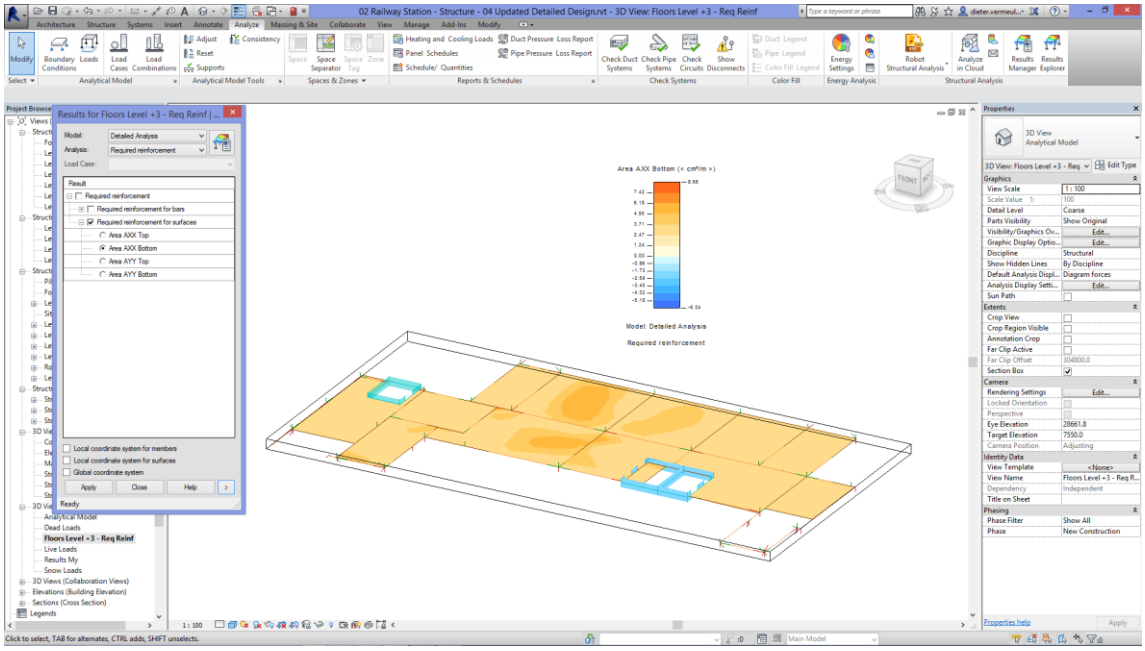


FIG. 11 - REQUIRED REINFORCEMENT AREA IN REVIT

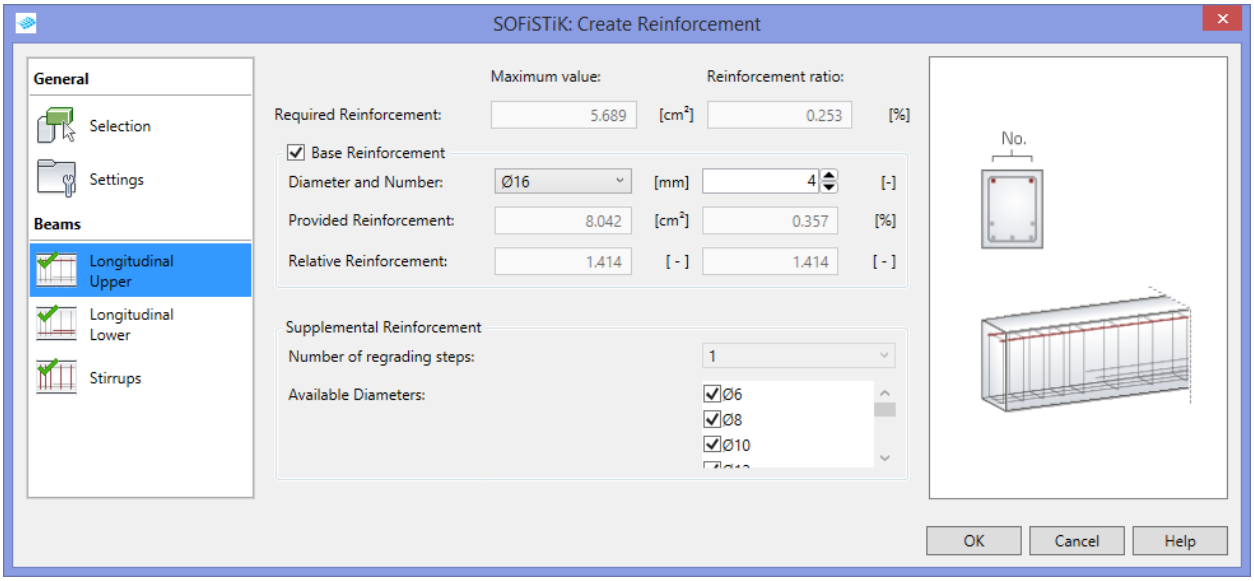


FIG. 12 – AUTOMATIC REINFORCEMENT GENERATION WITH SOFISTIK

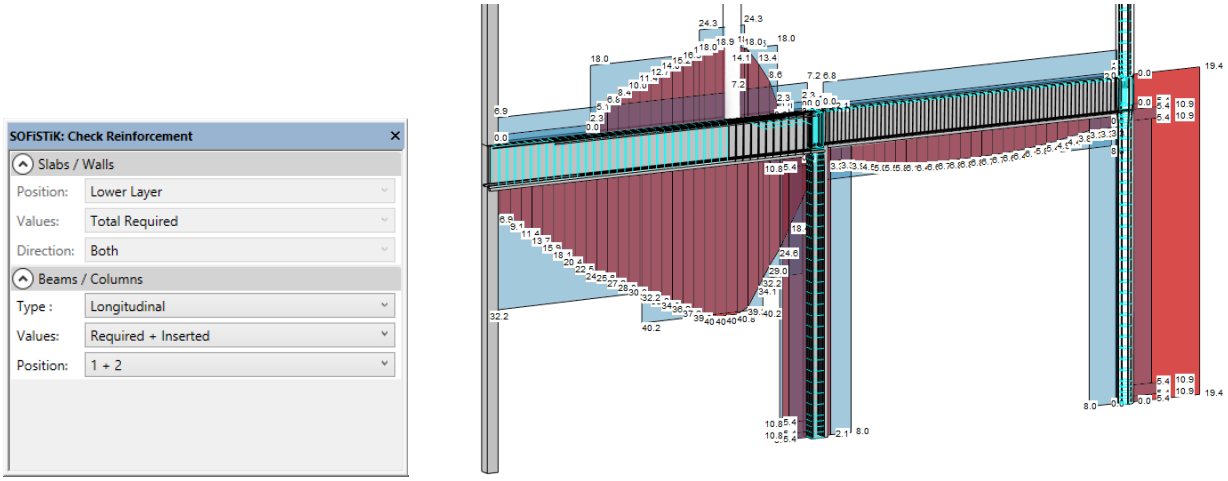
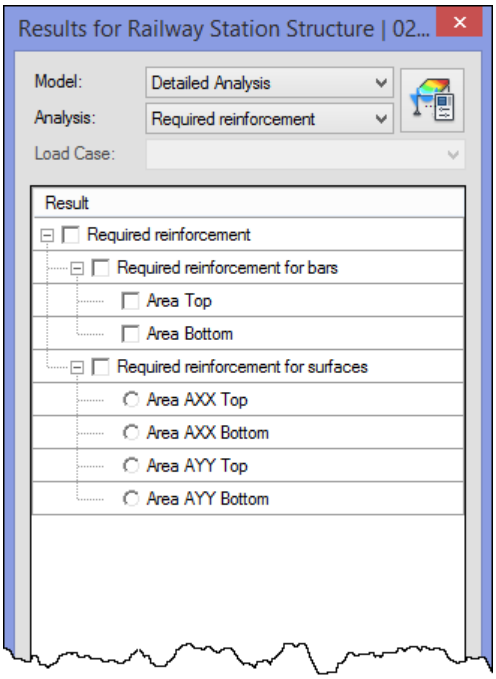


FIG. 13 - CHECK REINFORCEMENT DESIGN WITH SOFISTIK REINFORCEMENT GENERATION

Important notice – Known Issue

Currently, the results for required reinforcement sent from RSA 2016 to the Results Packages in Revit 2016 are limited for the bars (beams and columns). The information only contains values for the required reinforcement are for the top and bottom rebar creation.



