OPTIMIZING WALKING PATHS IN BUILDINGS

BIM
Portal Twente

VERSION: 1

DATE: 2/11/2012

NAME: Frederick M.C. van Amstel

2012

vernieuwt de bouw
pioneering

Contents

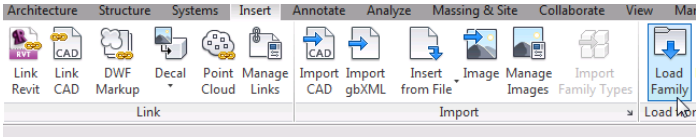
1.1 Purpose of this document

This document gives instructions on how to use a custom family called **Walking Paths.rfa** in Autodesk Revit 2012 to analyze the paths of inhabitants inside a building. The family can calculate the distances travelled and time spent, giving objective criteria to evaluate the performance of a floor plan in terms of work procedures. Different design options can be compared. Walkthroughs can be laid upon paths to visualize in first person the spatial experience of a given worker or user.

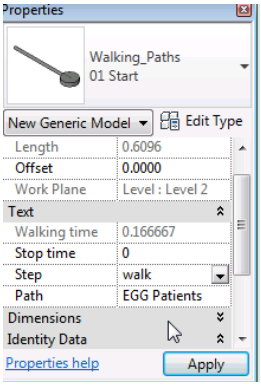
1.2 Drawing the path

Start with a floor plan that has already a floor, rooms and doors.

Load the Walking Path.rfa family at the Insert tab.

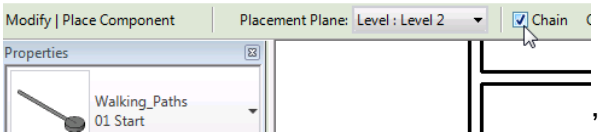


Check the properties panel, where the family displays its default parameters. The customized parameters of this family are under the Text section. It is advisable to change the **Step** and **Path** parameters before starting drawing so you can later distinguish this flow from the others. One **Path** is composed by many **Steps** and, sometimes, a **Step** has a **Stop time** to do a task in place. If it is just walking, leave **Stop time** as 0. Change the parameters and click the **Apply** button.

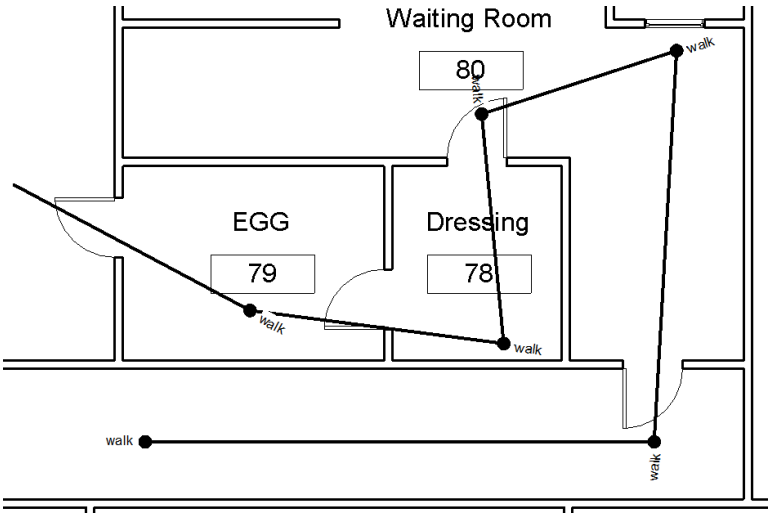


To draw a path, just click at the beginning of the line and again at the end. If there is no floor, this won't work. The lines are hosted on the floor, like doors are hosted on the walls.

You can draw the path line by line, but you can also create a chain of them. This makes it easier if you already know where to go. After you mark **Chain** in Place Component options, you can continue drawing the path after the second click. To finish a path you can double click.

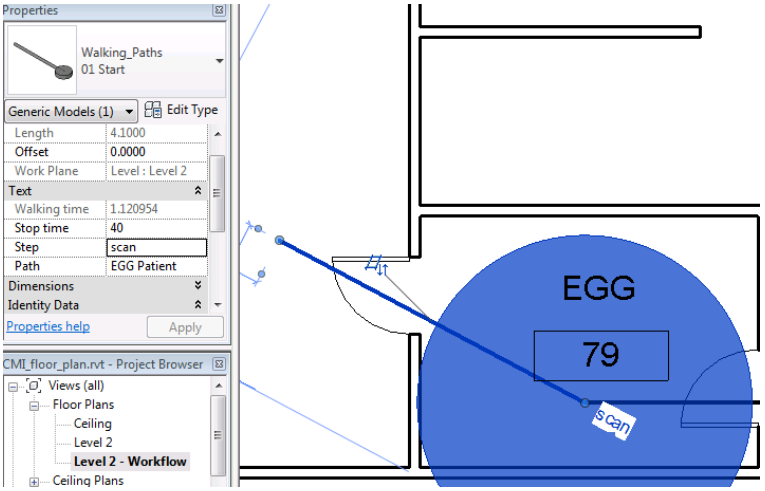


After you draw your first path, you get something like this:

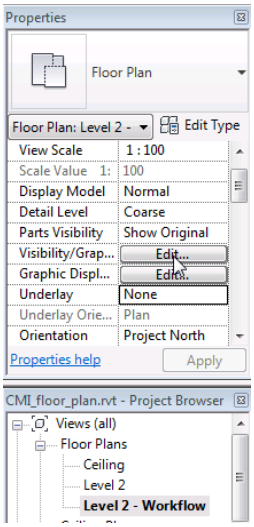


After it's drawn, you can go back and add more information to your steps. Select a step and add a **Stop time** and a specific description in the **Step** parameter. The bubble at the beginning of the step will grow according to **Stop time** parameter, helping you visualize where people spend more time.

