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Positioning Revit Models

Coordinating a Revit model with a survey drawing.

This white paper is written to illustrate the best workflow in setting up a coordinated site model (sometimes known as a container model) where all disciplines are using a mix of Revit and AutoCAD within the same organisation. This container model will then be used to host the Shared Coordinate system that can then be pushed or published to specific linked discipline's models.

If different companies are involved in the same Revit project, then the container model will be set up by the lead consultant and the other consultants will usually acquire coordinates from the agreed main container model. Once the task is complete, coordinate schedules can be run via Dynamo, or the API and components can be tagging for setting out drawings.



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Positioning Models – Introduction

SIMPLE COORDINATED REVIT MODEL SCHEMATIC



Fig. Example Schematic of a typical workflow setting coordinates of various discipline's models.

Within AutoCAD a CAD survey drawing has been audited and prepped. Units are checked and potential useful reference lines can be added to help establish useful reference points and angles. These may be useful later when linked into Revit.



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Fig. AutoCAD units should reflect the actual units the file has been drawn in!



Fig. The original AutoCAD drawing, located correctly to the WCS

The first task is to coordinate the Revit and AutoCAD data. The AutoCAD drawing shown in the example above is drawn in the correct point in space relative to the World UCS origin.

Prior to this task it is advised to first note 3 coordinates on the AutoCAD drawing to aid with the coordination task once imported into Revit. Try and ensure the points are distributed as widely as possible across the site.



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Copy and paste the notes from the 'ID' command or similar and note with a leader object. Alternatively, an attributed block with field driven attributes could be used for referencing once imported into Revit.



Fig. Coordinate Reference Point Using attributed fields



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Positioning Models – Establish True North Site View

Switch to Revit and using a suitable project template, create a new project and save it as Site-Coordination Model or similar.



Set the project Unit Length field to 6 decimal places to help with positioning accuracy.

Discipline:	Common			~	Use project s	ettings		
Un	nits	Forma	ət	^	Units:	Mill	imeters	,
Angle		12.35	0		Rounding:		Rounding incre	ement:
Area		1235 n	n²		Custom	~	0.000001	
Cost per Area	9	[\$/ft ²] 12	235]	Custom			
Distance		1235 [[']		Unit symbol:			
Length		1235 (m	im]		None	~		
Mass Density		1234.57 kg	g/m³		Suppress tra	lina O's		
Rotation Ang	le	12.35	•]	Supproce 0.6	a at		
Slope		12.35	•]	Suppress 0 in	eet		
Speed		1234.6 ki	m/h		Show + for p	ositive valu	es	
Time		1234.6	s		Use digit gro	uping		
Volume		1234.57	m³		Suppress spa	ces		
Currency		1234.5	57			_		
							OK	Cancel
Destand such				1.00				
Decimal symb	ool/aigit grouping	-						
123,456,789.	.00 🗸							
				_				
	OK	Cancel	Help					

Open the Site View and set the view aspect to True North.



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Project Browser - Project1	X	Properties				×
□ [□] Views (all) □ Floor Plans □ Level 0 □ Level 1		P	Floor Plan			•
Site		Floor Plan:	Site	~	🔠 Edit	Туре
E Ceiling Plans		Graphics				* ^
		View Scale		1:100		
Elevations (12mm Circle)		Scale Value	e 1:	100		
Egends		Display Mo	del	Normal		
Schedules/Quantities (all)		Detail Leve	el	Coarse		
A100 - Unnamed		Parts Visibi	lity	Show Original		
H P Families		Visibility/G	raphics Ov	Edit	1-	
Groups		Graphic Di	splay Opti	Edit		
🕫 Revit Links		Orientation	1	Project North		
		Wall Join D	Display	Clean all wall j	oins	
		Discipline		Architectural		
		Show Hidd	len Lines	By Discipline		

If necessary, duplicate this site view and set the copy to Project North, name the views accordingly.



Make the True North Site Plan Active.



Positioning Models – Define True North Using 'Rotate True North' Function

In the Site View on the Insert Tab choose Link CAD.

Archited	ture	Structur	re Steel	Precast	System	ns Ins	ert
	8	CAD	2	E	-		1
Link Revit	Link IFC	Link CAD	Link Topography	DWF Markup	Decal	Point Cloud	Coo

Locate the AutoCAD drawing to link and set the options as shown in the image below.

