

# PROJECT DOCUMENTATION

*A VR Simulation of a Multistory Building, Fire with Thunder, and rain Effect in a city near to the seashore.*

**Abstract:**

This project proposal aims to simulate a thunderstorm scenario in a multistory building located near the seashore for the course "Advanced Virtual Reality- CS6001." The primary objective is to create visually immersive thunderstorm effects. The scene will feature a multistory building constructed using grid nodes and enhanced with details such as trees, rocks, sand, roads, and lights to achieve a realistic environment.

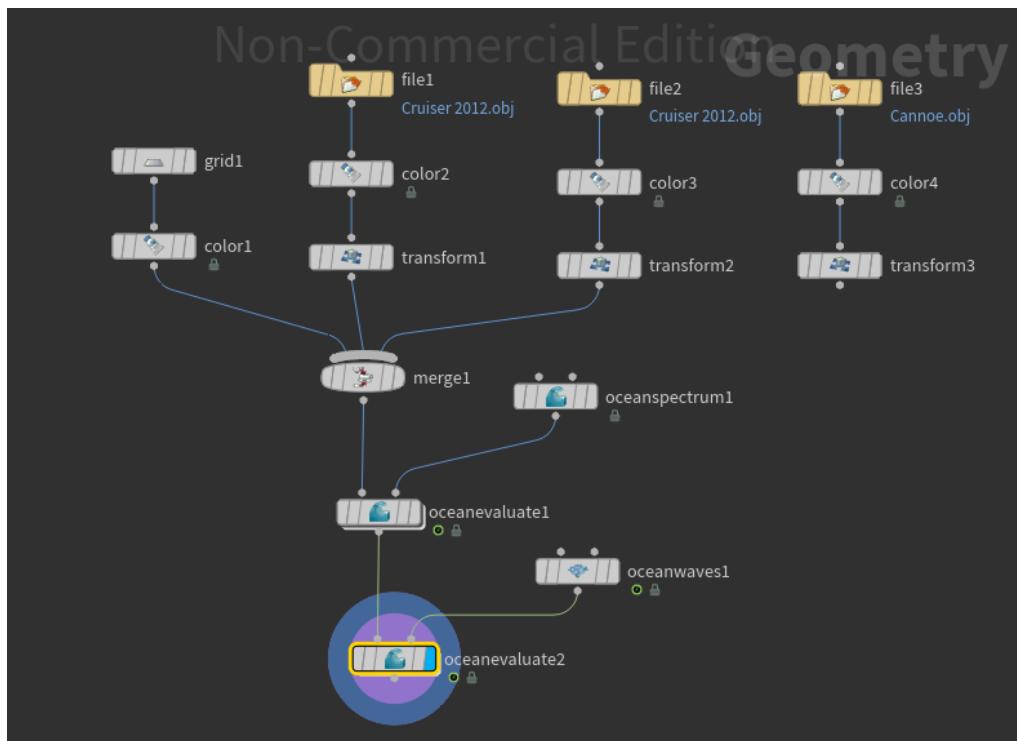
To depict the fire accident, various types of fire simulations available in Houdini will be explored, with spreading fire likely being the most suitable choice to illustrate the building engulfed in flames. The seashore will be represented using grid nodes as a base, complemented by ocean simulation nodes like oceanwaves, oceanspectrum, and oceanevaluation, with the addition of ships along the coastline.

Cloud formations and lightning effects will be simulated, with lightning triggered by collisions within the cloud formations, followed by rain generated using the popnet node. Animation will be applied to all elements to enhance realism and create compelling visuals within the Houdini platform.

**Details of the project Implementation:**

***Geomtry OCEAN***

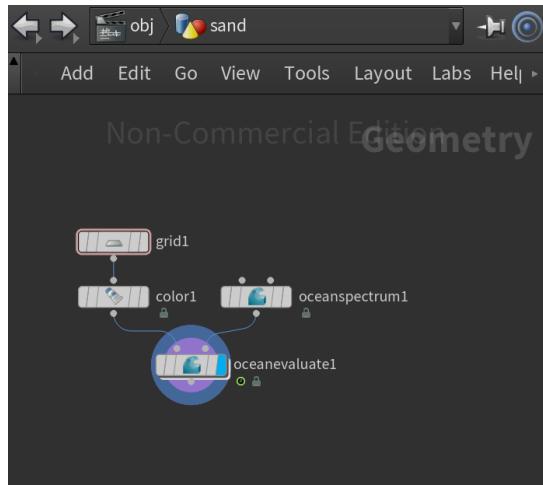
Initially we are going to see the creation of the ocean, land which consists of sand, and it has boats at the seashore and in the ocean. To implement this, we are going to start firstly by creating a geometry name it as ocean. Inside Ocean create a grid of size 40X40, add color node with blue color which represents the ocean view. Create a file node, in parameter pane geometryFile select the path of the object boat, add color to the boat and perform transform on the boat file object so that it gets positioned as desired. Similarly in the same way create two more boats using file node. Create a merge node now join the grid and boats to the merge. Now to create the ocean visuals create OCEANEVALUATE node and OCEANSPECTRUM node. In OCEANEVALUATE provide time as 7.125. In OCEANSPECTRUM change the parameters in the parameter pane as needed and how we want to produce the ocean waves and etc. Create OCEANWAVES check the "number of waves" parameter and change the parameter accordingly to form a wavy feature on the grid node crated. Nodes are supposed to be connected as shown in the Fig:1. Turn on the blue flag on the OCEANEVALUATE2 node.



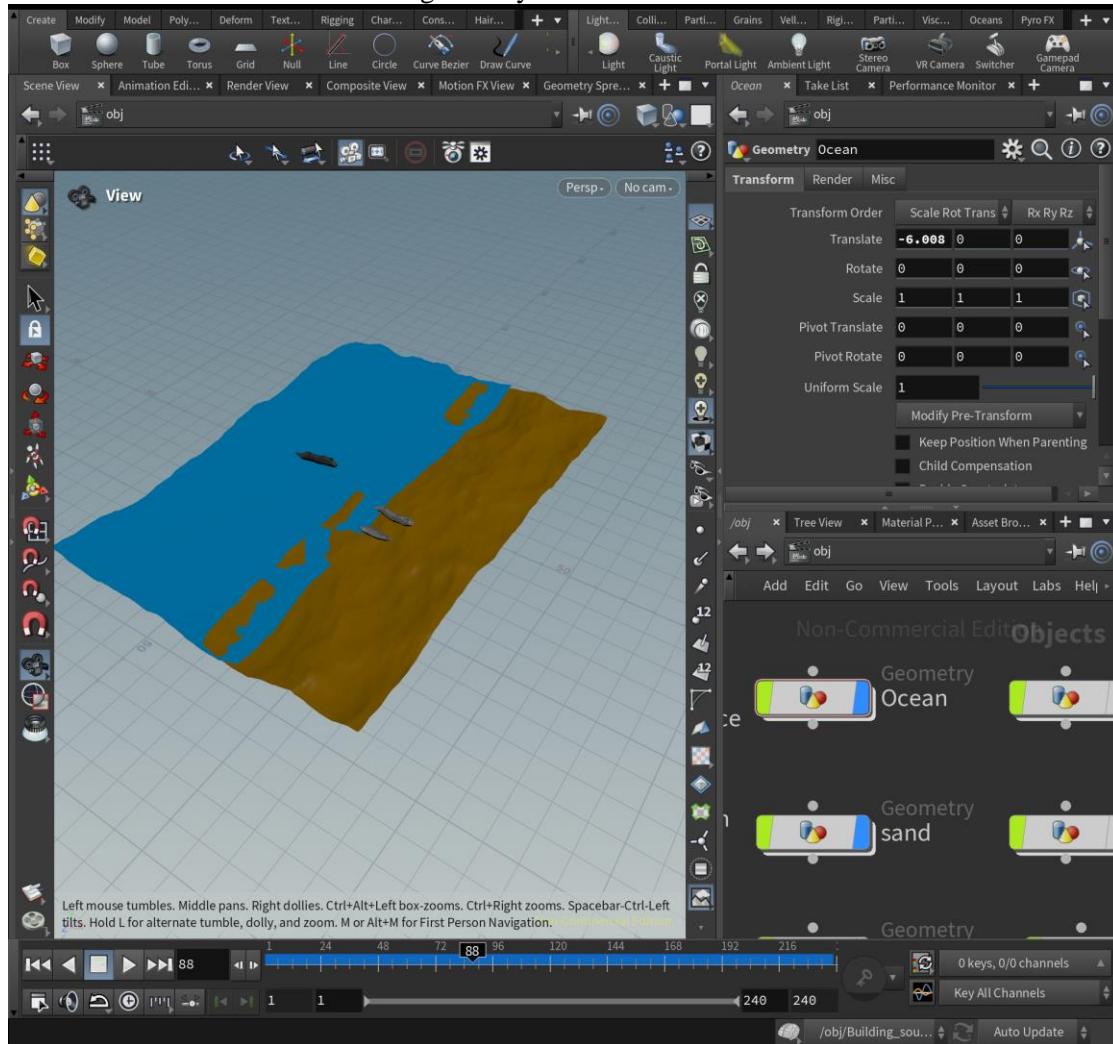
# PROJECT DOCUMENTATION

## **Geometry SAND**

Create a grid of size 30\*90 set the center as same center for ocean to meet the same level of land as ocean. Add color node. To create the flowing sand due to air add OceanSpectrum and ocean Evaluation node which create wavy nature to the sand. Connect all the nodes as shown In the below image. Turn on the blue flag of oceanevaluate node.



