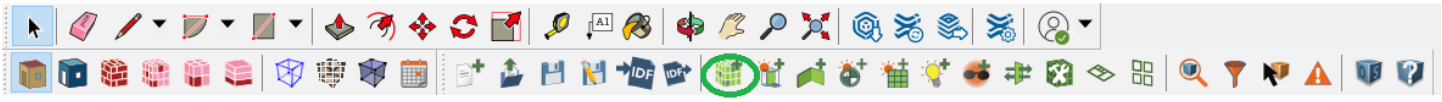
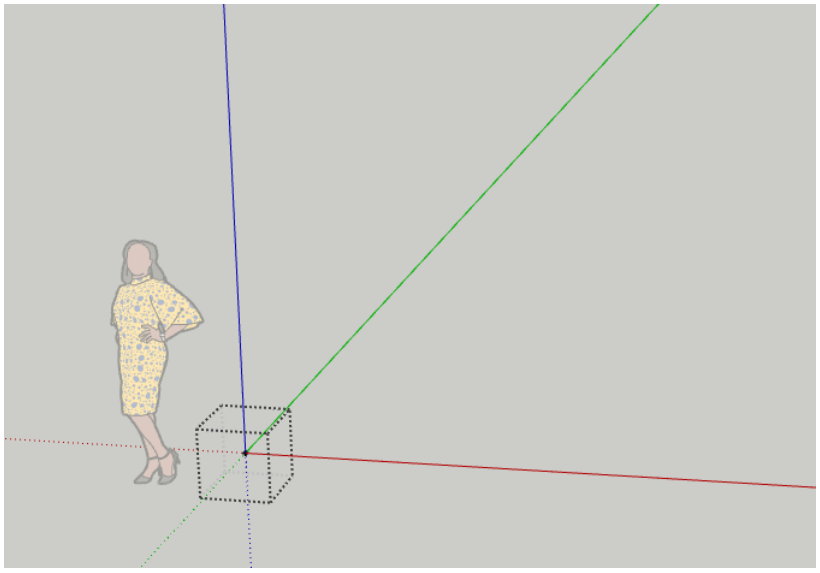
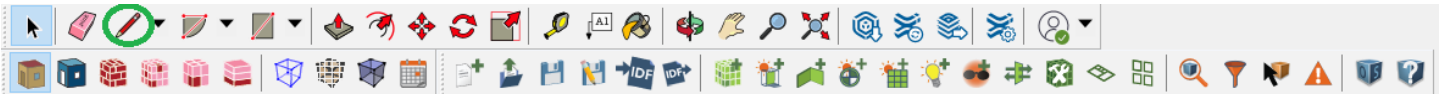
1. Open SketchUp and select the Architectural (mm) template
2. Create a Space using  from the tool bar (circled)



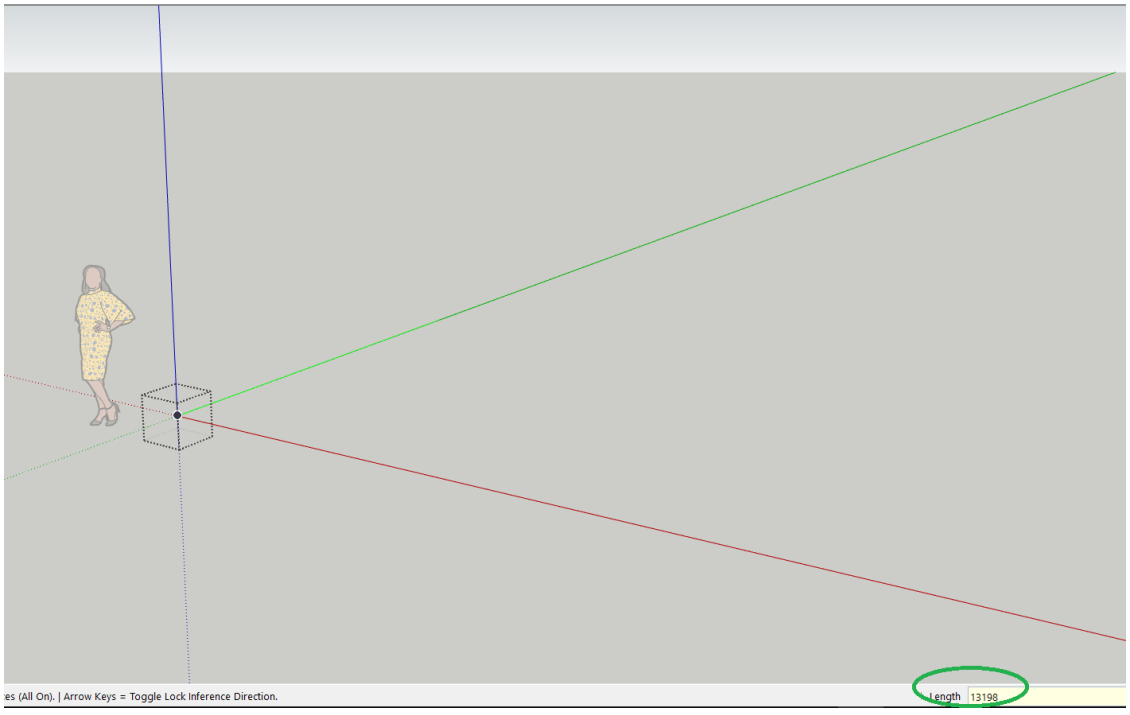
and place it at the origin by clicking on it (see below)