	File name:	Coordinated Su	rvey Drawing.d	lwg			~	
Desktop 🗸	Files of type:	DWG Files (*.o	lwg)				~	
Current view only		Colors:	Preserve	~		Positioning:	Auto - Center to Cente	r ~
		Layers/Levels:	All	~		Place at:	Level 0	
		Import units:	Auto-Detect	~	1.000000		Orient to View	
Tools -			Correct line	es that	are slightly off axis		Open	Cancel

Once complete the AutoCAD drawing should display as shown.

IMPORTANT. It is vital that the AutoCAD drawing units reflect the drawn units for appropriate scaling to take place. If left as unitless or at incorrect values the drawing will come in at a vastly incorrect size!

FTI		
L	A Drawing Units	× ,
44	Length Angle Type: Type:	
33	Decimal V Deg/Min/Sec V	I.
K W	Precision. Precision. 0.0000 V 0d00'00" V	1
AUT TO A	Clockwise	11
E IN	Insertion scale	- ·
	Units to scale inserted content:	and the second
	Meters ~	
AN	Sample Output	
8	1.5,2.0039,0 3<45d0'0" 0	Ba
J LITT	5,1500,0	
	Lighting	
- martin	Units for specifying the intensity of lighting:	
	International V	
18 85	OK Cancel <u>D</u> irection <u>H</u> elp	
	lu lu Street	Fig. Survey drawings are typically drawn in metres



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Once imported, Revit needs to be told the Project North, True North Deviation. As AutoCAD defaults to True North by default, but Revit thinks in terms of Project North, the user needs to rotate Revit's True North to the correct direction.

This can either be achieved with the aid of reference planes or grid lines drawn in Revit, or access linework from AutoCAD to set the rotational angle between Project and True North.

₩ 4 1 1 1 1 1 1 1 1 1 1	Modify	시 팩 X	View	۰. Measure	Create	B
Disjoin Copy An	gle:	C	enter of rota	tion Place	Default	
X	- Level 0	P 5	ite - True N	orth X	Site - Project	Nort

Using the standard Rotation Tool within Revit, rotate the linked CAD file to ensure the major axis of the building or site is Orthogonal to the view.



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Fig rotating the linked file to define Project North. Point 1, Centre of Rotate. Point 2 Angle Start, Point 3

Angle End

In the displayed example some linework has already been set out in the AutoCAD file and this geometry will serve to set a rotational base point and angle reference.



Fig. AutoCAD drawing aligned to Revit's Project North.

Now the AutoCAD drawing is aligned to Revit's Orthogonal Project North we can now establish the location of the True North Direction.



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Fig. Rotate True North, is located on the Manage Tab, Project Location panel

This is done by using the 'Rotate True North' Command.

Place the rotation base point at an appropriate intersection - in this example the intersecting lines within the AutoCAD drawing.

						the second
Angle from Project to True North: 24° 10'	03" Ea	ast v	CCW Rotation Angle:	Center of rotatio	· Place	Default

Rotate the true North so that the reference line at an angle now points up the screen.



Once complete you should be able to toggle between Project North and True North settings (or view) and see the building orientate to the correct aspect.



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Once this task is complete, the next step is to establish coordinates within Revit and link back to AutoCAD.



Positioning Models – Specifying Coordinates

Once the site has been set to True North, coordinates can be set and published back to AutoCAD and create a coordinated link.

Locate an established corner of the CAD link where the coordinates from AutoCAD can be identified.

To ensure Revit has the same coordinates as the AutoCAD drawing the 'Specify Coordinates at a Point' command can be used. This command is also located under the Manage tab.



As a check a Coordinate Tag can be placed at the same point. Initially the values will not match, but once the coordination task has been achieved the tag value will be the same as the coordinate text within the AutoCAD drawing.



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Relocate this project in Sha known values at the point y will move relative to global	ared Coordinates by specifyin you selected. Current project ly positioned links.
New Coordinates	
North/South:	130569356.0
East/West:	517304048.0
Elevation:	0.0
Angle from Project North	to True North
	Test

When specifying the coordinates, ensure the correct point is selected and enter the coordinates as shown on the CAD drawing. Revit tends to think in millimetres whilst surveyors tend to think in metres, but provided units are specified correctly in format and units, the coordinate tag should have the same value as the equivalent AutoCAD text.

Some formatting and thought may have to be applied when inputting coordinates as typical map coordinates (along the corridor, then up the stairs or Eastings, Northings) are reversed because of the global coordinate's convention (Latitude and Longitude).

In the example below the coordinate tag has been configured to work in the Easting/Northing display convention.



