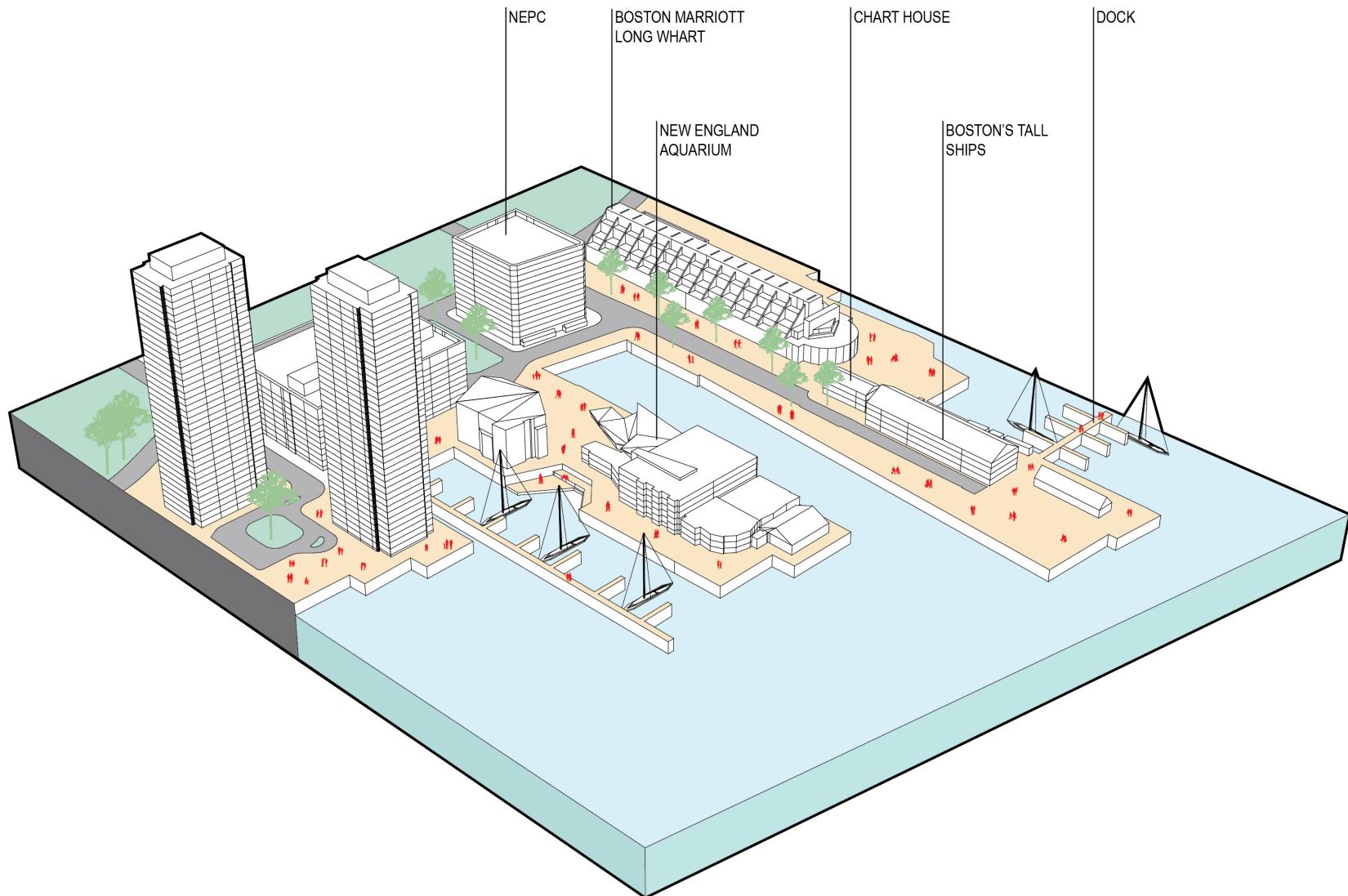


VIS 2129 Week 11 3D Building Form Assignment Workflow Demonstration

Friday, November 22, 2019

WEEK 12 BUILDING FORM
Yonghui Chen

Description: What are the problems of the existing site? What have you designed or proposed in response to the problems you have identified (in this case, a continuous riverfront promenade)? What is your concept? What is it for? Who is your audience?



1. Install Sketchup Pro and AutoCAD.

Harvard GSD has purchased official Sketchup Pro and AutoCAD for you to use freely. To access the GSD server where there are a number of softwares and other resources, please refer to: <https://www.gsd.harvard.edu/resources/connecting-to-gsdserver/>

If you have any troubles with accessing the GSD server, please go to Help Desk at the library downstairs. They will help you.

The image shows two separate file explorer windows from a Windows operating system. Both windows are navigating through the path: PC > public (\gsdserver.university.harvard.edu) (Z:) > Software. The left window lists various software packages, with 'AutoCAD' highlighted by a red box. The right window lists specific SketchUp Pro files, also with 'SketchUpPro 2018 for Mac.dmg' highlighted by a red box. The bottom window shows a single 'GSD ReadMe' file.

2. Create a folder named 'Week_12_3D_Building_Form' on your computer.

3. Again, I use City of Boston as an example. Download some data from open portals.

1) City of Boston Boundary shapefile:

<https://data.boston.gov/dataset/city-of-boston-boundary>

2) The road network shapefile:

<https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2019&layergroup=Roads>

3) The edge of pavement and/or sidewalk shapefile:

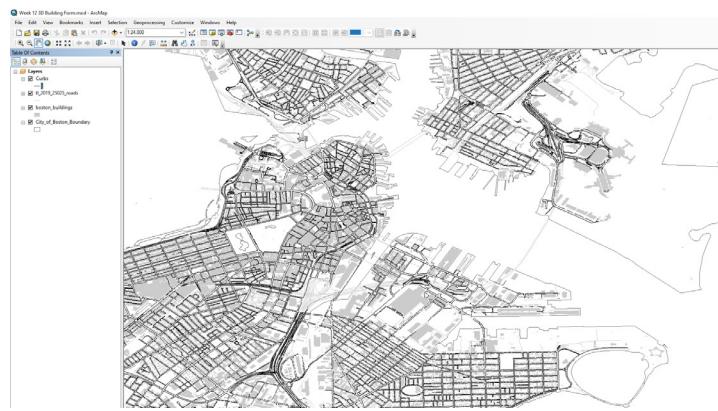
<http://bostonopendata-boston.opendata.arcgis.com/datasets/curbs>

4) And most importantly, the building footprint shapefile:

<https://www.arcgis.com/home/item.html?id=c423eda7a64b49c98a9ebdf5a6b7e135>

The image shows two screenshots of data portals. The left screenshot is from the United States Census Bureau's TIGER/Line® Shapefiles: Roads portal, specifically for the 'Curbs' dataset. It shows a map of Boston with various roads and curbs highlighted. The right screenshot is from the Boston Buildings portal, which displays building footprints for the City of Boston. Both screenshots show detailed maps and download options for the respective datasets.

4. Open ArcMap and import all the data you have downloaded.

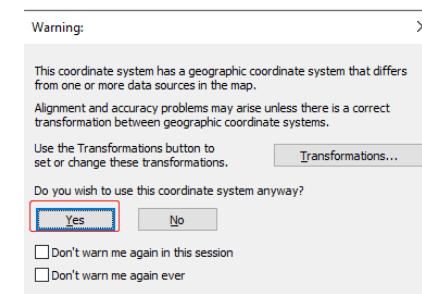
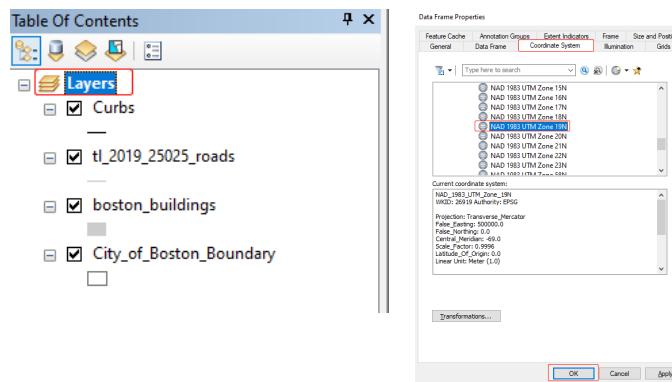


5. The map looks distorted because we have not defined a Projected Coordinate System. To define it, right click 'Layers' and choose Property.

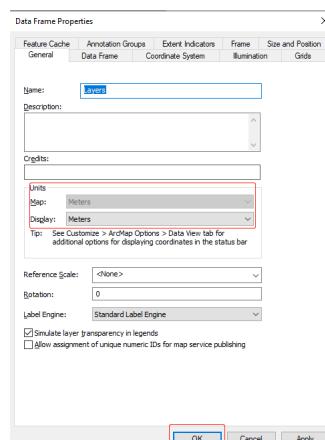
Under 'Coordinate System' tab, navigate to Projected Coordinate Systems -> UTM -> NAD 1983 -> NAD_1983_UTM_Zone_19N

(Note: NAD_1983_UTM_Zone_19N is suitable for City of Boston and is commonly used.)

The result should look like right below.



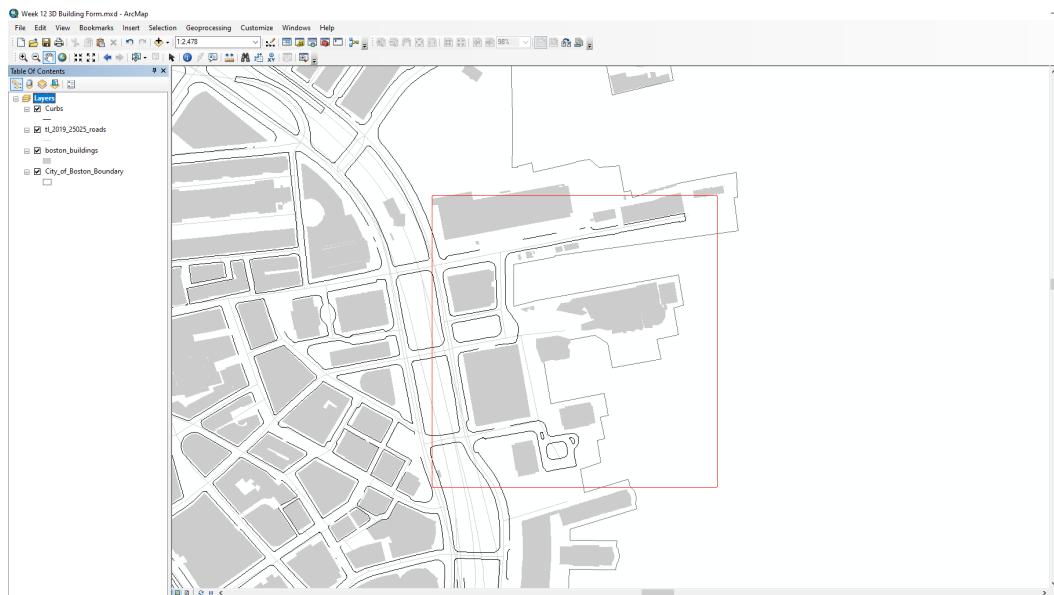
6. Right click 'Layers' again. Go to General tab. You see that, after defining the Projected Coordinated System, the map unit becomes meter. Set Display unit as meter as well.



7. Go to Google Map and search Boston. Switch to Satellite map. Then holding down 'Ctrl' key of your keyboard and left-click button of your mouse at the same time, move your mouse to show the 3D model like below. This will be your reference to build the following 3D model.
I am going to take New England Aquarium area for demonstration.