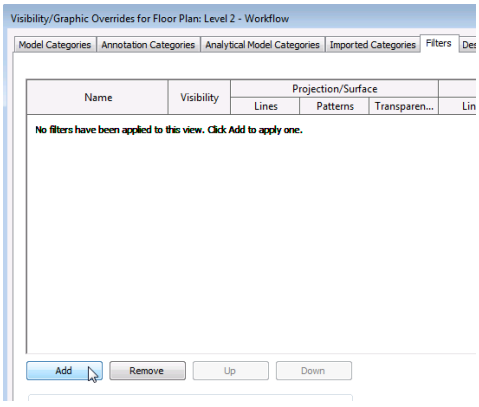
1.3 Improving visualization

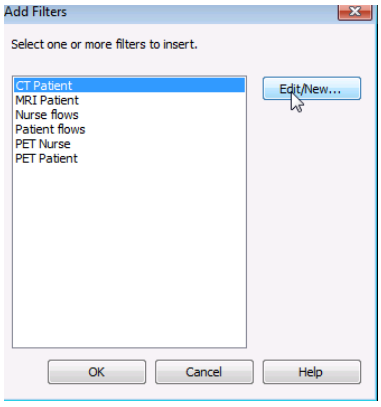


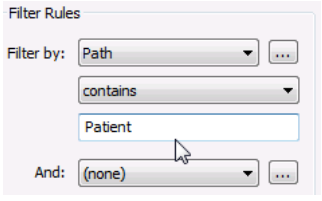
After bubbles start to grow, you might want to change the colors of them, not to confuse with walls. Thus, deselect the step by clicking in a blank part of the floor plan. The view properties will show up, where you have to open **Visibility/Graphics** dialogue.



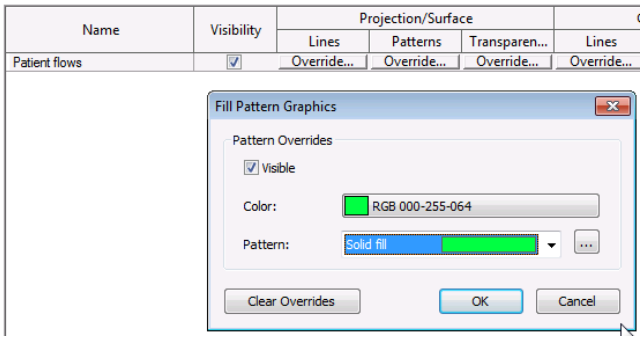
Go the Filters tab and add a filter. Add a new filter and add the rule to filter by Path and if it contains one of the words that you entered in the **Path** parameter.



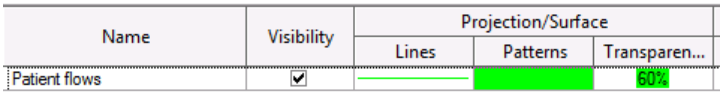




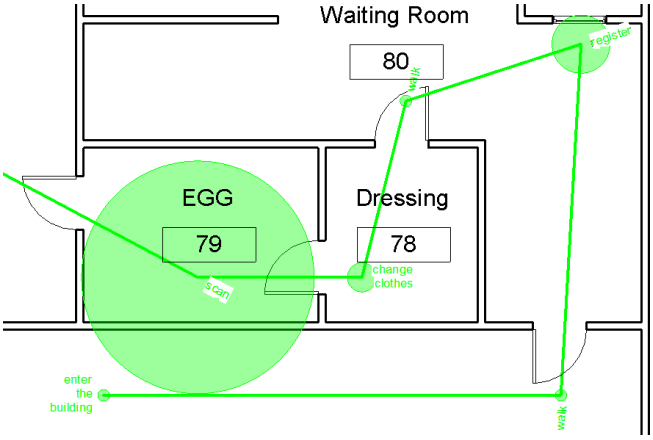
After you add a filter to select all the steps of a specific Path, you can change its appearance. In Patterns, chose the **Solid fill** and a color. In lines, just chose a color. Add 60% of transparency if you want a softer visualization for very complicated paths.



You should end up with something like this:

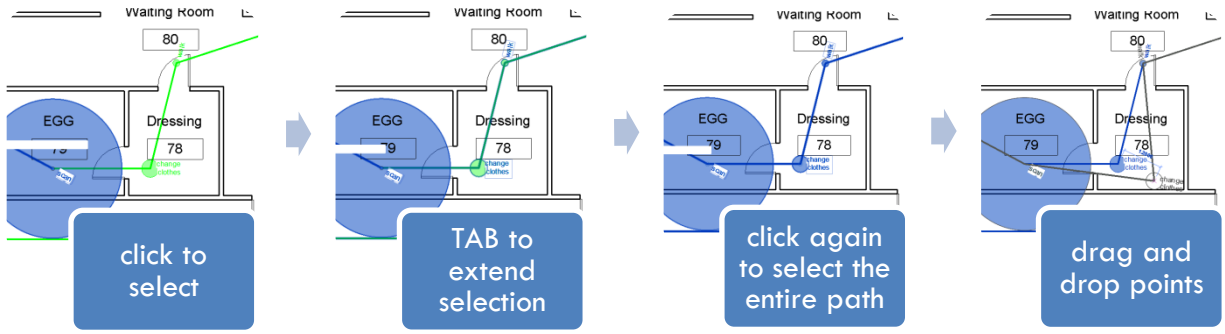


Click OK and, from now on, all the paths you draw with the word Patients will get the green color.

