FlowBIM

MAGNET Explorer

MAGNET Explorer workflows
Training material

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MAGNET Explorer – VDC model analysis

In previous tutorials you have managed to create a complete VDC model. You want to create a complete *VDC* model for various reasons. Some of those are:

- experience the complete *VDC* model before the construction starts (main driver for stakeholders and helping to deliver the design intent including project coordination);
- getting valuable information about crucial parameters/objects through object selection from the model or using intuitive measurement tools to check required clearances;
- checking how different sub-models merge with each other and therefore reducing design errors with automated clash detection tools;
- optimizing the construction processes by simulating various construction phases through *4D/5D* simulation tools;
- enhancing collaboration with various project partners through commenting into the model and synchronizing those over the cloud;
- creating a simple web-based model experience to allow participation of various stakeholders without the need of installation of special software tools;
- keeping a track of various design alternatives.

In this tutorial we show different tools inside **MAGNET Explorer** to see the power of various analysis tools that helps to minimize the *request of information* (*RFI*) on site as well as eliminating design errors as early as possible. From the collaboration side, we investigate commenting and model sharing features/options.

If you download tutorial files and extract those to your hard drive, you should see the following main structure:

📁 04 Exported package
📁 05 Analysis

This tutorial is built upon the result of *Tutorial 02*. The complete VDC model was exported into VMPZ package that is accessible from the folder *04 Exported package*. You can mimic similar workflows on any project, doesn't matter which software was used to generate sub-models. You start from the folder *04 Exported package* and the result is saved for you in a folder *05 Analysis*. During the tutorial you have been instructed to overwrite that same version which is available in the folder *05 Analysis*. If you want to keep those separate, please do rename the file before opening it with *MAGNET Explorer*. You can always extract the file from the downloaded content as well, if something goes wrong.

Contents

01 General workflows

If you already haven't, please start *Explorer*. While no project is opened, your user interface looks like this image:
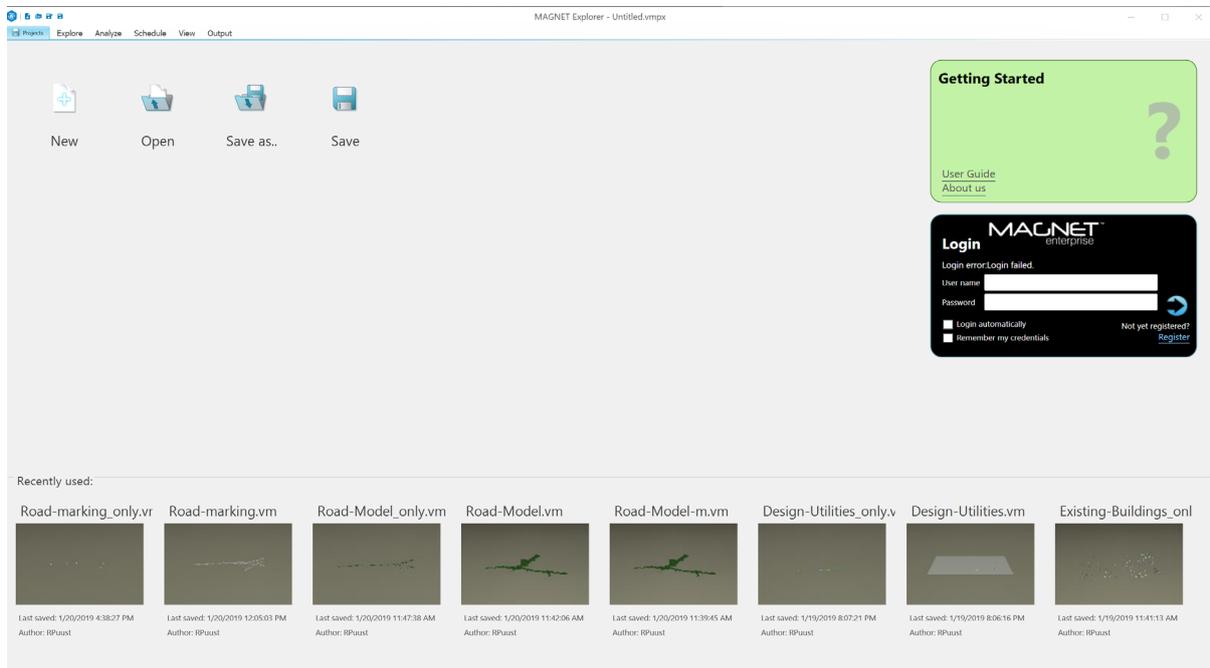
Please refer to *MAGNET Explorer* user guide to get the feeling of main user interface elements in *MAGNET Explorer*. In this tutorial we try to keep the workflow as simple as possible and focus only on those tools that we currently use. To open a previous project, click on *Open* button.

