Automated Modeling of Existing CAD Files

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Workflow Breakdown

Study Object: Automated Modeling of Rooms (outlines composed of polylines)



- Purge unecessary information in the CAD
- Add text for each type of geometry to be modeld in Revit and place in the center of geometry
- Export the xyz coordinate of these texts and the text value to Excel
- Add modeling information for each type in Excel

- · Import the geometry and get the coordinate of control points of each geometry
- Get the modeling information of each geometry by finding the shortest distance between the centroid of geometry and the xyz coordinate of the text added in the CAD
- Generate the curves by connecting the control points in Revit
- Generate the polygons by these curves in Revit • Model the elements in Revit from these polygons

1. Add the slab number to each room that is going to be modeled in Revit. This number represents the type of the assigned room, such as the slab thickness, its level, or its workset, etc.

SI	SI	S1
S3	S3 S23	S3
53	S3 51	S3 S1
53	S3	S3
53	S3	53
S3	S3	S3 51
S3	S3	S3
S3	53	S3
S3	S1 S1	S3 S1
53	S2	S3
S3	S3	S3
S3	S3 55	S3 S1
S3	S3	S3

#1 AutoCAD to Excel Data Extraction

2. Use the "DataExtraction" command in AutoCAD to export the xyz position of slab number and the text to an Excel spreadsheet.

	vizard extracts object	ct data from drawi	ings that can be exported to a table or to an exter	mal file.
elec	t whether to create a	a new data extract	ion, use previously saved settings from a templa	te, or edit an existing
xtra	ction.			
0	Create a new data e	xtraction		
	Use previous ex	xtraction as a temp	plate (.dxe or .blk)	
O	<u>E</u> dit an existing data	extraction		
				Next > Cano
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3. Double check the generated Excel spreadsheet, and input the information related to each slab number, such as the level or thickness it represents.

l	А	В	С	D
	Value	Position X	Position Y	Position Z
	S1	5927.9860	46744.430	0.0000
	S1	15697.816	46744.430	0.0000
	S1	33299.128	38773.727!	0.0000
	S1	10989.173	16292.256	0.0000
	S1	20439.173	16269.012	0.0000
	S1	33299.128	16482.384	0.0000
	S1	33299.128	7522.2118	0.0000
	S1	33299.128	27242.994	0.0000
	S1	25498.365	46744.430	0.0000
	S1	17494.064:	38514.015;	0.0000
	S2	14119.3961	14016.109	0.0000
	S23	*1 9393.935:	43325.132	0.0000
	S3	5152.2692	28787.632	0.0000
	S3	26421.6551	32829.782	0.0000
	S3	12564.071	36405.667:	0.0000
	S3	26421.655	28937.330	0.0000
	S3	5152.2692	25405.667	0.0000
	S3	14977.863	28787.632	0.0000
	S3	5152.2692	32680.084	0.0000
	S3	26421.655	25555.365	0.0000
	S3	12564.071	43680.084!	0.0000
	S3	5152.2692	39787.632	0.0000

#2 Excel to Dynamo Linking Data with Geometry

(run in Dynamo Studio Inteface only, as it supports the specific nodes in this script)





```
9 #Assign the intput
10 importedObejcts1 = IN[0]
11
12 #Convert Objects to String
13 stringObjects1 = []
14 for items in importedObejcts1:
      stringObjects1.append(String.FromObject(items))
15
L6
17 #Filter the Curve Objects
18 boolMask1 = []
19 for items in stringObjects1:
      boolMask1.append(String.StartsWith(items, "Curve", False))
20
21 filteredObject1 = []
22 for itemsString, itemsMask in zip(stringObjects1, boolMask1):
      if itemsMask == True:
          filteredObject1.append(itemsString)
24
25 uniqueID = []
26 for items in filteredObject1:
      uniqueID.append(String.Split(items, "ID = ", ", Sub Type"))
28 uniqueID1 = zip(*uniqueID)[1]
29
31 #Assign the output
 OUT = uniqueID1
```

Import the xyz coordinate of the slab number from Excel and its text

By using Python, we retrieve the unique ID of each geometry imported from AutoCAD This unique ID will be used to manage these geometry.