SceneView of the above discussed geometry:



# PROJECT DOCUMENTATION

## ***Geometry Road:***

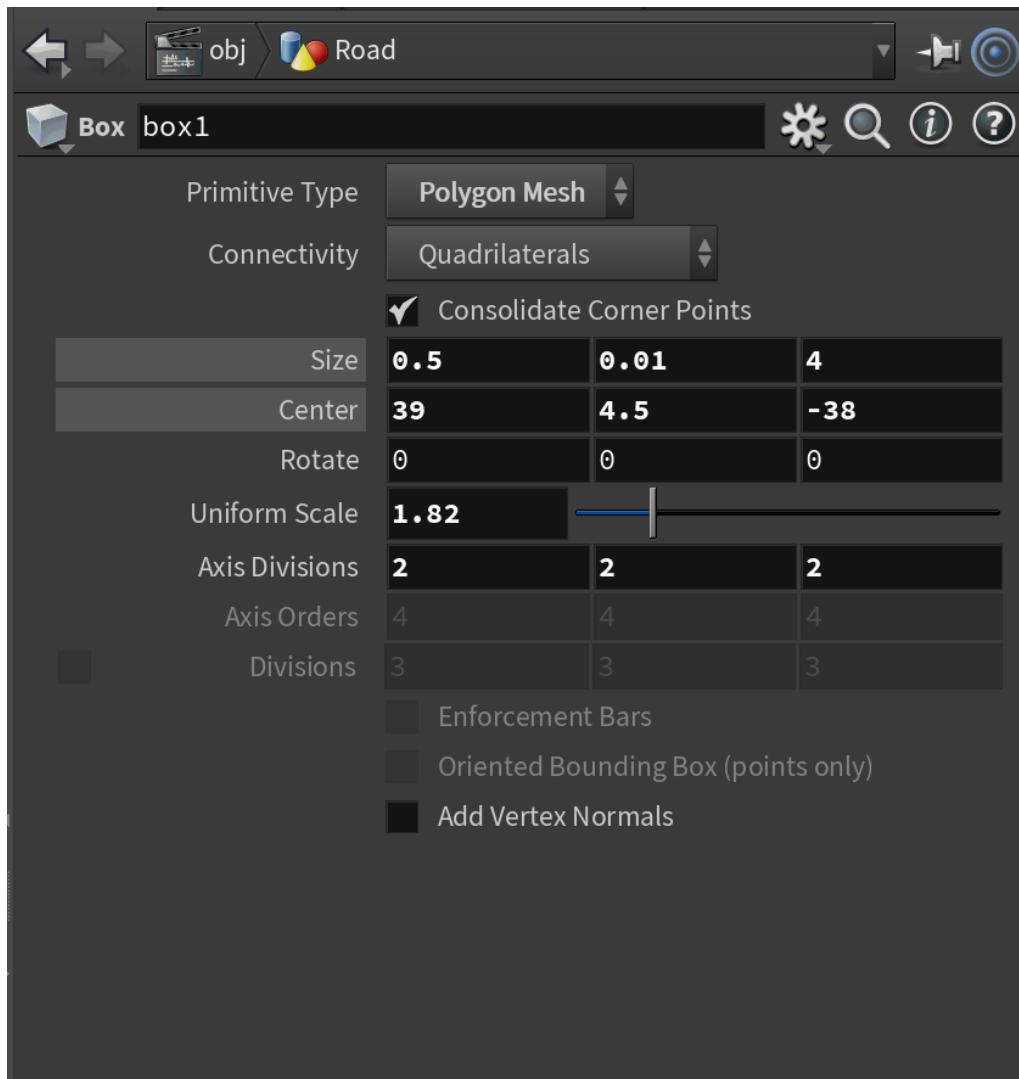
Now, in the next step here I'm going to create a road next to the land. The road geometry consists of a road, divider with yellow lines and the barricates of the road. To visualize this, first create a grid node of size 12\*90.

Center as(39,4.5,3). Rows & col =92,2). Add color node black color preferably. Now to create the divider create a box and position the center, accordingly, add color preferably yellow.

Create a copy and transform node and provide total number as 9. In translate parameter of Z-axis provide value as 10. For the sides of the road, to beautify the normal road.

Create a tube node provide the center approx. to (32, 6, -39) height =4.57, radius = 0.3. Rows and column (2\*100).

Create a copy and transform node provide total number as 11. Translate z-axis = 8.7.



# PROJECT DOCUMENTATION

The image shows a 3D modeling software interface with two tabs: "Tube" and "Sphere".

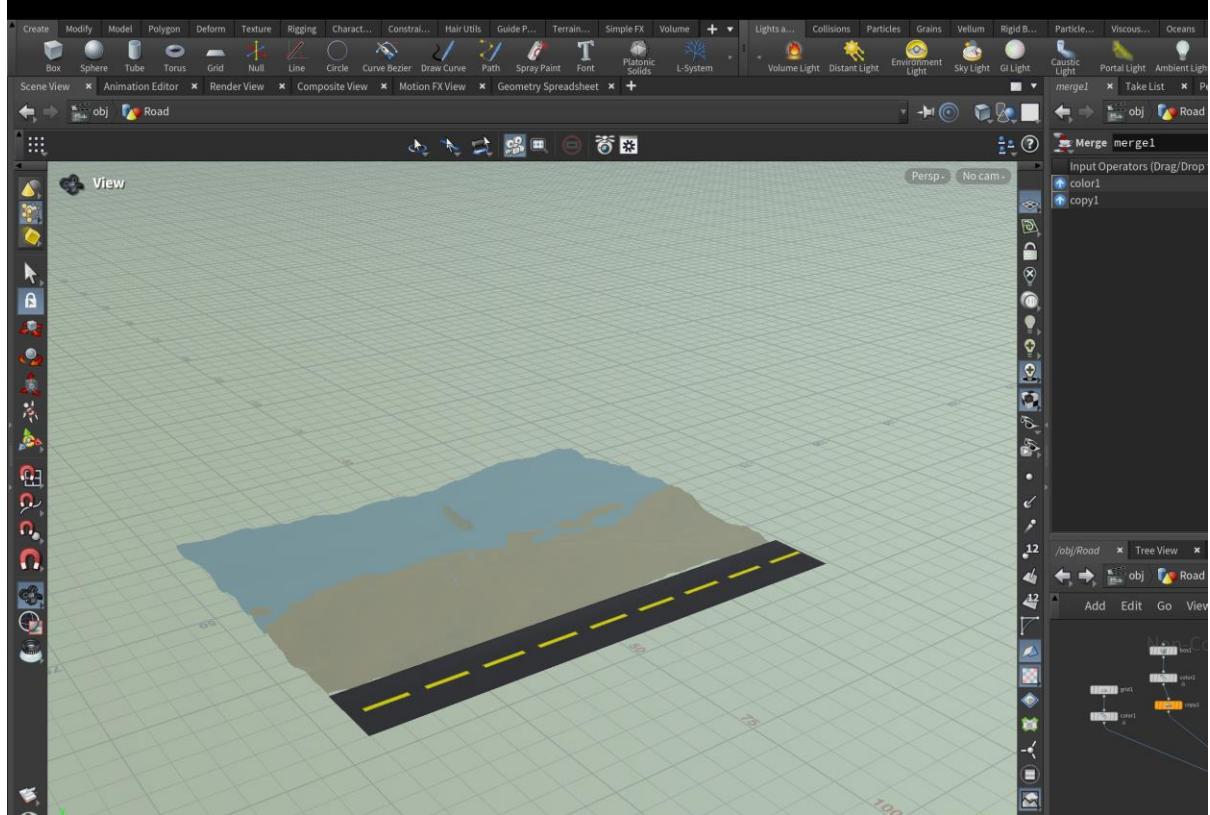
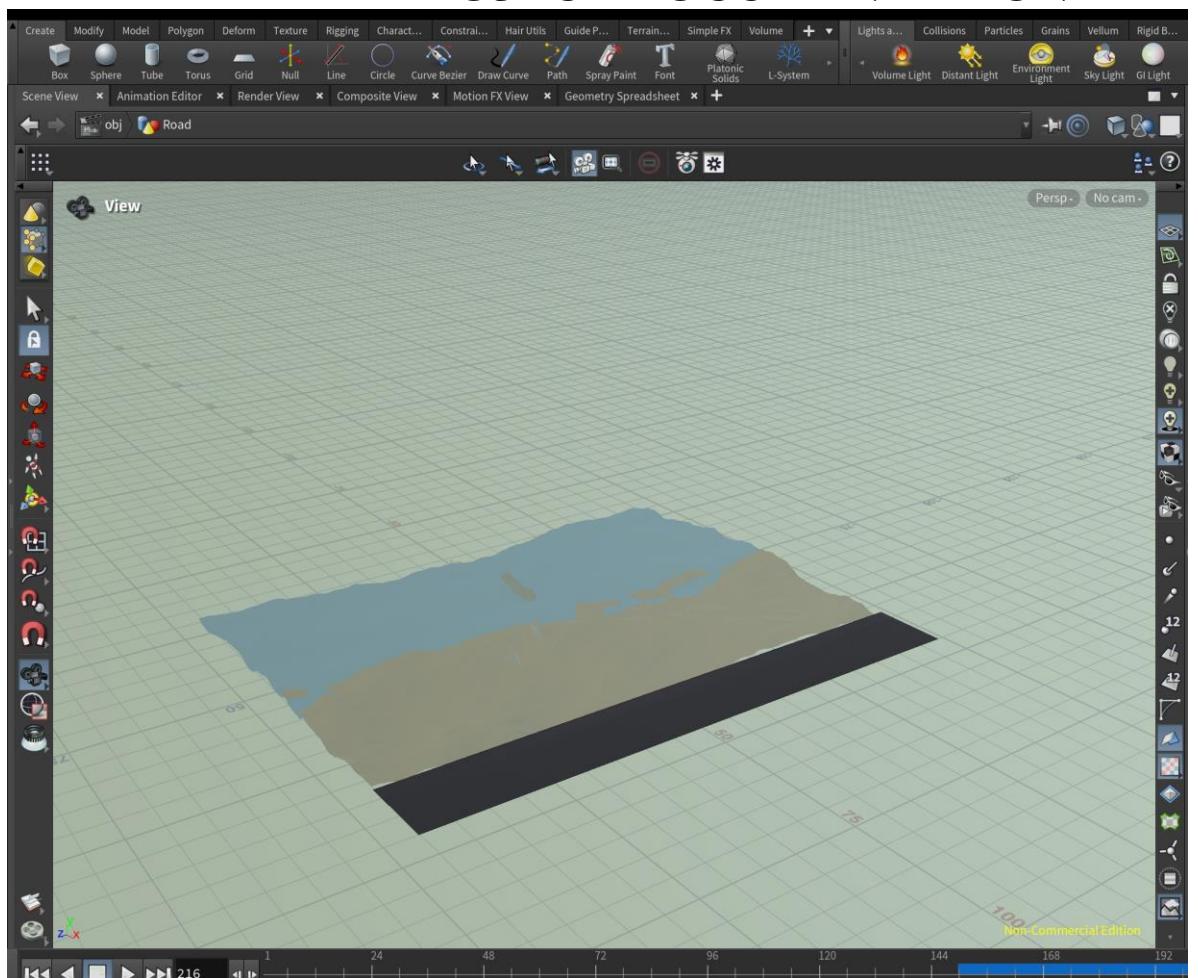
**Tube Properties:**