Fig. Initially the coordinate Tag and text do not match



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Fig. Once complete the annotations match

Once the basepoint is aligned, cross check the other two points and check that their coordinate values also tally with the original AutoCAD drawing. Now that coordinates have been established coordinate tags can be added to any Revit view.



Positioning Models – Publishing Coordinates

With the Revit project now correctly set, the coordinates can be published back to AutoCAD to establish the link.

In the coordination model, select the CAD link and select 'Shared Site' in the Properties Palette.

Properties			×
	Import Syr Coordinate	mbol ed Survey Draw	ing.dwg
Coordinate	ed Survey Dra	awing.dwg (~	🗄 Edit Type
Dimension	s		\$
Instance S	cale	1.000000	
Identity Da	ita		\$
Name		Coordinated	Survey Dr
Other			*
Shared Si	te	<not s<="" td=""><td>hared></td></not>	hared>
Draw Lay	મા	Background	1

Select the publish option in the resulting dialog and choose Reconcile.



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Share Coordinates	×
Shared coordinates of the current project and "Surve reconciled. This is a one-time operation.	y Drg.dwg" have not been
Publish the current shared coordinate system to " This will modify all Named Positions of the linked	Survey Drg.dwg." model.
Acquire the shared coordinate system from "Surve This will modify the current model and all Named models.	ey Drg.dwg." Positions of other linked
Record selected instance as being at Position: Survey Drg.dwg : Default	
	Location Change

Save the model and save the new position back to the linked file.

Location Position Changed	×
You have changed the "current" Position in Coordinated Drawing.dwg. What do you want to do?	Survey
→ Save Saves the new position back to the link.	
→ Do not save Returns to the previously saved position when the link is reloaded or	reopened.
→ Disable shared positioning Retains the current placement of the link and clears the Shared Positi	on parameter.
	Cancel
Click here to learn more	

A link has now been established with the linked AutoCAD drawing. The coordinates between the Revit and AutoCAD file should correlate.

Now the Site Container Model has been established, coordinates can now be published back to the respective linked Revit models.



Positioning Models – Publishing Coordinates to Revit Models

Within the Site Container model, link in the Revit Model to which the Site Container Model's coordinate system is to be published.

Favorites	<		×	
	File name:	rst-bsc-101.rvt	~	
Desktop 🗸	Files of type:	RVT Files (*.rvt)	~	
Tools 🔹	Positioning:	Auto - Center to Center	~	
			Open	▼ Cancel

Select the 'Auto - Centre to Centre' option for the positioning option.

Using some suitable references, locate and position the Revit model into the correct space. Revit's Align command is ideal for this task. First align the file in a plan view for the horizontal axis.



Then locate the project in the vertical axis. It is likely the Site Containers levels do not correspond to the linked projects levels. Use the Align command, ensuring the corresponding references match.



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If the heights need to be set, use the specify coordinates at point tool to set the 'Z' elevation of the project. Remembering to input the correct units.

Level 1	Specify Shared Coordinates X
4000	Relocate this project in Shared Coordinates by specifying known values at the point you selected. Current project will move relative to globally positioned links.
	New Coordinates
	North/South:
	East/West:
	Elevation: 23467.0
Level 0	Angle from Project North to True North
0	East
	OK Cancel
	Fig. Specifying level height in

ntainer model

Once the project is correctly positioned the coordinates can be published back to the building model. This can either be achieved with the Site function or the Publish Coordinates function under the Manage tab.



×

TR NB

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Settings Acquire Coordinates publish Coordinates	Manage	Add-Ins	Modif n nates *	y G	Ad	d k 1						
Location and Site Location Site Used for orientation and position of the project on the site and in relation to other buildings. There may be many Shared Sites defined in one project. Select the Position in 'rst-bsc-101.rvt'. Internal (current) Duplicate Delete Angle from Project North to True North : 249.10' 02" Detet	ject North	Acq Pub Rese	uire Coo lish Coor et Shared cify Coor	rdinates dinates d Coordir rdinates a	nates at Point	in						
Select the Position in 'rst-bsc-101.rvt'.	Locat Locat User may	ion and Si ion Site d for orienta	te	ed Coord d positio jites defi	inates on of the ined in o	project	t on th ject.	ne site	and in re	elation t	to other buildings. T	here
Angle from Project North to True North :	Sele	ect the Posit	ion in 'r	st-bsc-1	01.rvť.							
Angle from Project North to True North :	1010	rna (curre	nc)								Duplicate	
Angle from Project North to True North :											Rename	
Angle from Project North to True North :											Delete	
Angle from Project North to True North :												
	Ang	le from Pro	ject Nor	th to Tri	ue North	:	÷					

Click OK on the dialogue to confirm.