Open the project: *04 Exported package / VDC-exported-package.vmpz*

Before you continue with various, model-based analysis, you can check your model visually, turning it upside-down, showing/hiding various sub-models and by that way getting a feeling what you have, and what you may be missing. Also, you may notice some problems already by using a simple navigation workflow.
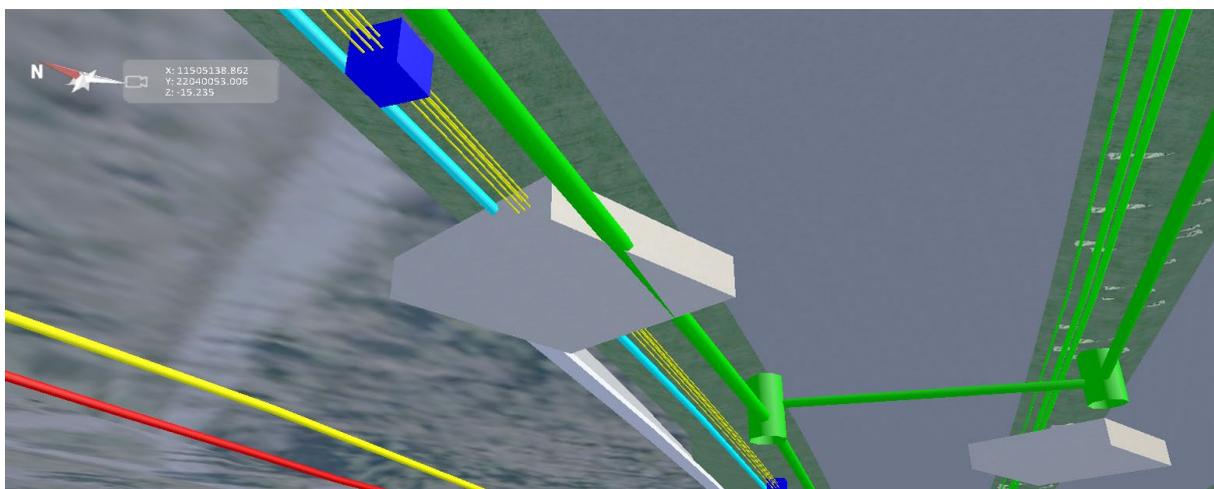
An example image, while looking the model from the proposed bridge location upside-down. Design utility lines are colliding with bridge support.

Saving a model state

Before we move forward with various model-based analysis, let's save our current model state. This workflow can be used for any model state/viewpoint saving for later reuse. Check that in your *Explorer* palette you see group view and click on the eye symbol to hide the following groups:

- *Existing/Structures/Demolish/Bridge*
- *Existing/Terrain/Remain/Mapped/ProjectArea*
- *Existing/Terrain/Remain/NoMap/EG_ProjectArea_Surface*
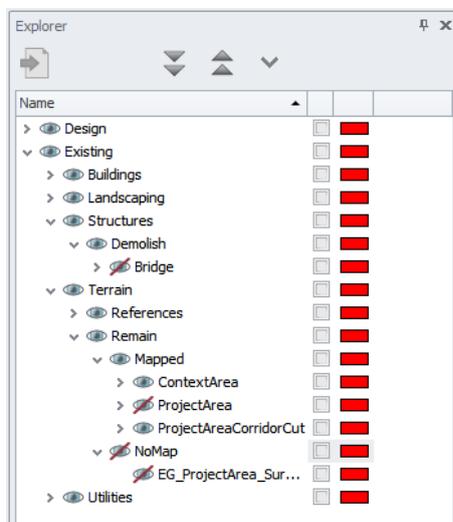
You can save this state by accessing *Topics list* tools. It should be opened by default, but if you do not see a separate *Topics list* palette that is down below your model viewport, go to *Explore* tab > *Topics List*.


You should now see a separate palette below your model viewport.
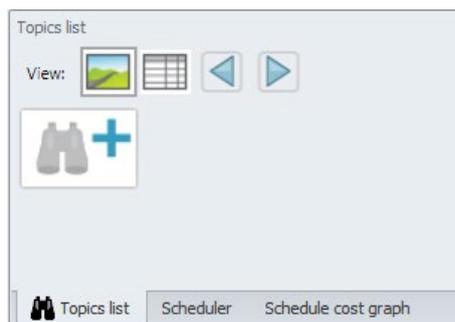
Please navigate to the similar viewpoint.

Focus again onto Topics list (below the main view). In here, after picking a new viewing angle and showing/hiding various groups or sub-groups, you can click on binoculars button and save your viewpoint with valid show/hide settings. Click on it and you can rename it directly from the default name location.
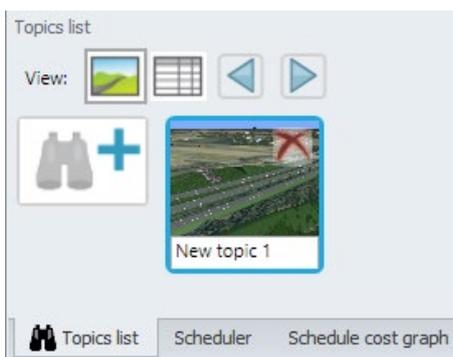

Give a new name as: *Design*
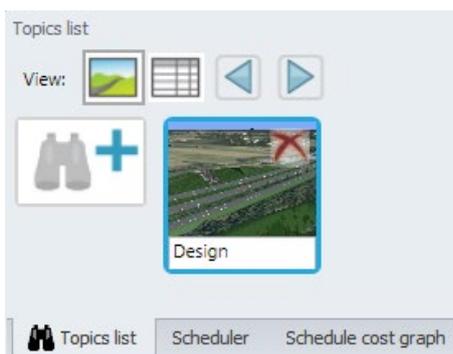
If you now do a simple test and re-navigate your model to a different viewing angle and hide some more groups/sub-groups, then a simple click on button (on your *Design* button) you can easily get back to the saved viewpoint/view state.