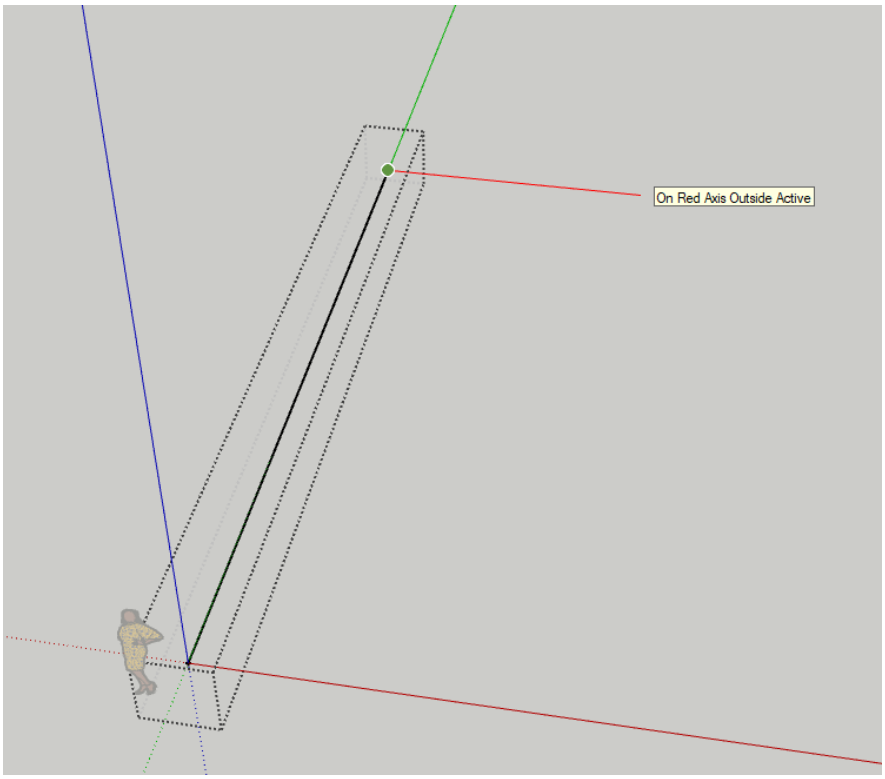
3. Select the lines tool 



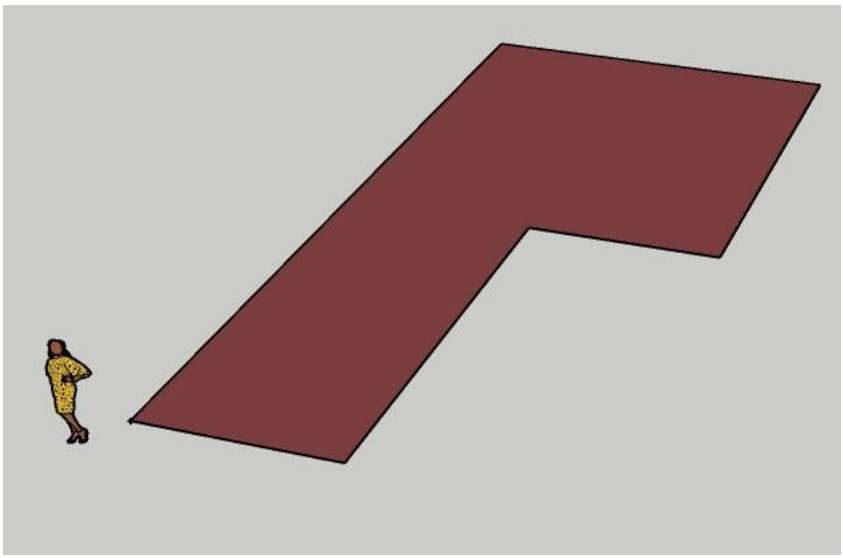
and start drawing by clicking on the origin once, then move the cursor along the solid green axis (north by default) and type in the first dimension "**13198**" and hit "**enter**" (this will default to units of mm).



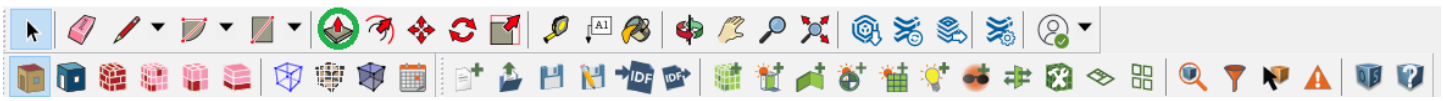
4. While the cursor remains connected to the end point, align it in parallel with the solid red axis (East) and draw type in "**6475**" and hit "**enter**".



