Session 13

Enhance your project workflow with Dynamo
Håvard Vasshaug, Dark Architects

Class Description

The visual programming interface of Dynamo enables every architect and engineer with the ability to interact with, manipulate and move Revit building data that has previously been difficult to access. This presentation will teach participants how developing custom scripts in Dynamo can help them to automate and enhance BIM workflows.

About the Speaker:

Håvard Vasshaug is a Structural Engineer (M.Sc.), BIM Manager and Design Technologist at Dark Architects. He has vast experience providing Revit training, solutions, and seminars for architects and engineers over the past 8 years, and now uses this background to share knowledge of digital building design solutions. He regularly speaks about technical workflows, digital innovation and human development at various national and international conferences and seminars, and receive wide acclaim for his talks and classes. He writes about BIM and visual scripting solutions on vasshaug.net, and administers the Norwegian Revit forum. Håvard has a passion for making technology work in human minds and on computers, and he has three tools in doing that: Building project development, technology research, and knowledge sharing.
Introduction

Dynamo is a visual programming interface that connects computational design to building information modelling (BIM). With Dynamo, users can create scripts that build, changes and moves building information in whatever way the user wants. It is free and open source.

Computational design with BIM through Dynamo creates some interesting opportunities for the building design industry.

First, Dynamo allows us to design organic and optimized buildings and structures faster than with traditional modelling tools, using computational methods. This is because we can create, associate and analyse multiple building parameters, and have them revise our designs automatically. We can iterate and evaluate multiple building design options with ease, and build structures based on natural and mathematical principles.

Second, visual programming in BIM offers us a way of expanding the boundaries of what actually can be accomplished in a BIM tool. We can access and edit building parameters more effectively than traditional hard coded tools allow. We can establish relationships between building element parameters, and modify these using almost any external data. We can move any information about a building or its surroundings through our BIM effortlessly, something that is normally reserved for those who are software savvy.

This opens the first door to a vision of building designers taking ownership of, and designing, their own design tools. Ever since the Personal Computer became mainstream, almost all building designers have been subject to what software developers have created for them. This is an opportunity for the building design industry to start getting actively involved in how its software works. We can create, and obtain a deep understanding of, our own design tools.

When I was introduced to the building industry as a young engineer more than a decade ago, my design tasks included drawing, copying and offsetting lines, while trying to make sense of complex 2D blueprints. It was not only mind numbing, but also time consuming and inefficient. I now focus all my energy on teaching young architects and engineers about the exceptional digital building design tools they can use. I try to help them to avoid the same experience, and show them how to create their own software.

Computation is going to be a big part of the future building design workflow for architects and engineers. Dynamo, right now, manifests that vision.
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Note

All information in this class handout is based on the following software versions: Revit 2015 Update Release 7 and Dynamo 0.8.0.

If any of our examples deviate from your experience, please run a check on the versions you are using.
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Extract, change and write data to and from the Revit database

Extract

Extracting building data from Revit often means getting family elements and their parameters.

In short, there are mainly two ways of selecting Revit data in Dynamo: manual and automatic. Manual selection mostly include family instances or faces (singular or plural), and look like this:

![Manual Selection Diagram]

Automatic selection can be based on Revit Categories, Family Types, Element Types and with the used of Custom Nodes. Normally, the two first methods are adequate for most operations:

![Automatic Selection Diagram]

When we use automatic selection, we need to extract the individual Revit instances from either a Category or Family Type node:
It is necessary to be able to filter any selection in Dynamo, especially if we are using automatic selection. One way to do this is Filtering by Strings (text). It is equally easy to filter by Numbers, or other data.

Last, we can extract element’s parameters.

Change

All the data that we extract from Revit can be processed and manipulated in almost any way we want in Dynamo. One example that people often use to show this is combining a set of different parameters and parameter types (Text, Length, Area and so on) into one ID string. Another is changing window openings based on different pattern principles (attractors, random, wave and so on). In this exercise, we calculate Shared Elevations for different geometrical instances of Ceiling Families.