Note: If you do changes in your model content or want to re-save the same topic from a different angle, you can simply do a right click on that specific topic preview image and select appropriate command.
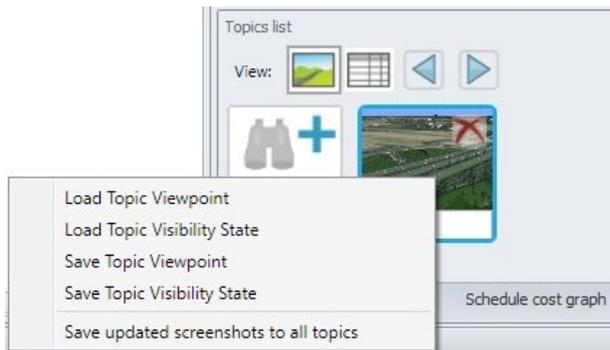
Topics are also used during collaboration stages. Where you add comments with your generated topic or answer to somebody's topics/comments. Create another topic, which shows only Existing groups. Name it as Existing. You can now switch in between two different viewpoints, project stages: before the design starts (Existing) and after the design is finished (Design).
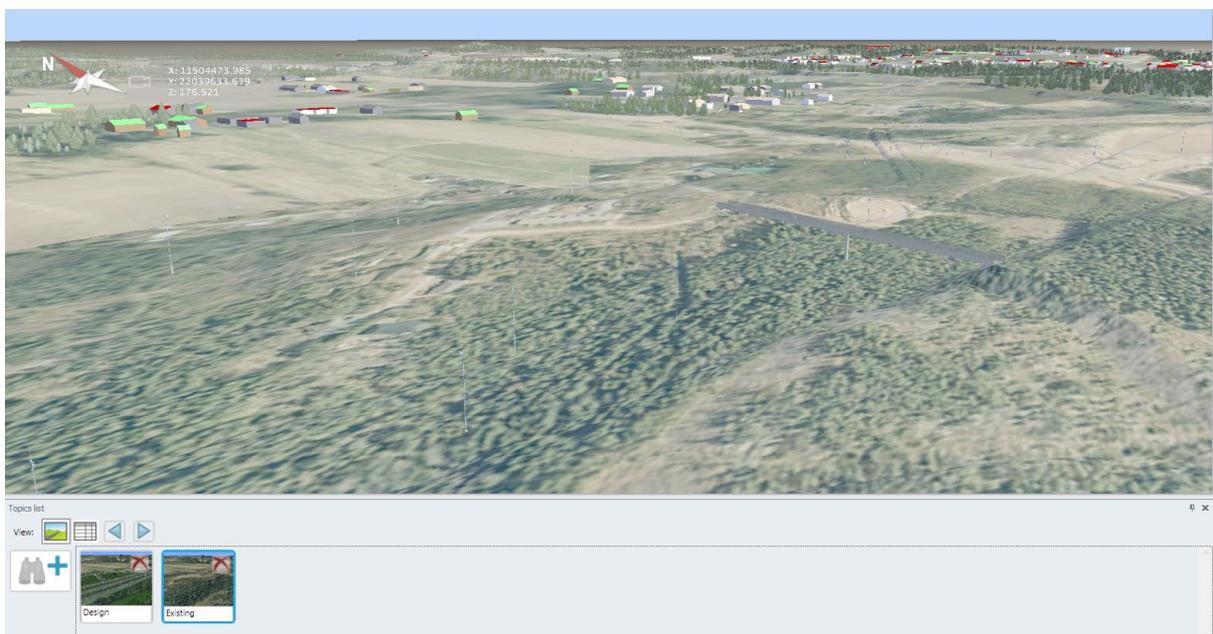

Please save your project before moving on.

02 Clash detection analysis

In *MAGNET Explorer* the clash detection tools have additional capabilities and that is why we call it *value based clash detection*. In general terms, clash detection analysis can be used:

- find disconnected (or slightly shifted) sub-models
- find important clashes that affect project cost as early as possible