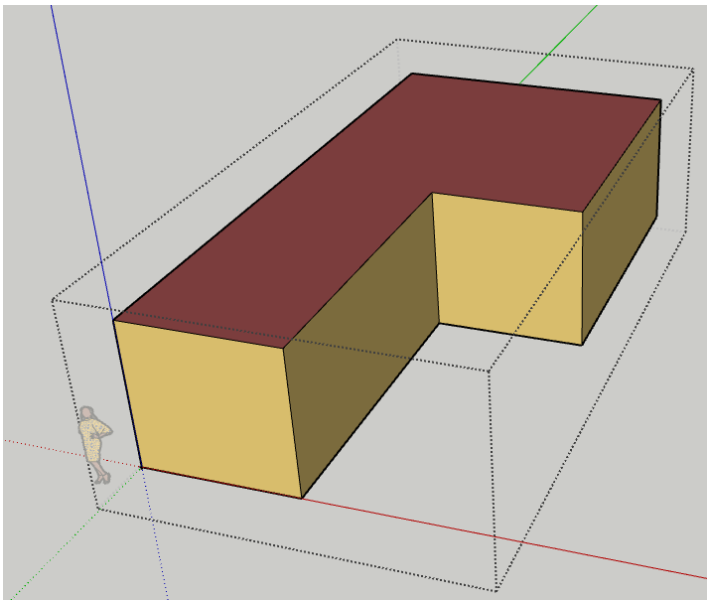
5. Drawing in the other edges of the 1st floor (living space) to form an upside down L shaped floor. The dotted box is the boundary of this Space. Remember, the smaller rectangle on the lower right corner is the garage floor and should not be drawn within this Space.



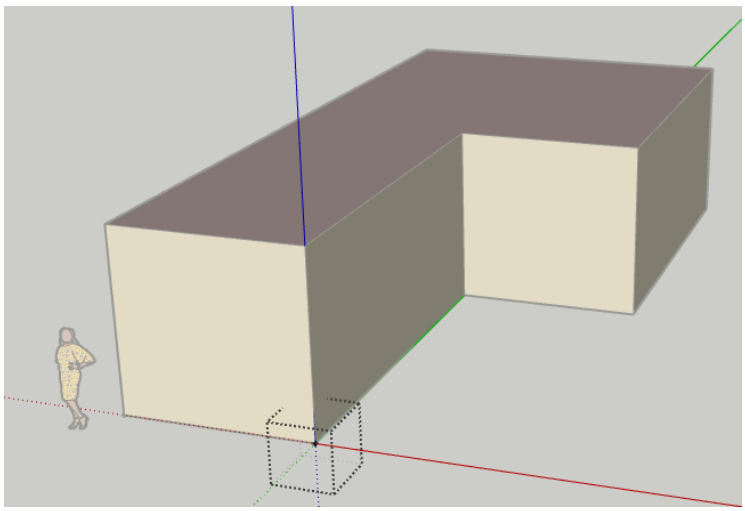
6. To turn this floor into a 3D space, select the 

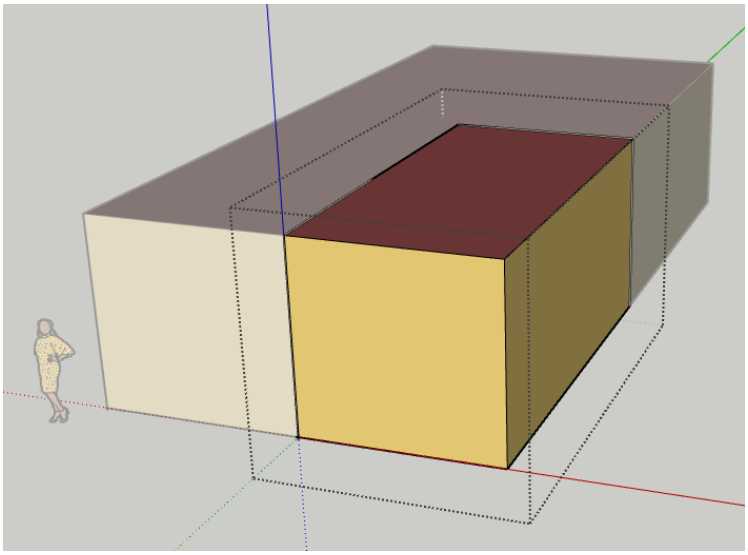


And click on the floor and pull upwards. Enter "**3100**".