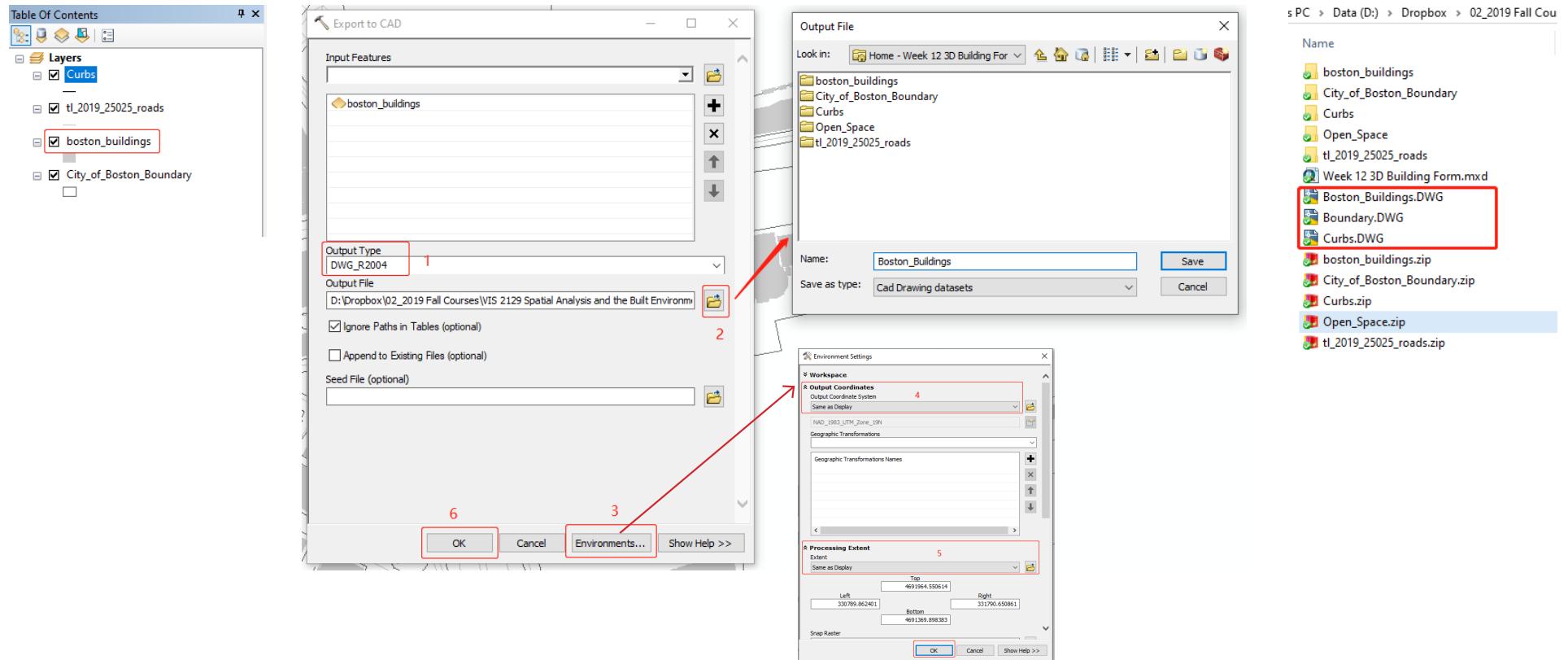


8. Go back to ArcMap. Zoom in on the area. Make it shown at the center of the map.

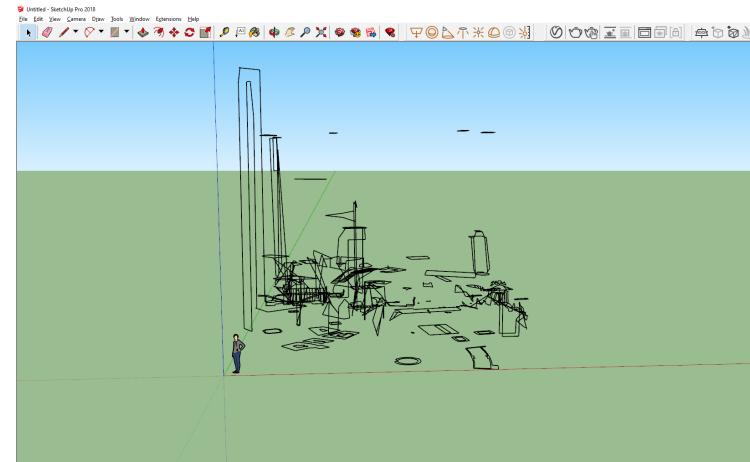
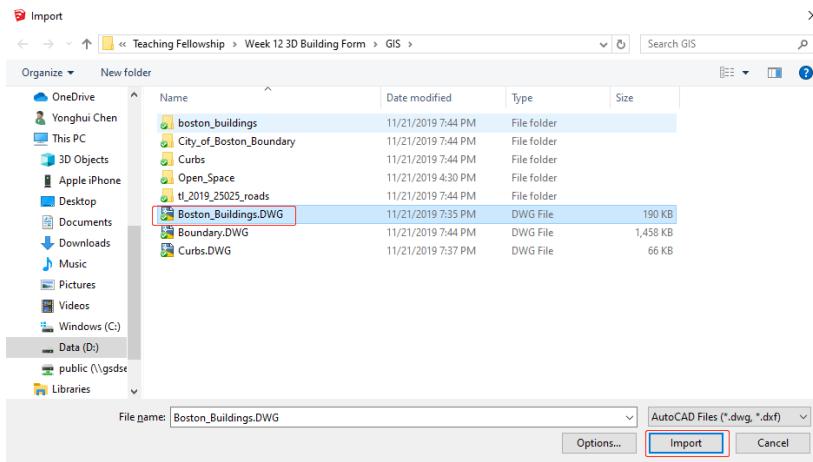


9. Right click 'boston_buildings' layer and choose 'Export CAD'.

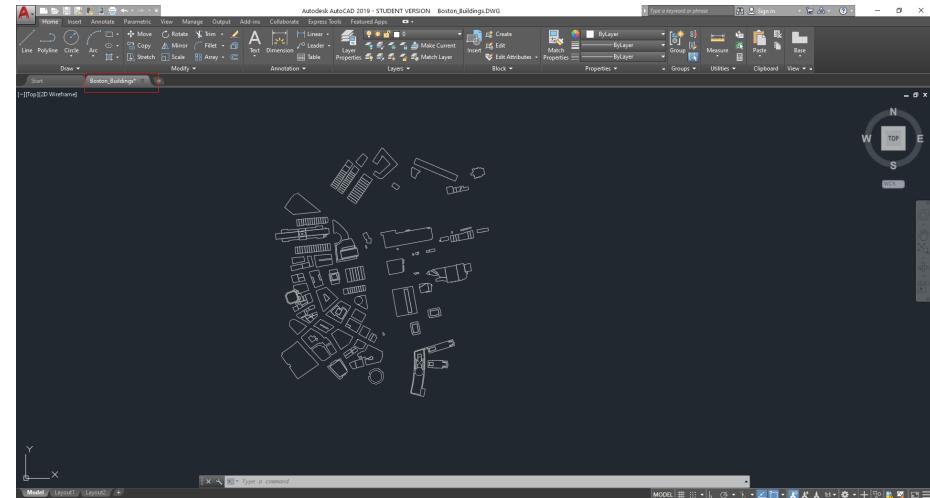
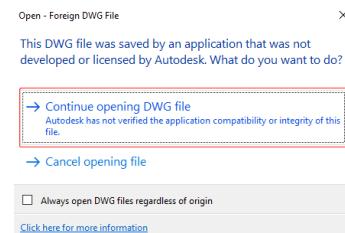
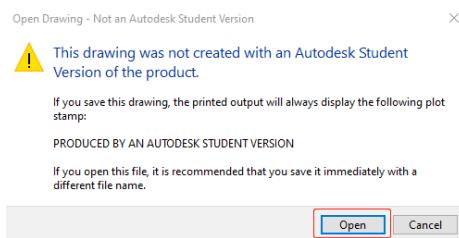
Similarly, export 'City_of_Boston_Boundary' layer and 'Curbs' layer as CAD files respectively. Finally, you will get three CAD files (.DWG) on your folder.



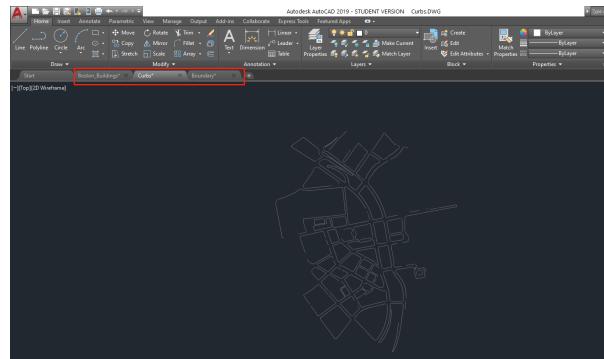
10. Open Sketchup. Navigate to File -> Import. Go to the CAD files, select 'Boston_Buildings.DWG' and click import. The result should look like right below, which is completely messy - many lines are not on the same plane. This is because of the untidy data downloaded from online.
 You will encounter this similar issue quite frequently in the future, so I want to teach you how to solve it.
 Close Sketchup.



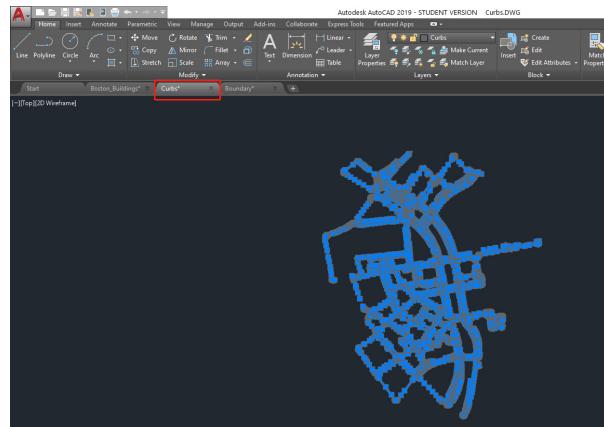
11. Go to your folder, double click 'Boston_Buildings.DWG' to open it with AutoCAD.



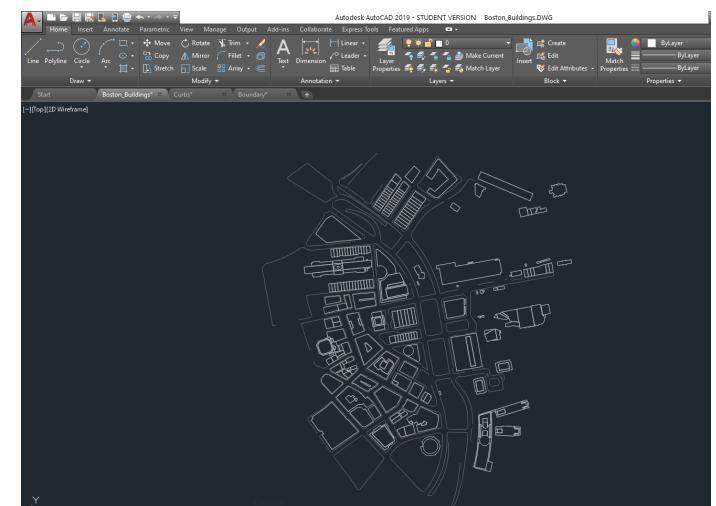
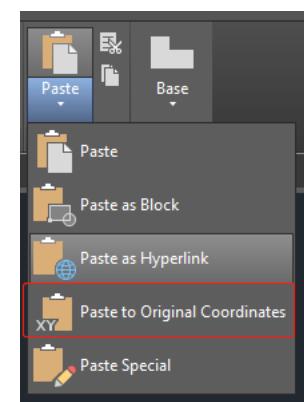
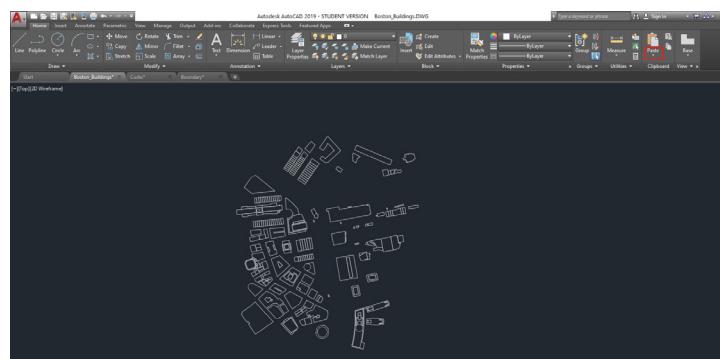
12. Similarly, double click the other two CAD files to open them subsequently. You will see three tabs show up.



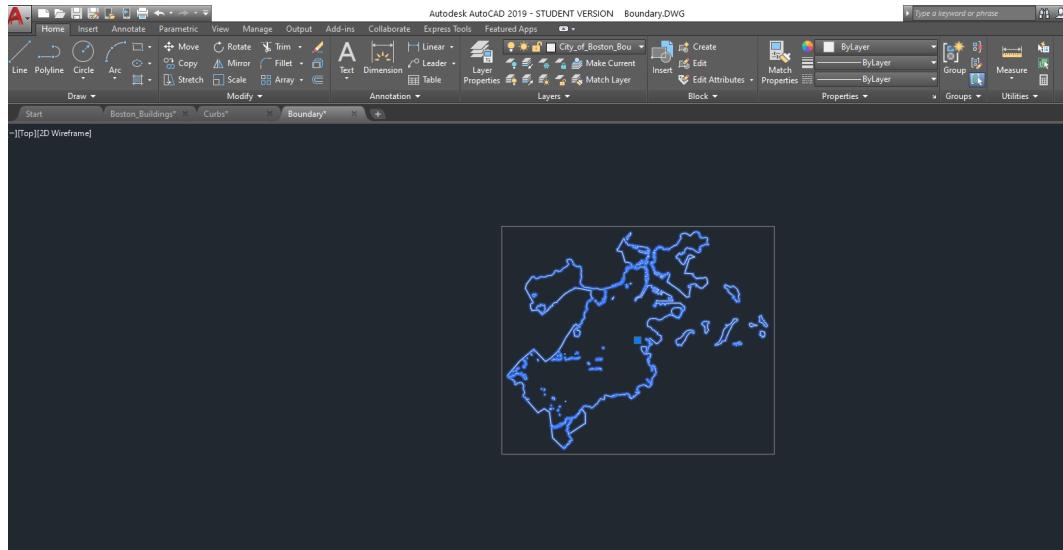
13. Toggle to 'Curbs' tab. Press down 'Ctrl + A' to select all the features. Press down 'Ctrl + C' to copy all the features.