Clash detection tools can be accessed from the ribbon tab: *Analyze > Clash Detection*.
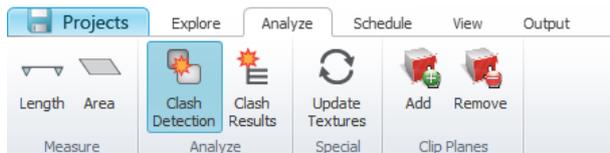
Note: If you see a blue shadow below *Clash Detection* tool, it means that this palette is already open on your user interface. Typically, when you click on *Clash Detection*, the new palette will appear on the left-hand side (where your *Explorer* palette is located as well).
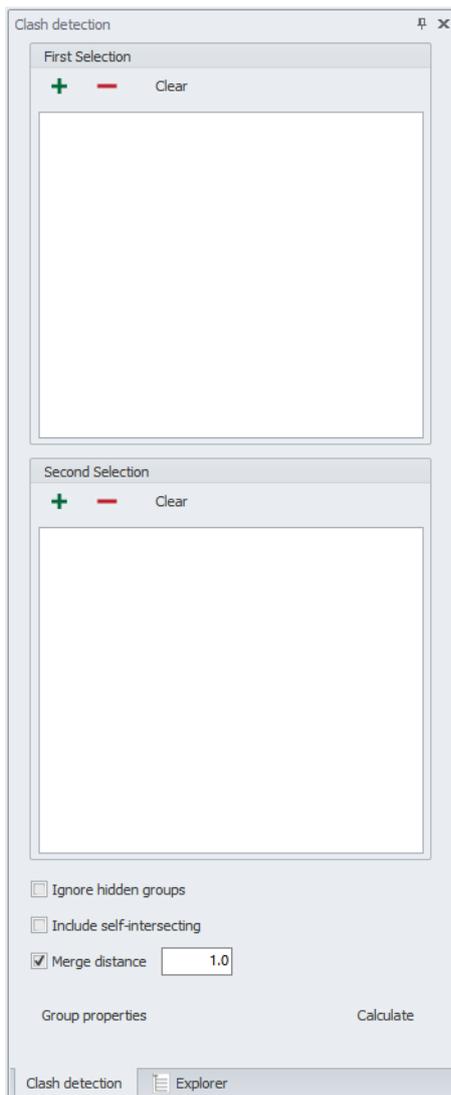
To use automated clash detection tools, you start by selecting groups in where you want to check, if those collide. You have *First Selection* and *Second Selection* where you assign one or more groups. To add a group into your *First Selection*, click on a green plus symbol. The following dialog opens:
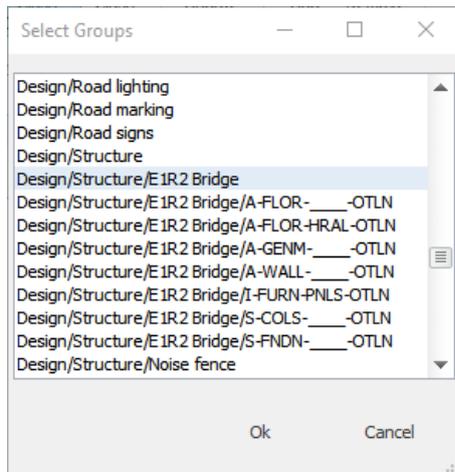
Select: *Design/Structure/E1R2 Bridge* (its our proposed bridge group). Click OK. To add a group into your *Second Selection*, click on a green plus symbol. The following dialog opens:
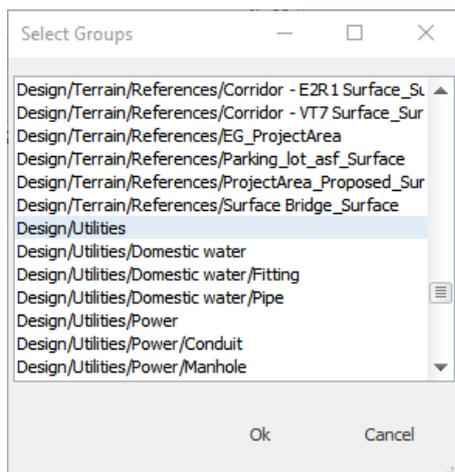
Select: *Design/Utilities*. Click OK. Because we want to make a quick clash detection analysis, just hit *Calculate*.
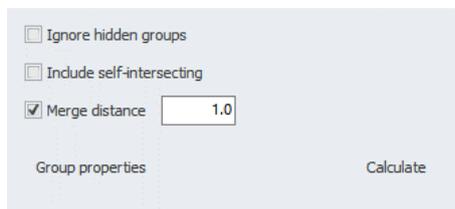
Clash detection analysis will be carried out and results are shown in the *Topics list* area as a separate tab, called *Clash Results*.

You can see, that in current the analysis, several clashes were found even in a simple model. You can click through all those clashes one-by-one (doing a double click).
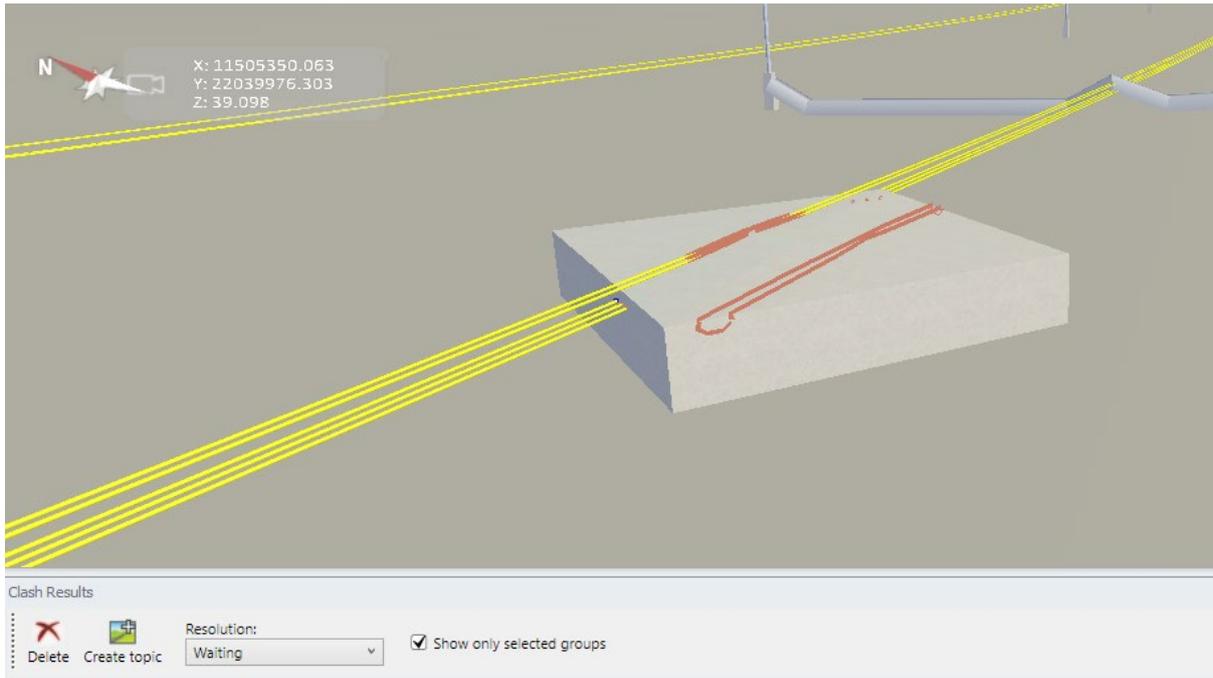

If the clash cannot be followed easily, click on *Show only selected groups* to hide away everything else that is not part of a clash group.