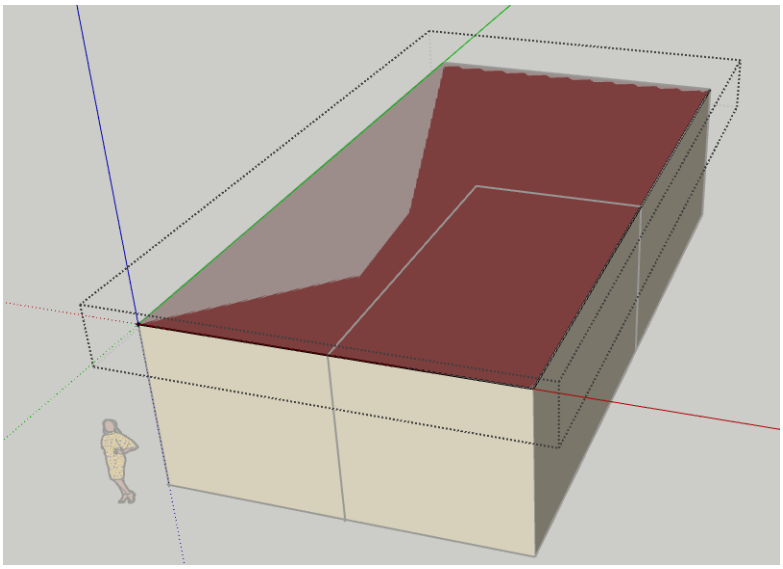


7. Create a 2nd Space so the garage can be drawn in.

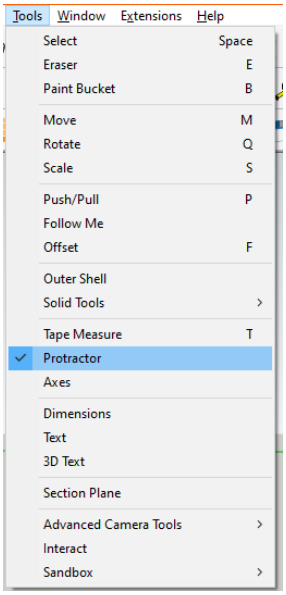


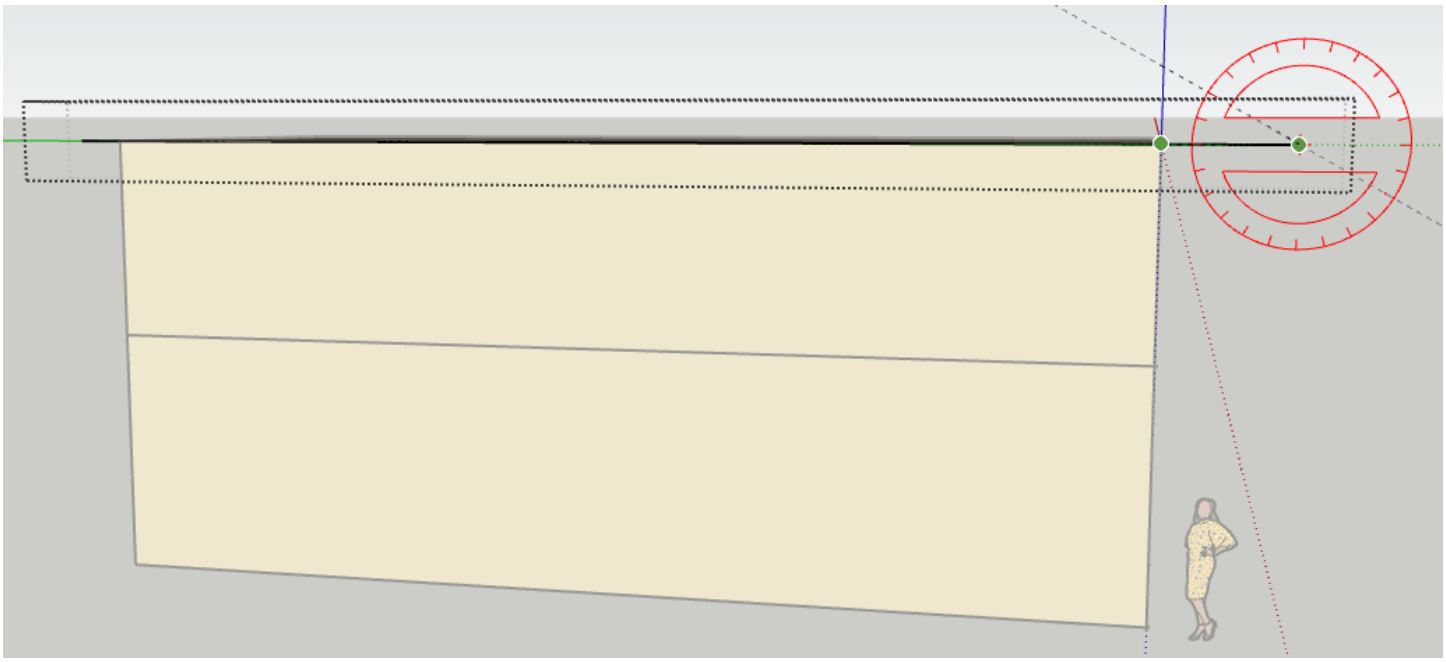


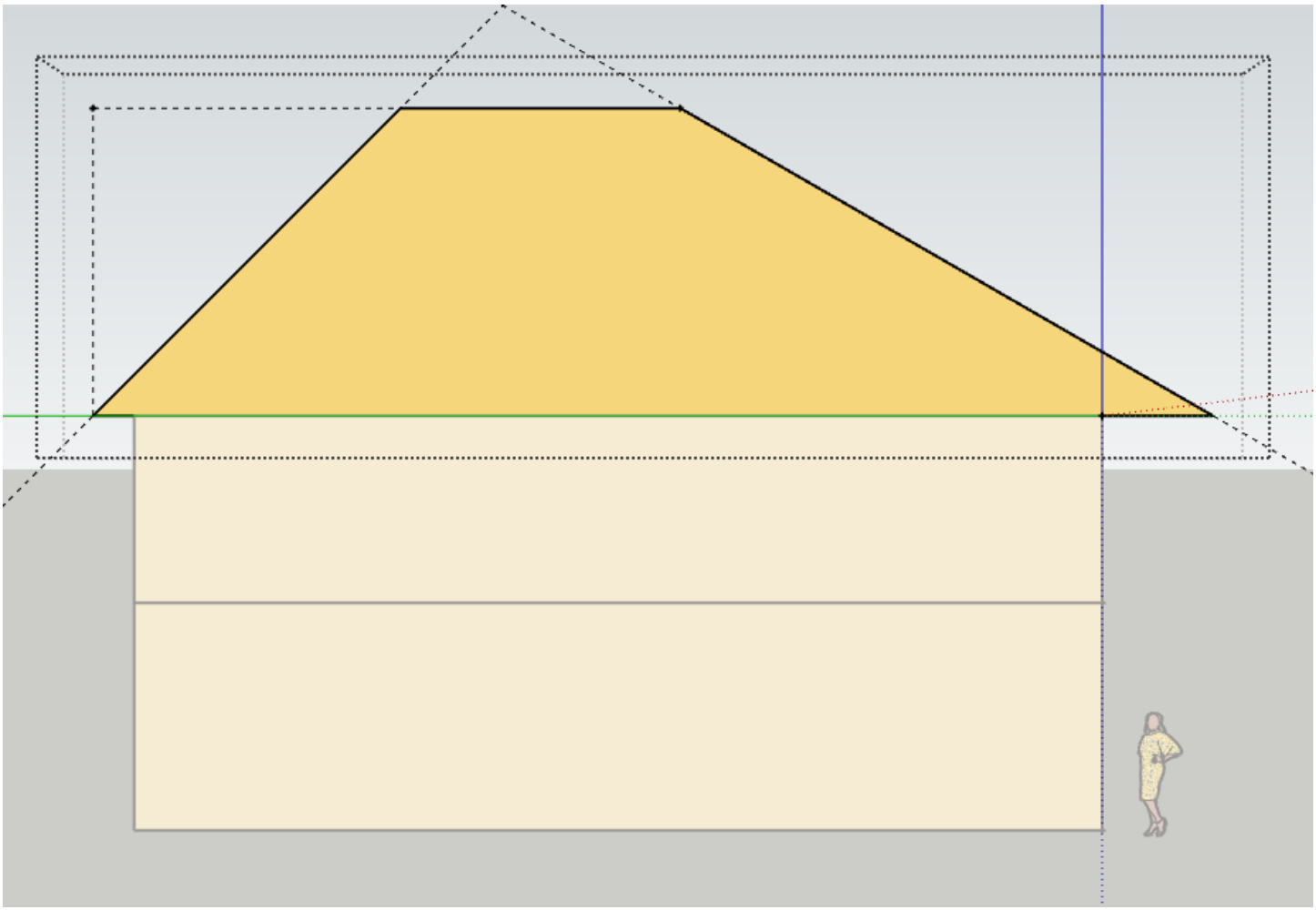
8. Draw in the 2nd storey (height = "**2550**") in a new Space