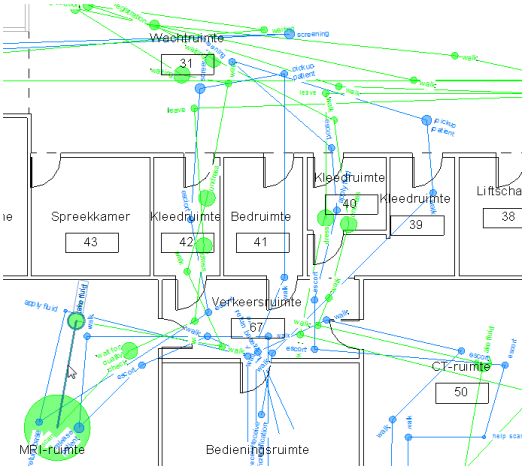


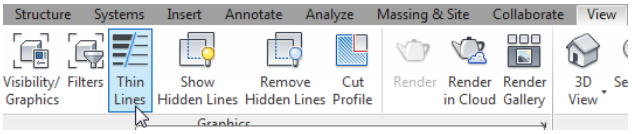
1.4 Changing paths

If you want to change the points of your path and just drag and drop the end point, you will end up with unconnected steps. You need to select the entire path in order to alter the points.



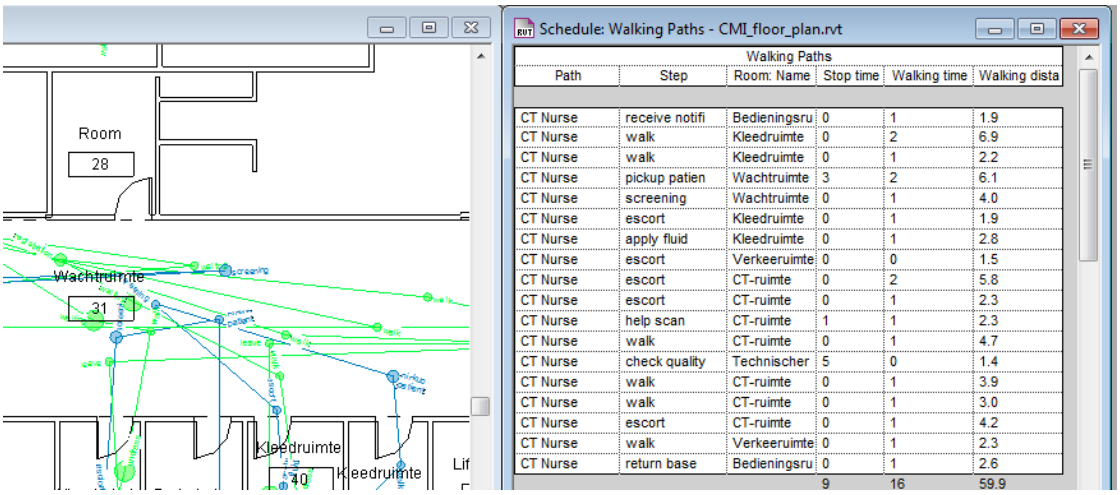
The example below has two different kind of paths: patients (green) and nurses (blue). To avoid visual cluttering of the many intersecting paths, the **Thin Lines** function was activated.





1.5 Performance indicators

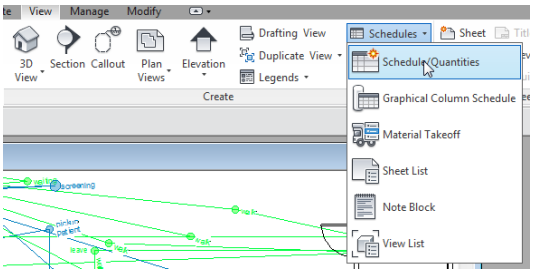
Filling the parameters for every step might be time consuming, but it is important to analyze performance. The parameters can be visualized as a schedule, where each step fills a line. You can check which room the path has passed through, how many meters of walking distance, and how much time does it take (in minutes).

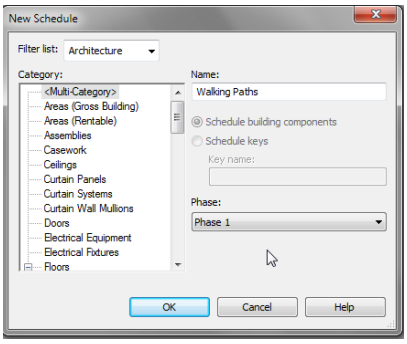


Walking Paths

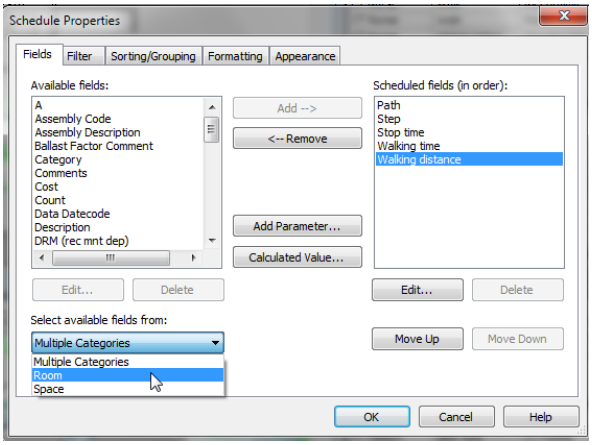
Path	Step	Room: Name	Stop time	Walking time	Walking dista
CT Nurse	receive notifi	Bedieningsru	0	1	1.9
CT Nurse	walk	Kleedruimte	0	2	6.9
CT Nurse	walk	Kleedruimte	0	1	2.2
CT Nurse	pickup patien	Wachtruimte	3	2	6.1
CT Nurse	screening	Wachtruimte	0	1	4.0
CT Nurse	escort	Kleedruimte	0	1	1.9
CT Nurse	apply fluid	Kleedruimte	0	1	2.8
CT Nurse	escort	Verkeeruimte	0	0	1.5
CT Nurse	escort	CT-ruimte	0	2	5.8
CT Nurse	escort	CT-ruimte	0	1	2.3
CT Nurse	help scan	CT-ruimte	1	1	2.3
CT Nurse	walk	CT-ruimte	0	1	4.7
CT Nurse	check quality	Technischer	5	0	1.4
CT Nurse	walk	CT-ruimte	0	1	3.9
CT Nurse	walk	CT-ruimte	0	1	3.0
CT Nurse	escort	CT-ruimte	0	1	4.2
CT Nurse	walk	Verkeeruimte	0	1	2.3
CT Nurse	return base	Bedieningsru	0	1	2.6
			9	16	59.9