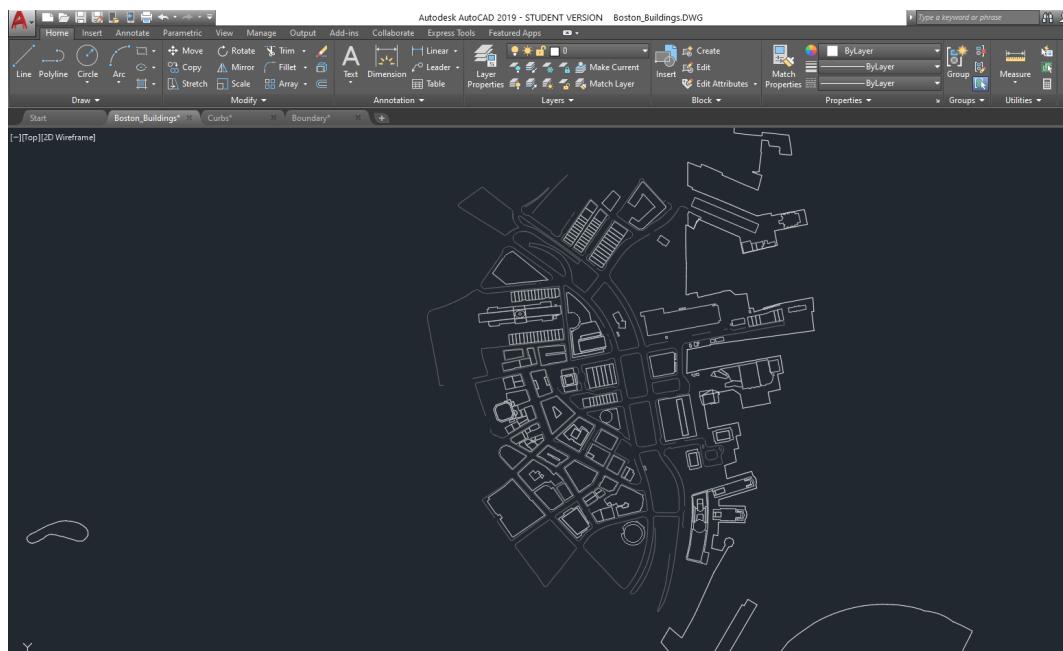
14. Toggle to 'Boston_Buildings' tab. Click on the triangular button to select 'Paste to Original Coordinate'. The result should look like below.



15. Toggle to 'Boundary' tab. Again, press down 'Ctrl + A' to select all the features. Press down 'Ctrl + C' to copy.



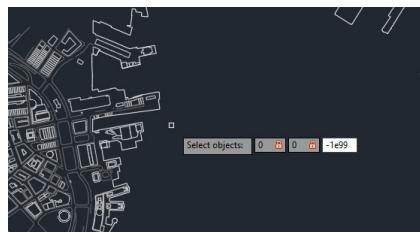
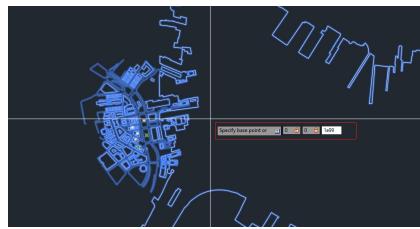
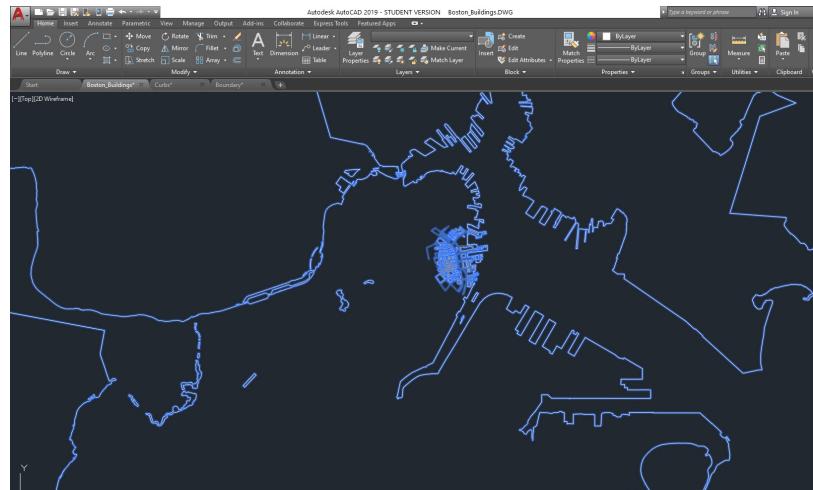
16. Toggle to 'Boston_Buildings' tab again. Click on the triangular button to select 'Paste to Original Coordinate'. The result should look like below.



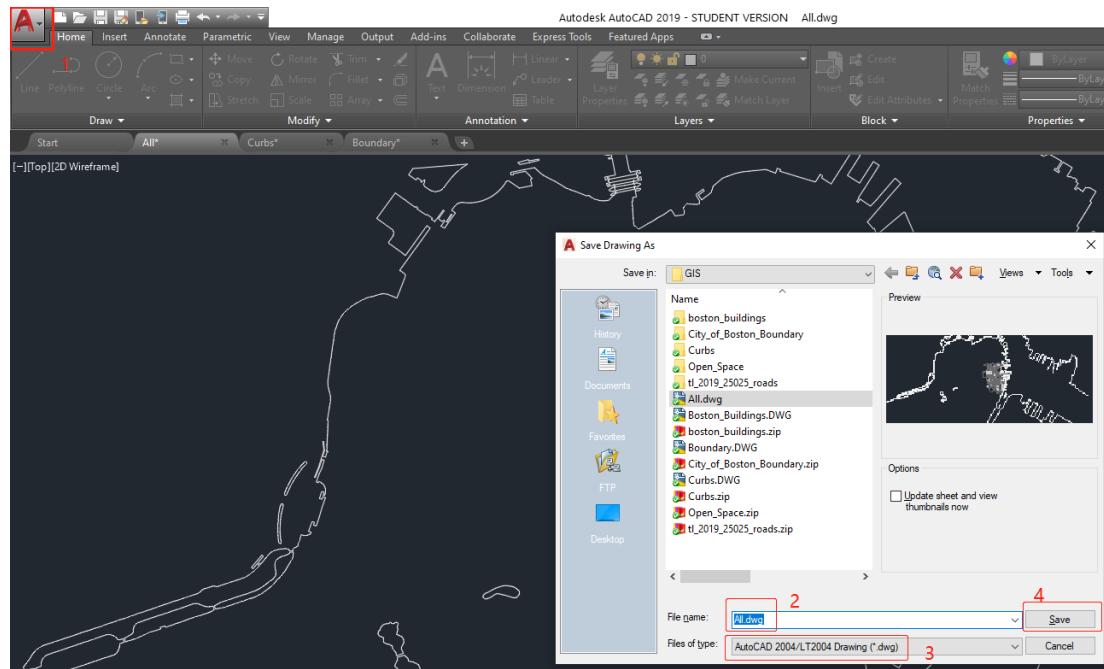
17. Now you have put all the layers together. Press down 'Ctrl + A' to select all.

Type into 'M' and hit 'Enter' on your keyboard to activate Move command. Then you do subsequently, 1) type number '0'; 2) type comma (,) ; 3) type '0' again; 4) type comma (,) again; 5) type '1e99'; 6) hit 'Enter' on your keyboard; 7) type number '0'; 8) type comma (,) ; 9) type '0' again; 10) type comma (,) again; 11) type '-1e99'; 12) hit 'Enter' on your keyboard.

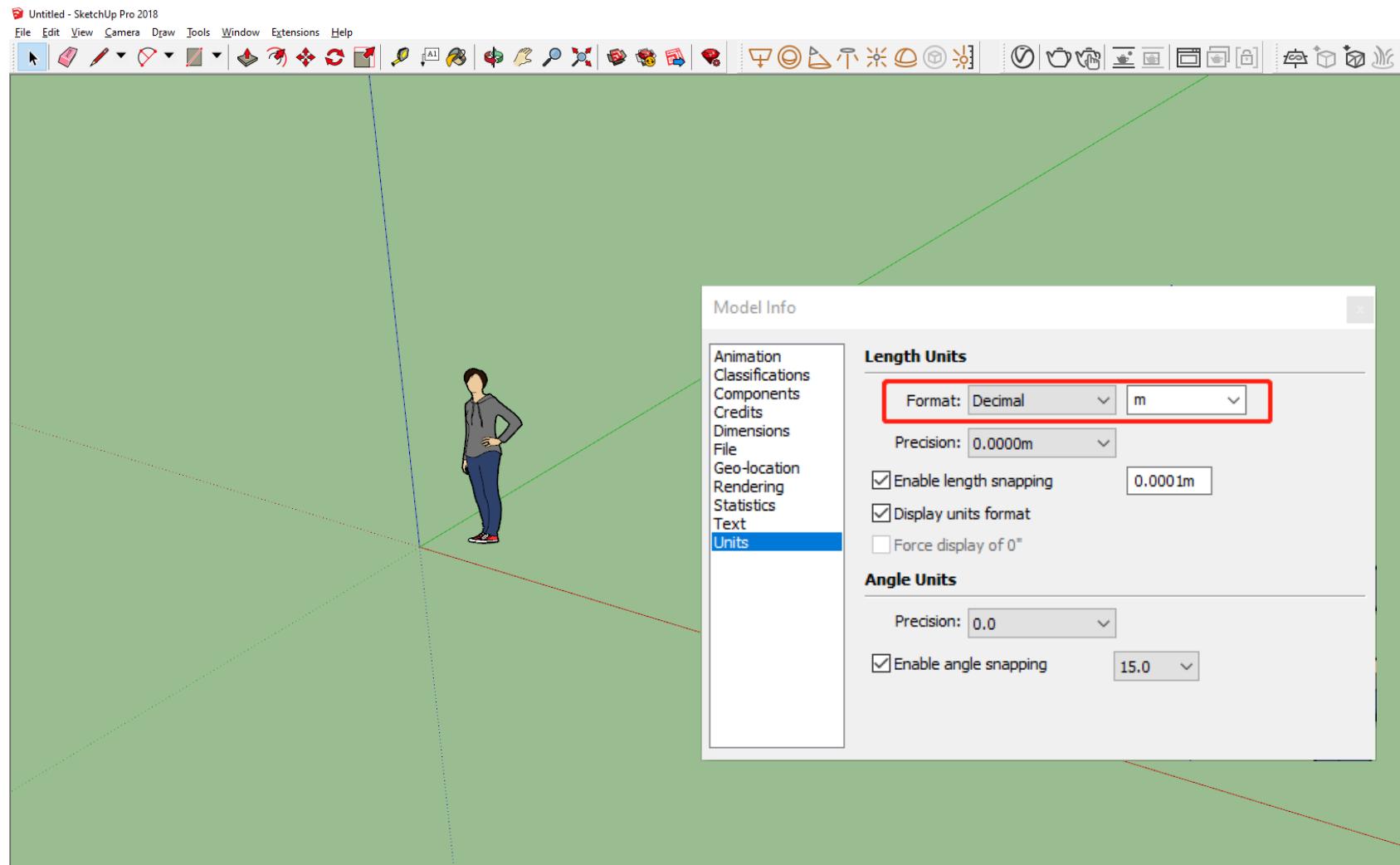
Note: steps 1) to 12) allow you to make all the features on the same plane ($z = 0$), by first moving all the features to infinity and then moving back to infinity. This is a trick in CAD. You only need to remember what it works for and how it works.



18. Click on the button on the left above corner. Then click on 'Save As' to find a location and save as a 'All.dwg' file.



19. Open Sketchup again. Navigate to Window -> Model Info. Set the Unit in Sketchup as meter, in accordance with the data unit in ArcMap as we have seen on Step 6.

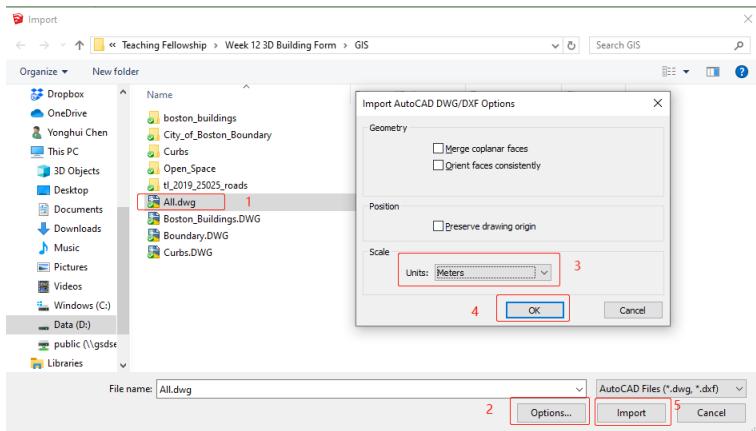


20. In Sketchup, navigate to File -> Import. Select the file 'All.dwg' and click import. The result shoud look like right below.

Note that in Sketchup, using hot keys can speed up your work significantly:

- 1) Scroll up or scroll down mouse wheel to zoom in or zoom out.
- 2) Holding down mouse wheel, move your mouse to orbit the view.
- 3) If you make a mistake, press down 'Ctrl + Z' to return to last step; press down 'Ctrl + Z' twice to return to last two steps; and so on.
- 4) Press down 'Ctrl + Y' to move forward a step; press down 'Ctrl + Y' twice to move two steps forward; and so on.
- 5) Press down 'Esc' to finish doing something.
- 6) Press down 'Space' to activate selection tool.

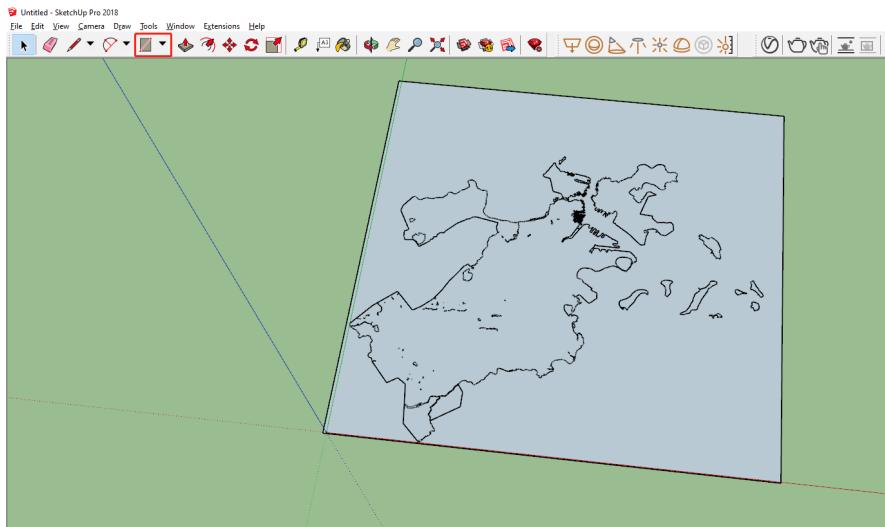
Press down 'Ctrl + S' to find a location to save the sketchup file. In the process, you should remember to save the file constantly in case the file collapses unexpectedly.