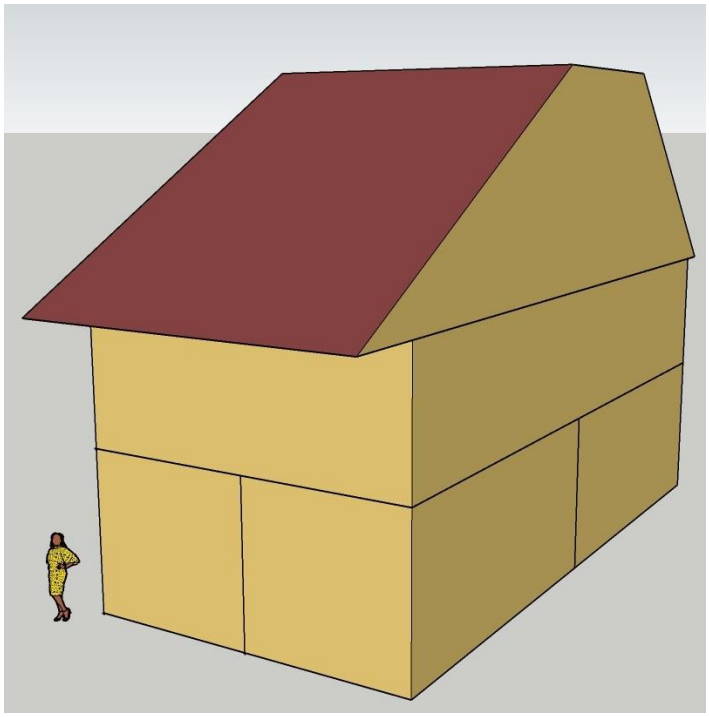
9. Draw the roof by drawing the longest edge. To draw the sloped surface, use the **Protractor** to draw guidelines first. To select the protractor, go to **Tools > Protractor**. Enter "**19.7**", the angle in degrees, just like the other dimensions.