Now the area of the clash can be more easily followed. Due to a different project partners, who designed a bridge and who did the utility lines, the collision was not noticed during their own design work. Maybe it was due to wrong coordination work, or missed conversation - in any case, this could be a major issue at construction site, when it will be discovered during the construction. Depending on clashed utility type, it might not be so easy to rearrange the piping during the construction. For example, we also have clashing storm water pipelines which should be placed at certain slopes. In any case, each correction potentially affects the project cost. If such analysis has been made during the design work, the fix could be more easily established.

You are free to navigate you model view from different angles. Once finished you can click on a button *Create topic* and the new viewpoint will be saved under *Topics list*, from where you can start collaboration (we look those possibilities later).

Go to *Topics list* tab, and rename you clash as: *Bridge vs Power*

Please save your project before moving on.

03 Value based clash detection analysis

In previous example, even in that simple example, there were many clashes and to go through each of them, takes some time. In a real project, much more clashes are usually common (during an early analysis). Therefore, to understand or order your clashes based on its severity (or cost) can give additional value to your project coordination. Quite often we are more interested about those clashes that may affect project cost and easy fix on the construction site is not available or causing costly *request for information* (*RFI*). Therefore, in **Explorer** you prioritize some groups during the whole clash detection analysis or include an average repair cost if the clash is found between those objects (groups). Please continue from the previous exercise.

Click on *Group properties* button.
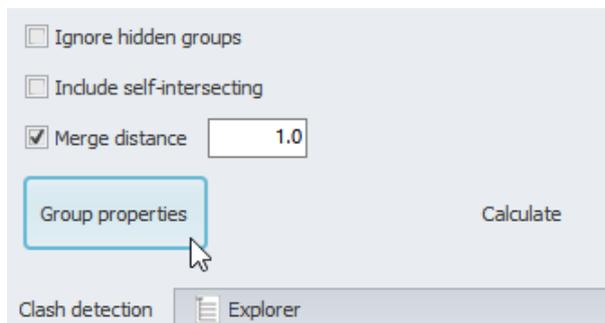
Dialog *Group Priority* opens. In here you see two columns. In *Value* column you can add an additional value parameter by which you can easily sort your most valuable clashes before the others (*value based clash detection*). *Tolerance* column is used when you want to carry out so called *soft clash detection studies*, in where you need ensure that some objects do have enough clearance in between. Let's assume that our road drainage network has a *Value = 1000*. Close the dialog by hitting OK.
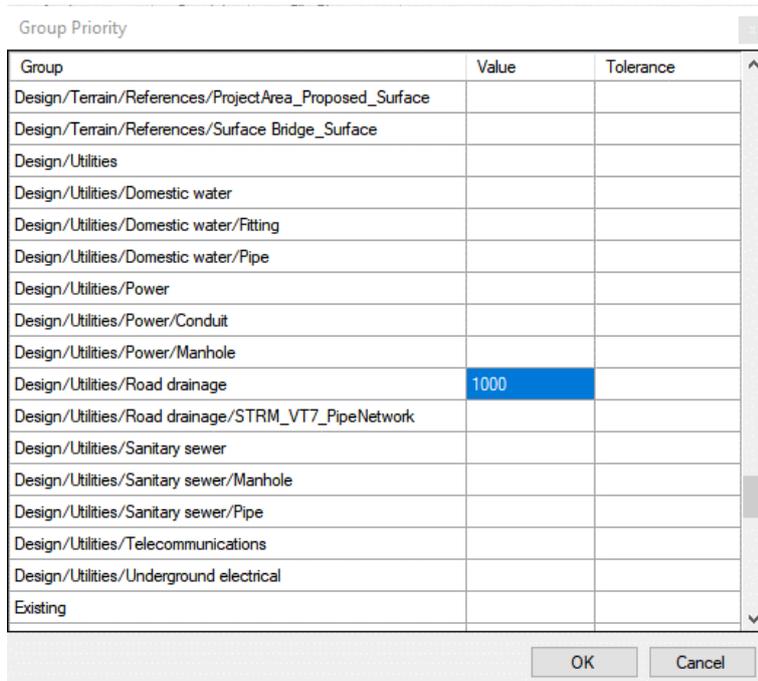
Run again your clash analysis. Click on *Calculate* button. You have now opportunity to sort your clashes based on a column *Value*. It is much easier to start from those clashes that may affect the project cost

tremendously. Therefore, you can click on *Value* column header, and sort your results based on the value (note: values are calculated based on settings in *Group Priority* dialog).

You can also sort your results based on other column headers, like *Size*, *Tolerance*, *Risk value*. *Size* gives an indication of how large the clash is, *Tolerance* is calculated based on safe clearance and *Risk value* is calculated as *Value * Tolerance %*. Please find additional information from the general help file.

Please save your project.

Tutorial summary

You can continue by evaluating other clash results and creating topics for those as well. You can create multiple topics if you first hold CTRL or SHIFT key and then select those clash rows that interests you. After that click on *Create topic*. Each clash result generates its own topic. Default name includes the *clash ID* value. Clash results can be marked based on its **Resolution**. If you rerun clash analysis, you also see additional information under **Status** column.