- Primitive Type: Polygon
- Connectivity: Quadrilaterals
- Orientation: YAxis
- End Caps:
- Consolidate Corner Points:
- Add Vertex Normals:
- Center: 32.9, 6.2, -39
- Rotate: 0, 0, 0
- Radius: 0.3, 0.3
- Radius Scale: 1
- Height: 4.57
- Rows: 2
- Columns: 100
- U Order: 4
- V Order: 2
- Imperfect

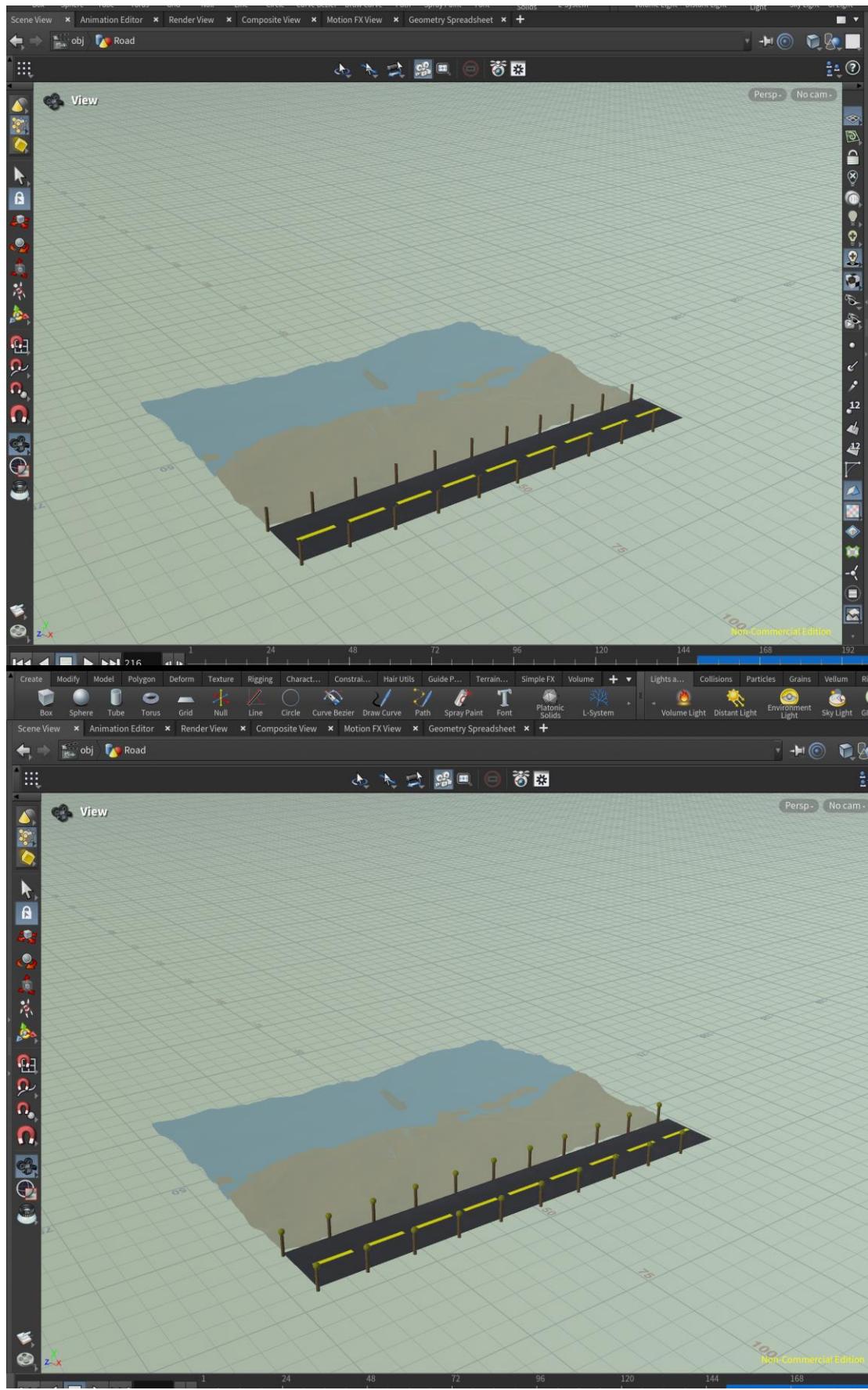
**Sphere Properties:**

- Primitive Type: Polygon Mesh
- Connectivity: Quadrilaterals
- Radius: 0.5, 0.5, 0.5
- Center: 32.9, 8.5, -39
- Rotate: 0, 0, 0
- Uniform Scale: 1.11
- Orientation: YAxis
- Frequency: 2
- Rows: 100
- Columns: 100
- U Order: 4
- V Order: 4
- Imperfect
- Unique Points per Pole
- Accurate Bounds
- Triangular Poles

