

CE4002 Assignment 1 (15%)
Modeling and
Scheduling and 4D Simulation (Due: 15/11/16 9:30)
"This is a group assignment!"

PART 1: Modeling Building Elements (Due: To be submitted together with HW1 Part 2)

In the first part of this assignment you are expected to explore basics techniques for creating a building information model of a simple structure - a one storey residence. You will model:

- Exterior and interior walls
- Exterior and interior door and windows
- Floors

You will be given a partial Revit model (HW1_part1_model.rvt) which includes a CAD underlay to show you the locations of the walls and other components you need to create.

- To start modeling open the given file in Revit.
- Open the Ground Floor plan view.
- Create new exterior walls using the Generic 8" (.20 m) wall type. Place the walls by setting the location line to Finish Face:Exterior and tracing the outer edge of the walls shown in the underlay drawing.
- Add new interior walls using the Generic 3" (.08 m) wall type. Place the walls by setting the location line to either the Finish Face:Exterior or Finish Face:Interior and tracing the corresponding edge of the walls shown in the underlay drawing.
- The door and window types and sizes needed are shown in the legend in Figure 1 below.
- Windows/doors must be consistent with walls.
- Set the head height property for all windows to be 2.13 m (7 ft).
- Create Generic 12" floors for rooms shown in Ground Floor view according to CAD underlay.
- Add GWB on Mtl. Stud Ceiling to Roof plan views.

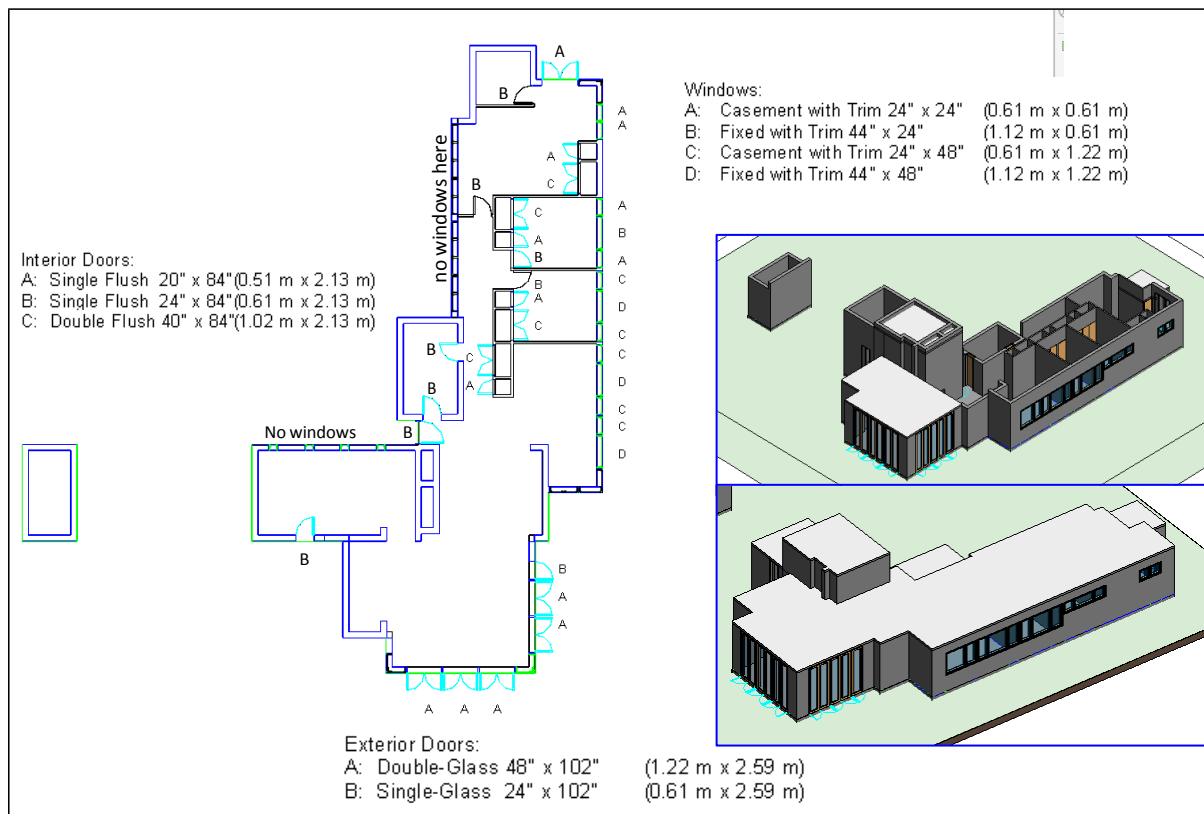


Figure 1. Window and Door Types

Submit Part 1 of your assignment:

i) Save your Revit model as HW1_part1_model_groupX.rvt.