Hands-On

More information can be found on the Autodesk Knowledge Network:
http://www.sofistik.com/en/solutions/soficad/reinforcement-generation/

Instructions on how to generate 3D rebar in Revit based on the analysis results with Sofistik are shown on the embedded videos in the class presentation.

DATASETS

Start model:
02 Railway Station - Structure - 03 Optimized Design.rvt

Finalized model:
02 Railway Station - Structure - 04 Detailing.rvt

Alternative Workflow

In many structural engineering companies the design of a structure starts with building up an analysis model. In this case it is also possible to build up a model in Robot Structural Analysis, make the detailed analysis and then send the model to Revit for design detailing.

Therefore you just need to change the order of integration with Revit as explained in and only perform the Update model changes from RSA to Revit.

As the analysis model is based on positions of analytical lines and surfaces, this method may imply that you need to do some positioning modifications:

- Vertical justification of the structural framing (beams under floors)
- Attaching of walls to the floor base
- Join geometry of walls, floors and beams

Possible solutions for this:

- Make use of Join > Multiple
- Use global parameters and set them to the beams and columns appropriate instance parameters
- Use Dynamo for automation of parameter setting.

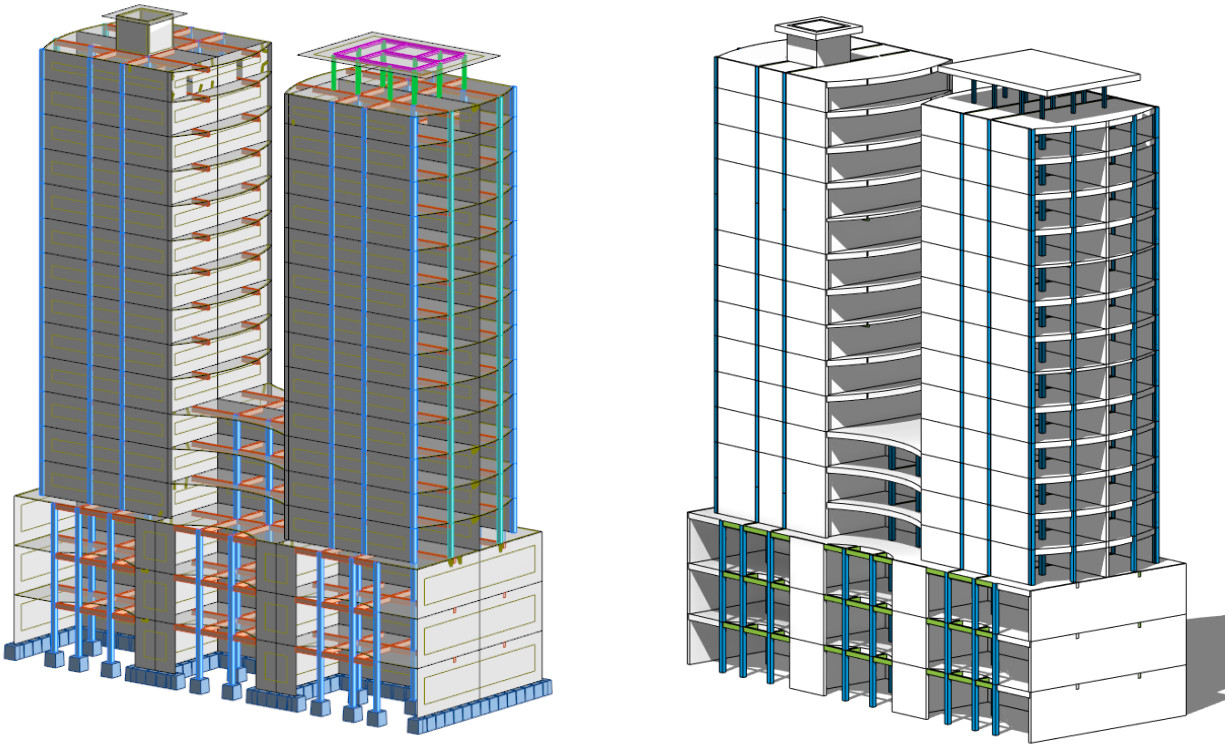


FIG. 14 - INTEGRATION OF RSA WITH REVIT IN AN ANALYSIS FOCUSED WORKFLOW

Hands-On

Instructions on how to generate a Revit model from a RSA analysis model are shown on the embedded videos in the class presentation.

DATASETS

Multi Story Building.rtd

Start model:
Multi Story Building_start.rvt

Finalized model:
Multi Story Building.rvt

Structural Analysis Toolkit

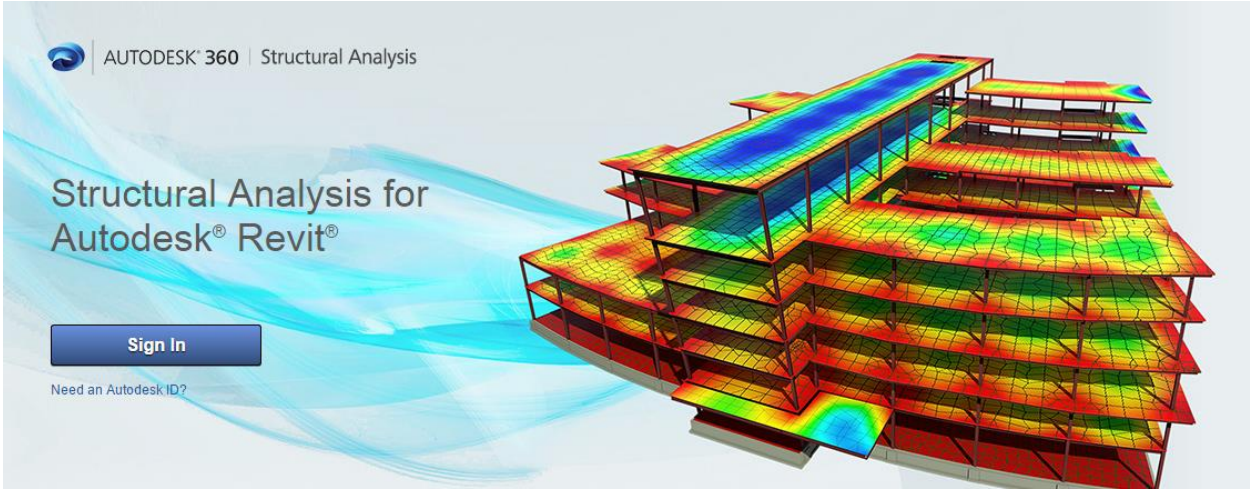
The Structural Analysis Toolkit for Autodesk® Revit® software is a suite of tools that supports the Building Information Modelling (BIM) process and allows structural engineers to analyse structures from within the Revit environment.

The toolkit contains the following items:

- Structural Analysis for Revit with Autodesk 360
- The link with Autodesk® Robot™ Structural Analysis Professional 2016
- Structural Results Storage & Exploration tools

Using this toolkit structural designers and engineers can optimize their workflows in the cloud and on the desktop by using the analytical model built in Revit to conduct cloud-based structural analysis with access to Autodesk 360 services and by extending the Revit model to Autodesk Robot Structural Analysis Professional software or supported third party analysis solutions. Once complete, analysis results can be easily stored and explored in the Revit environment.