The linked model is now set with the same coordinate system as the site container model.

OK

NB. Site container models are essential in establishing a good working practice for coordinated Revit models. All coordinated models should be linked in the site container model and aligned as per the

Cancel

Help



described process. Coordinates should then be published from this model to the respective files both when setting up the model or when addressing any coordination errors later in the project.

In certain situations, a consultant may link the site container model into their discipline's file, line up the references and use the Acquire coordinates option. This will pull the shared coordinate system into their project and set their origin accordingly. Once this process has been completed the coordination model should be detached.

Think of the PUBLISH option as PUSHING a coordinate system to another file therefore modifying it, whilst ACQUIRE is PULLING a coordinate system to your project also modifying it.

In both cases the coordinate system is shared and should mean that if the Linked files are detached, they can be relinked with the Shared Coordinates positioning Option. The models should then appear in the right place and the correct coordinates.

		R rst-bsc-1	01	6,328 KB	Autodesk Revit Pro	23/02/2021			
Pavorites		<				>	~		
		File name:	rst-bsc-101.rvt				\sim		
Desktop V Files of t	Files of type:	RVT Files (*.rvt)				\sim			
Toojs 🔹	•	Positioning:	Auto - By Shared	Coordinates			~		
						0	pen	-	Cancel

Fig. Once a Shared Coordinate System has been established, any related files can be linked together and appear in the correct place with this positioning option.



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Positioning Models – Working with Civil 3D

Site Collaboration was introduced in Revit 2019.1, a much-improved level of interoperability between the Revit and Civil 3D products therefore saving time and improving accuracy when transferring site information and project location data between different project teams. Topography from Civil 3D can be easily linked into Revit using Autodesk Desktop Connector and BIM 360 Docs. This linked geometry can interact with topography in Revit. Therefore, can be used for hosting, tagging and scheduling within a project.

The first step is to open the surface file in Civil 3D. Because the accurate positioning on the surface is important, a coordinate has been placed, for the same reasons as when working with a vanilla AutoCAD drawing, so it can be checked after the Revit import. See Figs 1 & 2.



Fig 1



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Fig 2

To export the surface, navigate to the Collaborate Tab and choose the Publish Surfaces option. Please note, this process will upload the file to a specified BIM 360 Docs Project on the Autodesk Construction Cloud (ACC) using the Desktop connector. These tools need to be installed and up to date otherwise the upload process will not work. See Figs 3 & 4.



Fig 3



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Publish Surfaces Х Publish Surface – Surface Style Display Specify surfaces to be published: A surface being published uses a style that will produce inaccurate results in other applications. What do you want to do? ---- 🔂 🗹 Composite To ensure that the published surface will be displayed correctly in other applications, the surface style will be New Road 1 - Surface automatically updated. \rightarrow Publish the surface with the updated style The style in the current drawing will not be changed \rightarrow Cancel the publish operation Always publish surfaces with the updated style 🔣 Choose from drawing Specify output file: Limited/Demo Project/Civil/Surface w corridor.shared.dwg ОК Cancel Help

Fig 4

Once the Publish the surface option has been chosen, select the BIM 360 object in the list, then the Project and folder you wish to upload your file to. See Figs 5 & 6.



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Save As							×
$\leftarrow \rightarrow \checkmark \uparrow *$	« Da	avidLewis > ACCDocs > CA	Dline Limited	~ Ŭ	, Search (CADIine Limited	
Organise 🔻						4 •	?
 Downloads Documents Pictures COORDINATE: Customer Succ 	* ^ * S V cces	Name * AEC Collaboration * AutoCAD Training * BIM 360 Coordination * BIM 360 Design	Status Pro		Version		^
 Phase 2 - Vide RPS Phase 2 OneDrive - Cad This PC 	eo (Ilin	 BIM Infra Workflow C3D 2020 Design colla Cadline demo project Civil 3D Training Civil3D Training 	abor				
a	\sim	<					>
File name:	Surfa	ce w corridor.shared					\sim
Save as type:	Auto	CAD Drawing File (*.dwg)					\sim
∧ Hide Folders					Save	Cancel	

Fig 5

Save As						×
$\leftarrow \rightarrow \land \uparrow *$	« ACCDocs > CADline Limited > Demo P	roject v	Ü		no Project	
Organise 🔻					€ ▼	?
🔶 Downloads	Name St	tatus		Version		Siz
Documents	* Civil					
Pictures	*					
COORDINATE	5 V					
📜 Customer Suce	es					
📜 Phase 2 - Vide	01					
📜 RPS Phase 2						
loneDrive - Cad	in					
This PC						
.	✓ <					>
File name:	Surface w corridor.shared					~
Save as type:	AutoCAD Drawing File (*.dwg)					\sim
∧ Hide Folders				Open	Cancel	
		10				:

Fig 6



The process in Civil 3D is now complete. Next access Revit to import the surface. In the Revit file we switch to the Site Plan View and navigate to the Insert Tab and choose the Link Topography option. See Fig 7.

