**Create Your Own Bidirectional   
Revit® Structure Stress Analysis Integration Link**

Jeremy Tammik – Autodesk Inc.

**DE201-1** Besides the physical building information model (BIM) defined by Revit Architecture, Revit Structure defines an analytical model of the building composed of geometry, loads, connectivity, release/boundary conditions, material properties, and other project parameters that can be used to link to an external stress analysis application for calculation and optimization of the building model. Compare Revit Architecture and Revit Structure and the physical versus the analytical BIM. Explore the Revit Structure API, which provides read-and-write access to and creation facilities for all the members and data required to implement an iterative bidirectional stress analysis link, such as geometry, location, sections, and materials, as well as physical building elements such as walls, floors, footings, foundations, columns, and framing elements. This class will implement a sample Revit add-in that links Revit with an external analysis package simulated using AutoCAD.

**About the Speaker:**Jeremy joined Autodesk in 1988 as the technology evangelist responsible for European developer support. In this capacity, he wrote articles, consulted, lectured on AutoCAD application programming techniques, and supported AutoCAD application developers in Europe, the U.S., Australia, and South Africa. He was a cofounder of ADGE (AutoCAD Developer Group Europe) and a prolific author on AutoCAD application development. He left Autodesk in 1994 to work as an HVAC application developer, and then rejoined the company in 2005 to work in the AEC group of the Autodesk Developer Network Technical Services Team.

# RST Stress Analysis Integration Link

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[1. Introduction 2](#_Toc182032172)

[2. Overview 3](#_Toc182032173)

[3. Revit Structure Analysis Labs 9](#_Toc182032174)

[4. Structural Analysis Link 15](#_Toc182032175)

## Introduction

**Content:** Beside the physical building information model (BIM) defined by Revit Architecture, Revit Structure (RST) defines an analytical model of the building composed of geometry, loads, connectivity, release and boundary conditions, material properties, and other project parameters, which can be used to link it to an external stress analysis application for calculation and optimisation of the building model. Compare Revit Architecture and Structure and the physical versus the analytical BIM. Explore the RST API, which provides read and write access to and creation facilities for all the members and data required to implement an iterative bidirectional stress analysis link, such as geometry, location, sections, materials, boundary and release conditions, load natures, cases, combinations, the point, line and area loads themselves as well as the physical building elements such as walls, floors, footings, foundations, columns and framing elements. Implement a sample Revit add-in linking Revit with an external analysis package simulated using AutoCAD.

**Target Audience, Who Should Attend:** Application developers and Revit users interested in Revit Structure programming, stress analysis, and linking with external calculation packages, with intermediate-level .NET and general Revit product knowledge.

**Session Objectives:** After attending this session, you will be able to:

* Implement a Revit Structure (RST) add-in linking bi-directionally with an external stress analysis application
* Evaluate, compare and modify the Revit Structure physical and analytical BIM
* Analyse, modify and create building model geometry, loads, connectivity, release and boundary conditions
* Export the RST analytical BIM to external applications for stress analysis
* Import stress analysis results and design modifications back into Revit and update the BIM

**Companion Presentations:** Please also refer to the following companion presentations, which expand on the topics discussed here:

* DE105-1 The ABCs of Programming in Revit
* DE305-1 A Closer Look at the Database with the Revit API
* DE111-1 The Revit SDK Sample Smörgåsbord
* DE115-1 Enhancing Your Revit Add-In
* DE205-1 Reinforce Your Design: Revit Structure API for Rebar and Detailing
* DE315-1 Answers to Your API Questions: Experts Talk About Revit and AutoCAD Architecture & MEP APIs

**Materials:** This presentation is accompanied by some additional samples and documentation:

* rst\_lab.zip – Labs – Sample code for exploration and self learning
* rst\_link.zip – RSLink – Sample link application and analysis simulation in AutoCAD

## Overview

### Agenda

* Overview

Workflow

Compare Architecture and Structure

Physical versus analytical model

* Requirements, Samples and Labs

Explore and implement base functionality

* Link

Sample application

Linking Revit with external analysis package

Simulated using AutoCAD

Our discussion here proceeds in three steps. First, we look at the workflow and how it is supported by Revit Structure or RST. Secondly, we walk through a series of labs related to extracting and analysing the data managed by RST. Finally, we will look at a sample application linking RST with an external application. In this case, the external stress analysis package is simulated by AutoCAD.