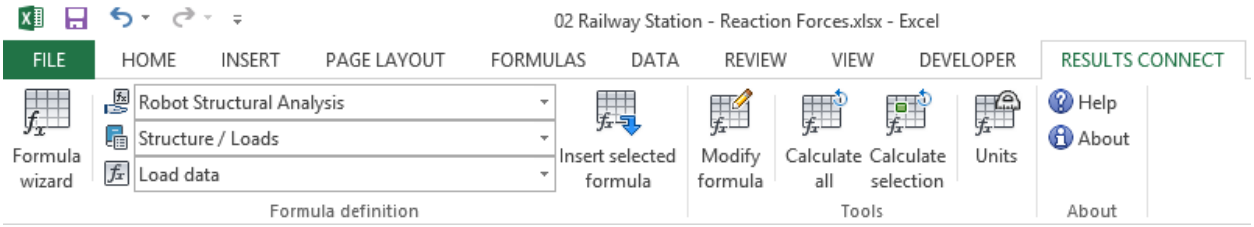
Download the toolkit here:
https://apps.autodesk.com/RVT/en/Detail/Index?id=appstore.exchange.autodesk.com%3astructuralanalysistoolkit20151427698407_windows64%3aen



Results Connect

Results Connect is an application that allows designers and engineers using Autodesk Robot Structural Analysis to seamlessly access data and results with Microsoft® Office Excel®.

Results Connect is fully integrated in Microsoft Office Excel as an Add-in, and allows accessing data and results from an Autodesk Robot Structural Analysis model using simple Excel formulas.



Note: It is not required to have programing skills or knowledge of Autodesk Robot Structural Analysis API to extract data for use in spreadsheets.

To use Results Connect, select a formula from a predefined list using wizard dialogs, or using the typical Microsoft Office Excel workflow.

Each formula takes as arguments a set of parameters that can be written directly inside the formula. These parameters can come from specific cells or from an active selection within Autodesk Robot Structural Analysis.

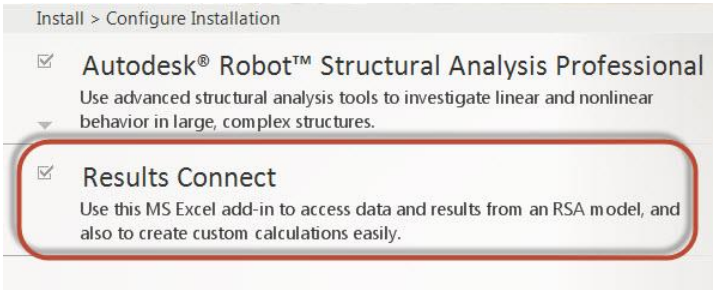
Once the link has been made with Results Connect, data is available for post processing with Excel formulas, graphs, pivot tables, and other methods present in the application.

Use the examples provided with the application to become familiar with Results Connect.

You can find these examples in the following location: C:\ProgramData\Autodesk\Examples\Results Connect\RSA.

Open both the *RSA_FORMULAS.rtd* and *RSA_FORMULAS.xlsx* files.

By default, Results Connect is automatically installed with Autodesk Robot Structural Analysis.



Learning resources

More learning resources on the products that have been used in this class can be found below:

Robot Structural Analysis	https://knowledge.autodesk.com/support/robot-structural-analysis-products/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/RSAPRO-NewUserQuickStart/files/GUID-112523BC-1AE3-4CA4-8314-C1BC1E75A369-htm.html http://au.autodesk.com/au-online/classes-on-demand/class-catalog/2014/robot-structural-analysis-professional/se6881-l#chapter=-1 http://autodesk.typepad.com/bimtoolbox/2015/06/robot-structural-analysis-learning-resources.html https://www.youtube.com/playlist?list=PLY-ggSrSwbZqow_60fiqJwS69mg1nQMzk
Structural Analysis Toolkit 2016	http://www.youtube.com/watch?v=786iJwu5_Ws
Results Connect	https://knowledge.autodesk.com/support/robot-structural-analysis-products/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/RSAPRO-WhatsNew/files/GUID-A8E4D3BD-FD44-4189-85B2-85B35705C704-htm.html http://help.autodesk.com/view/RSAPRO/2016/ENU/?guid=GUID-46071058-C572-467E-B464-F0D1DA37FA8E
SOFiSTiK Reinforcement Generation 2016	http://www.sofistik.com/en/solutions/soficad/reinforcement-generation/ http://www.youtube.com/watch?v=4H98OfXggog