You can also make a clash analysis between existing utilities and design utilities.

04 Scheduling (4D / 5D analysis)

In this lesson you work on model-based scheduling tasks to create *4D/5D* analysis. In general terms, *4D/5D* analysis can be used:

- presenting project construction schedule to various project partners (*4D/5D*)
- showing project cost according to construction tasks for on-time allocation of project budget (*5D*)
- showing environmental, financial or social aspects of the project that are affected during project construction period (for example *CO2* emissions per hour/day/week etc.)

We continue from the previous tutorial where we created a complete *VDC* model and carried out clash detection studies.

You start *4D/5D* analysis by opening a separate palette called *Scheduler*. You can find it from the ribbon interface: *Schedule > Scheduler*. If it has a blue shadow beneath the icon, it means that it is already opened in the user interface element.
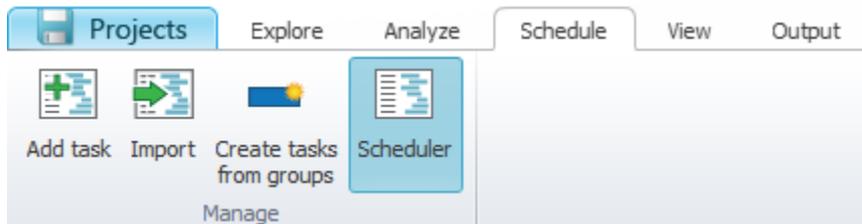
The default location for *Scheduler* palette is below viewport. For example, if *Topics list* is opened, then it appears as a separate tab.
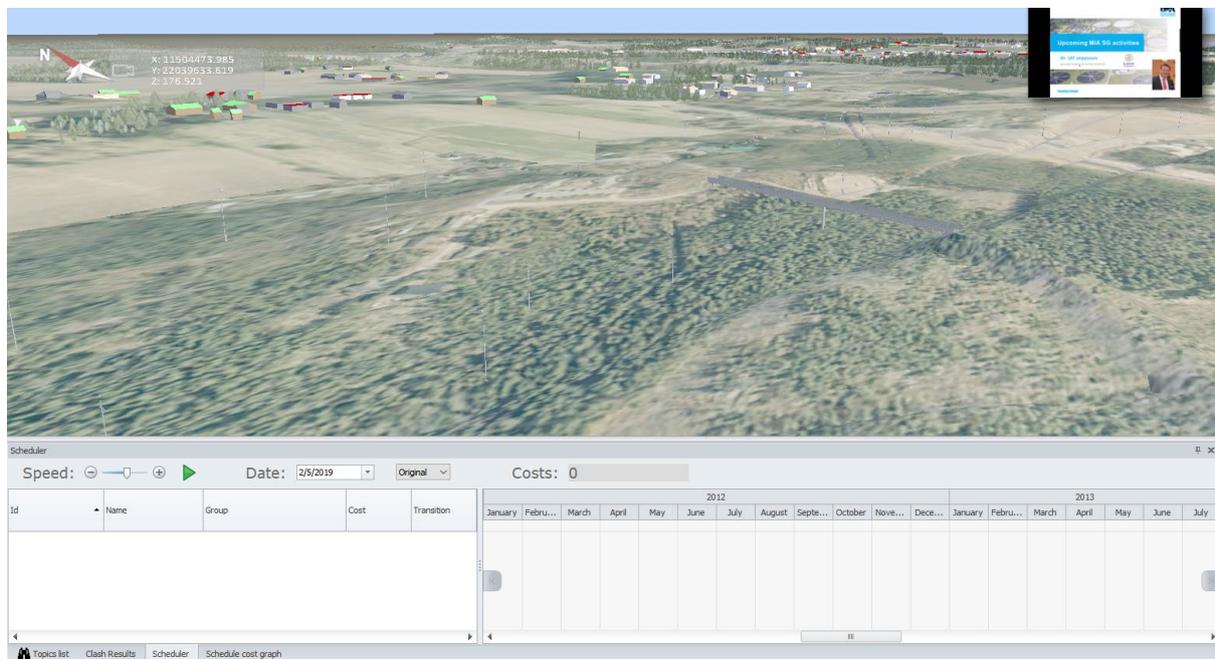
Basically, *4D* simulation consists of various tasks that are ordered based on their construction timeline. Each task relates to respective model element (group) with some specific transition (work type). This transition (work type) can be for example: adding, removing, temporary work, repair, redesigned etc. If you add cost value (parameter) for each of your task, *4D* model becomes *5D* model. But that

additional parameter can be also any other parameter that needs to be simulated. For example, *CO2* emissions at construction site.

In *MAGNET Explorer* you can add tasks:

- manually (one-by-one)
- automatically (generating for each model group a separate task)
- importing from *MS Project XML* file (in that way you can easily ensure that you use the same task name as in project planning software)

In the current tutorial we first follow the manual way and later import the schedule also from *MS Project XML*. You can add new tasks from the ribbon (clicking on *Add task*) or doing a right click in the *Scheduler* area and selecting *Add task*. Right click enables to add also subtasks. Please create the following list of tasks. Do not worry about task *Id* values this time, as those are generated automatically, but please do follow the task/subtask structure.

The task that follows is for practicing a manual method for adding tasks. We demonstrate this for couple of tasks and then delete those to include a task lists from a *MS Project XML*.