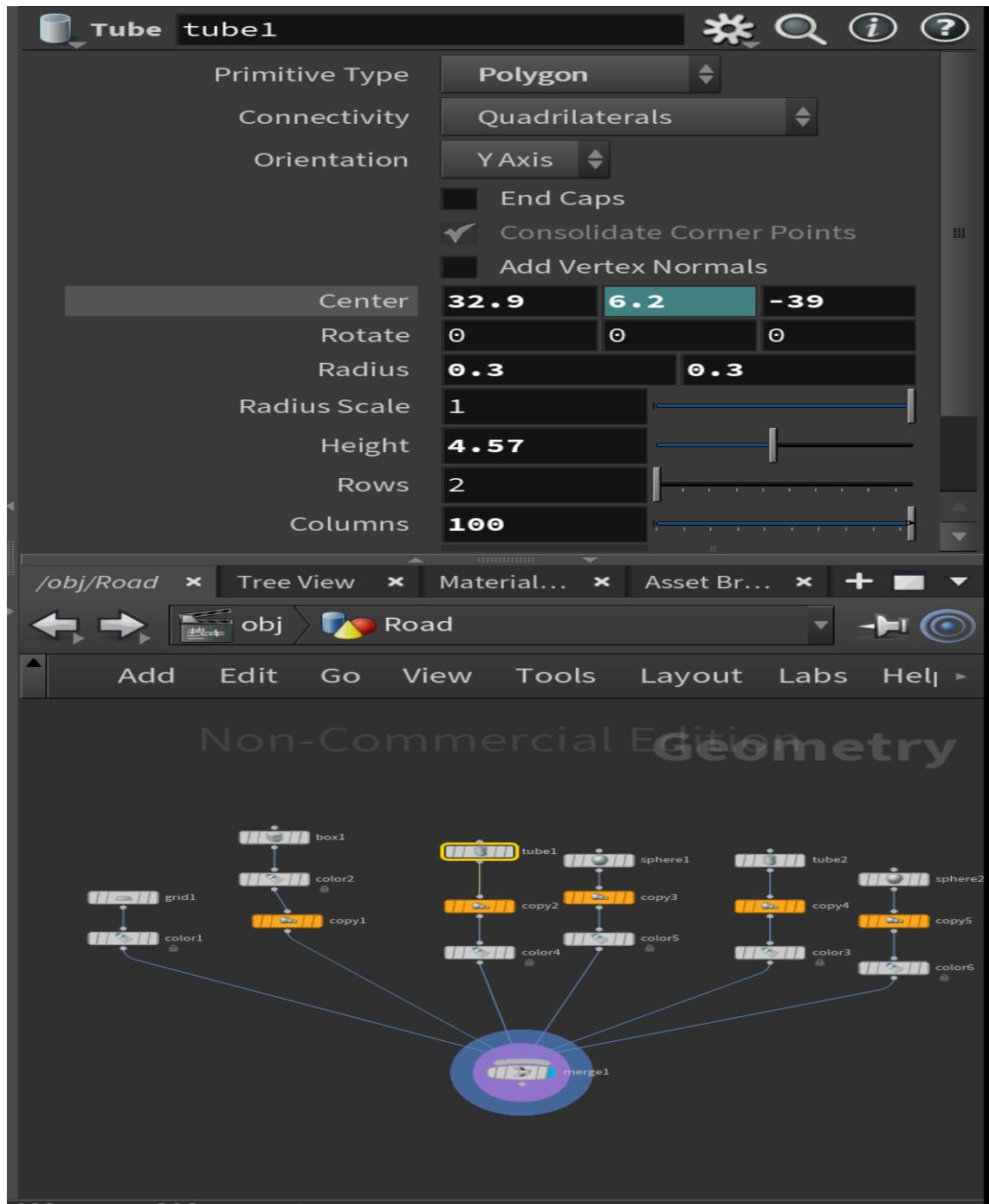
# PROJECT DOCUMENTATION



# PROJECT DOCUMENTATION

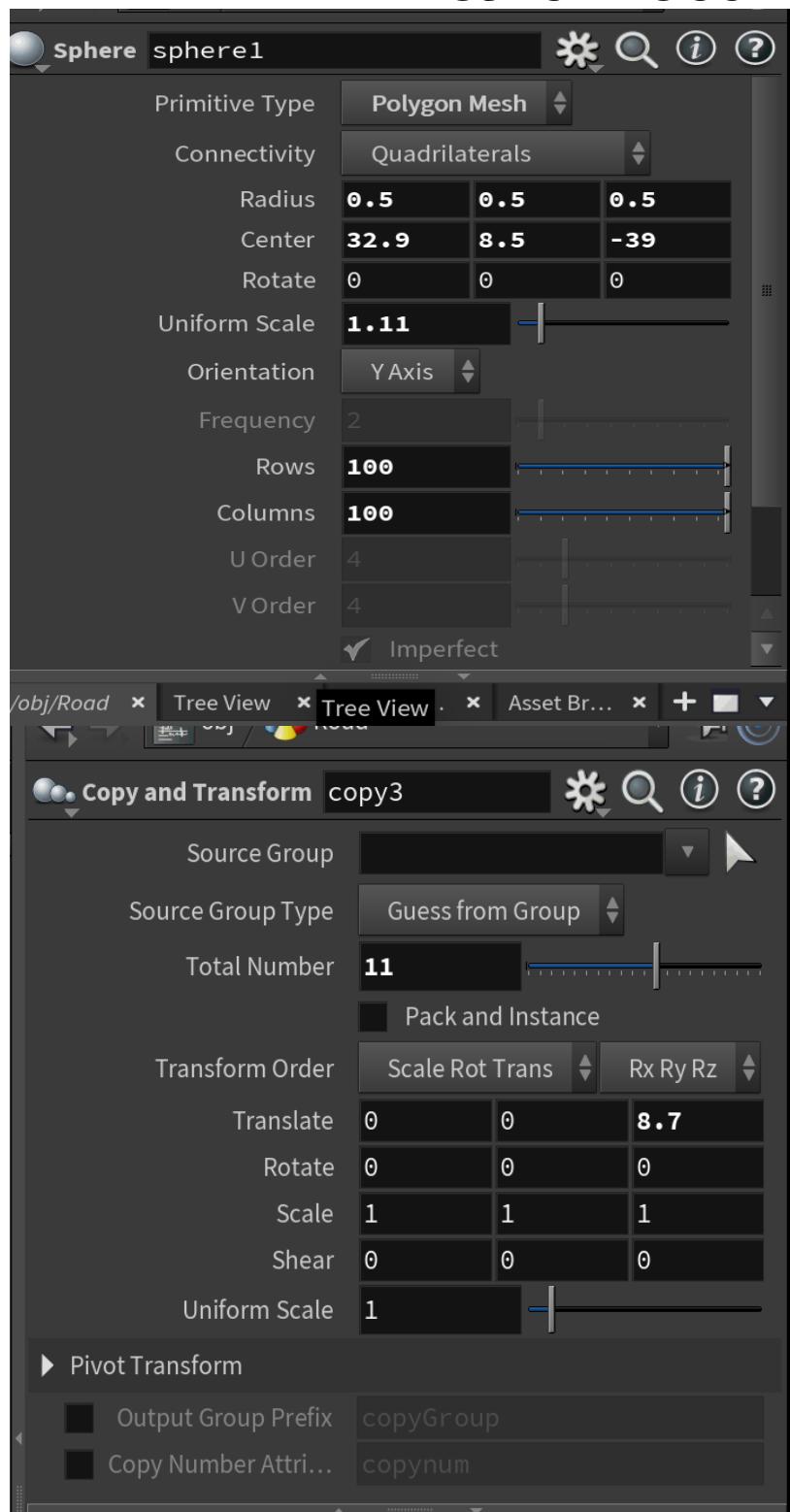


# PROJECT DOCUMENTATION

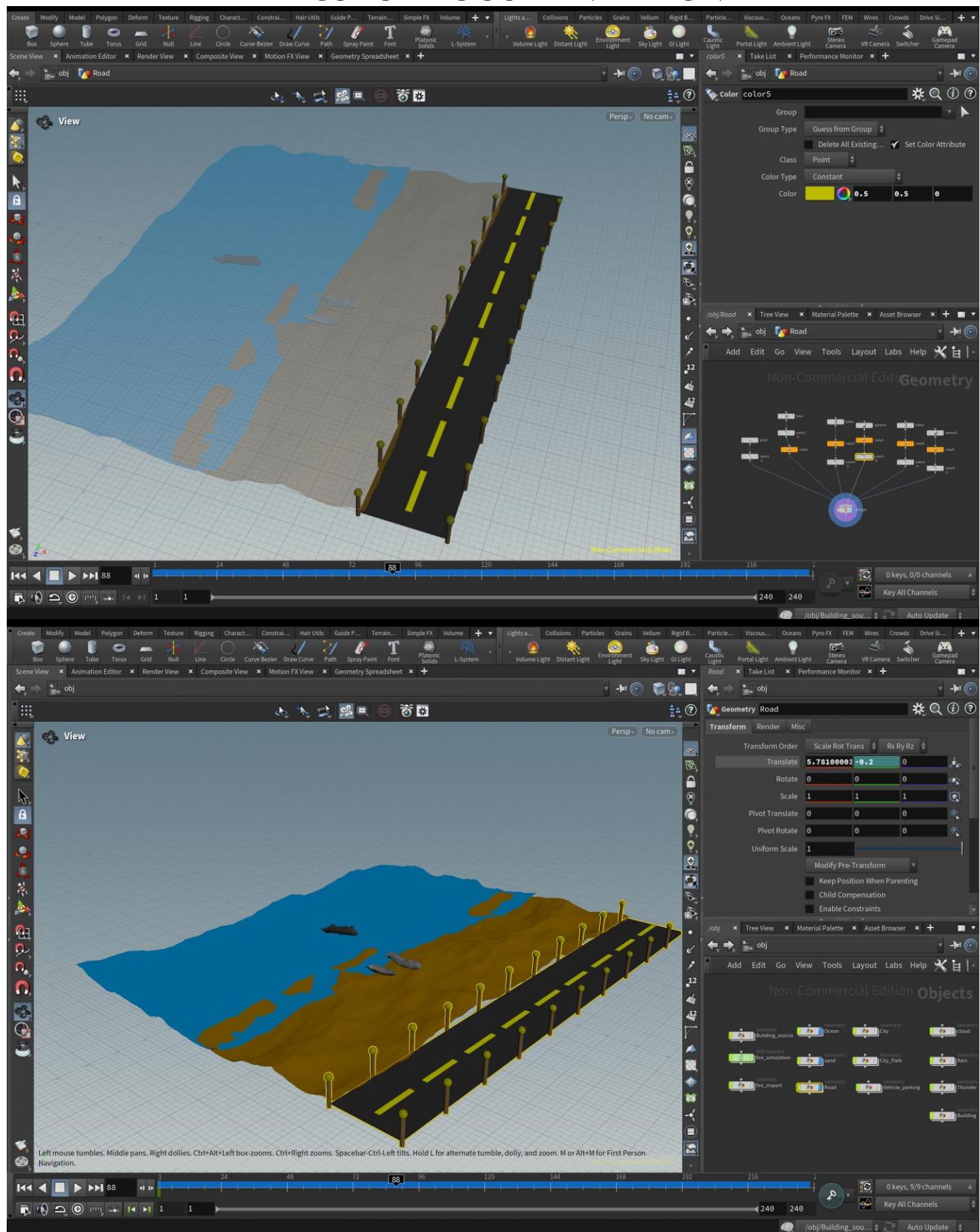


Create a sphere and position it as head of the tube created in previous step. Perform copy and transform for the sphere node as well. Add color to tube and sphere and connect them using merge node as shown in the below network pane structure. Now perform the same action and create the other side of the road. And adjust the center accordingly.