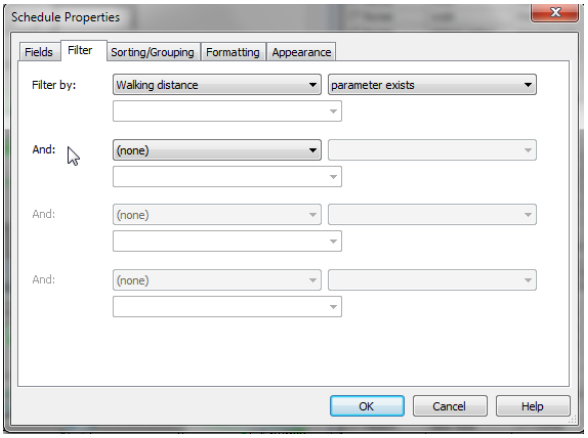
To make a schedule like the one above, go to the **View** tab and find the **Schedules** drop down. Filter by Architecture discipline, Multi-Category and give it a name, like “Walking Paths”. Pay attention to the Phase selected, since if the paths are not in this phase, they will not show up in the schedule. You can check in which phase your paths are by canceling this window, selecting a path, and looking at the properties panel.

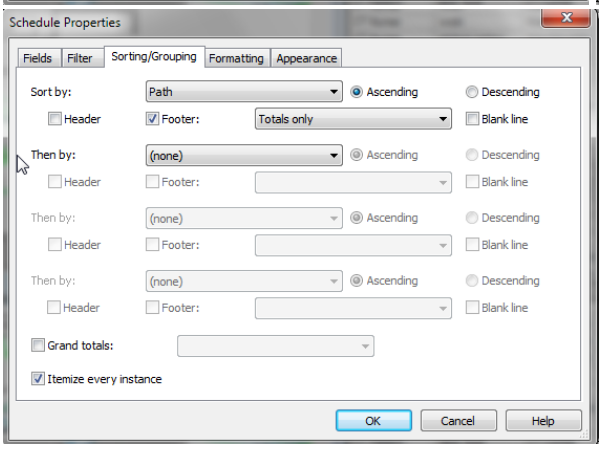


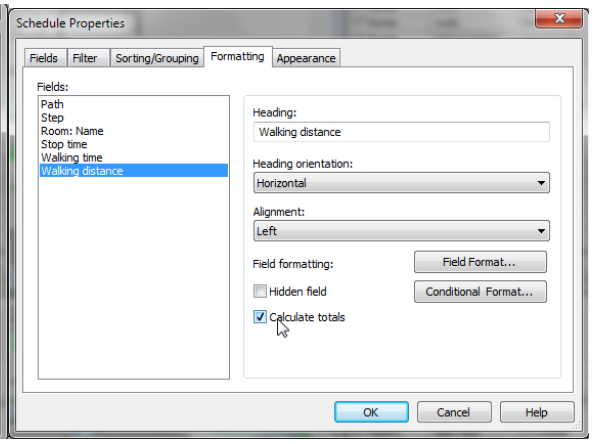


The next step is to add the parameters to the schedule. Look for the parameters that you have filled previously: **Path, Step** and **Stop time.** Also add the calculated parameters **Walking time** and **Walking distance.** In the available fields dropdown, change to Room and find the **Room:Name** parameter so you can see which rooms a single path goes cross. Configure the other tabs as shown below. Make sure that you mark **Calculate totals** at the Formatting tab for **Stop time, Walking time** and **Walking distance.**

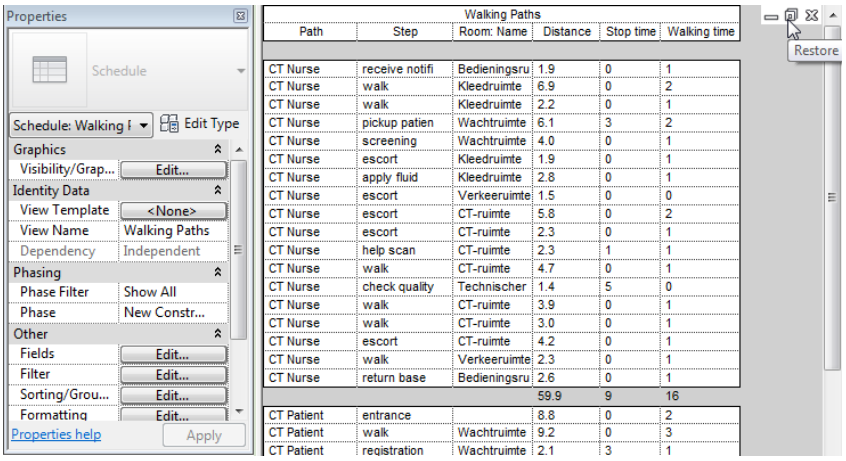








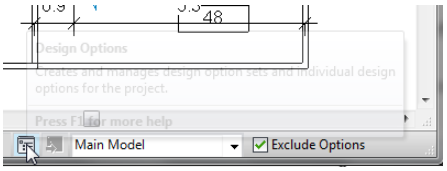
When you create a schedule, it will be opened maximized. If you want to see the schedule besides the floor plan, you should **Restore** the window. This is handy if you want to make changes in the paths and check the effects over the performance indicators. You can also double click in an element in the schedule to highlight on the floor plan.