### Completing the Building Information Model

Building information modelling (BIM) is the creation and use of coordinated, internally consistent, computable information about a building project in design and construction that yields reliable digital representations of the building – representations used for design decision-making, production of high-quality construction documents, performance predictions, cost-estimating and construction planning, and, eventually, for managing and operating the facility. The focus of this presentation is on the structural part of it with Revit Structure.

### Revit Structure Target Projects

Buildings – any type, size, and complexity, made of any kind of materials.

Even if structural engineers can design any type of structures including bridges, tunnels, plants etc., RST focuses on building design. It does not mean that a user cannot design other type of structures, but the marketing that we do, the training and documentation materials that we provide are positioning RST on building design.

### Current Analysis Process

Currently, the analysis of a building involves a lot of manual data transfer with accompanying loss of information and additional cost. The aim of Revit and its building information model and Revit Structure and its linked physical and analytical model is to preserve more information, support communication between all parties involved, and reduce cost.

### Structural Market Definition

The structural industry is extremely fragmented. We segment it into two parts: design and fabrication. The design is composed of two tasks (analysis and construction drawings) done by three actors and the fabrication focuses on shop drawings.

### Tasks and User Focus

The focus that we have for RST is on the design part only where we do modelling for drawings and analysis. We do not do analysis.

### Issues to Address

Problems addressed by Revit Structure:

* Same information is duplicated for different tasks
* Lack of coordination tools

Between drafters and engineers

Between architects and engineers

* Lack of standard software modelling platform

How are these problems addressed?

### Introduction

Revit Structure is used by a structural engineer to manage and combine data from several different sources:

* Architectural data, the building design, which can come from Revit Architecture, but also from other Autodesk or non-Autodesk products.
* Analysis data for stress analysis in external packages.
* Details that are designed based on the analysis results.

### Structural BIM Workflow: The 4 Cs

In the context of the structural BIM, we focus on four C’s, which require significant coordination between architects, structural engineers, fabricators and builders:

* Coordination
* Calculations
* Construction Documents
* Construction

Developers and ADN partners can develop applications for each of the four Cs:

* Coordination with other disciplines

Using the rich information in RST and process it against other disciplines

* Calculations or Analysis

Link analysis and design applications

* Construction documentations

Focus on local standards

Automation

* Construction

Use the information downstream for fabrication

### Application Development Opportunities

* Integration of analysis and design software
* Automatic modelling

Reinforcement

Framing

Connections (Steel, precast)

Portal frames

Bridge/tunnels

Special structures (towers, retaining walls)

* Data exchange (with other AutoCAD based applications)
* Scheduling
* Drawing automation
* ...

As the API is becoming more and more robust, there are many areas of opportunity to port existing applications to RST or to develop new ones.

The API is a great way to automate repetitive manual tasks such as reinforcement, framing modelling, etc. There is also an opportunity to create dedicated Revit families and to drive their generation with the API, such as steel connections. You can also imagine building wizard type applications that generate civil structures including soil, geometry reinforcement, etc. The API is also built so you can link the RST model to your existing application and complete what RST does not do such as local standard drawings or schedules. With the API, you can drive an application to generate a dwg file and then import it automatically in RST.

Today we will focus on

* Integration of analysis and design software
* Automatic modelling of Reinforcement
* Drawing automation

### Comparison with Revit Architecture

Revit Architecture and Structure have many common features. The differences are visible in the user interface in the command organisation and the category filtering. Some structure-specific functionality has been added. Some functionality has also been removed.

General User Interface:

* Command organization
* Category filtering

Functionality added:

* Analytical model (generation and adjustment)
* Load modelling
* API specific model and load objects
* Rebar modelling
* Composite metal deck
* Graphical column schedule
* ...

Functionality removed:

* Reflected ceiling plans
* Room related functionalities
* Model text
* ...