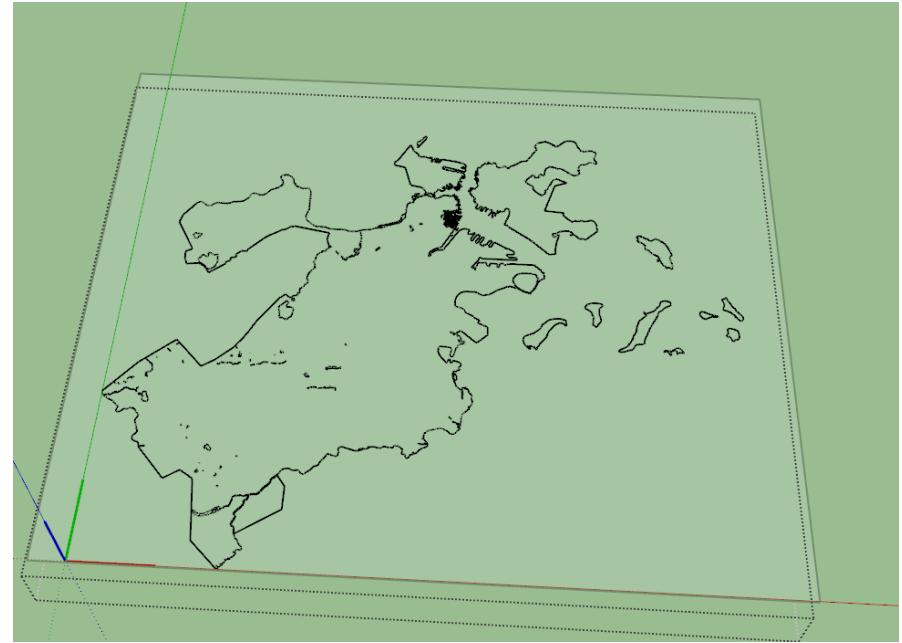
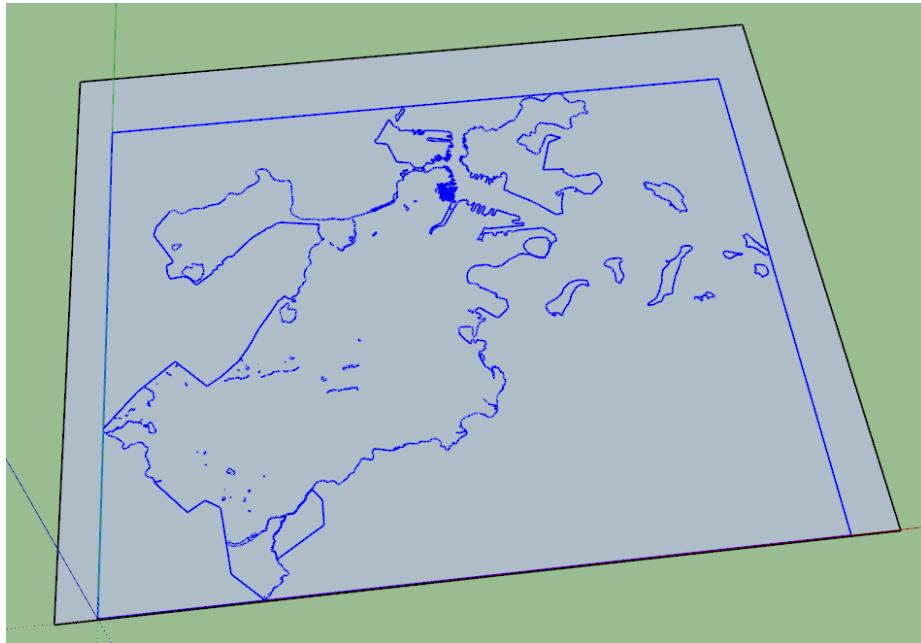
21. Click on the 'Rectangular Tool' button and then draw a rectangular. Having a rectangular as the background makes you zoom in or zoom out on some specific areas more easily and prevents the view from skipping around.

Then double click the rectangular you have drawn to select it. Right click and select 'Make Group'.

Click on the rectangular again and then right click to select 'Lock'.

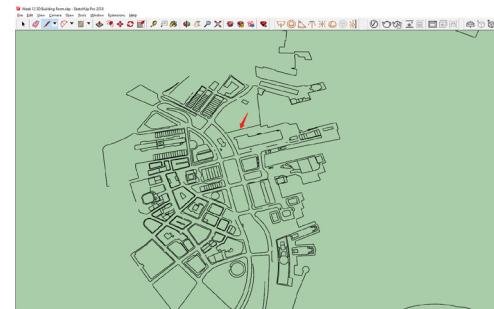
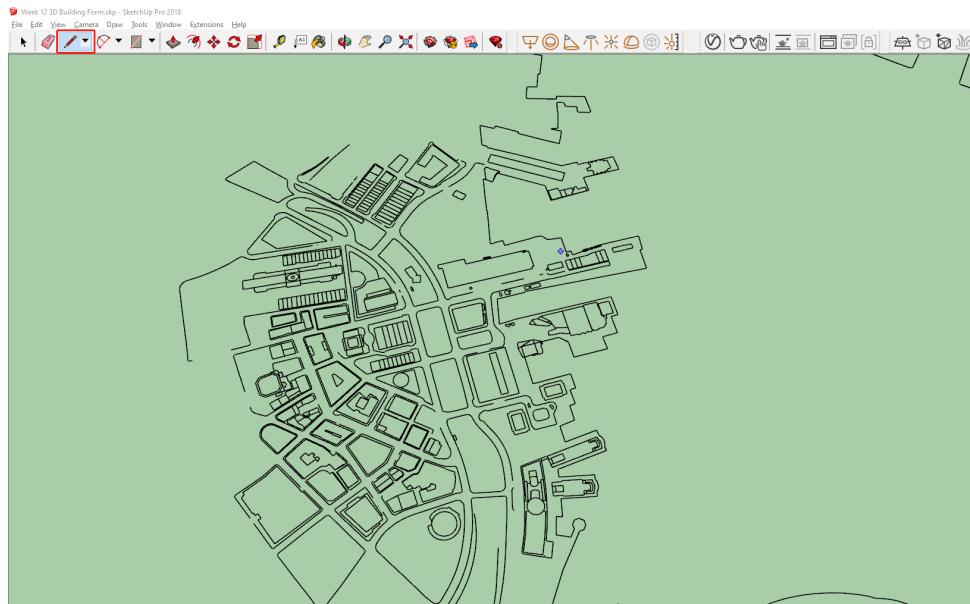


22. Click on the boundary of Boston to select all the elements. Then double click to enter the editing mode.



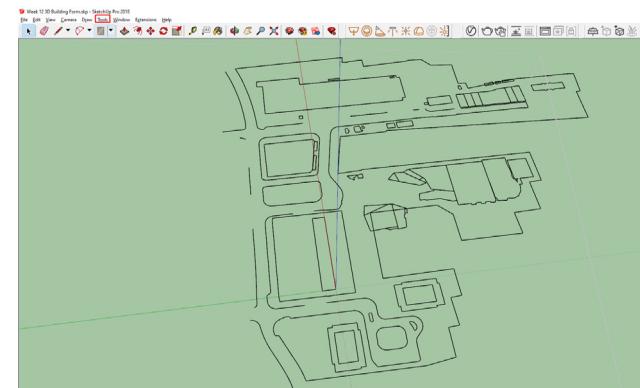
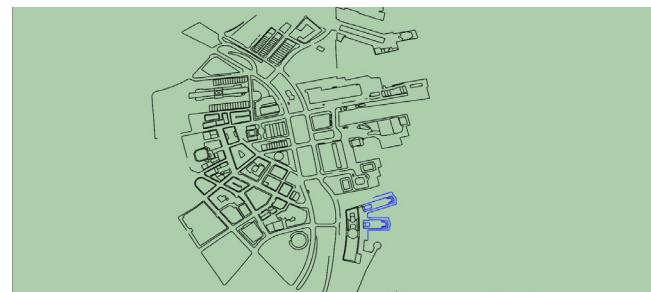
23. Zoom in on the the area of your interest. Click on the 'Pencil' icon on the toolbar (or you can directly press down 'L' on your keyboard) to activate the Pencil tool. Draw a line to define the northern boundary of the area. Press 'Esc' on your keyboard to finish the drawing.

Similarly to draw another line to define the southern boundary of the area. Press 'Esc' on your keyboard to finish the drawing.

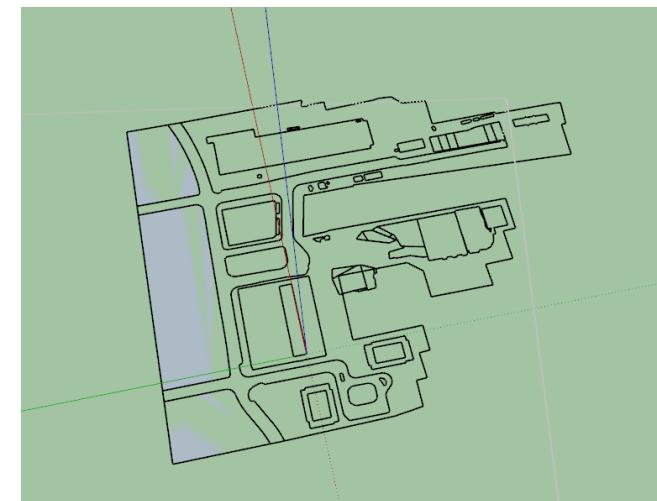
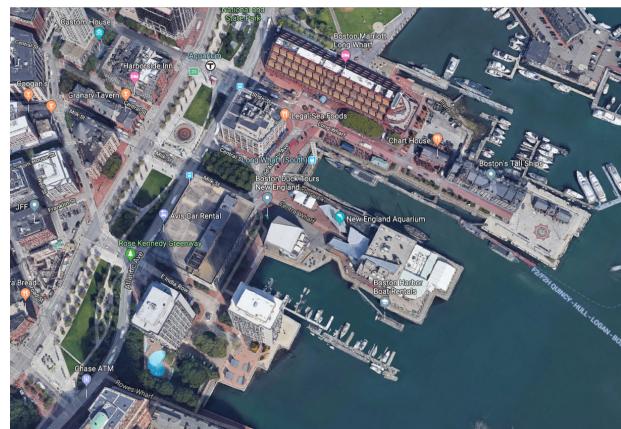


24. Click on Eraser icon on the toolbar. Delete by clicking the lines outside the area of your interest.

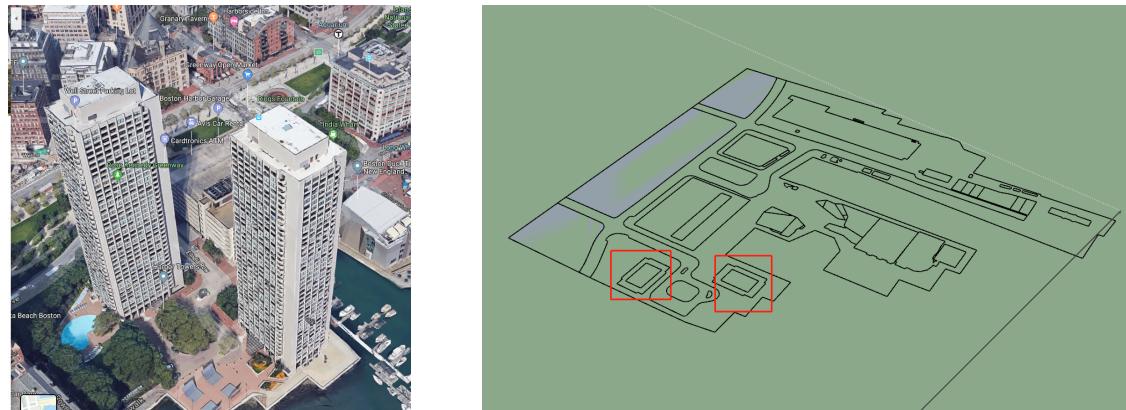
Or you can drag your mouse to select the features on the map and press down 'Delete' key on your keyboard to delete. The final result should look like right below.



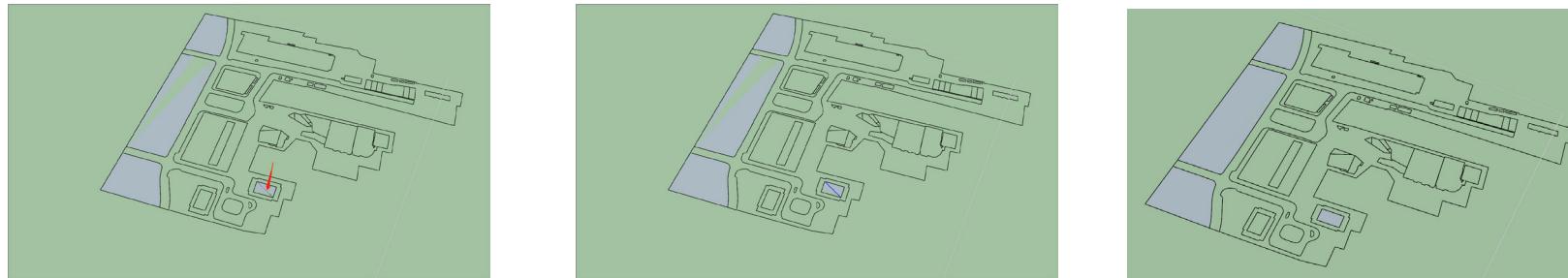
25. Open Google Map for reference. In Sketchup, use Pencil tool again to draw some connecting lines to make to ground plan as a complete and enclosed piece of work.