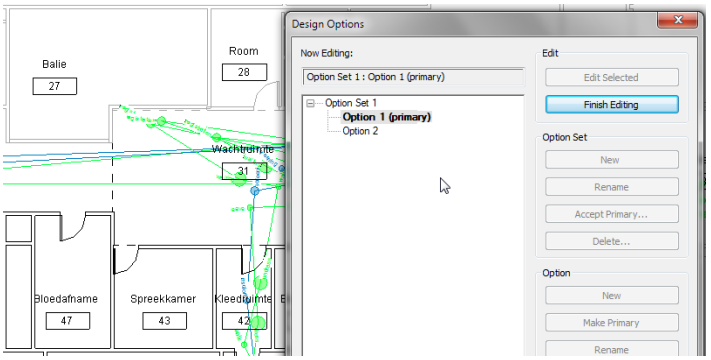


Path	Step	Room: Name	Distance	Stop time	Walking time
CT Nurse	receive notifi	Bedieningsru	1.9	0	1
CT Nurse	walk	Kleedruimte	6.9	0	2
CT Nurse	walk	Kleedruimte	2.2	0	1
CT Nurse	pickup patien	Wachtruimte	6.1	3	2
CT Nurse	screening	Wachtruimte	4.0	0	1
CT Nurse	escort	Kleedruimte	1.9	0	1
CT Nurse	apply fluid	Kleedruimte	2.8	0	1
CT Nurse	escort	Verkeeruimte	1.5	0	0
CT Nurse	escort	CT-ruimte	5.8	0	2
CT Nurse	escort	CT-ruimte	2.3	0	1
CT Nurse	help scan	CT-ruimte	2.3	1	1
CT Nurse	walk	CT-ruimte	4.7	0	1
CT Nurse	check quality	Technischer	1.4	5	0
CT Nurse	walk	CT-ruimte	3.9	0	1
CT Nurse	walk	CT-ruimte	3.0	0	1
CT Nurse	escort	CT-ruimte	4.2	0	1
CT Nurse	walk	Verkeeruimte	2.3	0	1
CT Nurse	return base	Bedieningsru	2.6	0	1
			59.9	9	16
CT Patient	entrance		8.8	0	2
CT Patient	walk	Wachtruimte	9.2	0	3
CT Patient	registration	Wachtruimte	2.1	3	1

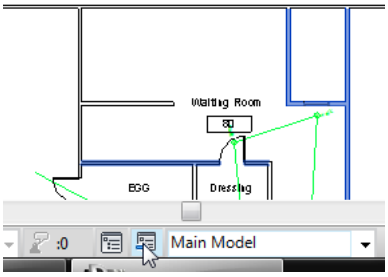
1.6 Working with Design Options

With performance indicators from the schedule, you can compare different design options based on objective data. Revit has a functionality to manage multiple design options for a single part of the drawing. Click on **Design Options** button at the bottom of the screen.

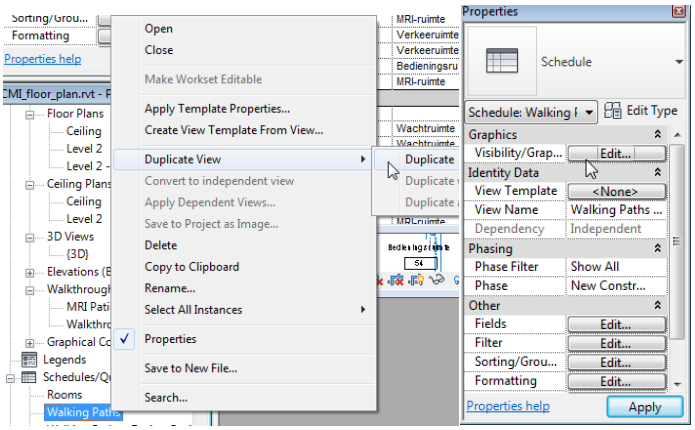




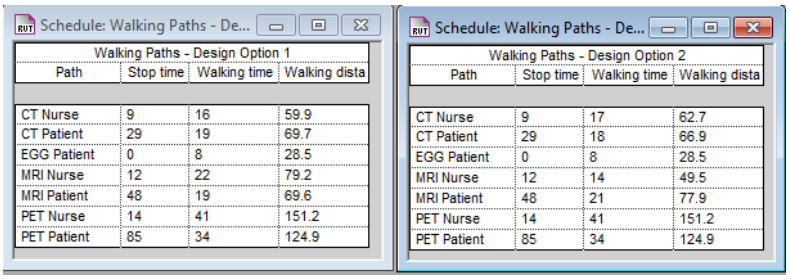
Add as many options as you wish. As soon as you click on **Edit selected**, the elements from other options will turn gray and you won't be able to select them. If you want to move objects from the Main Model to other options, you can select the elements and use the **Add to set** button.



You can compare the performance of design options using schedules. Duplicate the schedule in the project browser and configure it to show only the Option 1. You need to go to **Visibility/Graphs** Edit button at the properties panel.



For each option, you need to create a new schedule. You can display a summary of the paths by unchecking the option **Itemize every instance** in Sorting/Grouping schedule properties. In that case, you should also remove the parameters **Step** and **Room:Name** from your schedule in Fields tab. As you can see from the example below, the second design option reduces nurse walking distance, but increases it for patients.



Schedule: Walking Paths - De...