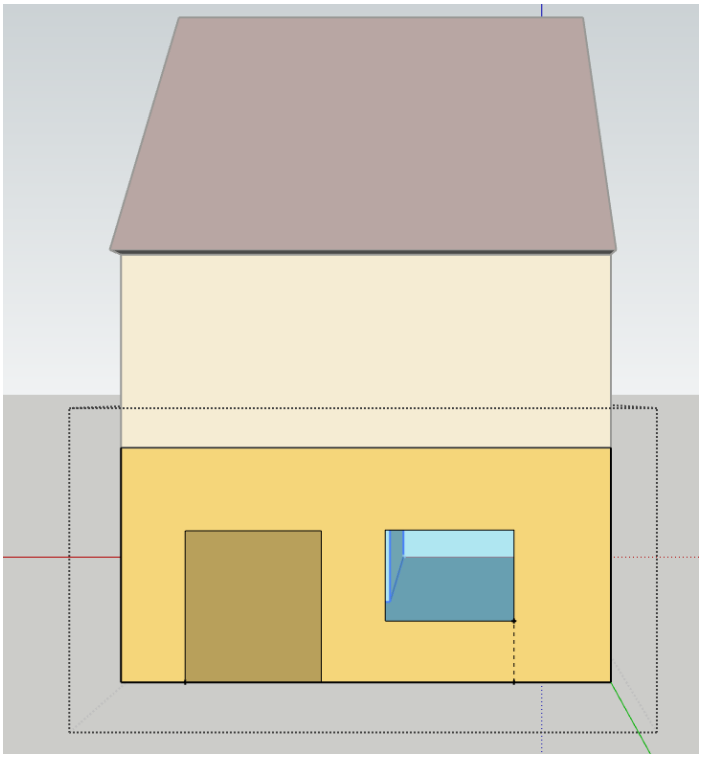




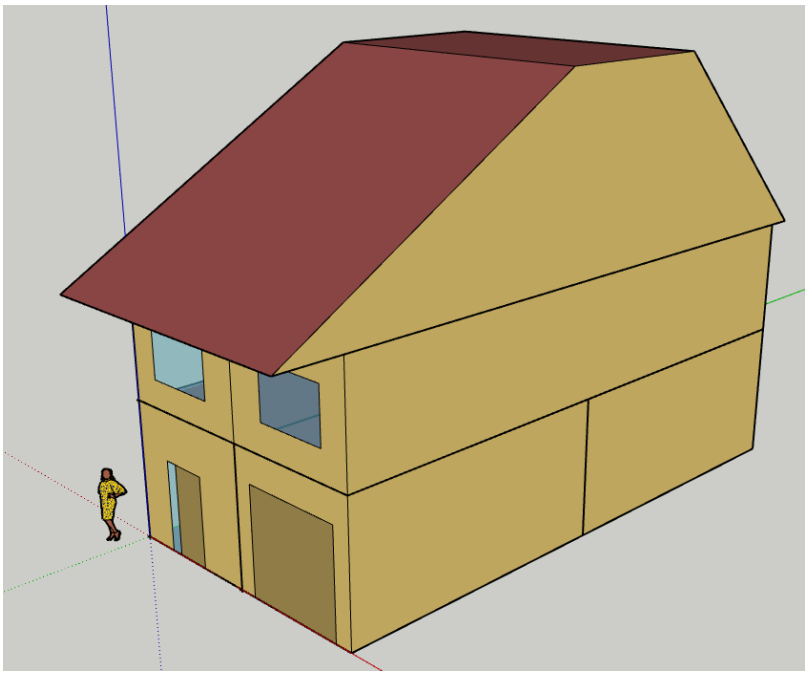
10. Use the pull/push tool and snap the new volume in place



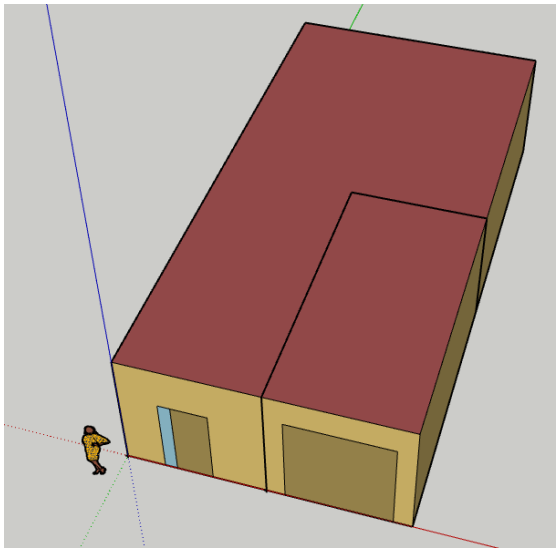
11. Fenestration can be added by selecting a Space (double click on a surface in that zone) and drawing the window or door on that surface. Start doing this on the north face side (the back). Use guidelines to set the origin for each window and door as necessary. By default, drawing a fenestration (called a **subsurface** in OpenStudio) at the edge of a wall will default to a door. Right click on the door, **OpenStudio>SubSurface Type>GlassDoor**.



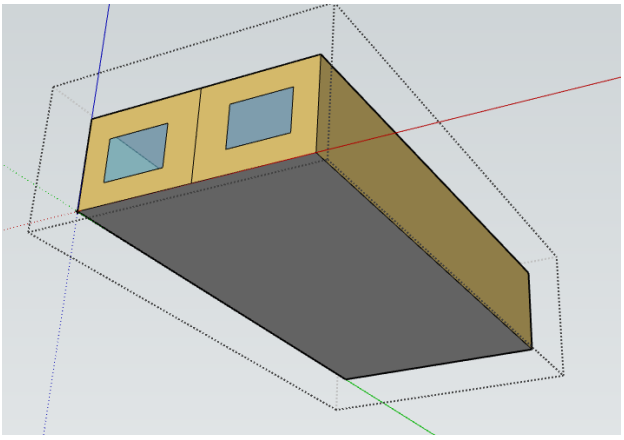
Then do the front (south facing) of the house. The final building should look like this.