# PROJECT DOCUMENTATION



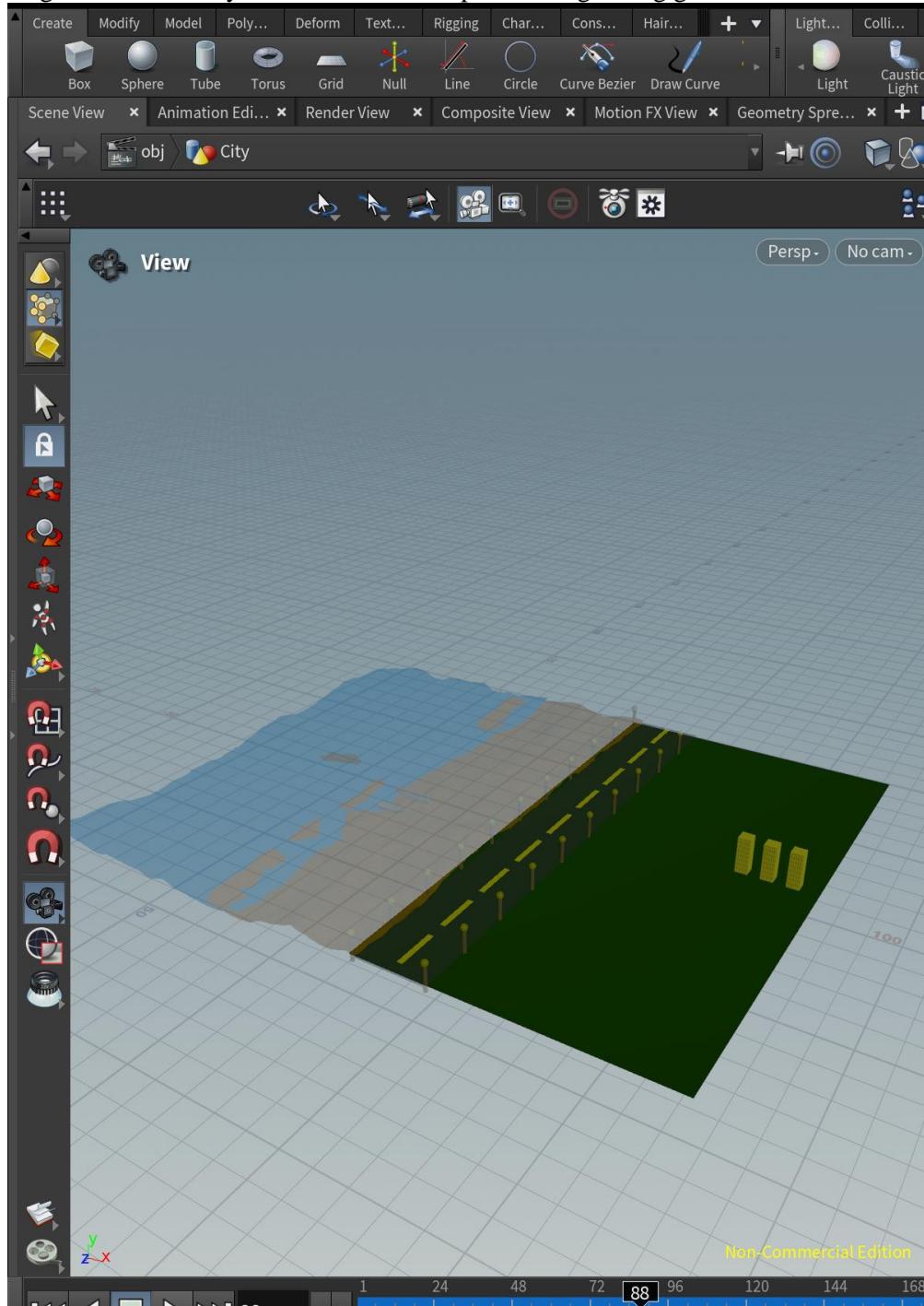
# PROJECT DOCUMENTATION



# PROJECT DOCUMENTATION

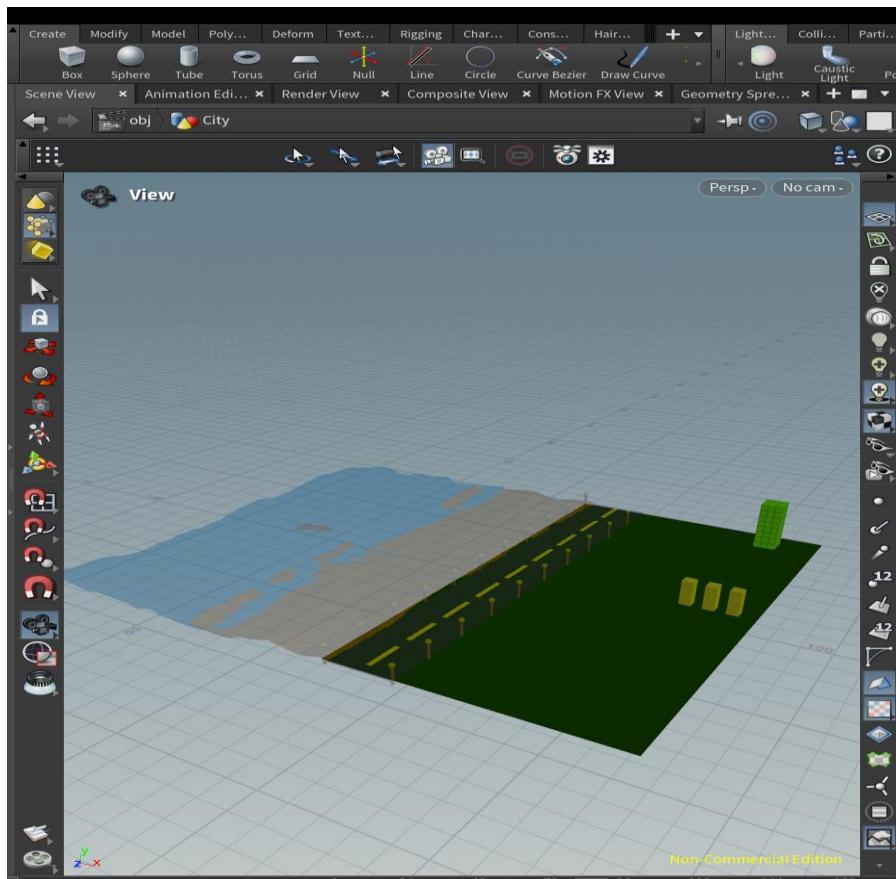
## Geometry CITY:

Create a geometry name it as CITY, inside this geometry create a base grid which acts as land/floor. On this grid create new grid with center as (75,5,0). Size =(2,2). Rows and columns =(4,7). Create a polyextrude node, distance parameter as 6. Create a copy and Transform node. Provide total number as 3 and in translate x-axis.= 4. Which create 3 buildings of height 6. Similar way I have created multiple buildings using grid node.

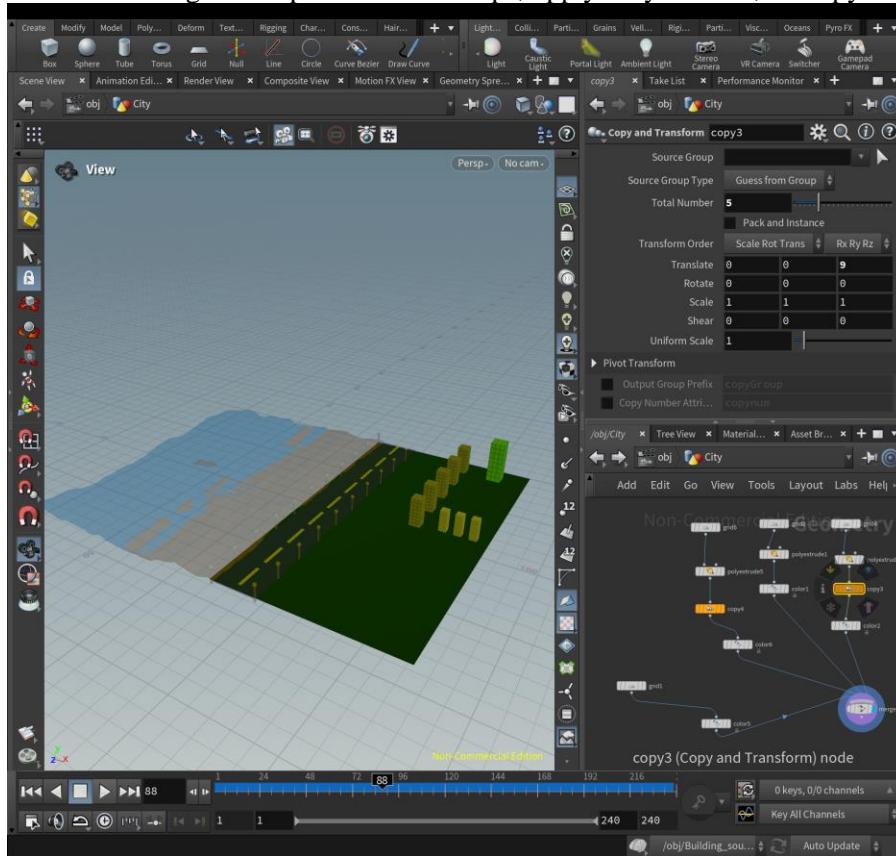


Create one more building using same steps as above.

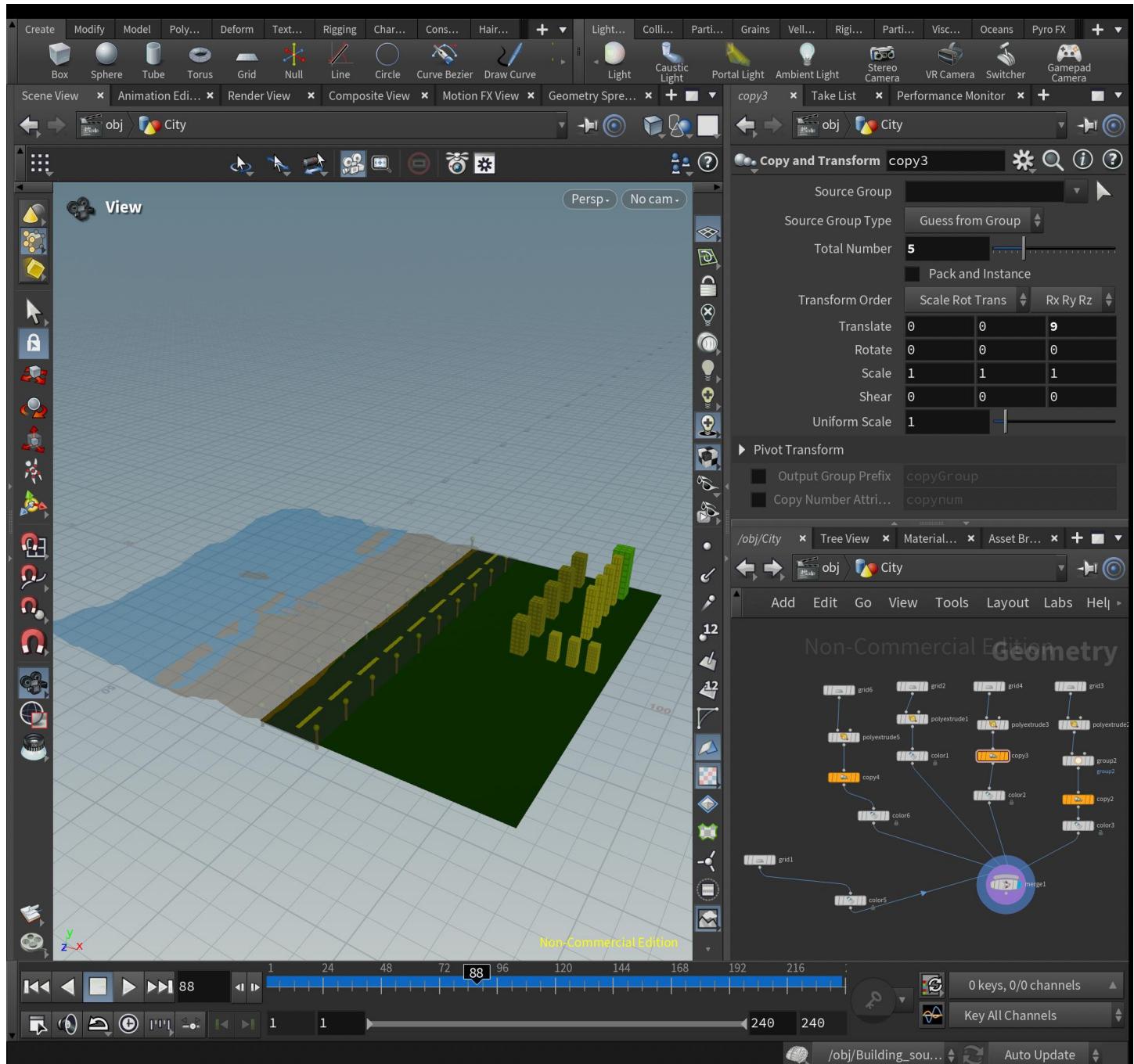
# PROJECT DOCUMENTATION



Create another grid and perform same steps, apply Polyextrude , do copy and transform and add color to it.