### Analytical Model

The most important problem of the structural industry is the fact that the information used for structural analysis is physically different than the one used for drawings. Revit Structure solves this problem. The physical model is the model that we use for drawings, coordination and construction, and the analytical model is the simplified model used for analysis.

* Structural analysis model differs from drawing model
* Revit Structure solves this problem
* **Physical** model is used for drawings, coordination and construction
* **Analytical** model is the simplified model used for analysis

Some examples show the discrepancies between the analytical and physical models.

For example, consider a plan view where the walls need to be aligned for the analysis and the beams need to join the centre of columns to end of walls.

Another example is an elevation where the analytical model is horizontally projected even if the physical model of the beam has a slope.

Finally, consider a situation where the physical model of the beam is curved and the analytical model is segmented.

Revit Structure maintains the coordination between the two models and will keep the analytical model of each element connected.

As a third party analysis developer, you just need to work with the analytical model.

### What is in the analytical model?

* Members that need to participate in the analysis
* Geometry (location)

Sections

Materials

Release conditions

Reference to level (optional)

* Loads

Load cases

Load combinations

Point, line, area loads

* Boundary conditions

Support data

In this presentation, we explain how to access all this information.

### Analytical versus Physical Model

Revit Structure combines the physical model which drives the modelling and documentation process with the analytical model which drives the analysis process and export to third party analysis software.

The Revit Structure analytical model can be adjusted for analysis purposes while the physical model stays accurate for documentation.

Here are examples of different cases highlighting the difference between the physical and the analytical models and the need for flexibility in linking the two:

* The end points of two beams are not at the same location. We want the end points of their analytical models to be located at the same point. An engineer decides to move the end of one beam.
* Remodelling an old historic building, walls may not be straight. An engineer decides to approximate them by planes for analysis.
* Two walls with different thicknesses but aligned analytical planes.
* A wall with a parapet that does not need to be included in the analysis.
* Adjusting the location of analytical columns horizontally.

### Data Exchange Workflow

A number of model features need to be coordinated:

* Separate Physical and Analytical Geometry
* Loads
* Connectivity
* Material
* Project parameters

In general, we start off with a physical model. This can be used to automatically generate the analytical one. The analytical model is exported to an external analysis package, which adds its own data. As a result of the analysis, the analytical model may be modified, resulting in changes in the physical model as well. New changes may be added in the physical model as well. All of these processes may continue over many iterations.

For example, we might have the following steps:

* RST defines the physical model, analytical model composed of geometry, loads, connectivity (release and boundary conditions), material properties, and project parameters. This is information is accessible via the API.
* In the analysis software, we get the analytical model.
* The analytical application initializes specific properties not present in RST, symbolized here with X and Y, and the user can change them. We can do an analysis, delete specific members, change sections and then the analysis software updates the RST model.
* Changes can be add, delete, create, and move members and also add new properties to RST members.
* If we select a column and duplicate it, the copy will also have the Y parameter that was defined above.
* So the next time we round trip the data to the third party, we retrieve the Y parameter.

### Analysis Requirements

Now we understand the structural workflow and its needs, we can start looking at the API features provided to address these needs. Here is an overview of the typical requirements for implementing a link to an external analysis package using the RST API.

* Extract the analytical model geometry
* Extract the load cases, load combinations, loads
* Extract release and boundary conditions
* Update the model with changes and new and deleted elements
* Add load cases and load combinations
* Add loads and reactions
* Add project information, shared parameters
* Add shared parameters on structural objects

In the following slides, we will look at the Revit samples and a series of labs demonstrating how to address these issues one by one. Finally, the results of these labs will be integrated into the sample link application.

### Adding local parameters to Revit

Here are some different strategies for a third party application to add new properties in the database.

Shared parameters:

* Can be defined in an external file
* Can be added with the API
* Can be defined per element
* Can be project specific, e.g. building codes

Templates

* Can contain specific information such as load combinations

### Analytical model access

Here are some typical frequently asked questions and examples on how to solve them.

How to get the ...

* ... thickness of a wall with multiple layers?

SDK sample TestWallThickness

* ... analytical model of an in-place family?

SDK sample AnalyticalViewer

* ... analytical model defined in an external family?