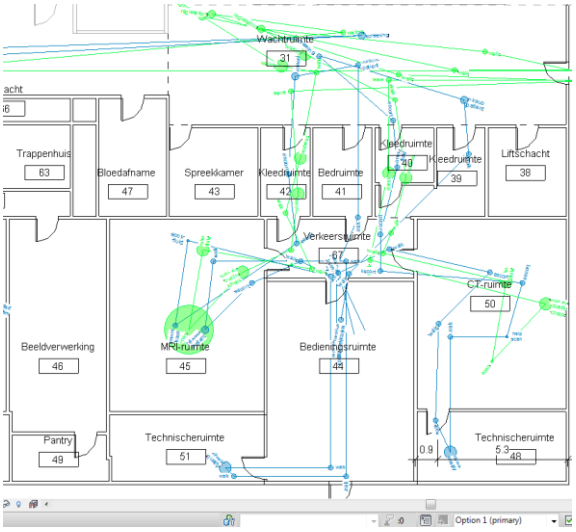
Walking Paths - Design Option 1

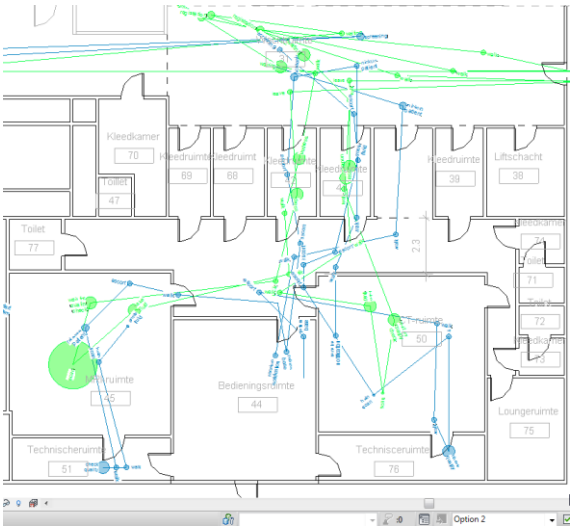
Path	Stop time	Walking time	Walking dista
CT Nurse	9	16	59.9
CT Patient	29	19	69.7
EGG Patient	0	8	28.5
MRI Nurse	12	22	79.2
MRI Patient	48	19	69.6
PET Nurse	14	41	151.2
PET Patient	85	34	124.9

Schedule: Walking Paths - De...

Walking Paths - Design Option 2

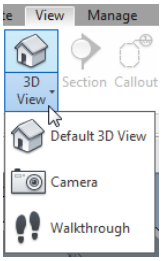
Path	Stop time	Walking time	Walking dista
CT Nurse	9	17	62.7
CT Patient	29	18	66.9
EGG Patient	0	8	28.5
MRI Nurse	12	14	49.5
MRI Patient	48	21	77.9
PET Nurse	14	41	151.2
PET Patient	85	34	124.9

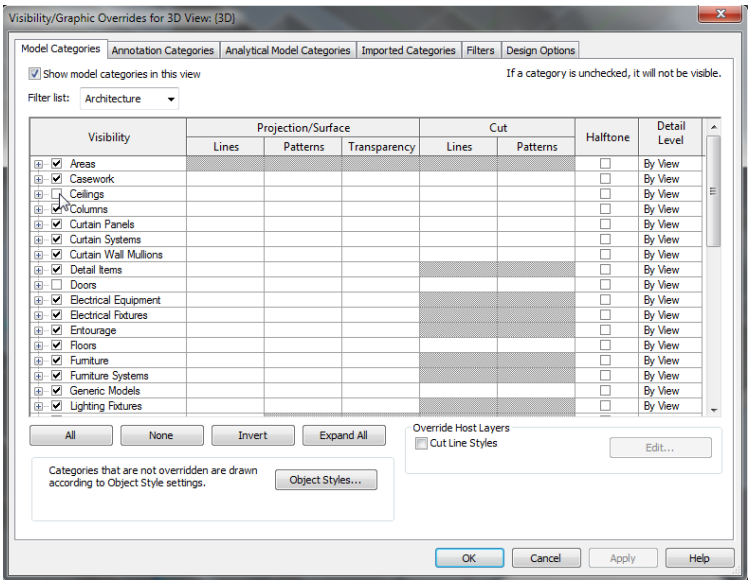




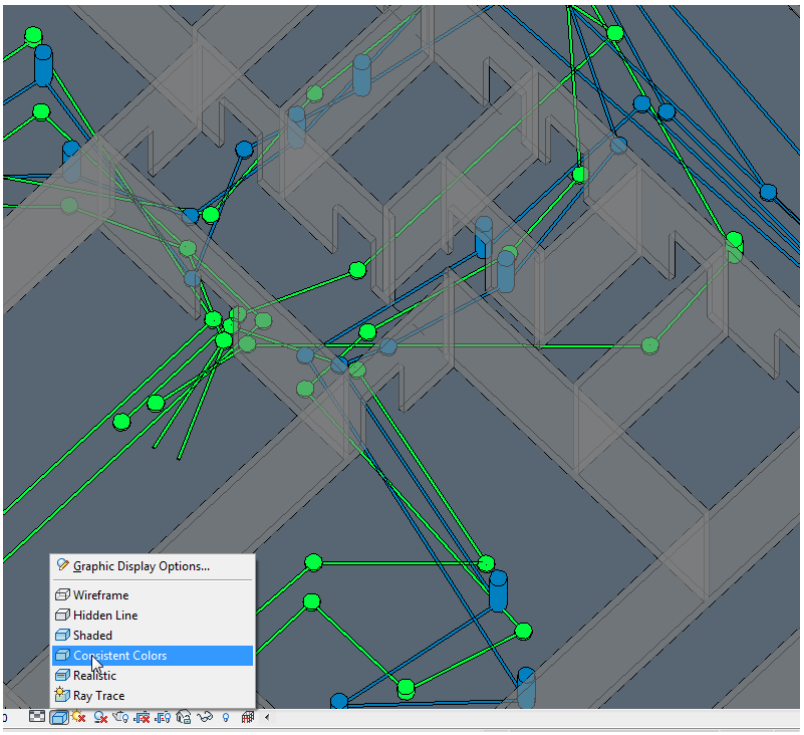
1.7 3D Visualization

You can also see your paths in a 3D view. Create a **Default 3D View** in View tab and change its Visibility/Graphic options. You might want to uncheck displaying **Ceilings** and **Doors**, plus 40% of transparency for Walls. In the Filters tab, follow the same procedure described at the previous section Improving Visualization to color different paths.