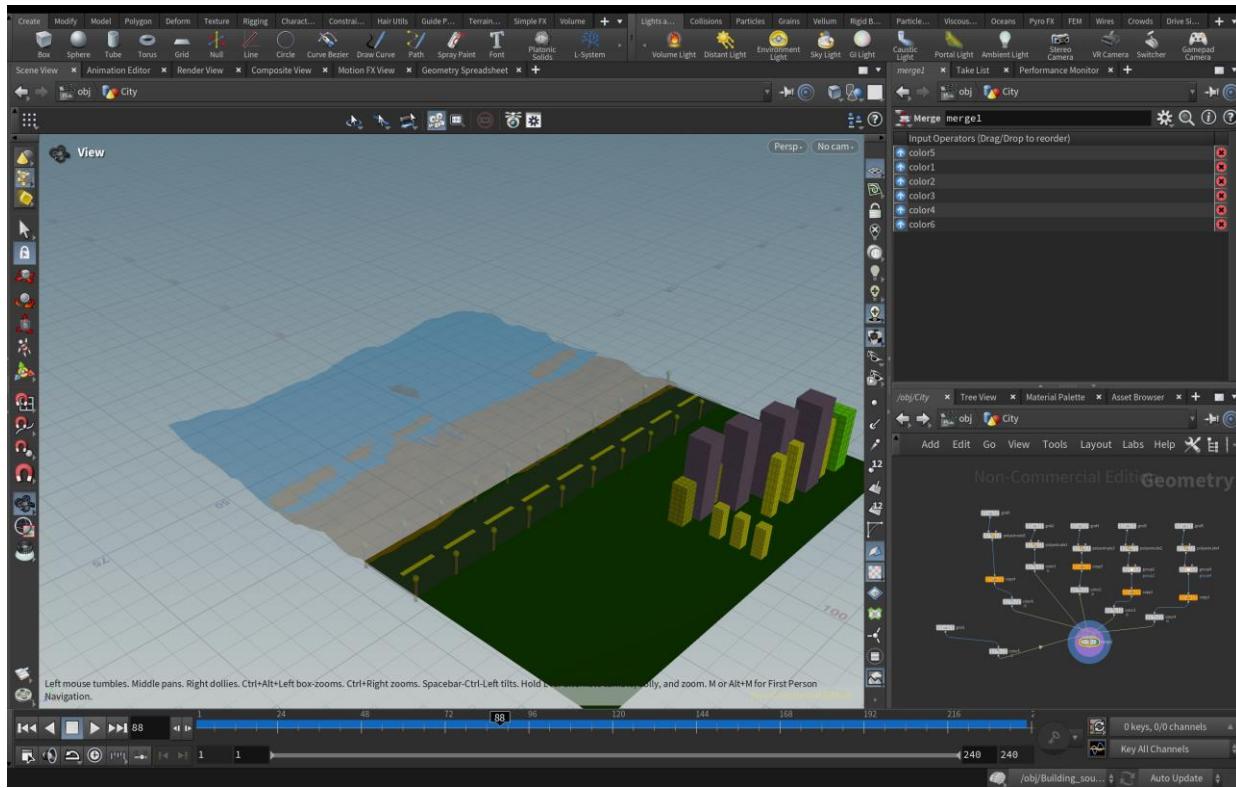


# PROJECT DOCUMENTATION



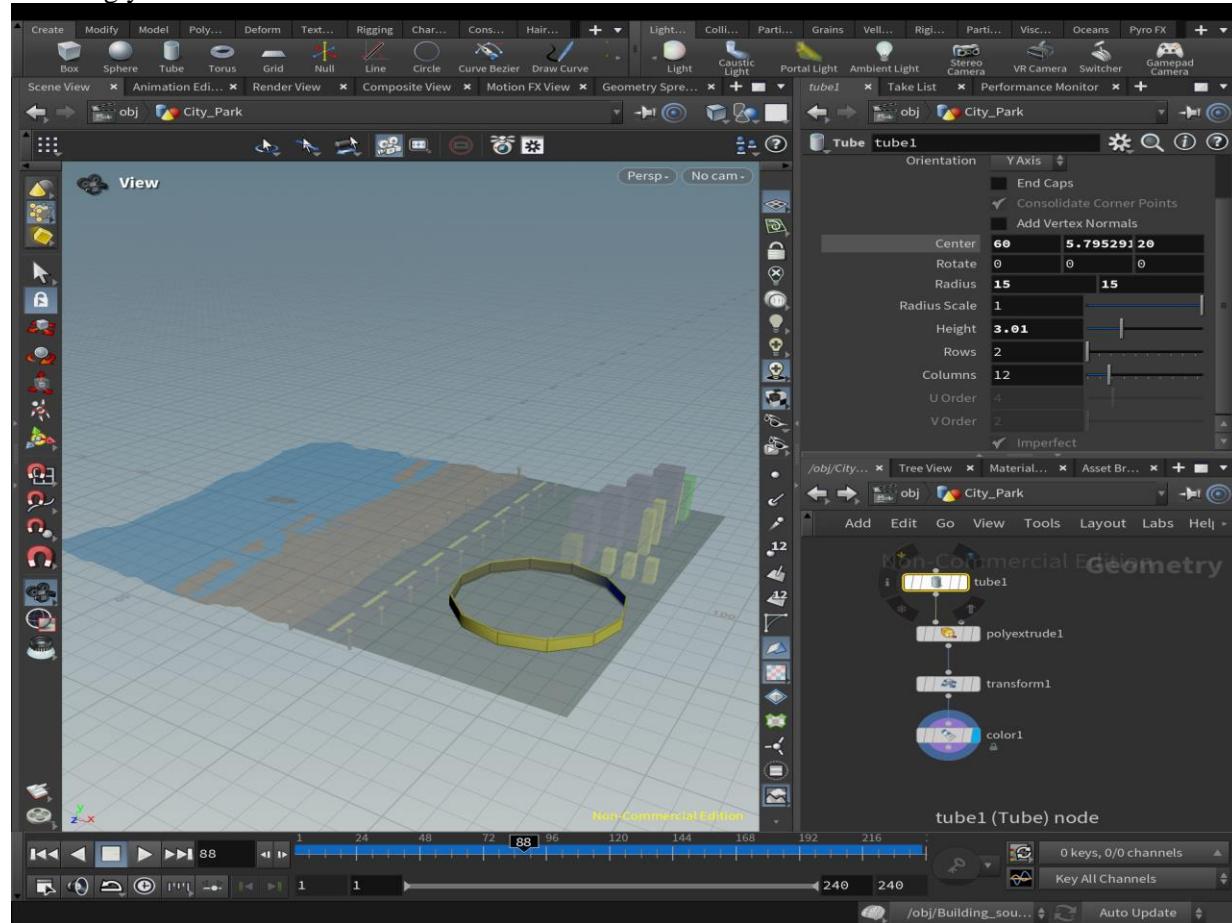
And 3 more building in the same way and finally join all the grids created to a merge node and turn on the blue flag of Merge node so that whole of the scene is visible.

# PROJECT DOCUMENTATION



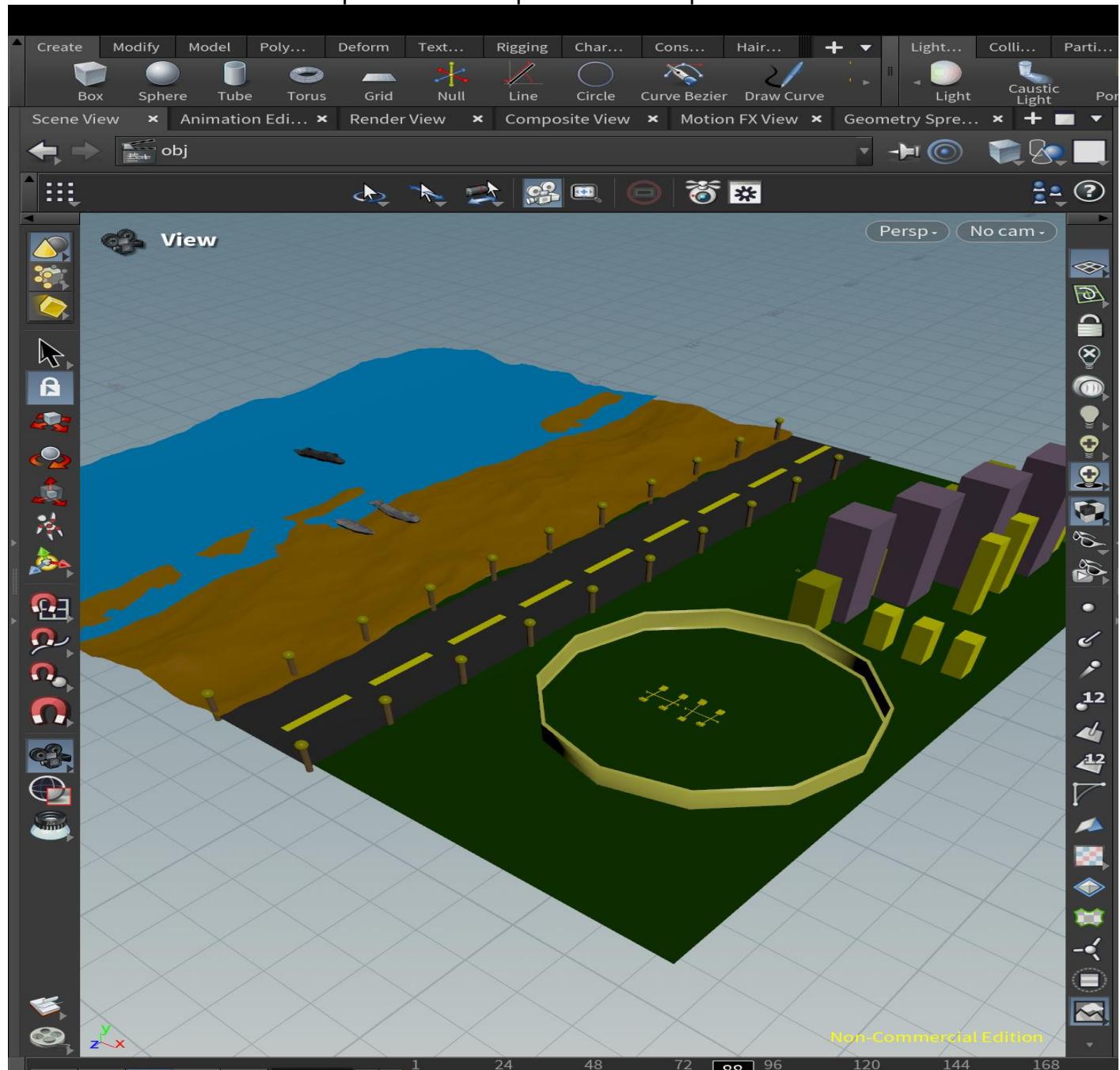
## ***Geometry CITYPARK:***

Create a geometry and name it as city\_Park. Firstly create a tube node. Set height to 3.01, radius as 915,15) and cenetr accordingly.