ii) Create a word or pdf document (HW1_groupX.doc) which includes a **screenshot** of your completed model and brief **answers** to following questions (1 page in total);

1. After completing the model make changes to the model and observe:
 - a. In ground floor view move one of the exterior walls to the outer side by 1m. What happens to the other walls and the floor plan?
 - b. In East Elevation view move the Workspace Roof elevation to 6.27m, by moving the associated line or by retyping the elevation number. What changes you observe in the model as a result of this modification? If you don't see any changes what might be the reason?
2. How can you connect a wall to other walls?
3. Attach top of the walls to associated ceiling components. What this connection will enable?

Create zip file labeled **HW1.groupX.zip** together with Part 2 of your assignment. (The Part 1 of the assignment needs to be submitted together with Part 2.)

PART 2: Scheduling and 4D Simulation (70 pts)

you will be practicing scheduling (using MS Project or Excel) and will also be exploring a 4D modeling software (Navisworks Manage 2016). In this assignment, you will learn how to link activities in your schedule to components in your model by using Navisworks in order to visualize and analyze construction processes. This will help you in assessing the usefulness of 4D modeling to streamline construction processes.

You will develop a schedule for the construction of the columns, beams, floors, exterior and interior walls, roof, stairs, windows and doors of the building model given to you (Figure 1).

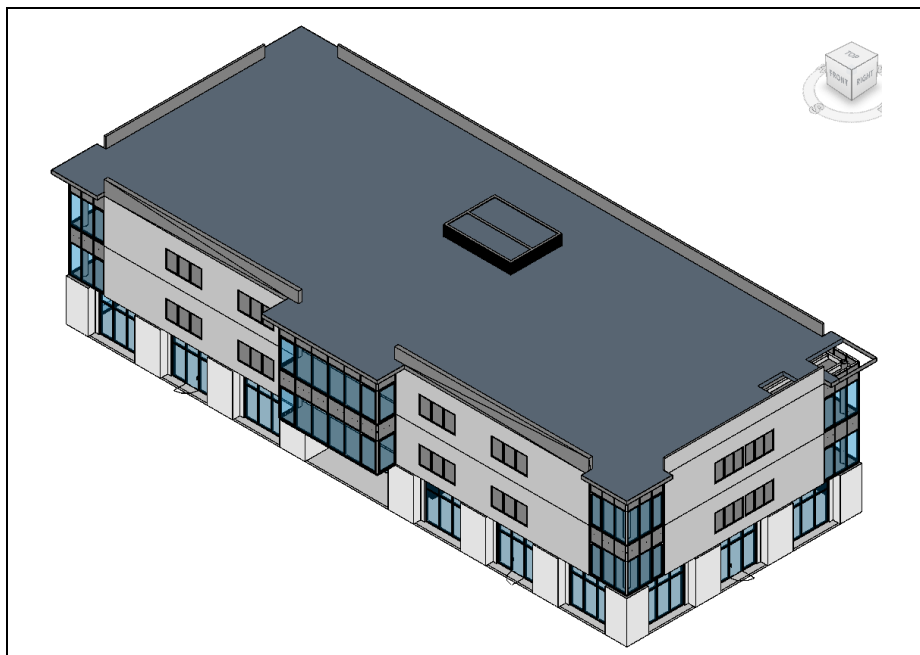


Figure 1: 3D view of the Revit model

You are given a base schedule (in .CSV format) showing you the task IDs for different activities in the schedule. The start date for construction will be **February 1, 2017**. Total duration of the activities is also given. You are required to; i) figure out the dependencies/sequence of these activities (by defining predecessors of each one); and ii) divide the construction of columns and beams into phases (see Figure 2) for shorter total construction duration. Assume that there is one team available for each activity (eg. 1 team for erecting steel columns). As a result, you will achieve an improved fast-track schedule that aims at completing the project in a shorter time frame.