26. Now we can begin to build up 3D models. Start with the two identical towers.



27. Use Pencil tool to draw a diagonal line to create a solid plane. Then select the line and delete it. Now we want to extrude the plane into a 3D volume. But we do not know how tall is the building.



28. The answer lies in 'boston_building' shapefile in ArcMap. Use 'Identify' tool to click on the rectangular shape. In the open window, three columns are of particular importance. One is 'Ground_ELE' short for 'Ground Elevation' that represents the ground height relative to sea level plane. One is 'ROOF_ELEVA' short for 'Roof Elevation' that represents the building height relative to sea level plane. Another one is 'Building_H' short for 'Building height' that represents the sheer building height measuring from its bottom to the roof.

Their relationship is:

$$\text{ROOF_ELEVA} = \text{Ground_ElE} + \text{Building_H}$$

Field	Value
FIELD_ID	1
PARCEL_ID	0301000000_A0
PART_ID	1
PART_AREA	0.1510
PART_USE	CH
PART_CONTA	HARBOUR TOWERS 1 CONDO TT
PART_STATU	BUILT
PART_VIEW	PUBLIC
PART_FOOT	1.5
PART_ROOF	1.5
PART_HEIGHT	395.399999
PART_GROSS	407.7
PART_BLDG	1
PART_CEN_X	43.3819
GROUND_ELE	0.0517
BUILDING_H	397.4003
BLDG_FOOT	1.5
BLDG_ROOF	1.5
Identified 1 feature	

29. But they are measured in feet rather than in meter. So right click the 'boston_buildings' layer to 'Open Attribute Table'. Create a column named BH of Double data type. Click OK.

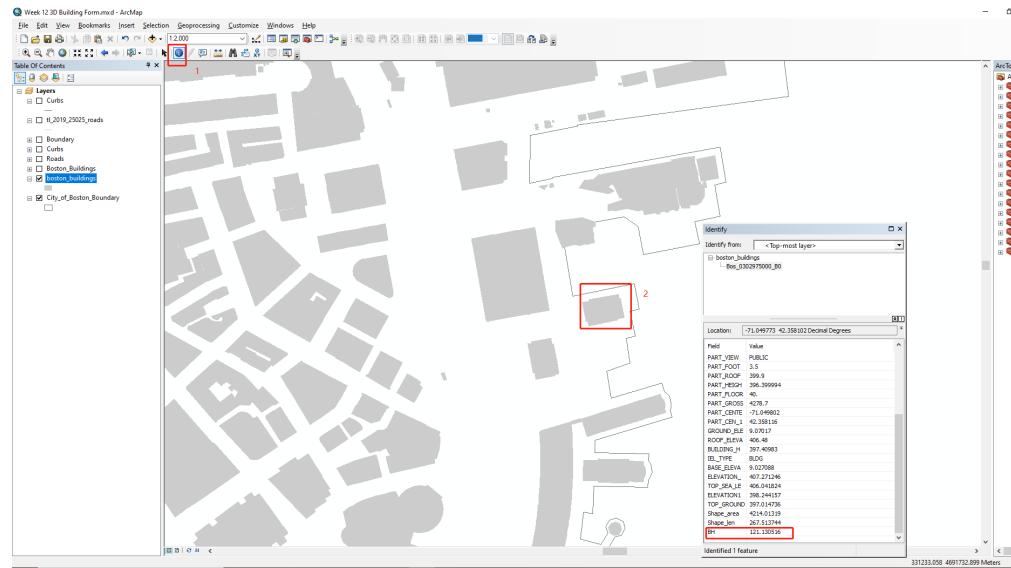
The screenshot shows the ArcGIS Table Of Contents window with the 'boston_buildings' layer selected. A context menu is open over the table, and the 'Add Field' option is highlighted. A 'Field Properties' dialog box is displayed, showing the field name 'BH' and data type 'Double'. The 'OK' button is highlighted with a red box. Below the dialog, the 'boston_buildings' attribute table is shown in a table view, with the newly created 'BH' column visible at the end of the schema.

30. Right click the column and choose Field Calculator. Type into the function.

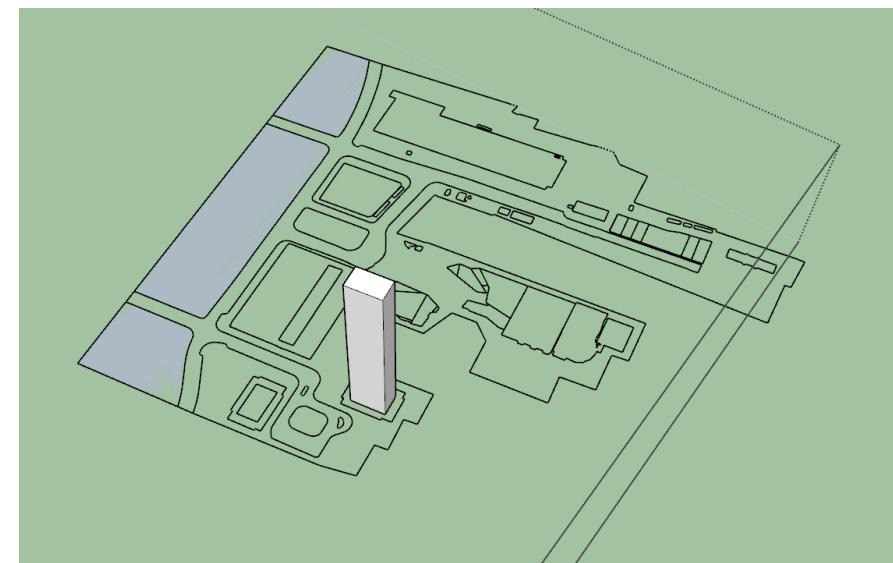
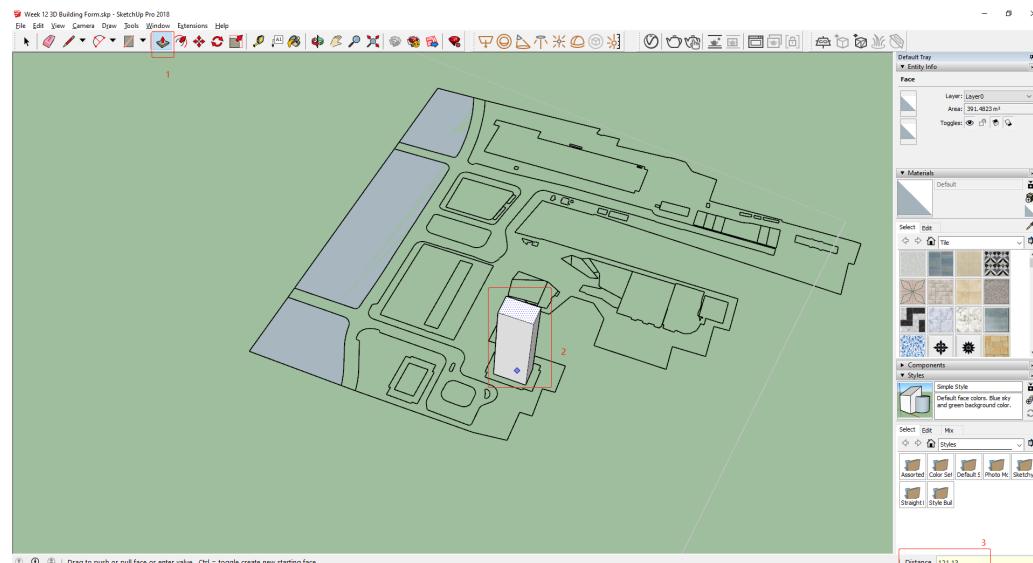
The screenshot shows the ArcGIS Table Of Contents window with the 'boston_buildings' layer selected. A context menu is open over the table, and the 'Field Calculator' option is highlighted. A 'Field Calculator' dialog box is displayed, showing the formula `(ft * 0.3048)`. To the right of the dialog, a search bar for 'feet to meters' is shown with the result '1 ft = 0.3048 Meter'.

Below the dialog, the 'boston_buildings' attribute table is shown in a table view, with the newly calculated values for the 'BH' column visible.

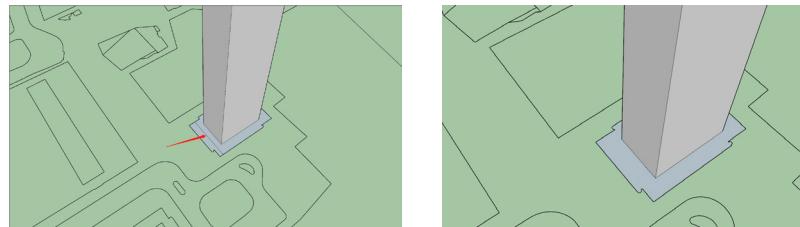
31. Now you see that the building is 121.13-meter high.



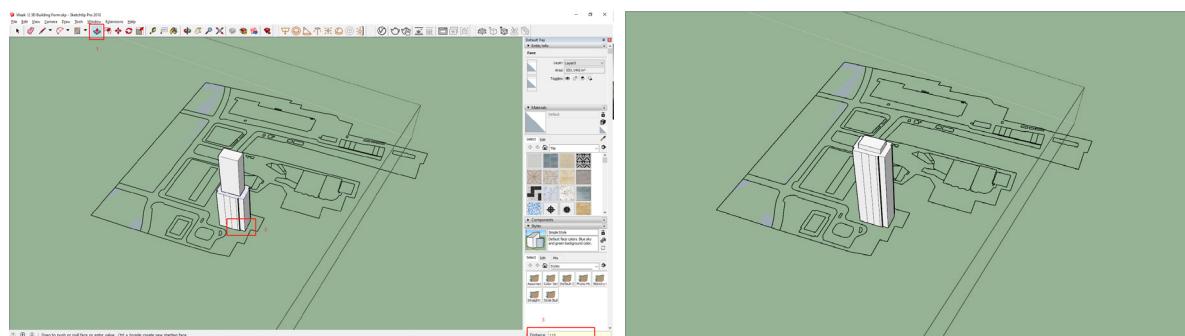
32. Back to Sketchup again. Click on Push/Pull tool; then move to the plane, click on it and move your mouse upward. Type '121.13' and hit 'Enter' on your keyboard.



33. Use Pencil tool to draw a line to create a solid plane. Then select it and delete it.



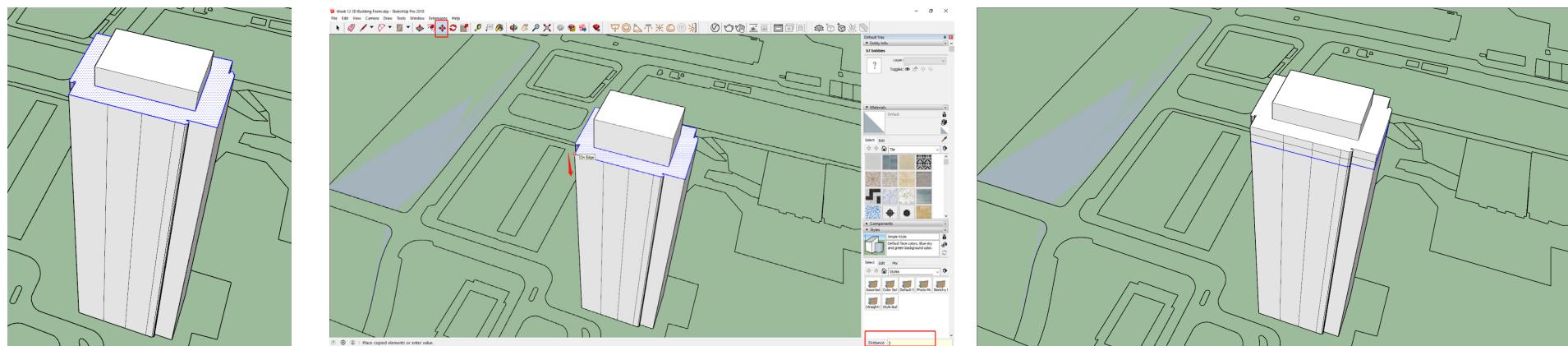
34. Click on Push/Pull tool to extrude the plane to a proper height.