After adding a task, it should relate to model group (subgroup), you do that from the *Group* column. Simply select the appropriate cell and select correct group. Because this list follows the same hierarchy as in *Explorer* palette, it is once again important to mention that you should add your models into correct groups from the beginning. It makes later steps much easier.
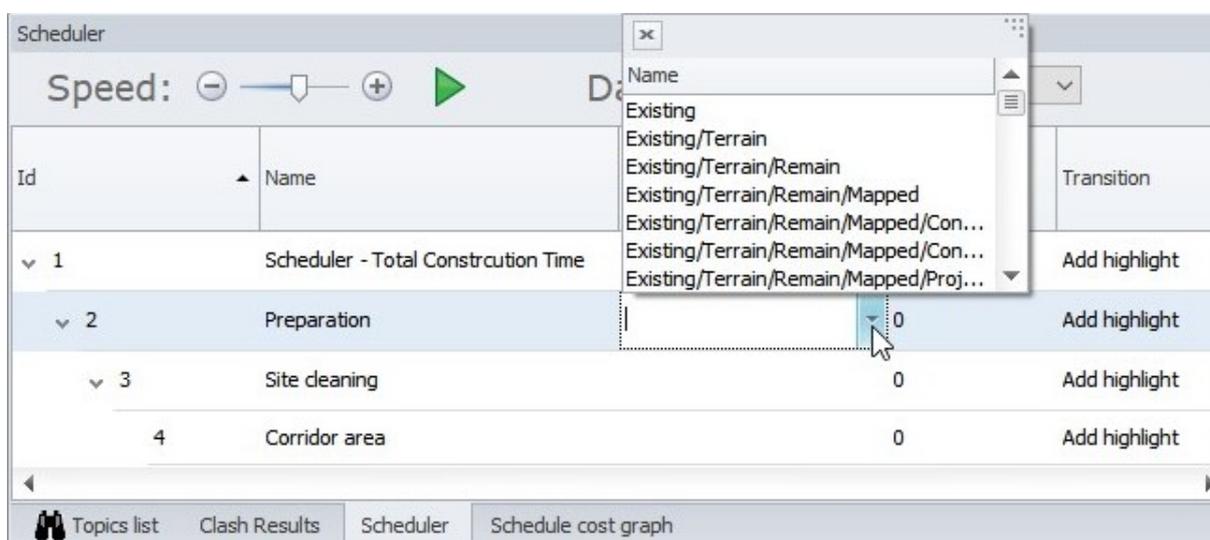
As you see we do not add groups for each task, because some of those are more like a general name, work group name. Follow the next picture to select remaining group names.

While connecting a group to a task, you see from the viewport, that some model components may start to appear that were hidden beforehand. Let's turn our attention to *Transition* column. From here you select a specific work type for each of your task. Just click on the cell to see the list.

While *Temporary* shows and object during the timeline only, *Add highlight* brings the component in with an highlight and *Remove* will hide the component that was shown beforehand. Follow the next image to select all other transitions.

With each task you add, a default timeline is added to the right-hand side (blue bars). By default, those start from the current date, but you can easily shift those to correct timeframe and change its length using a mouse (dragging one end) or doing a double click.

If you have sub-tasks, then it makes sense that the main task length is a sum of sub-tasks. Let's define a simple schedule here. New task begins when the previous one ends (of course in reality tasks happen in parallel). Follow the next image to rearrange blue bars.

Note: In the top image we do not use a summed-up timeline value for *Preparation*, because we want to show that component only temporary.

We also want to add cost value for each task. Please fill in those values according the following image. Note that by a manual workflow you need to sum up sub-tasks manually.

Id	Name	Group	Cost	Transition
˅ 1	Scheduler - Total Constrcution Time		0	Add highlight
˅ 2	Preparation	Existing/Terrain/Remain/NoMap/EG_ProjectArea_Surface	110000	Temporary
˅ 3	Site cleaning	Existing/Terrain/Remain/Mapped/ProjectArea	90000	Remove
4	Corridor area	Existing/Terrain/Remain/Mapped/ProjectAreaCorridorCut	0	Add highlight

Adding a cost parameter, you will see that in the *Scheduler* top bar, *Costs* value box changes its value during a simulation. You can simply drag the *red line* from left/right/left or click on a *green play button* to start a simulation (click again to stop the simulation).

By now you should be familiar how to start your own first *4D* simulation project. Therefore, we delete the current schedule, import the full list from *MS Project XML* file and add group/cost data to all tasks.

Let's first delete the current schedule. Do a right click on top-most row and select *Delete*.

Id	Name	Group	Cost	Transition
∨ 1	Scheduler - Tota~~~ Delete		0	Add highlight
∨ 2	Preparation Add task	Existing/Terrain/Remain/NoMap/EG_ProjectArea_Surface	110000	Temporary
∨ 3	Site cleaning Add subtask	Existing/Terrain/Remain/Mapped/ProjectArea	90000	Remove
4	Corridor area	Existing/Terrain/Remain/Mapped/ProjectAreaCorridorCut	0	Add highlight

You have now empty schedule. You can import a schedule from *MS Project XML* file. You can import that **.xml* file using the same *Import* tool that you used to bring in model data or go to ribbon tab *Schedule* and choose *Import* tool from there.
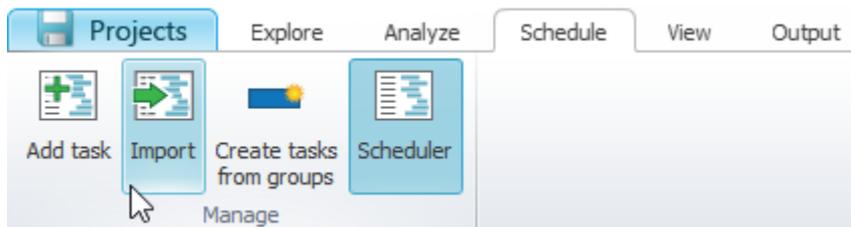
Select the following **.xml* file: /05 Analysis*/MS-Project/Scheduler-w-Cost.xml*

After import, you should have the full schedule with cost data available in **Explorer**.