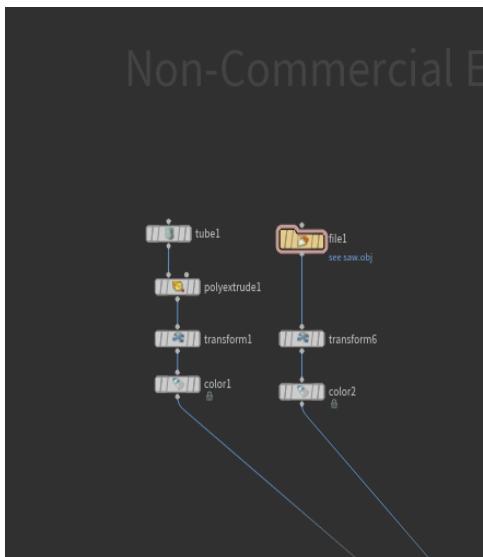
# PROJECT DOCUMENTATION

Now create a file node and import a see-saw picture into the park.

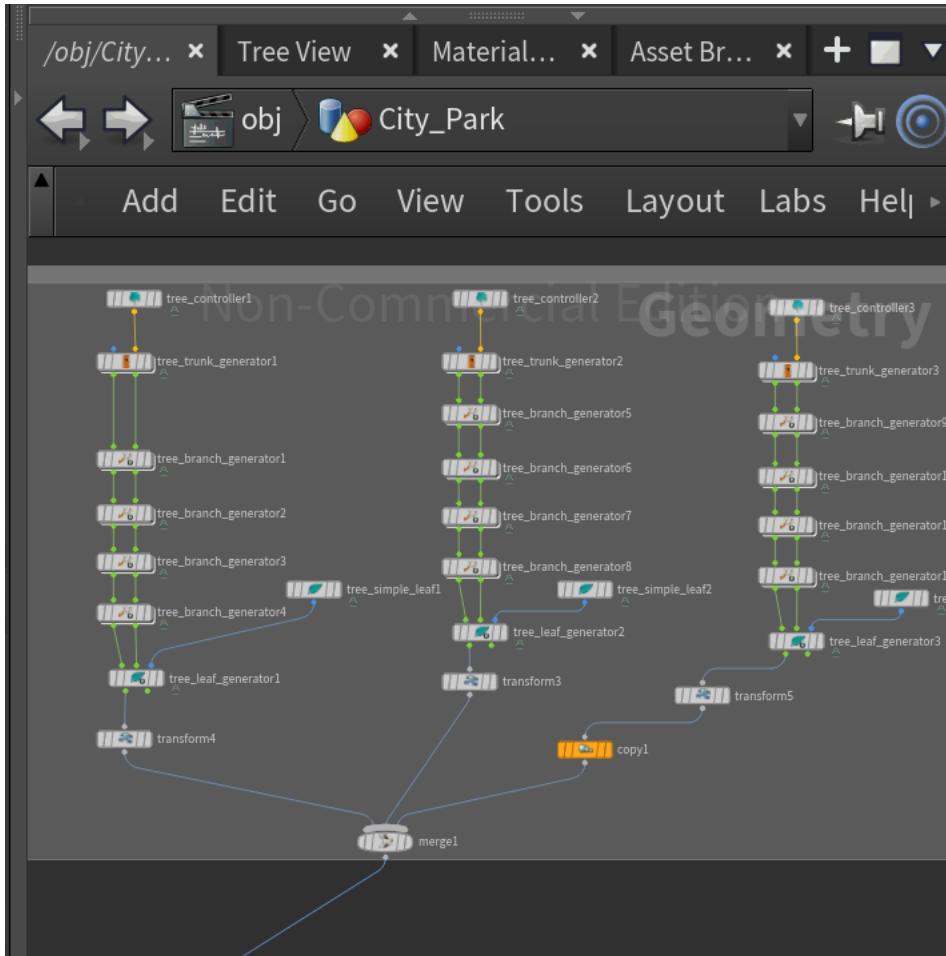


Now lets create trees, inside and around the park.