Number	Thickness	Offset	UniqueID
S1	150	0	10
S3	120	0	100
S3	120	0	101
S3	120	0	102
S3	120	0	103
S3	120	0	104
S3	120	0	105
S1	150	0	106
S1	150	0	107
S1	150	0	108
S1	150	0	109
S1	150	0	11
S1	150	0	110
S1	150	0	111
S3	120	0	112
S3	120	0	113
S2	90	-20	114
S2	90	-20	115
S23	100	-300	116

Import the geometry from AutoCAD

```
12 #Assign the intput
13 convertedCurve1 = IN[0]
14 toleranceSimplify = IN[1]
16 #Simplify Converted curves
17 simplifiedCurve1 = []
18 for items in convertedCurve1:
19
      try:
          simplifiedCurve1.append(Curve.Simplify(items, toleranceSimplify))
20
      except:
          simplifiedCurve1.append(items)
23
24 #Convert Curve to NurbsCurve to get ControlPoints
25 nurbsCurve1 = []
26 for items in simplifiedCurve1:
      nurbsCurve1.append(Curve.ToNurbsCurve(items))
28 curvePoints1 = []
29 for items in nurbsCurve1:
      curvePoints1.append(NurbsCurve.ControlPoints(items))
30
32 #Create Polygon to get the Centroid
33 polygon1 = []
34 for items in curvePoints1:
      polygon1.append(Polygon.ByPoints(items))
36 center1 = []
37 for items in polygon1:
      center1.append(Polygon.Center(items))
38
40 #Assign the output
41 OUT = [curvePoints1, center1]
```

#2-02

points.

Create polygons from these imported curves, in order to get the centroid.

By measuring and finding the shortest distance between the centroid and the position of text, we match the geometry with its modeling information.

terPoint	Match
tPoint	GridPt
	//Տօպ
	a=l ist
	h=list
	c=Inde
	d=list
	u-LIS

listCe

listTex

Convert curves which were imported from the CAD drawing to NurbsCurve to get control