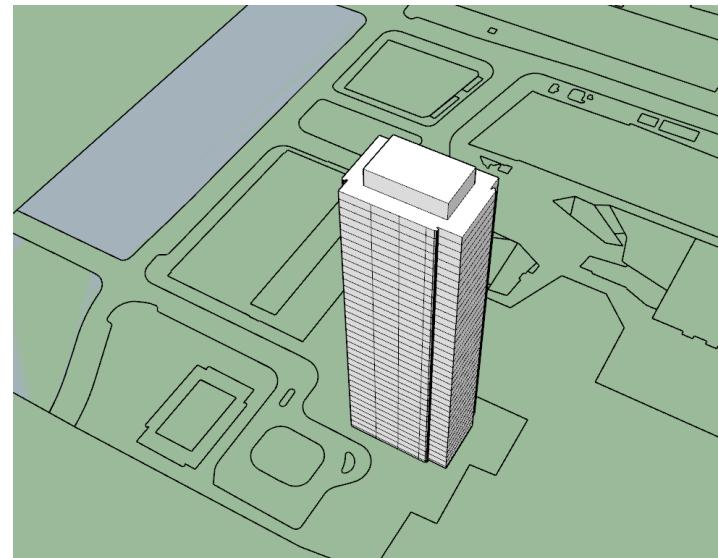
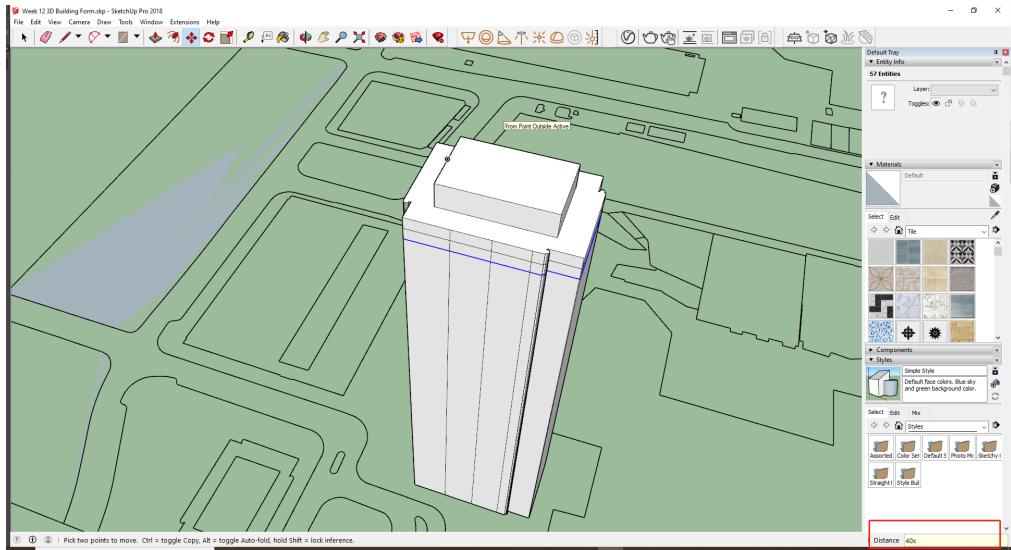


35. Double click the top face of the plane to select it.

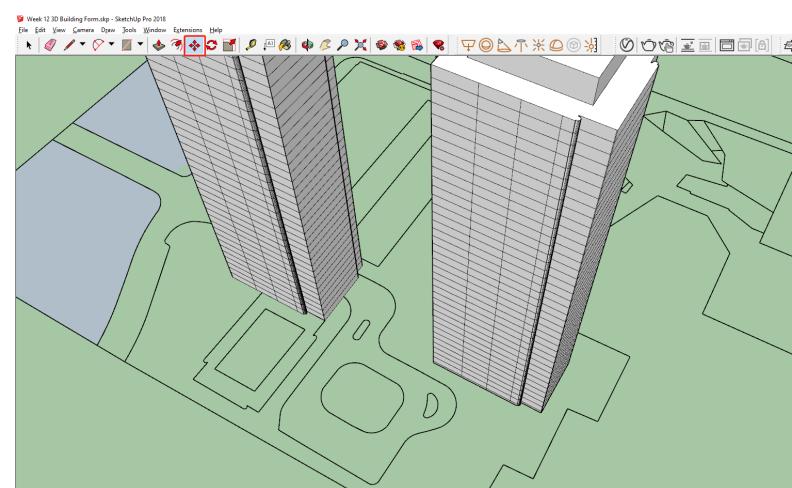
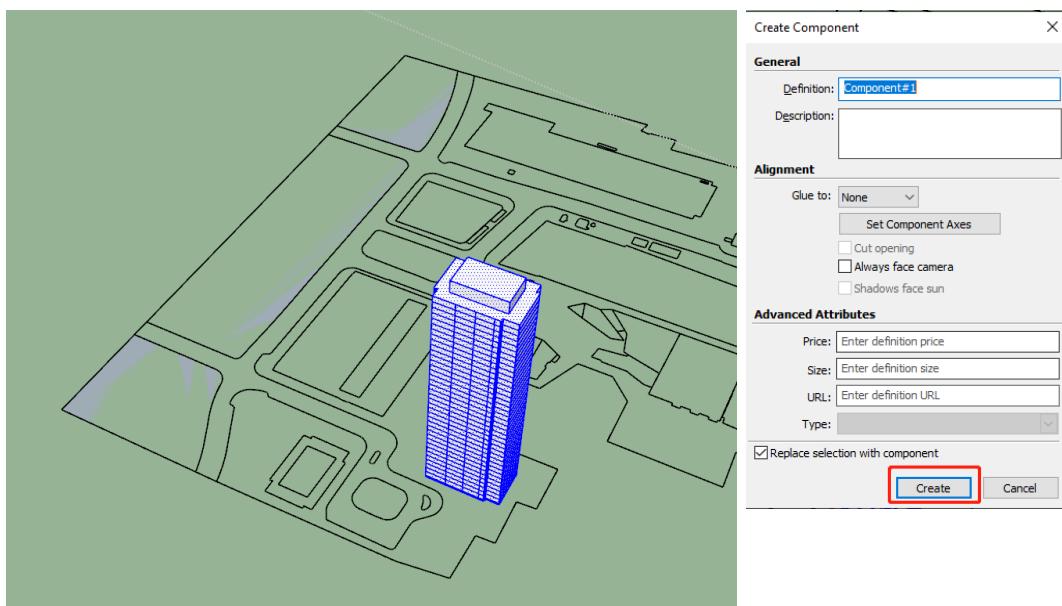
Click on Move tool.

While you are pressing down 'Ctrl' on your keyboard, click on an anchor point and then move the plane downward. Type '3' and hit 'Enter'. Immediately type '40x' to multiply.

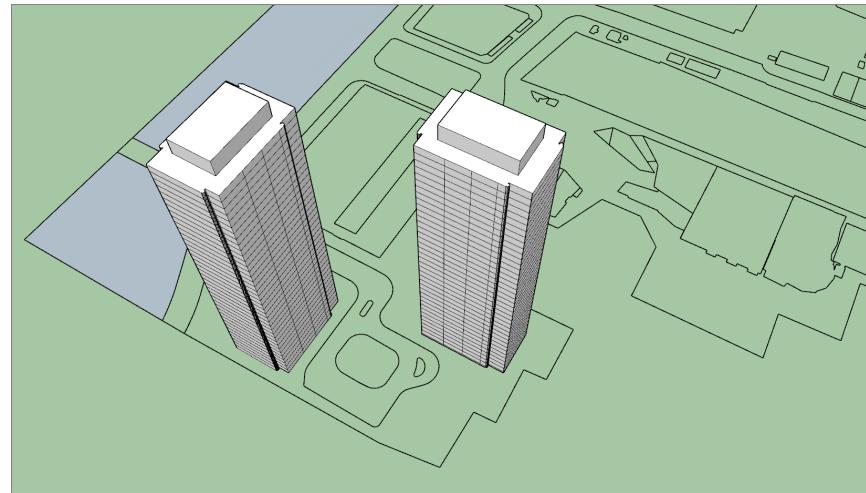
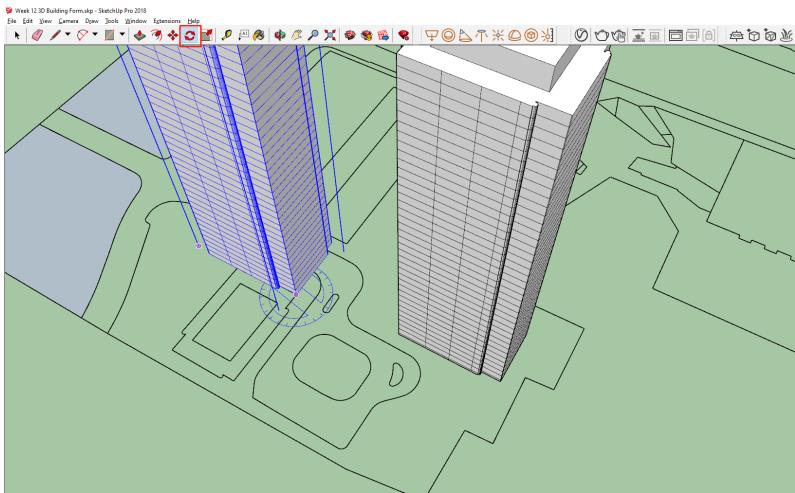




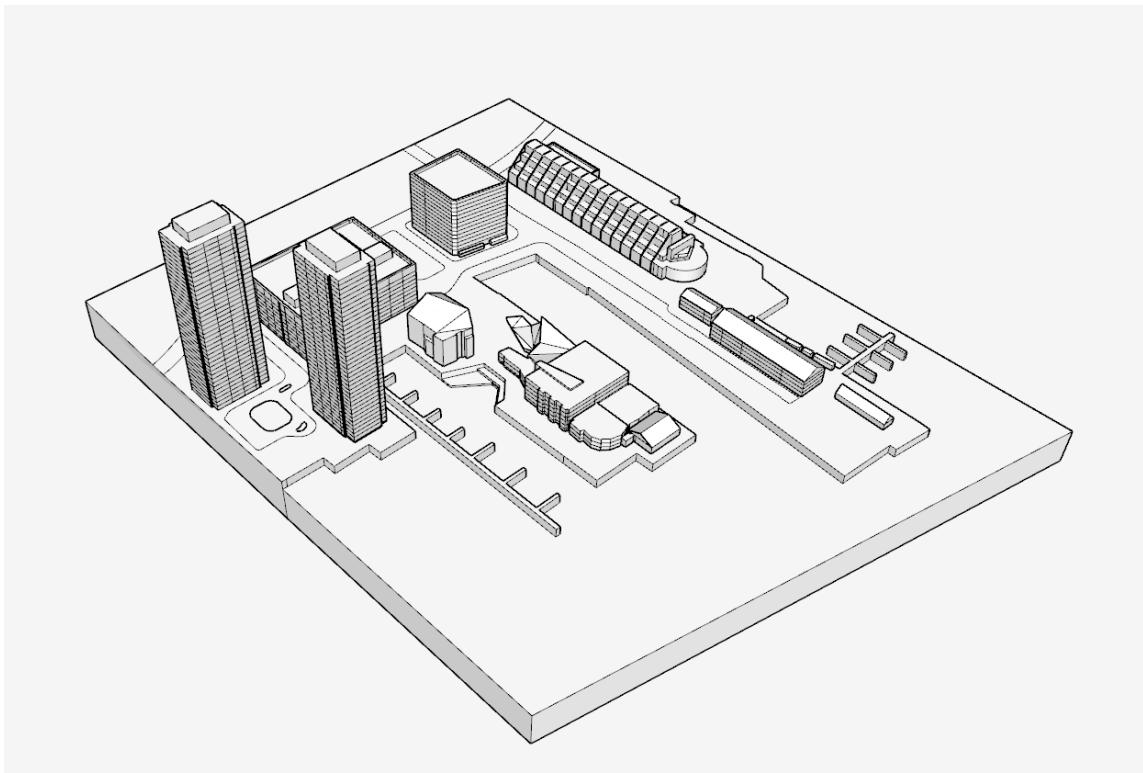
36 . Tripple click the volume to select it. Right click to select 'Make Component'.
Copy and paste the building to make an identical one.



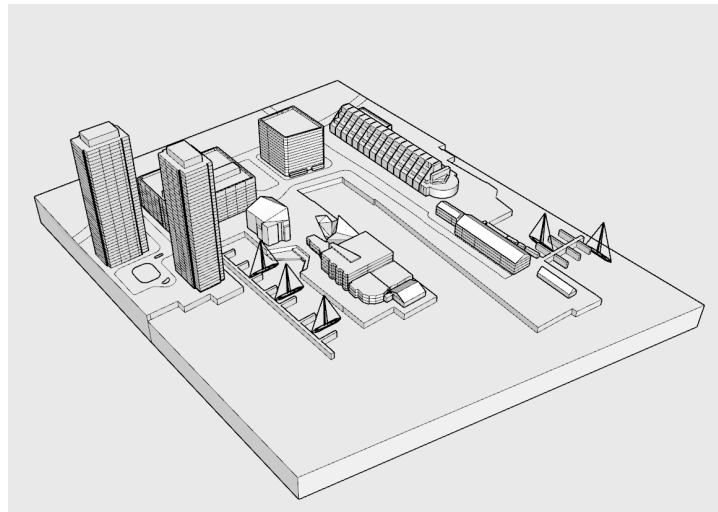
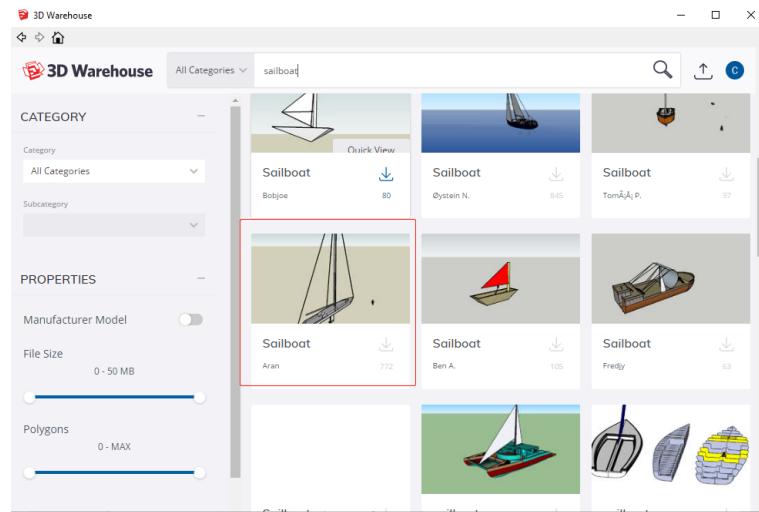
37. Use Move tool to move it the the right place. Then click on Rotate tool to rotate the building to the exact place.