First, we need to extract the Shared Project Elevation. This is stored in the current Project Base Point in the parameter “Elev”:
Next, up we pull out all the Ceiling instances in our Revit Project:

Get local floor Ceiling heights:

Get all the relevant Level Elevation parameters. To do this in an easy way we need to download and install the Dynamo Package Clockwork by Andreas Dieckmann. In short, users around the world are sharing Dynamo workflow enhancements online through Dynamo’s built in Package Manager. Andreas' collection of helpful additions is a necessary addition for anyone using the...
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program. After installation of Clockwork, use the Element.Level node to get all the hosted levels form each Ceiling instance:

Now we add all these values:

Write

Using the same exercise, we write the changed elevation parameters back to each Ceiling Instance using an Element.SetParameterByName node:
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These simple methods show how valuable Dynamo becomes for design professionals who want to extend their design software.

Next we venture into the land of boring, and investigate how lazy architects and engineers can use visual scripting to make working life more pleasant. Moreover, effective, mind you.
Automate boring design tasks

Dynamo is perfect for designers who want to automate repetitive tasks in Revit. A very boring task and popular automation exercise is creating Placeholder Sheets or Sheets, and placing Views on Sheets.

Open a Revit Project file with a set of Levels, Views and a loaded Title Block family. Create or open an Excel spreadsheet with a corresponding set of Sheet Numbers and Names. Here is one simple example:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>101 Floor Plan 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>102 Floor Plan 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>103 Floor Plan 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>104 Floor Plan 4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>105 Floor Plan 5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>106 Floor Plan 6</td>
<td></td>
</tr>
</tbody>
</table>

Open Dynamo, and install Konrad K. Sobon’s Package archi-lab.net.

Konrad has made a Node the extracts all views from a Revit Project: Get All Views. Use this to create a list of all Floor and Ceiling Plans.
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Extract all Excel rows and columns.

Convert the data to Strings, and isolate the relevant indexes.
With this data, we can use Clockwork to create Placeholder Sheets.
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We can also combine these Strings with the extracted Views, and use Dynamo’s built-in Node SheetByNameNumberTitleBlockAndView to create all Sheets and place each corresponding View.
We could probably skip Excel in this operation and just combine the View Names and a set of Numbers to Sheet Names and Numbers, but then we would not learn about using Excel data in Dynamo!

Dynamo is not limited to Excel when it comes to using external data. In the next section, we will establish a live link between Rhino and Revit, through Grasshopper and Dynamo. Interoperability FTW!
Move building data to Revit from Grasshopper and Rhino

There are currently two Dynamo Packages that will move geometry and data from Rhino to Revit; Mantis Shrimp (MS) by Konrad K. Sobon and Rhynamo by Nathan Miller. Rhynamo will pull Rhino geometry from Layers to Dynamo. Mantis Shrimp can do that, and live link certain geometry and data between Dynamo and Grasshopper.

Rhynamo simply installs as a Dynamo Package, while MS requires you to do some manual operations to get the Grasshopper menu and components set up. For details on the latter, check out Konrad’s website at archi-lab.net.

This example will use Mantis Shrimp to live link a topography between Rhino and Revit.

Open a Rhino file with a topographical Surface and two closed curves representing the site extends and a building pad. Start Grasshopper (GH).

Extract the Rhino Surface and all its points to GH.
Filter the surface points that lie within the site extent curve.

Now send these points to Dynamo using Mantis Shrimp. The Mantis Shrimp Export component uses a temporary host file with the file extension ".geo". The file gets automatically created when we write the entire file path in a Panel and use a Boolean Toggle "True" in _export.
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Do the same procedure with a building pad curve.
Finally, press “True” in both Boolean Toggles, executing the script and generating the two temporary host files.

Now, we open Revit and Dynamo. Use the Read GH node from MS, and convert all Rhino Surface points to Revit Topography with this setup:
Now, with all four programs running, and Run Automatically activated in Dynamo, we can try modifying the Surface in Rhino and observe instant changes in Revit. Perfect demo material!

Let us finish by adding a Revit Pad.

Create the Building Pad from these Model Lines.
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