File	Archited	cture	Structu	ire Steel	Systems	Insert	Ann	otate
\$		82	CAD	5	ស្នា	-		
Modify	Link Revit	Link IFC	Link CAD	Link Topography	DWF Markup	Decal	Point Cloud	Coordin Mod
Select -					Link			

Fig 7

The process is linked to the BIM 360 Docs environment, so the dialogue box that opens will show only those projects. See Fig 8.

Link Topography			×
Switch Account > Project CADline Limited > Demo Project • Demo Project / Civil			
Name 🔨	Version	Modified Date	
Atkins Surface	V1	9 August 2019 14:38	
COMPOSITE STAIRS	V2	7 August 2019 20:23	
Day 3 - New Road	V1	19 July 2019 14:40	
Surface w corridor	V2	17 May 2021 08:40	
Surface w corridor		,	
How do I link topography to a Revit model?		Link Cancel]

Fig 8

Choose the surface to import and then select the Link button. The surface is then imported. It will be placed at the centre of the screen if the screen limits are too vast. See Fig 9.



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Fig 9

To relocate the Surface to the correct world coordinates, select the surface and in the Properties Palette, choose the Not Shared Button in the Shared Site Category and Reconcile from the next dialogue box. See Fig 10.

Properties	×	Share Coordinates	×
Linked Topography Surface w corridor		Shared coordinates of the current project and "Surface w corridor" have not been reconciled. This is a one-time operation.	
Topography Links (1) Identity Data	✓ ☐ Edit Type	 Publish the current shared coordinate system to "Surface w corridor." You cannot publish coordinates to linked topography. 	
Link Name Saved Path	Surface w corridor Autodesk Docs://CADL		
Other	*	Acquire the shared coordinate system from "Surface w corridor." This will modify the current model and all Named Positions of other linked	
Shared Site	<not shared=""></not>	models.	
		Record selected instance as being at Position:	
Properties help	Apply	Surface w corridor : DefaultLocation Change	
		Changing positions is disabled for linked toposurfa	ces,
		What are shared coordinates? Reconcile Cancel	

Fig 10



The final part of the process is to check that the surface has been placed to the correct world coordinates. Place a coordinate tag on a known reference point. The information should have the same coordinates that are reported in the Civil 3D file. See Fig 11.

🦹 🗈 🕞 🗍 🎧 • फ्रि •	🗟 - 🖨 😑 - 🖍 😰 🗛	·@•• ● ﷺ 號 등• =	Autodesk Revit 2022 - Project1 - Floor Plan: Site	4 🖽 🔔 david.lewisW8* 🦙 🔞 - 🗖	×
File Architecture Structur	re Steel Precast System	s Insert Annotate Analyze Massing & Sit	e Collaborate View Manage Add-Ins Modify Spot Coordinates		
Modify Select + Properties Clipboa	 ※ K Notch • [□ 6] □ 0 Cut • □ 0 0 2 Cut • □ 0 2 Oin • K 4 Geometry 	Compare			
Modify Spot Coordinates	Leader Shoulder	Prefer: Wall centerline ~			
Properties	X 📄 Level 0	📑 Site 🛛 🗙			₹
Spot Coordinates Horizontal					^
Spot Coordinates (1)	🗸 🗄 Edit Type				
Graphics	* ^	<u></u>	////		
Leader		~			
Text	*				
Top Coordinate Pref					
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Bottom Coordinate					
Bottom Coordinate	~				
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Site)	N 403853168		
Ceiling Plans	/		,		
B - 3D Views	, í				
Elevations (12mm Circle)					
North		\setminus (
South					
West	\sim	\mathcal{V}			
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View List					~
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Click to select, TAB for alternates,	CTRL adds, SHIFT unselects.	di i	🗠 🌌 :0 🔚 💹 Main Model 🗠	🊏 🎜 🛼 ট 🏷 🔿 🏹:1	

Fig 11