SDK sample AnalyticalViewer

* ... multiple analytical segments of a curved beam?

Tessellate the underlying curve

### Useful Revit SDK Samples

Currently, information on how to combine Revit API calls to achieve certain complex tasks is contained mainly in the SDK samples. Here is a list of some of the Revit SDK samples, which address areas related to structure.

* Parameters

BrowseBindings

CreateShared

FireRating

InvisibleParam

* Analytical Model

AnalyticalSupportData\_Info

AnalyticalViewer

BoundaryConditions

InplaceFamilyAnalyticalModel3D

Loads

RotateFramingObjects

SlabProperties

SpanDirection

## Revit Structure Analysis Labs

In the section, we demonstrate step by step how to implement the functionality required for an application linking Revit Structure with an external analysis package. The first group of labs addresses access and modification of load data, the second examines the building structure, and the third addresses the entire analytical model.

Loads

* 1-1 Load cases, natures, combinations, usages
* 1-2 Point, line and area loads
* 1-3 Load parameters and modification
* 1-4 Load symbols
* 1-5 Creating load objects

Structure

* 2-1 Columns and framing
* 2-2 Foundations
* 2-3 Walls, floors, footings

Analytical Model

* 3 Analytical model

### Loads

The first set of labs explores accessing and modifying load related data in RST.

#### Load Grouping Objects

The first Lab 1-1 extracts and lists the load cases, natures, combinations and usages defined in the Revit model.

* Load Cases
* Load Natures
* Load Combinations
* Load Usages

To retrieve load case, nature, combination and usage objects, simply iterate over the document elements and check for the corresponding object class LoadCase, LoadNature, LoadCombination and LoadUsage.

To create new objects, use the Autodesk.Revit.Creation.Document methods NewLoadCase(), NewLoadCombination(), NewLoadNature(), NewLoadUsage(), accessible through ActiveDocument.Create.

#### Access to Load Objects

Lab 1-2 shows how to access all load objects using the base or specific classes.

* Point Loads
* Line Loads
* Area Loads

All three load classes are derived from LoadBase. They are creation through NewAreaLoad() (3 overloads), NewLineLoad() (2), and NewPointLoad().

Just like in the preceding lab, we iterate over all Revit elements and pick out the object types of interest. For each load type object, a number of properties are defined for extracting and modifying data.

#### Load Object Parameters

Lab 1-3 continues the exploration about loads:

* Shows more details about loads, this time from selected objects
* How to access load parameters
* How to modify load objects

#### Get Parameter by Display Name

Some element parameters can be accessed via display name only, so a utility function is provided for this. In general, we try to use the BuiltInParameter enum to access parameters whenever possible, since it is language independent.

#### Point Load Parameters

Here are some point load parameters. Some can be accessed via either built-in parameter enum or localised name, other only one or the other:

Equivalent

* LOAD\_IS\_REACTION "Is Reaction"
* LOAD\_CASE\_ID "Load Case"

Similar

* LOAD\_USE\_LOCAL\_COORDINATE\_SYSTEM "Orient to"

Built-in only

* LOAD\_USE\_LOCAL\_COORDINATE\_SYSTEM\_HOSTED
* LOAD\_IS\_CREATED\_BY\_API

Display name only

* "Fz"

Parameters may vary from Revit version to version.

A long list of 59 different parameters relevant to loads is given in the comment at the end of Labs1.vb.

#### Point Load Properties

Some of the point load properties accessible through parameters are also exposed directly as properties on the object class.

* LoadBase

HostElement

LoadCaseName

LoadCategoryName

LoadNatureName

* PointLoad

Force

Moment

Point

The HostElement property was added in 2008. Many other properties are also available.

Whenever you are looking for a specific property, you will need to explore the Revit API and one or more suitable sample models to determine what exactly you are looking for and how to access it.

* Help file
* Reflection
* Debugger
* BuitInParamsChecker

**DE105-1** The ABCs of Programming in Revit

* RvtMgdDbg

**DE305-1** A Closer Look at the Database with the Revit API

#### Load Symbols

Lab 1-4 demonstrates how to:

* Retrieve load symbols, also known as types, available in the project
* Determine load symbol family

One utility for all load symbols (point, line and area)

Another one specifically for point loads

* Load symbols are system families, not standard ones

#### Retrieve Load Symbols

To retrieve load symbols from the current model, we use a standard Revit element iteration loop, pick out all the Symbol instances, and check for the structural loads category.