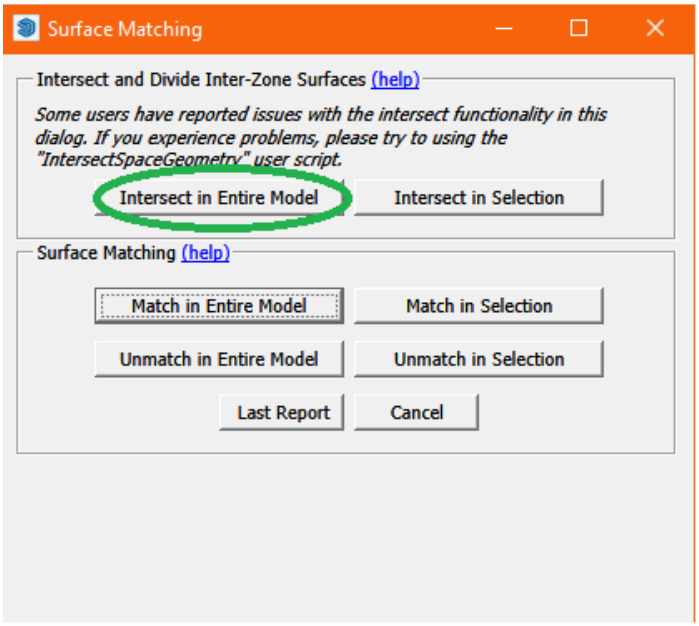
12. There are missing surfaces that needs to be drawn in. The first storey contains the living space + the garage and a top view (other storeys hidden) depicts the different ceiling surfaces.



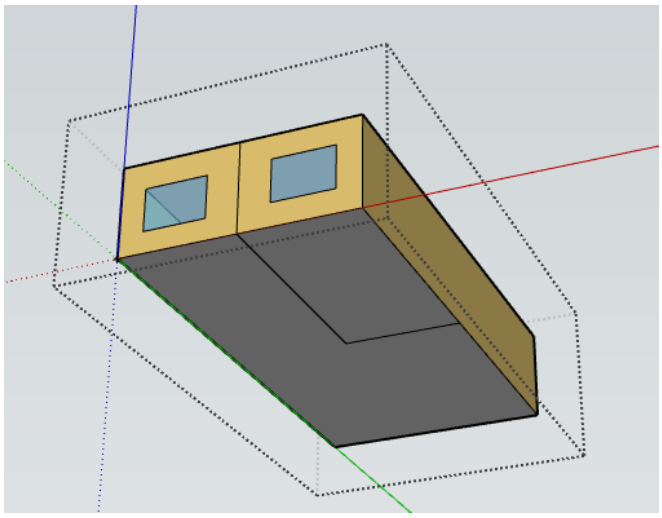
But these adjacent or opposite surfaces are missing from the second storey's floor. OpenStudio can't handle one surface having multiple surfaces interacting with it.



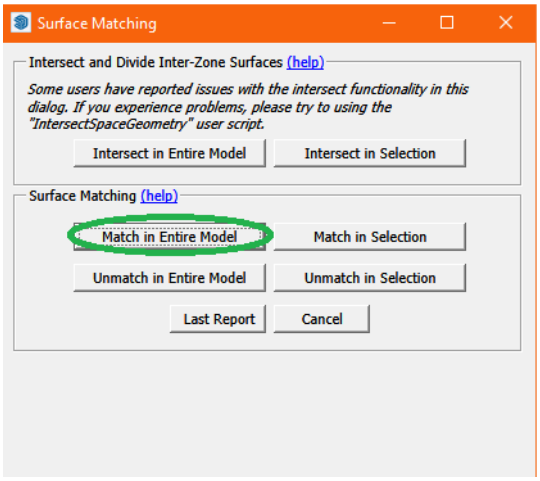
The floor of the second storey needs to be split just like the ceiling in the first storey. Use the **surface matching tool**  to do this. This tool will draw in lines, splitting surfaces so they match with adjacent surfaces. Remember to save before doing this.



And now the surfaces are drawn on the floor of the second storey.