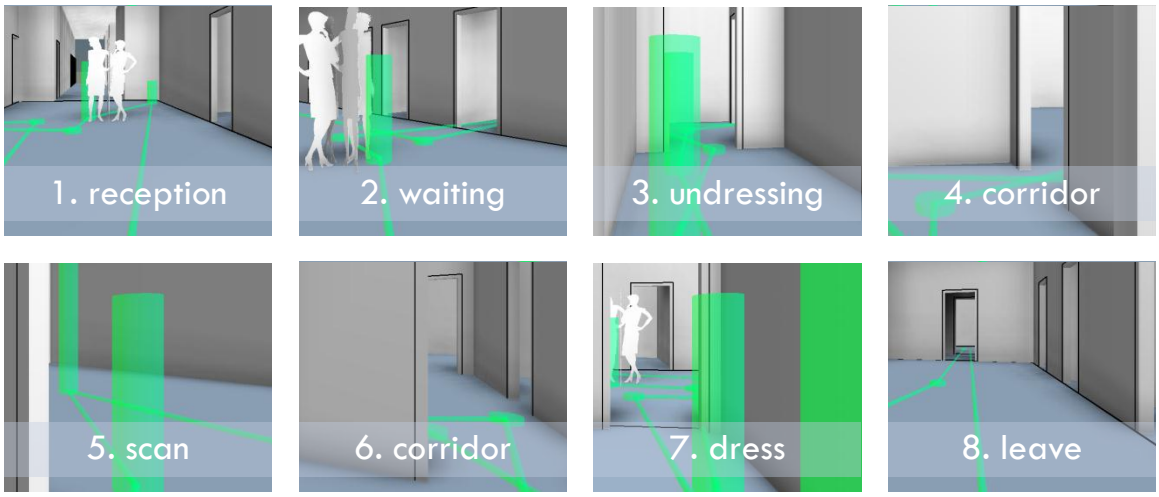


You may change the visual style from **Hidden Line** to **Consistent Colors** for better visualizing spatial dimensions.



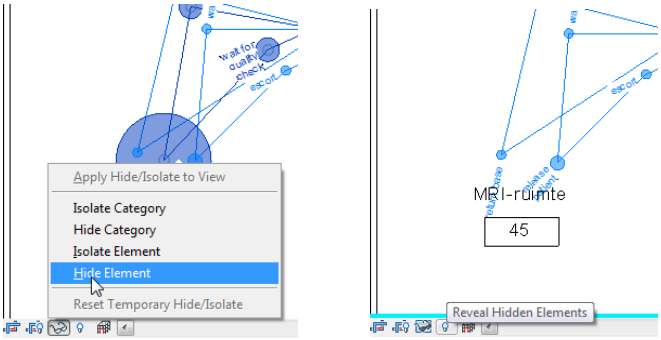
1.8 Walkthroughs

Revit can render on the fly 3D walkthroughs to analyze spatial dimensions from a first person perspective. This is useful to check if the layout can confuse people where to go in a path, if rooms are big enough, if the order of them makes sense, and other possibilities. Communication with users is a major application of this feature. To help users grasp spatial dimensions, it's recommended to insert a human figure at the beginning of the walkthrough. You can download human families at http://www.revitcity.com

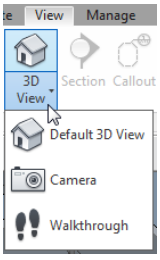


For every path, you can create a walkthrough, but this is not automatically. You need to draw them again, taking care of camera movements and other visual characteristics.

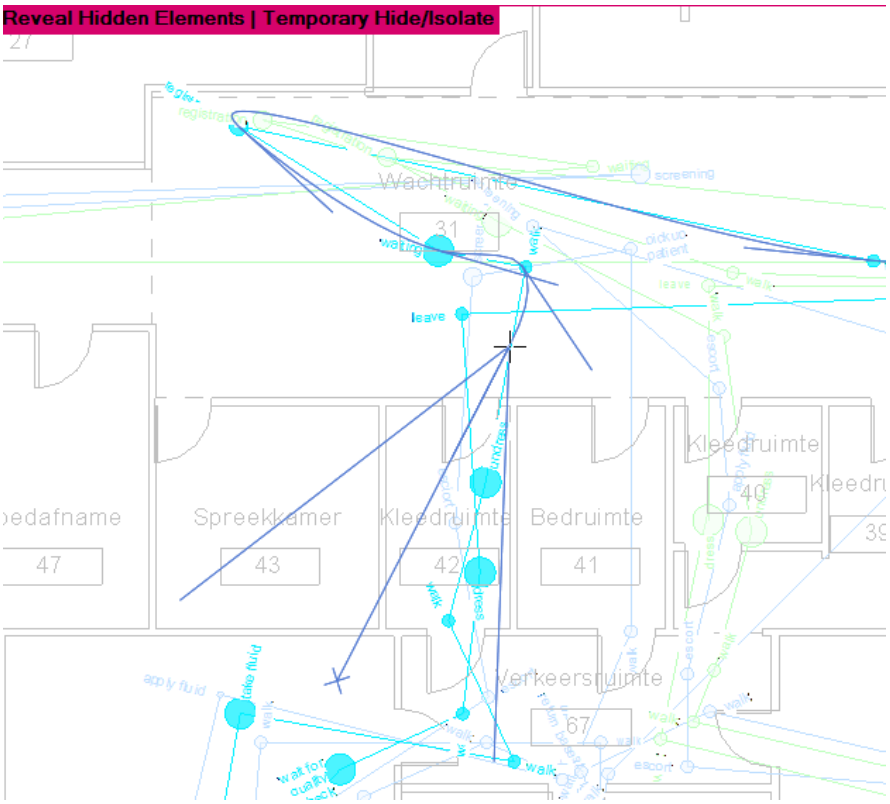
Open a 2D floor plan view. If you have many paths, it might be confusing to follow a specific one to create the walkthrough, thus, before drawing the walkthrough, you can hide and isolate the path. Select the whole path using the trick explained in Changing Paths section; activate **Hide Element** at the bottom of the screen, then **Reveal Hidden Elements**.