#### Determine Load Symbol Family

The built-in parameter SYMBOL\_FAMILY\_NAME\_PARAM that returns the family name can be used to determine a load symbol’s family:

* No dedicated classes
* Examine family name parameter
* BuiltInParameter.SYMBOL\_FAMILY\_NAME\_PARAM equals "Point Loads", "Line Loads", "Area Loads"

#### Creating Load Objects

Lab 1-5 shows how to create a new load object, specifically a point load. It creates two new point loads by calling NewPointLoad() with somewhat arbitrary parameters. One as reaction, simulating an analysis result, the other is a standard external load. It also shows how to set a selected symbol for this new load and assign the load to a selected load case. To assign a selected symbol to it, all point load symbols in the document are retrieved and the user is allowed to select one of them. Its id is then assigned to the newly created point load ELEM\_TYPE\_PARAM. Similarly, to assign a load case, all load cases are retrieved and displayed and the selected one's id is assigned to the LOAD\_CASE\_ID parameter.

#### Point Load Creation

Create

Autodesk.Revit.Creation.Document.NewPointLoad(

ByRef point As XYZ,

ByRef force As XYZ,

ByRef moment As XYZ,

ByVal isReaction As Boolean

) As PointLoad

Assign Symbol

* Iterate over all point load symbols
* Assign selected one's id to parameter

BuiltInParameter.ELEM\_TYPE\_PARAM

Assign Load Case

* Iterate over all load cases
* Assign selected one's id to parameter

BuiltInParameter.LOAD\_CASE\_ID

### Structural Elements

The next section explores accessing and modifying structural elements and their data in RST.

#### Columns and Framing

Columns and framing elements are structural elements using standard families. Lab 2-1 demonstrates how to retrieve all structural 'line segment' or 'stick' elements. Columns belong to a separate standard family. Others such as beam, brace, joist, etc. belong to the framing standard family.

#### Select all columns

To select all columns in the model, we once again iterate over the Revit document elements and select all standard family instances for category OST\_StructuralColumns. We can display generic element and column properties such as element id, symbol name, structural type and analytical model type. We make use of a simple utility method to get all standard family instances for a given category:

' Helper to get all Standard Family Instances for a given Category

Shared Function GetAllStandardFamilyInstancesForACategory( \_

ByVal revitApp As Revit.Application, \_

ByVal catName As String \_

) As ElementSet

Dim elems As ElementSet = revitApp.Create.NewElementSet

Dim iter As IEnumerator = revitApp.ActiveDocument.Elements

Do While (iter.MoveNext())

Dim elem As Revit.Element = iter.Current

' First check for the class, then for specific category name

If TypeOf elem Is FamilyInstance Then

Try

If elem.Category.Name.Equals(catName) Then

elems.Insert(elem)

End If

Catch

End Try

End If

Loop

Return elems

End Function

#### Select all framing elements

Selecting beams and other framing elements is similar and makes use of the OST\_StructuralFraming category.

#### Foundations

Foundations are structural elements and also make use of a standard family. Lab 2-2 demonstrates how to retrieve all structural foundation elements. This may not be required for every analysis package. An alternative approach would be to retrieve all standard family instances having structural usage, i.e., having an analytical model.

#### Retrieve Foundations

To retrieve all foundations in the model, we can use the same approach as above, getting all standard structural foundation elements, using the category OST\_StructuralFoundation. This excludes the 'Wall Foundation' system type under 'Structural Foundations' category in the browser, because these belong to the 'Continuous Footing' system family, and also the 'Foundation Slab' system type under the 'Structural Foundations' category in the browser, which are internally implemented as Revit 'Floor' system family. These are examined in Lab 2-3.

#### Retrieve Structural Family Instances

As an alternative approach, we can also iterate over the document elements and select all FamilyInstance objects having an analytical model.