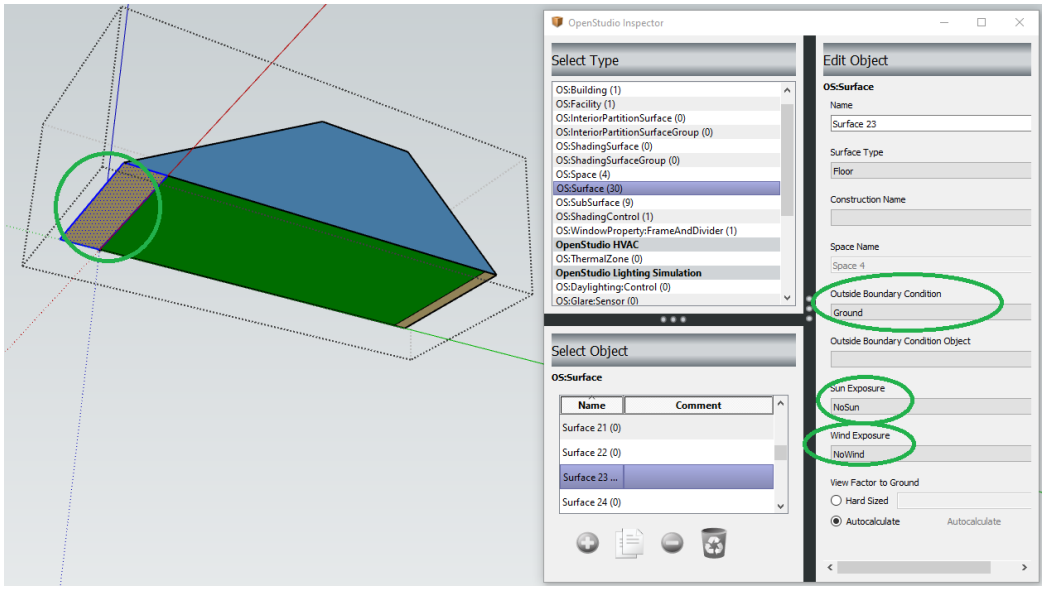
13. With adjacent surfaces drawn, these surfaces can now be matched. This cements the relationship between them (i.e. the ceiling of one zone is the floor of another). Use  .



14. After matching the surfaces, check for problems by clicking on the **Render Boundary**  .
    Surfaces (walls/roofs/floors/subsurfaces) exposed to
    - outside air will be in blue,
    - ground will be in yellow
    - other surfaces (e.g. 1st storey ceiling underneath 2nd storey floor) will be in green.

You can see surfaces between the storeys by only showing the selected space using  .

15. Some surfaces might not have the correct boundary conditions, manually change those surfaces using the **Inspector** tool  . Which will open the following window



The current selected surface (dotted yellow rectangular surface) is the floor overhanging the edge of the second storey. In the **Inspector**, the

- **Outside Boundary Condition**, is set to **Ground**
- **Sun Exposure** is set to **NoSun**, and

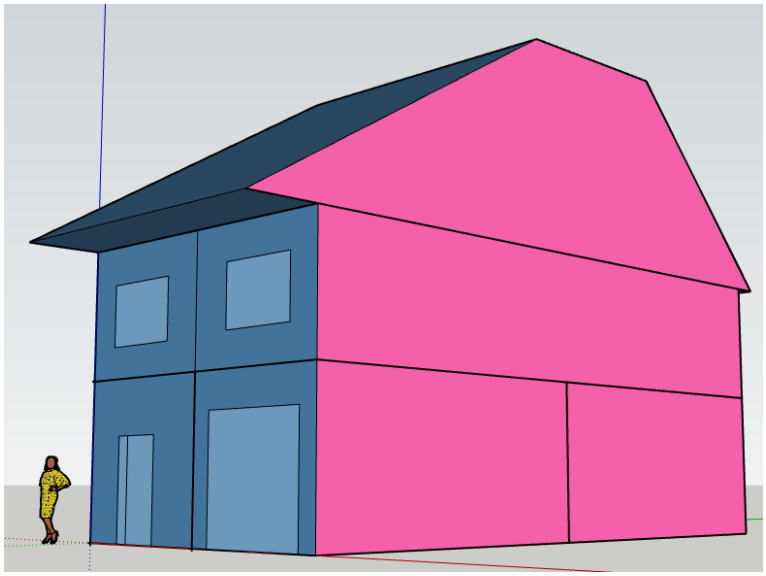
- **Wind Exposure** is set to **NoWind**

Which is incorrect. It's an overhanging surface exposure to the outdoors, including the sun and wind. Manually change

- **Outside Boundary Condition**, to **Outdoors**
- **Sun Exposure** is set to **SunExposed**, and
- **Wind Exposure** is set to **WindExposed**.

Repeat for the smaller overhanging surface on the opposite end of the attic and the first storey ground.

16. The surfaces on the east are actually adjacent surfaces to CCHT E. Instead of modelling the adjacent building, set these to **adiabatic surfaces** and remove sun and wind exposure, by adjusting the same fields from the previous step.



17. Rename surfaces using the **Inspector** so they're easier to identify when debugging and assigning construction. There should be
    - 4 spaces
    - 30 surfaces
    - 9 subsurfaces

18. Create thermal zones. This step must always be done. **Extension**>**OpenStudio User Scripts**>**Alter or Add Model Elements**>**Add New Thermal Zone for Spaces With No Thermal Zone**.

    Thermal zones are EnergyPlus objects, it contains a well-mixed volume of air with a single temperature, bordered by surfaces. **Spaces** are an abstraction that only exists in OpenStudio and doesn't exist in EnergyPlus. For simplicity **Thermal Zones** and **Spaces** can be thought of as the same thing for this workshop (and in most cases beyond).

19. Name your **Spaces** and **Thermal Zones**. They can be the same name.
20. Delete the autogenerated **SpaceTypes** and **Default SurfaceConstructions**, **Default SubSurfaceConstructions**, **DefaultConstructionSet**, and **DefaultScheduleSet**.