Id	Name	Group	Cost	Transition
∨ 57	Scheduler - Total Construction Time	<None>	0	Add highlight
∨ 41	Route E2R1	<None>	0	Add highlight
43	Segment 2	<None>	100000	Add highlight
42	Segment 1	<None>	600000	Add highlight
∨ 35	Route E1R2	<None>	0	Add highlight
39	Segment 4	<None>	200000	Add highlight
40	Segment 5	<None>	200000	Add highlight
38	Segment 3	<None>	200000	Add highlight
36	Segment 1	<None>	200000	Add highlight

You can now connect your tasks to your model groups and define a transition type.

Note: You can also add group connections already in *MS Project* file and export those into **.xml* file. For that, a special column should be added in MS Project. You can test this workflow as well.

Delete the current schedule. Now import the following file: /05 Analysis*/MS-Project/Scheduler-w-VDCGroup.xml*

If a special column named *VdcGroup* is recognized from the **.xml* file, you get the following dialog:
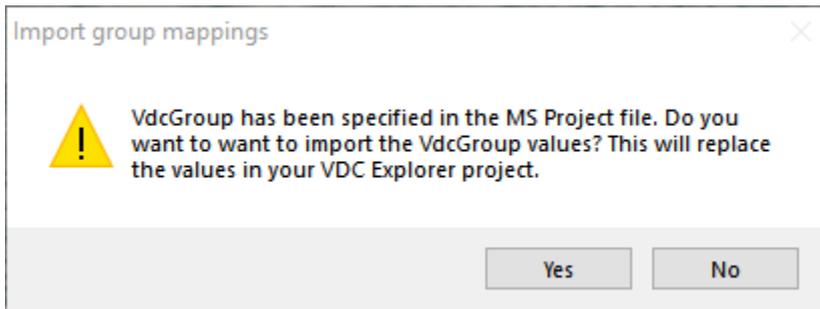
Click *Yes*, and you should have complete schedule with connected group and cost data. You now need to add only *Transition*. Because most of the data will be made visible during the simulation, you simply leave those to default values *Add highlight*. But you need to change those groups that should be hidden or shown temporary as follows:

- Preparation, *Existing/Terrain/Remain/NoMap/EG_ProjectArea_Surface = Temporary*
- Site cleaning, *Existing/Terrain/Remain/Mapped/ProjectArea = Remove*
- Remove existing structure, *Existing/Structures/Demolish/Bridge = Remove*
- Remove existing, *Existing/Utilities = Remove*

You can now play the full *5D* simulation. Click on green play button to start a simulation. You are free to navigate inside your model while the simulation is playing. Pay also attention to simulated cost value.

IMAGE IMAGE

It is also possible to add some other data into your schedule. This data should be specifically formatted, and more info can be found from general *Help* file. Using *MS Excel*, please open the file: *Scheduler-add-CO2.xlsx*

|	Unique ID	ID	Name	Cost
1				
2	57	1	Scheduler - Total Construction Time	
3	1	2	Preparation	218
4	2	3	Site cleaning	831
5	3	4	Corridor area	108

From the file you can find an additional column named as *CO2*. For example, you goal is to show *CO2* emission rates during a project you can add that data as an extra column.

Close the *Excel* file and return to **Explorer**. Using *Import* tool, select the file: *Scheduler-add-CO2.xlsx*

IMAGE IMAGE

Id	Name	Group	Cost	Transition	CO2
⌄ 57	Scheduler - Total Co...	<None>	0	Add highlight	0
⌄ 1	Preparation	E_AREA/NoMap/EG_ProjectArea...	0	Add highlight	347
2	Site cleaning	E_AREA/Mapped/ProjectArea	90000	Add highlight	805
3	Corridor area	E_AREA/Mapped/ProjectAreaCo...	0	Add highlight	27

Topics list   Scheduler   Schedule cost graph

If you import other parameters into your schedule, you can also use *Schedule cost graph* to see those values cumulatively or as single parameters.
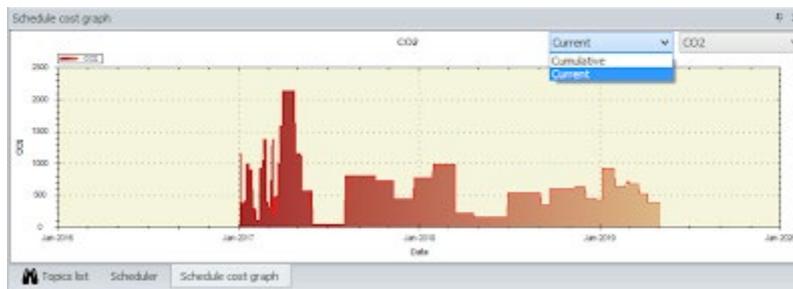
Final version of this tutorial is saved as: /05 Analysis/*VDC-exported-package-finished.vmpz*

Note: If you used to overwrite is version, you can extract it from the tutorial files.

Tutorial summary

You can continue by testing various *4D/5D* settings that are more common to your own project. Also, you can edit *MS Excel* file and add some other information as separate column and import that into *MAGNET Explorer*.