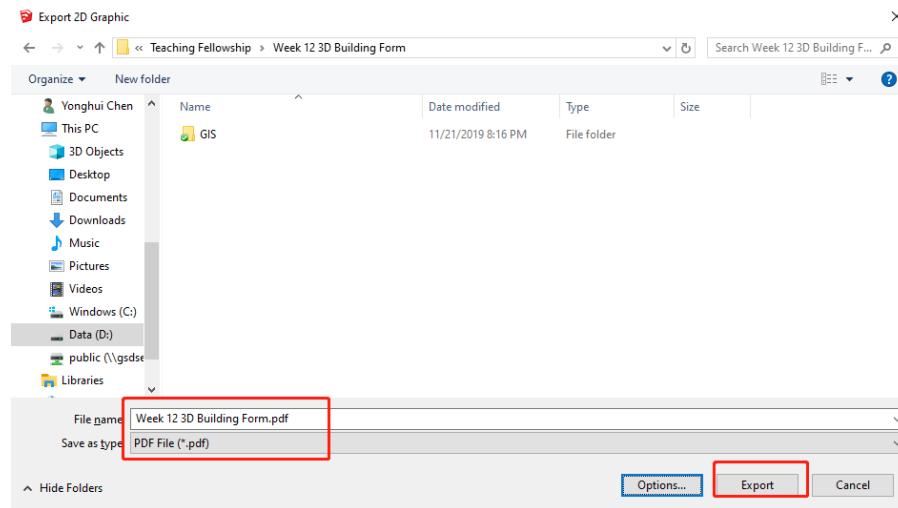
38. You may similary make more 3D volumes as below.



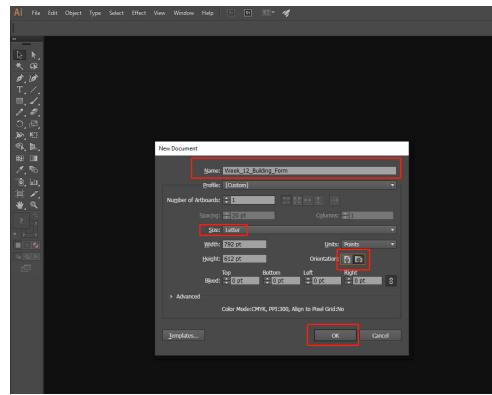
39. Navigate to Window -> 3D Warehouse. Search 'sailboat' and import the model you like. The final 3D model should look like right below.



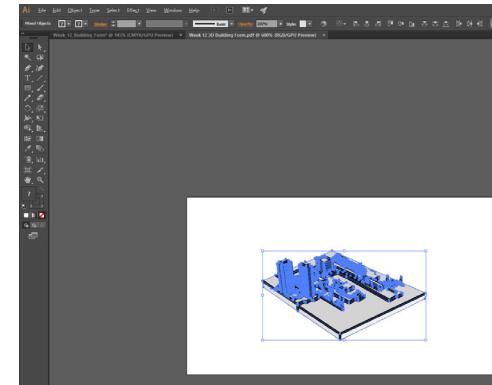
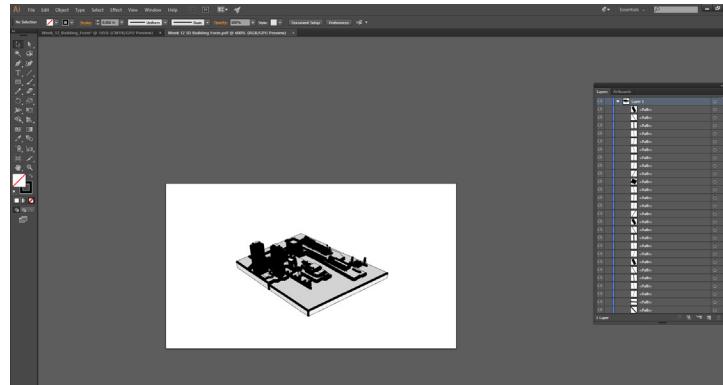
40. Navigate to File -> Export -> 2D Graphic. Find a location to export the model as a pdf file.



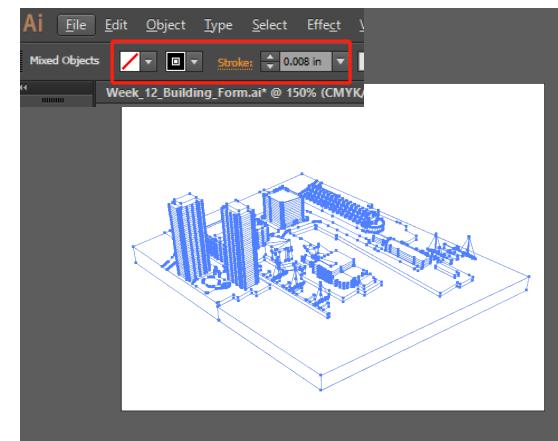
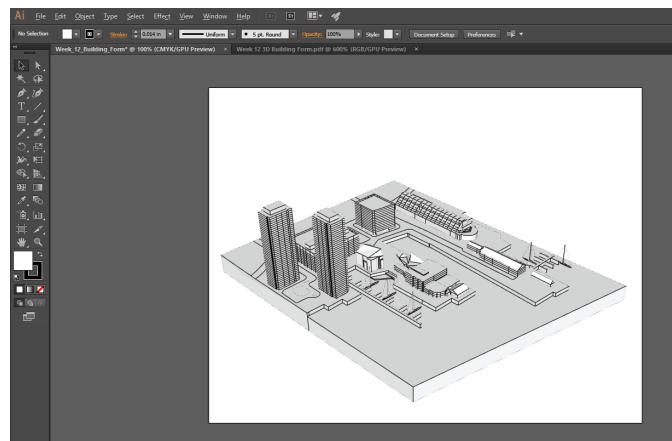
41. Open Illustrator and create a letter size landscape document named ‘Week_12_Building_Form’.



42. Navigate to File -> Open. Find the pdf file you have just created. Open it in Illustrator.
Select all the features and then press down ‘Ctrl + C’ to copy them.



43. Toggle to ‘Week_12_Building_Form’ tab. Then press down ‘Ctrl + P’ to paste the features. Scale it up or down to a proper size.
Select all the features and make the lines thinner and filled with no color.

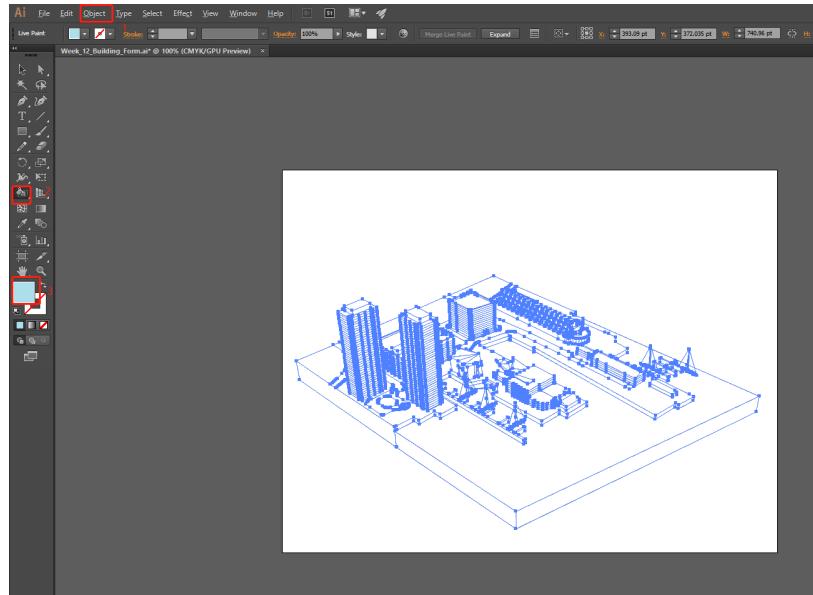


44. Select all the features.

Then navigate to Object -> Live Paint -> Make.

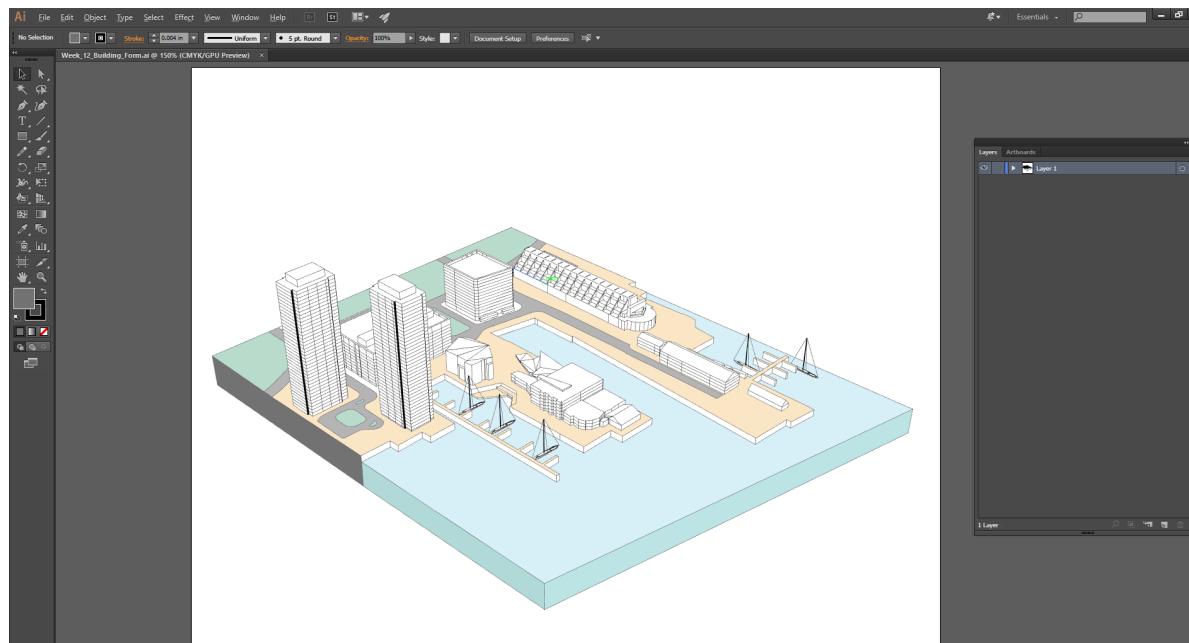
Click on 'Live Paint Bucket' tool (or you can press down 'K').

Choose a fill color.



45. Click on waters to fill with blue color.

Change other fill colors to fill the other shapes. The result should look like below. After you finish painting, navigate to Object -> Live Paint -> Expand.

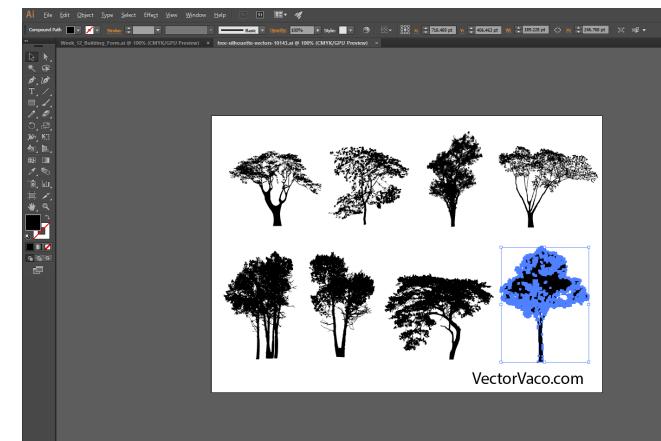
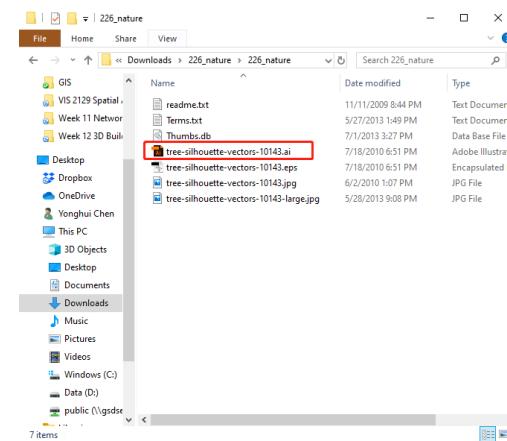
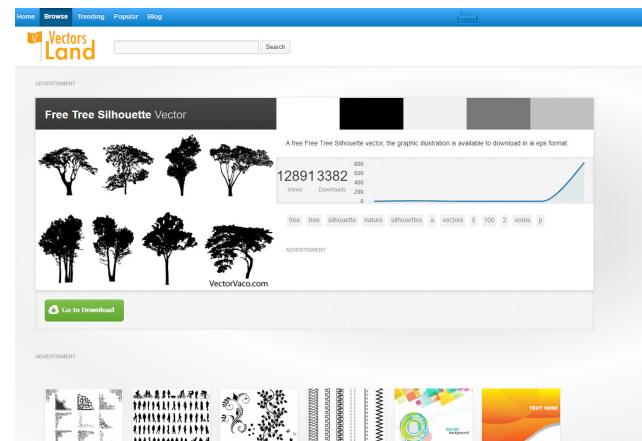


46. Go to the website: <http://www.vectorsland.com/>

Find some vector trees and download the file.

Unzip the file.

Double click the Illustrator file to open it.