	А	В	0		D	E		F	G
1	Number	UniqueID							
2	S1	10	2251	11.79	25678.46	28845.13	320)11.79	
3	S3	100	2311	1.793	4778.46	7245.126	971	1.793	
4	S3	101	1051	11.79	12511.79	14511.79	165	511.79	
5	S3	102	2231	11.79	25611.79	28911.79	322	211.79	
6	S3	103	2311	1.793	4778.46	7245.126	971	1.793	
7	S3	104	1051	11.79	12511.79	14511.79	165	511.79	
8	S3	105	2231	11.79	25611.79	28911.79	322	211.79	
9	S1	106	1816	51.79	18161.79	18161.79	181	L61.79	
10	S1	107	1856	51.79	18561.79	18561.79	185	561.79	
11	S1	108	1266	51.79	12661.79	12661.79	126	561.79	
12	S1	109	1226	51.79	12261.79	12261.79	122	261.79	
13	S1	11	3301	11.79	33536.79	34061.79	345	586.79	
14	S1	110	1936	51.79	19361.79	19361.79	193	361.79	
15	S1	111	1976	51.79	19761.79	19761.79	197	761.79	
16	S3	112	1266	51.79	14895.13	17128.46	193	361.79	
17	S3	113	1266	51.79	14895.13	17128.46	193	361.79	
18	S2	114	1266	51.79	14895.13	17128.46	193	361.79	
19	S2	115	1266	51.79	14895.13	17128.46	193	361.79	
20	S23	116	2151	11.79	20528.46	19545.13	185	561.79	
21	S23	117	2151	11.79	20528.46	19545.13	185	561.79	
22	S5	118	1741	11.79	18778.46	20145.13	215	511.79	
23	S5	119	1741	11.79	18778.46	20145.13	215	511.79	
24	S3	12	2511	1.793	4845.126	7178.46	951	1.793	
25	S1	120	3458	36.79	34586.79	34586.79	345	586.79	
26	S1	121	3418	36.79	34186.79	34186.79	341	186.79	
27	S1	122	3418	36.79	34186.79	34186.79	341	186.79	
28	S1	123	3418	36.79	34186.79	34186.79	341	186.79	
29	S1	124	3418	36.79	34186.79	34186.79	341	186.79	
30	S3	125	2311	1.793	4778.46	7245.126	971	1.793	
31	S3	126	104:	11.79	14111.79	17811.79	215	511.79	
32	S3	127	223	11.79	25611.79	28911.79	322	211.79	
33	S3	128	2311	1.793	4778.46	7245.126	971	1.793	
34	S3	129	1041	11.79	14111.79	17811.79	215	511.79	
35	S3	13	1051	11.79	12511.79	14511.79	165	511.79	
36	S3	130	223:	11.79	25611.79	28911.79	322	211.79	
37	S3	131	2311	1.793	4778.46	7245.126	971	1.793	
38	S3	132	1041	11.79	14111.79	17811.79	215	511.79	
39	S3	133	223	11.79	25611.79	28911.79	322	211.79	
40	S3	134	2311	1.793	4745.126	7178.46	961	1.793	
41	S3	135	1041	11.79	14111.79	17811.79	215	511.79	
42	S3	136	223	11.79	25611.79	28911.79	322	211.79	
43	S3	137	2311	1.793	4778.46	7245.126	971	1.793	
44	S3	138	2311	1.793	4778.46	7245.126	971	1.793	
15	C 2	139	221	1 792	1778 /6	72/15 126	971 V	1 793 Rec.	donu 7
	4 F -	SlabDat	ta	Bour	1dary_X 📋	Boundary	Y	Bou	ndary_Z 🛛

#2-03

Export the xyz coordinate of control points of each geometry, as well as its corresponding uniqueID. Also, the slab information is remained for next step.

Left: X-axis Coordiante **Below: Slab Information**

Number	Thickness	Offset	UniqueID
S1	150	0	10
S3	120	0	100
S3	120	0	101
S3	120	0	102
S3	120	0	103
S3	120	0	104
S3	120	0	105
S1	150	0	106
S1	150	0	107
S1	150	0	108
S1	150	0	109

#3 Dynamo to Revit Modeling Geometry

(run in Revit Application Inteface)



11 null 12 null 13 null 14 null 15 null @L3@L2 @L1 {1329}

	Code Block	
path1	//Import Excel Data and Clean Null Value	
sheetName	<pre>file1 = File.FromPath(path1);</pre>	>
funMap1	<pre>importedData = DSOffice.Excel.ReadFromFile(</pre>	>
funcCreateFloor1	<pre>file1, sheetName, false);</pre>	
	<pre>listData = List.Clean(importedData, true);</pre>	>
	//Get Slab Info Data from Excel	
	<pre>slabInfo = List.Transpose(</pre>	>
	List.RemoveItemAtIndex(listData[1], 0));	
	<pre>slabNumberUnique = slabInto[0];</pre>	>
	slabwidthunique = slabinto[1];	>
	//Get Slab Design Data from Excel	
	clabData - List Transpose(>
	List RemoveItemAtIndex(listData[0] 0)):	-
	<pre>slabNumber = slabData[0]:</pre>	>
	<pre>slabOffest = slabData[2];</pre>	>
	<pre>slabID = String.FromObject(slabData[3]);</pre>	>
	//Get and manage Coordinates Data from Excel	
	<pre>boundary_X =Map(funMap1, List.DropItems(listData[2], 1));</pre>	>
	<pre>boundary Y = Map(funMap1, List.DropItems(listData[3], 1));</pre>	>
	<pre>boundary_Z =Map(funMap1, List.DropItems(listData[4], 1));</pre>	>
	//Create Polygon from Points by Coordinates	
	listPoints = Point.ByCoordinates(boundary_X, boundary_Y, boundary_Z);	>
	<pre>outlineCurves = Polygon.ByPoints(listPoints);</pre>	>
	//Use for Loop to Create Multiple Floor	
	elementFloor1 = funcCreateFloor(outlineCurves, funcCreateFloor1);	>