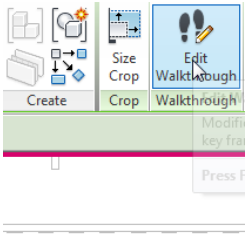
Now you can create a Walkthrough at the View tab and **Walkthrough**.

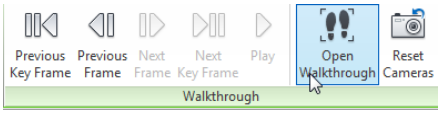


The screen highlights the selected path while still showing other elements, so you can avoid crossing walls with your walkthrough. To revert back to the normal view, just go back to the same buttons that activated this highlight.

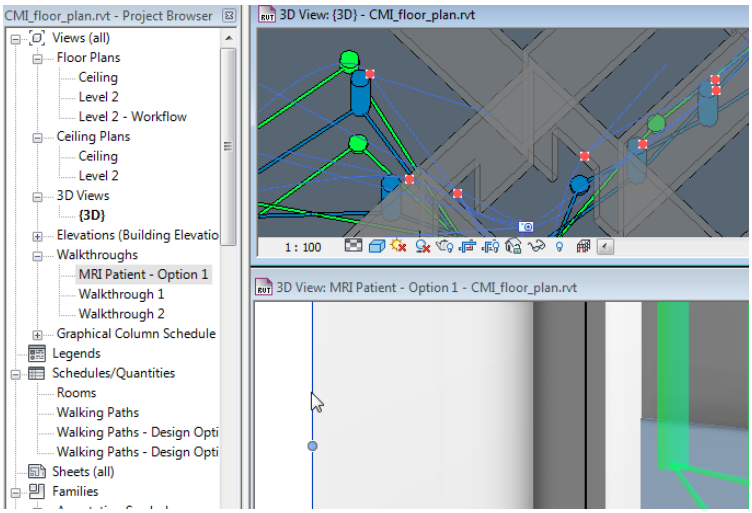


After you finished, you can test or adjust your walkthrough by clicking in **Edit Walkthrough**. Rewind to the **Previous Key Frame** and **Play**.

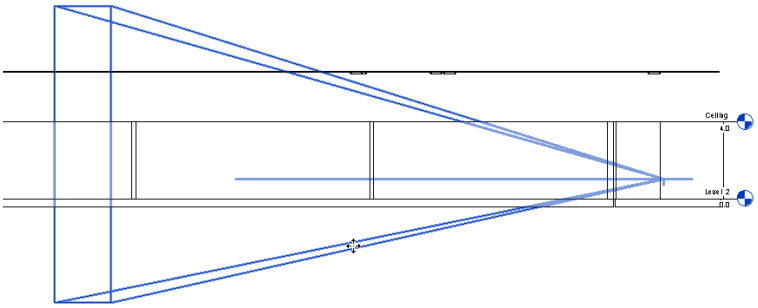




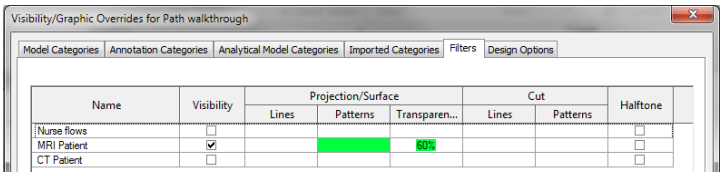
You can open the 3D view while editing the walkthrough. Just open the walkthrough and restore the window, like you did with the schedules. If you close editing your walkthrough and wants to open it again, double click at the edges of the walkthrough view and **Edit Walkthrough** at the top. The small camera icon shows the first person point of view. You can drag it and move around.



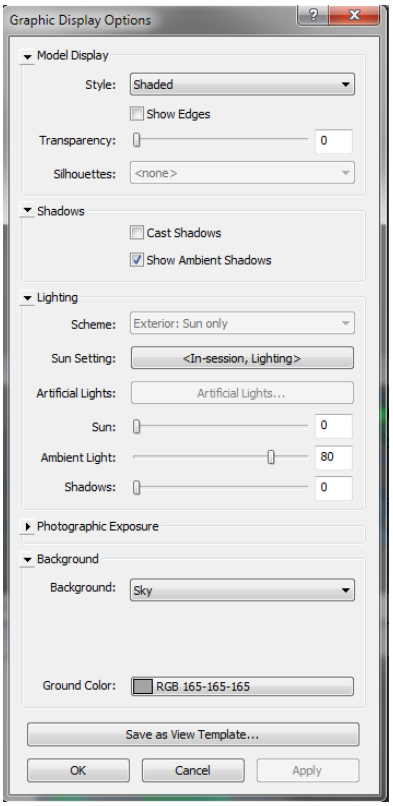
The standard height for the first person perspective might not be appropriate to give a good sense of spatial dimensions. You can lower the whole walkthrough by switching to an elevation view.



If you want to see only one path in the walkthrough, add filters at the Visibility/Graphic properties. Hiding doors is very important because Revit doesn't open them. The user can get very confused after crossing a closed door in a walkthrough. Avoid that by putting Doors 100% transparency at the Model Categories tab.



Finally, you can customize the visual aspects of your walkthrough at the Graphic Display Options. The configuration below is rendered fast but still gives a good sense of spatial dimension, due to the shading, ambient shadows and light. You can save this configuration as a View Template in order to apply to future walkthroughs. In that way, you just need to configure the visual style once.



You can export the walkthrough as an animation if rendering on the fly takes too much time.