#### Walls, Floors, Footings

The structural elements walls, floors, and footings also all make use of system families, specifically Wall, Floor (Slab), and Continuous Footing, respectively. Lab 2-3 shows how to retrieve all structural elements from each of these system families. Please note that some instances may not have an analytical model, since this property is user definable.

### Analytical Model

The analytical model makes use of a separate little class hierarchy derived from the abstract base class AnalyticalModel. It defines specialised derived classes for various structural elements:

* Wall AnalyticalModelWall
* Floor AnalyticalModelFloor
* Cont.Footing AnalyticalModel3D
* Column, Framing AnalyticalModelFrame
* Foundation AnalyticalModelLocation

#### Retrieve Analytical Walls

To retrieve all Wall elements having an analytical model, we perform the normal Revit document elements iteration, pick out wall elements, and check for the presence of an analytical model using the Wall.AnalyticalModel property. The same approach can be used for ContFooting elements.

#### Retrieve Analytical Floors

A similar approach as for walls can also be used for floor elements. However, in the case of floors, the analytical model may well be non-null, but still be empty, so we need to add an additional check that the number of curves in it, given by AnalyticalModelFloor.Curves.Size, is actually greater than zero.

#### Examine Analytical Model

Lab 3 implements some code to investigate the geometry contained in the analytical model. It retrieves detailed analytical model geometry for selected elements, depending on their family and/or category.

Lab 3 iterates over the currently selected elements and examines all of the following:

* Wall
* Floor
* ContFooting
* FamilyInstance with category

OST\_StructuralColumns

OST\_StructuralFraming

OST\_StructuralFoundation

For each of these, it queries the analytical model and lists all of its

* Curves
* Support data

For analysis of the support data, please also refer to the Revit SDK sample AnalyticalSupportData\_Info.

## Structural Analysis Link

Now we have worked out all the pieces we might need, let us put them together into an actual Revit Structure Analysis link application. First, we discuss some general questions regarding applications linking Revit with external programs, followed by some practical examples.

### Analysis Link Introduction

There are many different implementation scenarios in which it might be useful to link a Revit building model with some external data, both RST-specific for analysis as we are discussing here, and also generic for other situations. Obviously, there are also many ways in which such a link can be designed.

For the RST analysis link, we need to decide which structural elements are passed between the applications and what kind of model changes are automatically supported in either of them.

It is obviously up to the individual third party package and its implementer to design, code and document the link. The Revit Structure API provides the required tools to do this, and does not pre-determine the design of the link application in any way.

### Analysis Link Export

For data export from Revit to a third party A&D application, one will generally use a custom Revit external command to export relevant data. The format used for this communication is once again completely up to the implementer, and could be any one of the following:

* App's native file/DB format, typically proprietary
* App's neutral file/DB format, typically public
* Public neutral file/DB format supported by the app
* Intermediate file/DB format purpose-designed for the link
* ...

The choice depends on the combination of technical, functional, commercial and political requirements.

### Analysis Link Import

For importing the updated and modified data from the external application back into Revit, one would generally define another custom Revit external command. The choice of options and reasoning is basically the same as for the export. The chosen file format does not need to be the same as for the export, though typically it would be.

### Practical Examples

RSLink

* Simple demonstration application

MidasLink

* Simple but real

FireRating

* Minimal generic Revit

RDBLink

* Generic Revit BIM, not RST specific

Commercial Software

### Practical Example

We have implemented a custom designed practical example of a Revit Structure analysis link application called RSLink to accompany this presentation. We use AutoCAD 2008 with an AutoCAD.NET plug-in to simulate the external third party analysis and design application and extended entity data, also known as xdata, to store Revit Structure specific information on standard AutoCAD entities. We use the AutoCAD Dynamic Properties COM API and the Object Property Manager OPM for the link-specific user interface within AutoCAD.

* AutoCAD.NET API utilities used on the 'other' side
* Xdata used to store Revit Structure specific info on standard AutoCAD entities
* AutoCAD Dynamic Properties COM API used for the link-specific UI within AutoCAD

The data exchange in both directions between the Revit model and the A&D simulation in AutoCAD is implemented using an intermediate, custom designed XML format. For simplicity, the XML format is based on .NET SOAP serialization. Some neutral custom .NET classes are utilised by both sides' export and import commands.