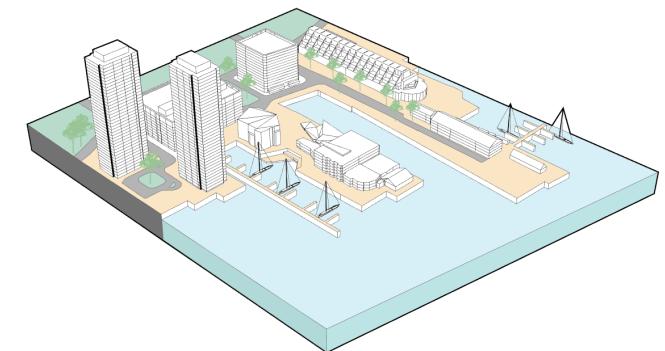
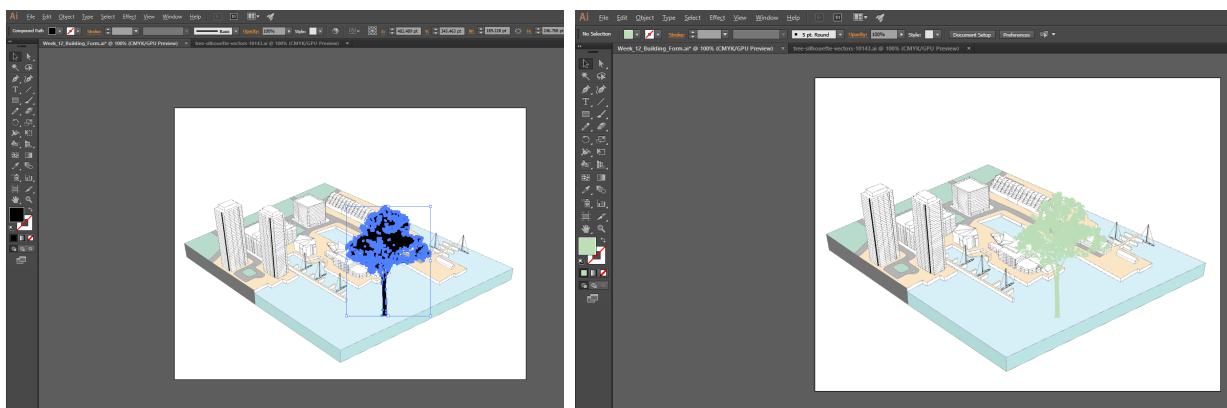


47. Copy and paste one of the trees to your artboard.

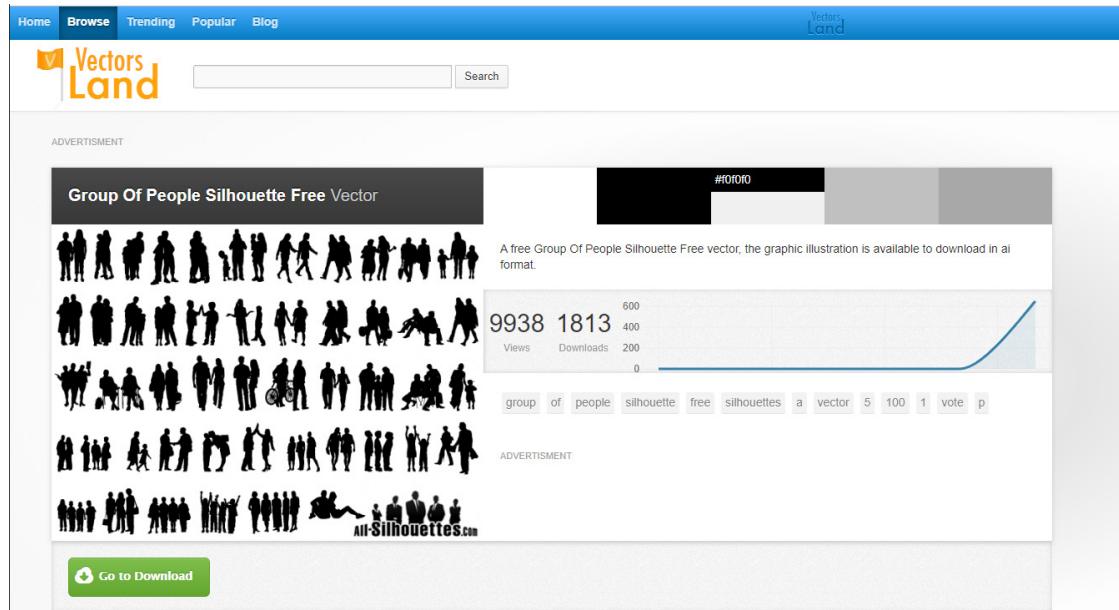
Change the tree color into light green.

Scale it up or down to the proper size.

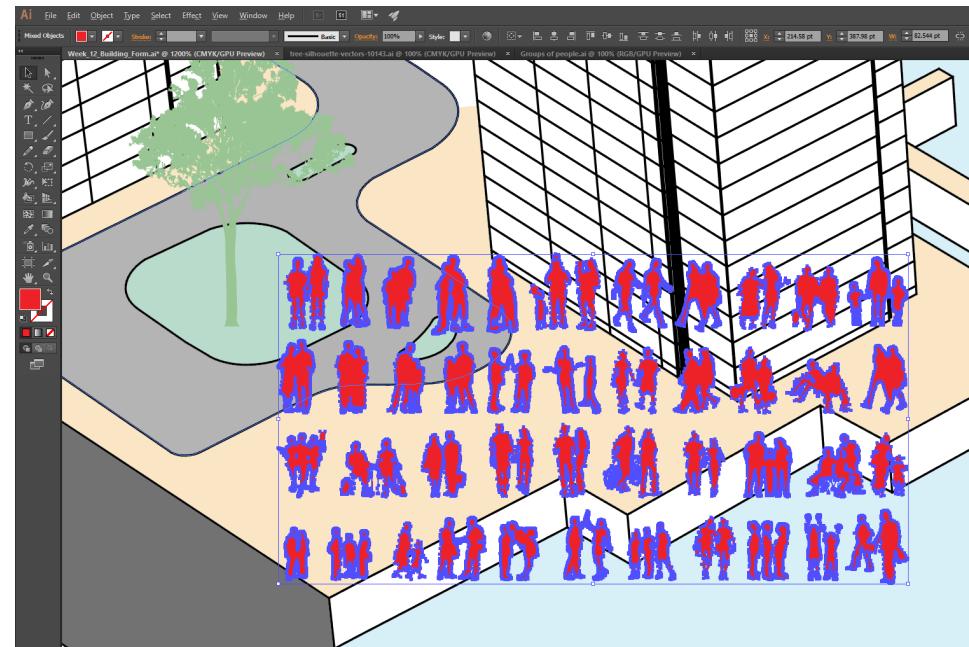
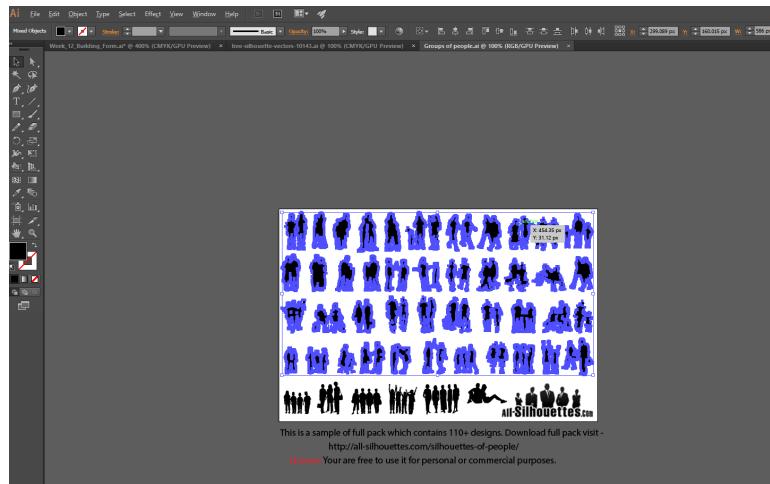
Copy and paste the trees across the site.



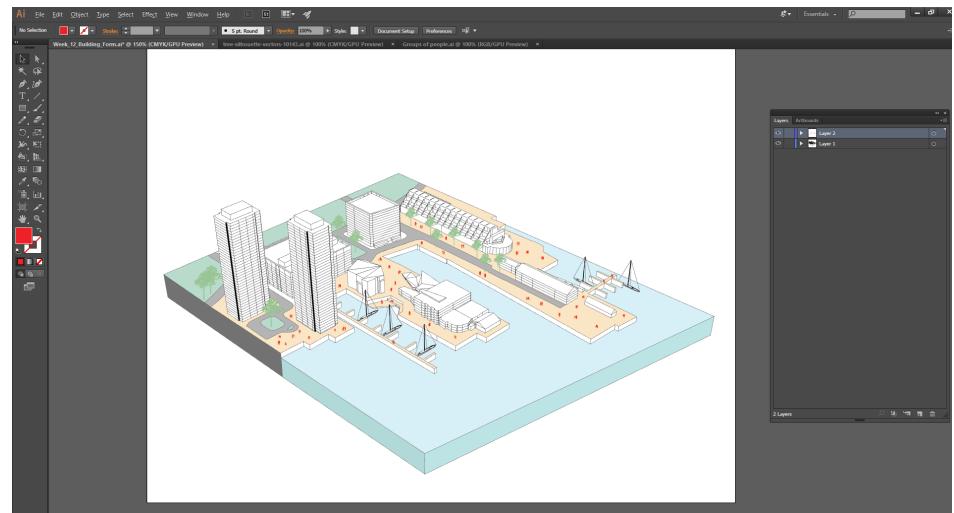
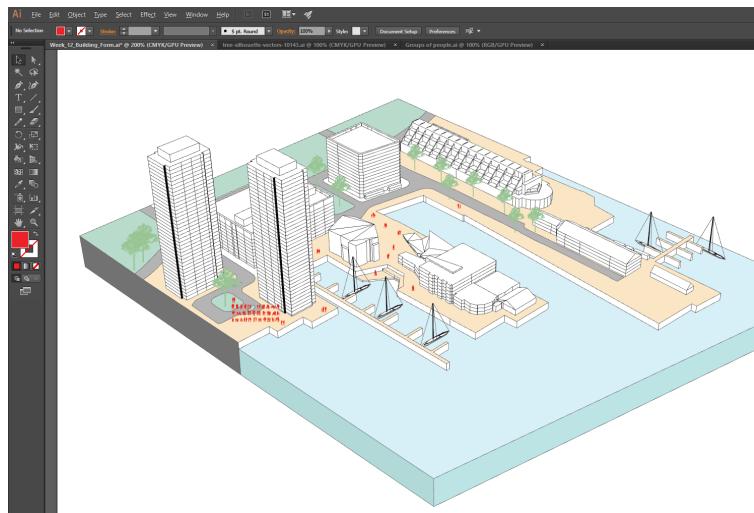
48. Similarly, download some vector peoples.



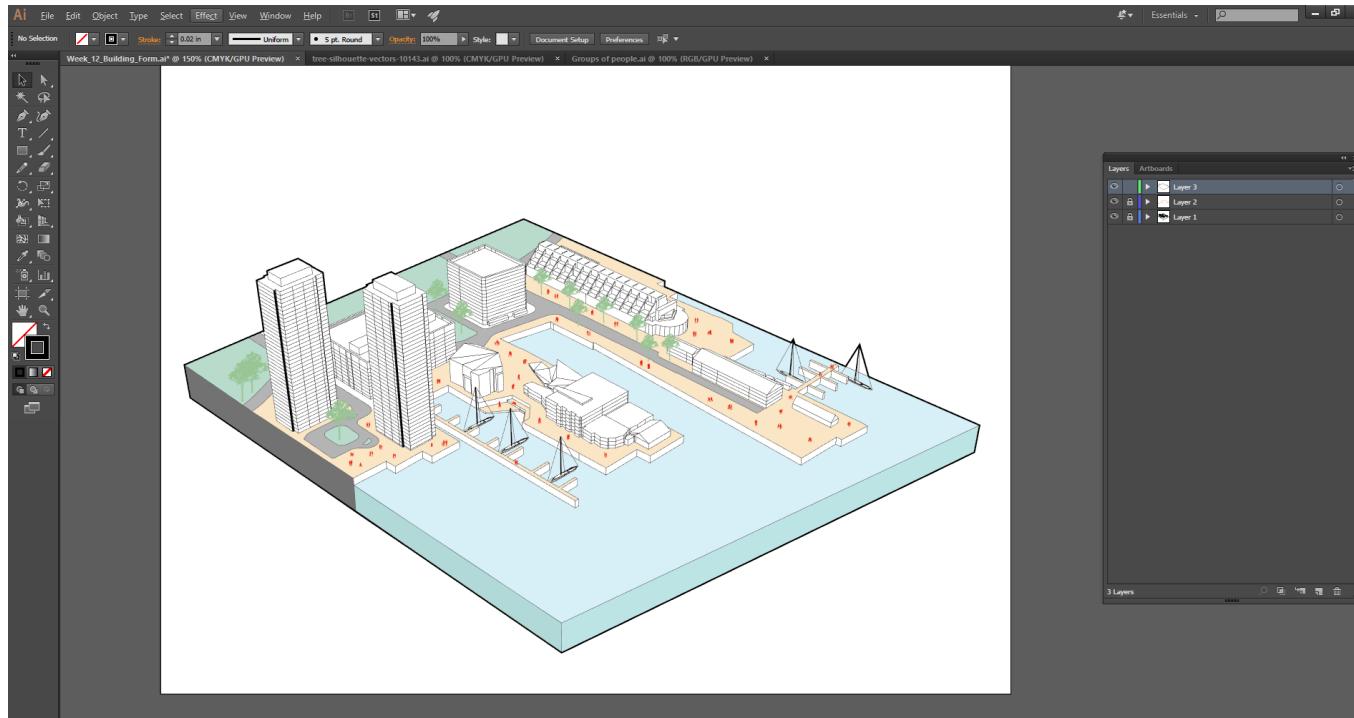
48. Copy and paste some people to your artboard. And scale it up or down to the proper size. Change the color into red.



49. Distribute the people along the continuous riverfront promenade.



50. Create a new layer and lock the other layers. Draw a thick black contour.



50. Add some keys to illustrate your map.

Finally export the map as a PDF file Submit to Canvas.