You will bring your completed schedule (fast-track) to Navisworks 4D environment and analyze the construction processes to identify any possible constructability issues in your schedules and/or improvement opportunities to deliver the facility in a shorter duration.

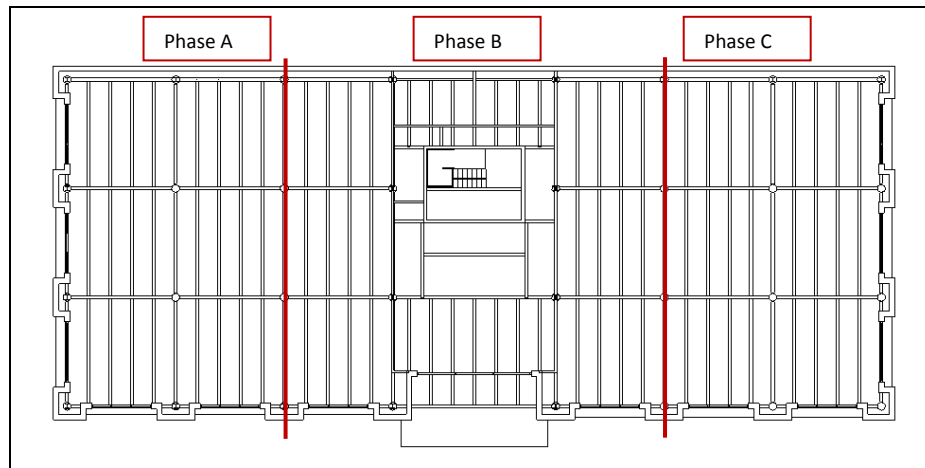


Figure 2: Phases of Construction

Givens:

1. You are given the model in .RVT format (HW1_P2_model.rvt).
2. You are given a base schedule (HW1_schedule.csv).
3. You are given the steps to follow for completing your assignment as described below.
4. You are given screenshots of several steps as a manual to help you while completing your assignment (HW1_guidelines.pdf).
5. You can also use Revit and Navisworks guidelines and help menus.

Steps to follow:

1. Start with Revit model file. Open HW1_P2_model.rvt file and save it with your group's name (HW1_P2_model_groupX.rvt). Look through different components in the model that you should include in the construction schedule.
2. Create a New shared parameter file from Manage > Shared parameters.
3. Create a New shared parameter group named 4D Simulation.
4. Create a New shared parameter under this group named 4D_Task_ID (**Figure 3**). Choose its type as "text" and discipline as "common".

5. Add the parameter you have created as a project parameter to this model. To do this click Manage > Project parameters. Add from shared parameters, choose 4D_Task_ID, Group it under Construction category. Associate this parameter with all components by clicking the relevant box in the menu (**Figure 4a, 4b, 4c**).
6. Now you will need to add the task IDs in the schedule to associated components (e.g. level 1 - phase A - column to columns at level 1 in phase A, etc.). For that you will need to complete your schedule first so move on to next step.
7. To work on your schedule, Open Excel, Go to Data, Get External Data, From Text. Choose comma separated (as shown in class) for viewing the text files properly in Excel (**Figure 5a, 5b, 5c**).

Alternatively, you can use MS Project to automatically calculate start and end dates based on dependencies. But no guarantees that your MS project schedule could be imported back to Navisworks flawlessly (you should try and figure out yourself if there are any problems). [Another option: You can also copy and paste scheduled dates from MS Project to your Excel file.]

8. Use three phases as seen in the Figure 2. Create your new schedule in Excel based on the given CSV file. Create new IDS for 3 phases for i) columns and ii) beams (called structural framing – girder and joist) only. Total duration for component construction should not change. (Eg. Level 1 columns should be constructed in 6 days but total duration will be divided into three phases, 2 days each).
9. Divide construction of Windows & Doors, Curtain Walls, and Interior Walls (610, 710, 910) to three levels (Level 1, 2, 3). (Eg. There will be three tasks for Interior Walls, as Floor 1, Floor 2, and Floor 3 Interior Walls).
10. In Revit Select and then Filter components to assign schedule task IDs to 4D_Task_ID parameters of each group of component in the model, using the appropriate view (**Figure 6**).