#3-01

Import the xyz coordinate of control points of each nurbs curve from Excel, and organize the list.

Generate polygons based on these control points.

Generate Revit floors from these polygons.

```
funcCreateFloor
def funcCreateFloor(listCurves:var[], func)
{
  return = [Imperative]
  {
  listCurves2 = {};
  index = 0;
  for (items in listCurves)
  {
  listCurves2[index] = __Apply(func, items);
  index = index + 1;
  }
  return = listCurves2;
  }
};
```

```
def tolist(obj1):
    if hasattr(obj1,"__iter__"): return obj1
    else: return [obj1]
def output1(l1):
    if len(l1) == 1: return l1[0]
    else: return l1
fs = UnwrapElement(IN[0])
names = tolist(IN[1])
width = tolist(IN[2])
#Convert width to Metric Unit
widthMetric = []
for items in width:
    widthMetric.append(items / 304.8)
nfs = []
TransactionManager.Instance.EnsureInTransaction(doc)
 For i in xrange(len(names)):
    try:
        try:
            x = fs.Duplicate(str(names[i]))
            cs = x.GetCompoundStructure()
            ind = cs.StructuralMaterialIndex
            cs.SetLayerWidth(ind,widthMetric[i])
            x.SetCompoundStructure(cs)
            nfs.append(x.ToDSType(False))
        except:
            nfs.append(Revit.Elements.FloorType.ByName(str(names[i])))
    except:
        nfs.append(None)
TransactionManager.Instance.TransactionTaskDone()
OUT = output1(nfs)
```

#3-02

Set slab data to each floor generated before.

during the process.

elementFloor1	//Set Slab Data
slabNumber	Element.SetPara
slabOffest	elementFloor1,
slabID	Element.SetPara
	elementFloor1,
	Element.SetPara
	elementFloor1,

Return all the slab type that's been applied to the model. This is to check if any elements get missing

Code Block

to each Floor ameterByName("Type", FloorType.ByName(slabNumber)); ameterByName("Height Offset From Level", slabOffest); ameterByName("Comments", slabID);

Conclusion:

Extracting data out of AutoCAD through Excel, recreating polygons based on imported curves, and then modeling from these polygons is an efficient and easy-to-understand method to convert AutoCAD elements to Revit. Due to the different element-specific conditions, eg. modeling columns and rooms from imported curves are two differnt mechanisms, each scenario shall be categorized and studied separately, but they can all be solved by this same workflow and the thought.

Automated modeling is a prospective topic, and we'll continue our research in this field. It takes efforts to develop the automation workflow that works for complex practical project environment, but once it matures, we'll greatly benefit from its outcomes.

Reference:

Autodesk University dynamobim.org/forum

Special thanks to:

Viakram Subbalah Jia Lin Chou

Floor S23	
Floors (1)	✓ ₽ Edit Type
Constraints	*
Level	Level 1
Height Offset From Lev	vel -300.0
Room Bounding	
Related to Mass	
Structural	\$
Structural	
Enable Analytical Mod	el 📋
Dimensions	\$
Slope	
Perimeter	14269.0
Area	12.404 m ²
Volume	1.240 m ³
Elevation at Top	-300.0
Elevation at Bottom	-400.0
Thickness	100.0
Identity Data	*
Image	
Comments	7
Mark	
Phasing	\$
Phase Created	Phase 1
Phase Demolished	None