* Used in both directions
* For simplicity, based on .NET SOAP serialization
* Custom .NET neutral classes utilized by both sides' export/import commands

Before running the demo, the following applications need to be present:

* RSLink - helper dll shared by AutoCAD and Revit clients
* RSLinkRevitClient - command implementations
* RSLinkRevitApp - external application
* RSLinkAcadClient - AutoCAD client
* RSLinkAcadClientDynProps - dynamic Revit properties for AutoCAD objects

Here are some suggestions for possible steps to run the demo:

Set up Revit.ini to load either the client or the external application or both.

Open or create a sample model in Revit Structure.

Run the export command. You are prompted for a file location. A dialogue box pops up, reporting the number of exported elements.

Start up AutoCAD and load the client and the dynamic property application.

This can be achieved automatically by setting up AutoCAD to start in the RVT sample directory and placing an acad.lsp file there containing:

(defun s::startup()

(command "\_netload" "RSLinkAcadClient.dll")

(princ "\nAutoCAD RSLink client loaded.")

(arxload "RSLinkAcadClientDynProps.arx")

(princ "\nAutoCAD RSLink dynamic properties loaded.")

(princ)

)

If it does not load automatically, you can load it manually by calling

(load "C:/a/j/adn/revit/rst\_api/RVT/acad.lsp")

with the appropriate full path, and then call

(s::startup)

The commands defined by the AutoCAD client are RSImport, RSExport and RSMakeMember.

Use RSImport to load the xml file just exported from Revit.

Modify some cross sections in the model using the OPM, simulating modifications made by the A&D application, and optionally RSMakeMember to add some new elements.

Use RSExport to write the model back out again.

Back in Revit, use the import command to read the modifications and update the Revit model accordingly. Dialogue boxes are displayed to report the number of elements imported and modified. Note that the column types were swapped. Currently, the new elements defined by RsMakeMember are ignored.

### Another Practical Example

MidasLink is a Revit Structure add-in program that exports and imports the Revit model to and from the MIDAS/Gen structure analysis application. The source code is provided to help developers integrating analysis programs with Revit Structure. The compiled add-in is available to Revit Structure subscription customers.

The source code available on ADN and can be found by searching for "MidasLink" or using the URL <http://adn.autodesk.com/adn/servlet/item?siteID=4814862&id=9628885&linkID=4901650>. The package includes

* Analysis package executable
* Documentation
* Source code
* Installer

### Analysis Software

An overview of some available analysis link packages is provided on the analysis partners site at

* http://usa.autodesk.com/adsk/servlet/item?id=8447050&siteID=123112

### Revit Structure Product and SDK

A small heads-up for developers who may have missed it: The Revit 2008 SP2 version is currently available for download. This version also includes a slightly updated SDK. Among other things, two new samples have been added, RoomSchedule and RDBLink. These are discussed in the Revit SDK Smörgåsbord presentation.

The SP2 version is available for download from the product site:

* <http://usa.autodesk.com/adsk/servlet/item?siteID=123112&id=9281007>

Including the updated SDK in

* <Revit>\Download\Utilities\Common\Software Development Kit\Revit 2008 SDK.zip
* Two new samples: RoomSchedule and RDBLink

### Learning More

To learn more, please refer to the additional presentations listed in the introduction. The Revit online help offers a wealth of product related information, and the reference material included in the SDK documentation lists all the classes provided by the API and their methods and properties. The largest Revit programming knowledgebase is provided by the SDK samples. Finally, there are several useful online resources available:

Discussion Groups

* [http://discussion.autodesk.com](http://discussion.autodesk.com/)
* Revit API

API Training Classes

* [www.autodesk.com/apitraining](http://www.autodesk.com/apitraining)

Autodesk Developer Network

* [www.autodesk.com/joinadn](http://www.autodesk.com/joinadn)

DevHelp Online for ADN members

* [adn.autodesk.com/](http://www.autodesk.com/joinadn)

### The End

Thank you very much for your attention. I wish you much success and enjoyment with your Revit development work.

### Acknowledgement

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