You may need to select individual components for some types (e.g. interior walls). You can select one interior wall, right-click and choose “select all in view”, to select all interior walls in the floor plan (**Figure 7**).

Curtain walls are composed of several pieces of component and you need to select the Curtain Wall Panels and Curtain Wall Mullions together (no curtain wall grids) in each floor.

11. After each selection group in the previous step, assign the task IDs in your schedule by typing those numbers to 4D_Task_ID parameter field in the model (e.g. 120A for Level1A Columns for Phase A).
12. When done, save your Revit model (HW1_P2_model_groupX.rvt) and also Export it as .NWC file while in **3D view**. Go to Add-ins tab, select External tools, then Navisworks, and choose .NWC file format, to export (**Figure 8**).
13. Append this exported model to Navisworks (HW1_P2_model_groupX.nwc) (**Figure 9**).
14. Bring in your .CSV schedule to Navisworks. Open Timeliner window, click Data sources tab, and Add data source (**Figure 10**). Map the columns for export (**Figure 11a, 11b**).
15. Select your Data Source and click Refresh under Data sources tab, then Selected data source, Rebuild the task hierarchy to bring all your task list to Timeliner Tasks tab (**Figure 12**).
16. Create Sets by using Find items tool and your schedule IDs, for each Task ID (1 to 910). Save the search in Sets window with same Task ID as the name of the set (**Figure 13a, 13b**). Do this for each Task ID one-by-one.

17. Use the Rules in Timeliner Tasks Tab to link the model components to schedule tasks based on the created sets (**Figure 14a, 14b, 14c, 14d**).
18. Run your simulation from Timeliner Simulate tab, based on the settings you define (**Figure 15**). Look for any possible constructability issues in your schedules and/or improvement opportunities.
19. Create a video (.AVI file) using Animation export (**Figure 16a**). In order to reduce the size of the AVI file to be able to email it, change the export settings (**Figure 16b**).
20. Save your Navisworks 4D project as .NWD file. This file will include your model, tasks, and timeline links.

Deliverables: (*Due: 15/11/2016 9:30*)

1. Your schedule (.CSV or MS Project file).
2. Your .NWC model exported after 4D_Task_ID assignments in Revit.
3. Your 4D simulation .AVI file.
4. Your .NWD file after you finished task links and 4D simulation preparation in Navisworks.
5. A one to two-page report with a brief overview of the process of formulating and analyzing a schedule using 4D model. The report should contain discussion of the questions below and any other views that you would like to share on this process.

On 15/11/16, submit your assignment zip file (HW1.groupX.zip) as a Group to odtuclass.metu.edu.tr.

The main goal of 4D modeling is to analyze the scheduled construction processes for identifying any possible constructability issues in your schedules and/or finding out any improvement opportunities to complete the construction project in a shorter duration.

Here are the discussion points in relation to this assignment that you are supposed to answer:

1. Describe some interesting sequencing constraints incorporated in the schedule - How did you define the linkage/dependency of the tasks in the schedule? Discuss what opportunities for improvement (if any) that you have identified on this schedule and how you identified them. If 4D didn't help with identifying, what was its limitation?
2. The schedule that you created (the fast track schedule) should contain more detailed breakdown of the activities than the base schedule initially given to you. You may not need to decompose every activity to its subtasks. However, do you think the more detail that you have (in terms of components, zones, etc.) in the schedule and in the model, the better assessment that you will have about the capabilities of 4D? Why?
3. Project schedules and even designs get changed and updated frequently during construction. Assuming that your schedule is modified version of the base schedule, discuss how easy it would be to recreate the 4D simulation when there are updates. (Optional: you can try to modify a task in the schedule and a component in the model to try this process for answering this question.)
4. Discuss the features that you liked and the things that can be improved in the 4D system that you have used (i.e. Navisworks). Create a wishlist containing a couple of items that you would like to have in an "ideal" 4D system.

5. Discuss whether you think you will gain a value from creating a 4D model during construction. Similarly, discuss the barriers/problems 4D modeling may cause in the planning process (if there are any).

The selected groups (Groups 1-2-3) will be asked to make a 15-20 minutes presentation on this assignment by discussing specific topics assigned to them (the guidelines for the presentation will be provided separately). The presentations will be during the class on 15/11/2016.