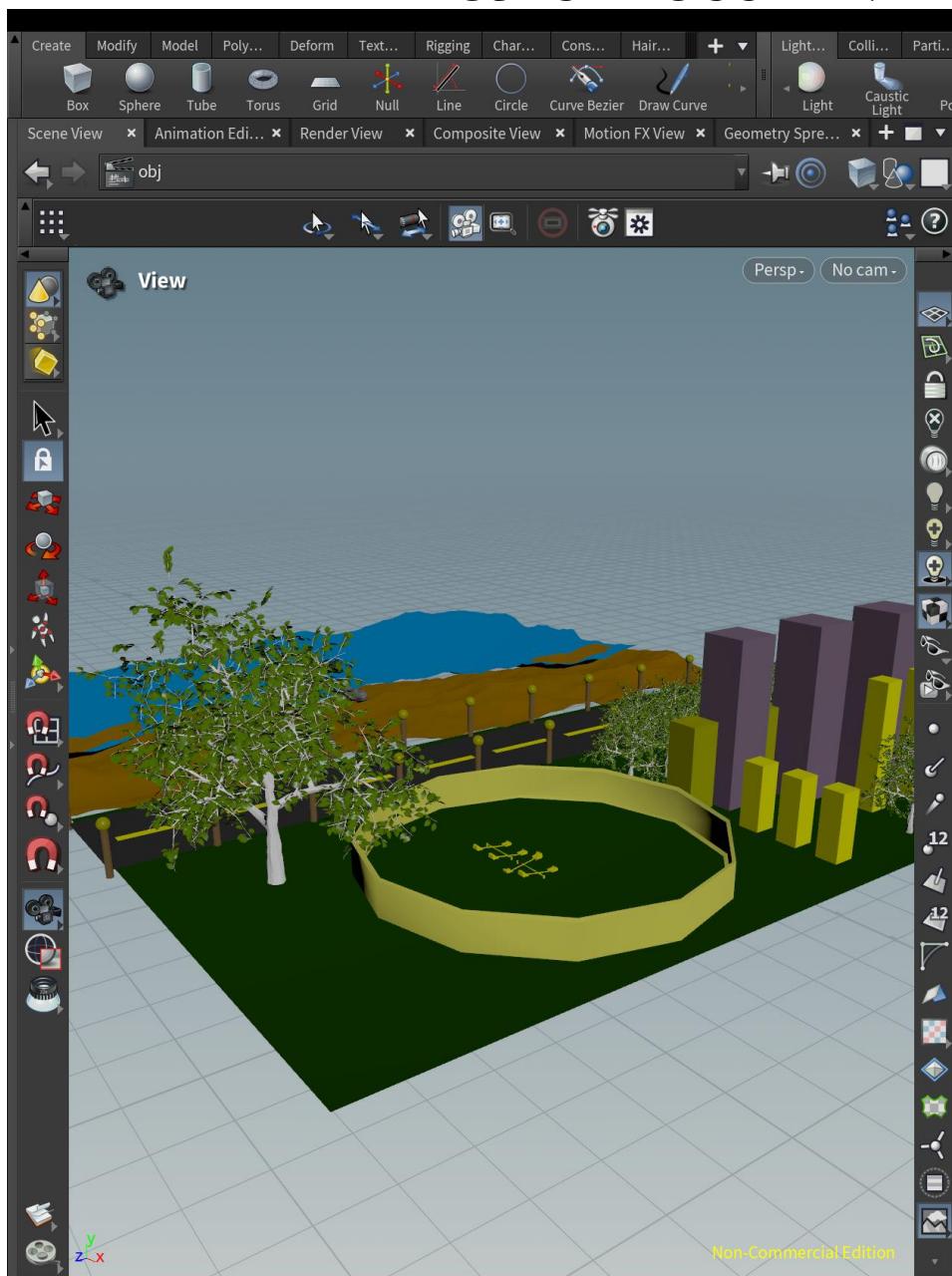
# PROJECT DOCUMENTATION



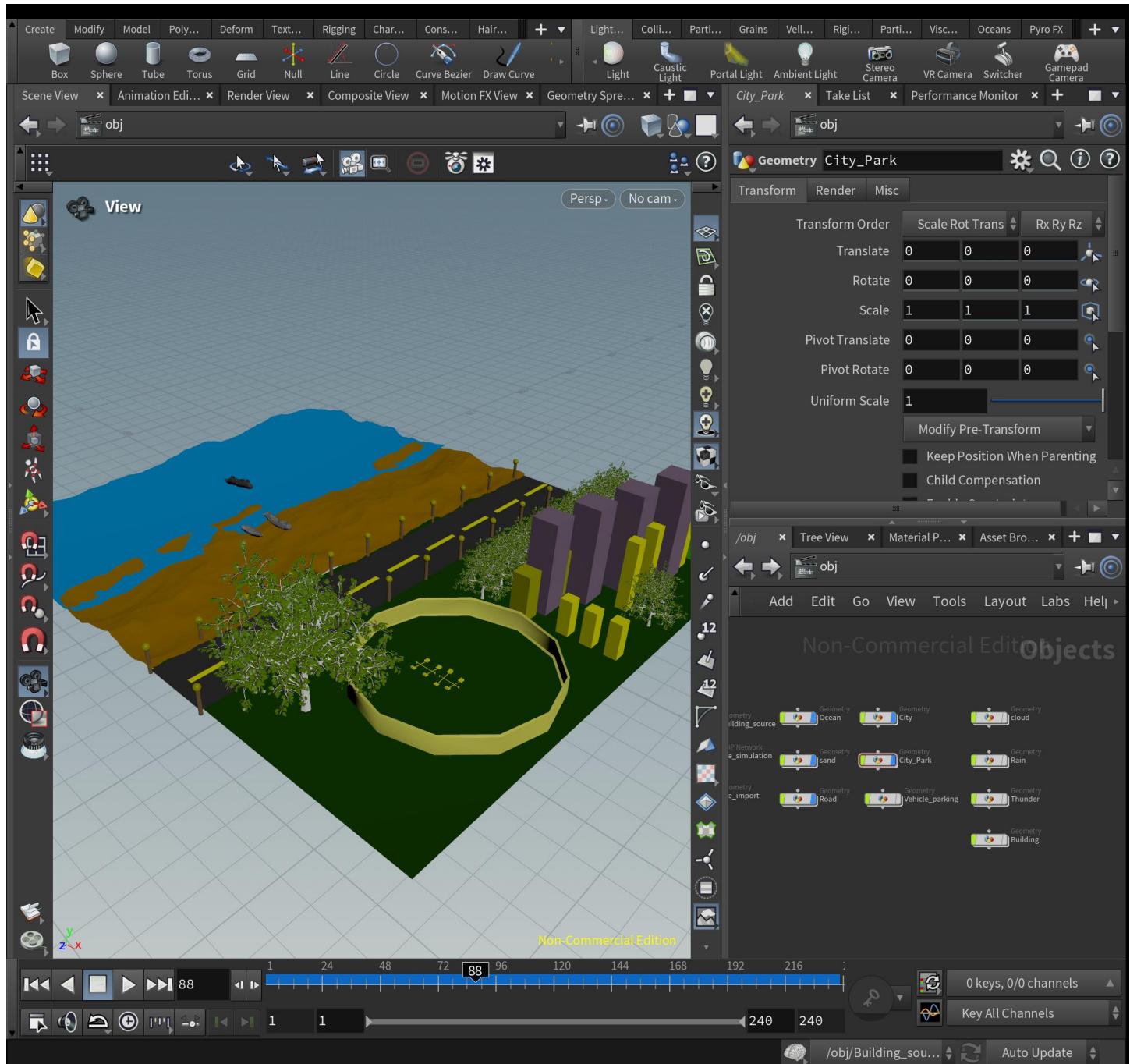
Now, to create trees firstly create a tree controller, and then tree trunk generated. Tree Branch generator1 to Branch\_generator 4, tree leaf generator,tree simple leaf. Network pane for tree creation. Transform the trees using the transform node.



# PROJECT DOCUMENTATION



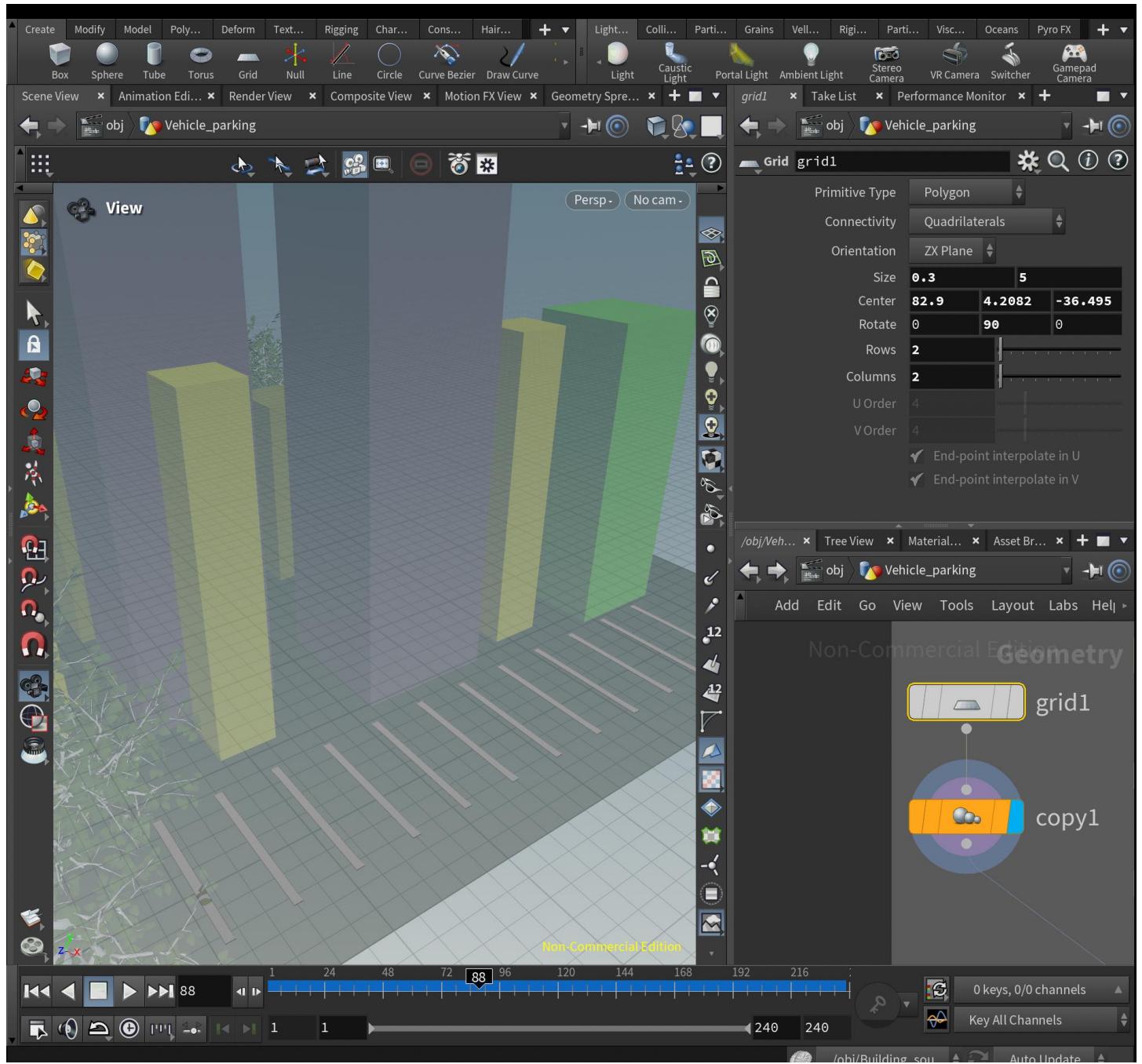
# PROJECT DOCUMENTATION



### Geometry Vehicle Parking:

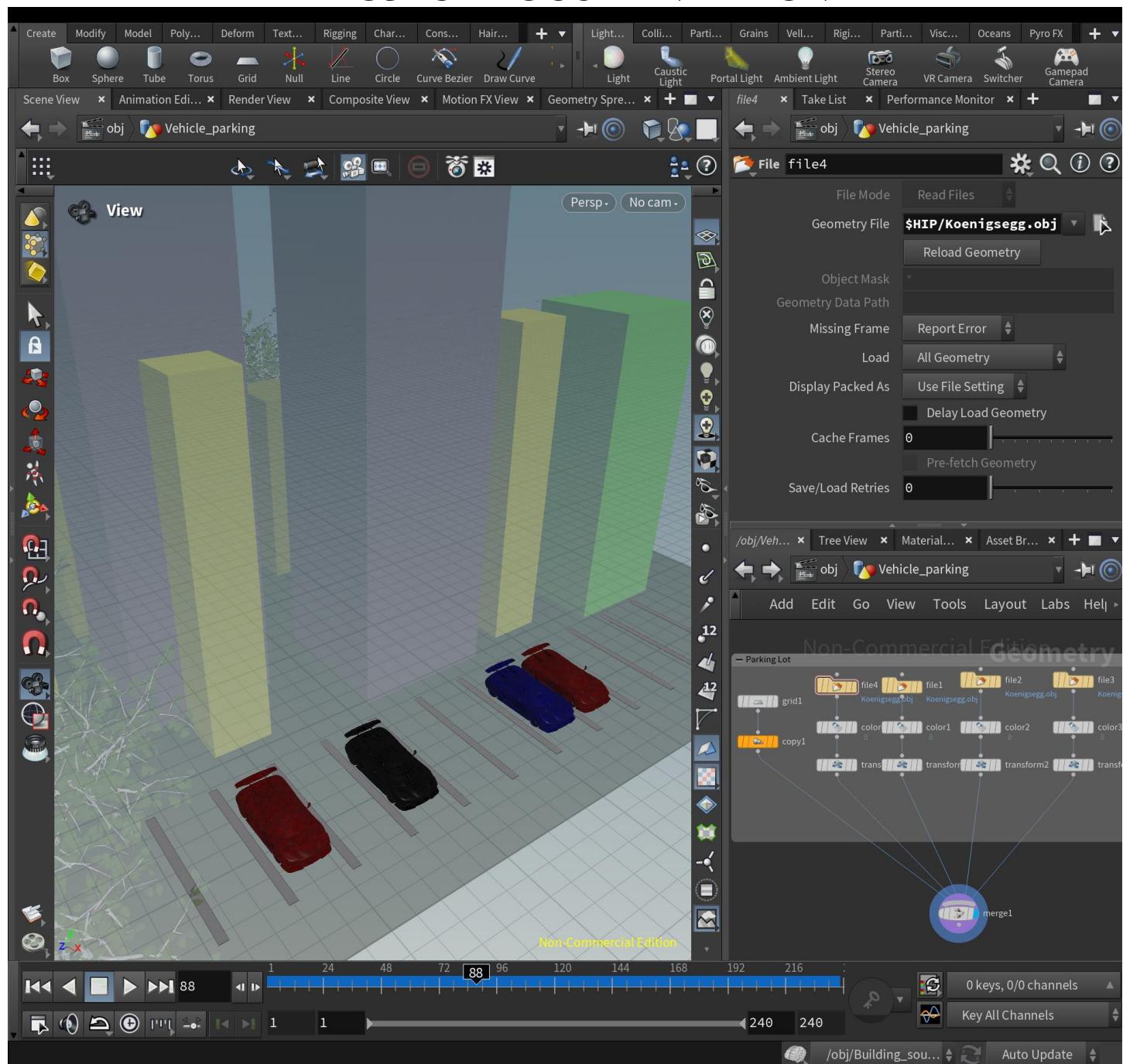
In the city we have parking space. To picturize this. Firstly create a grid of size  $0.3 \times 5$ . Set the center accordingly. rotate-y\_axis=90. Rows \*cols= (2\*2). Create a copy and transform node provide total number =12. Translate z-axis = 2. Now you can see the parking lanes created.

# PROJECT DOCUMENTATION

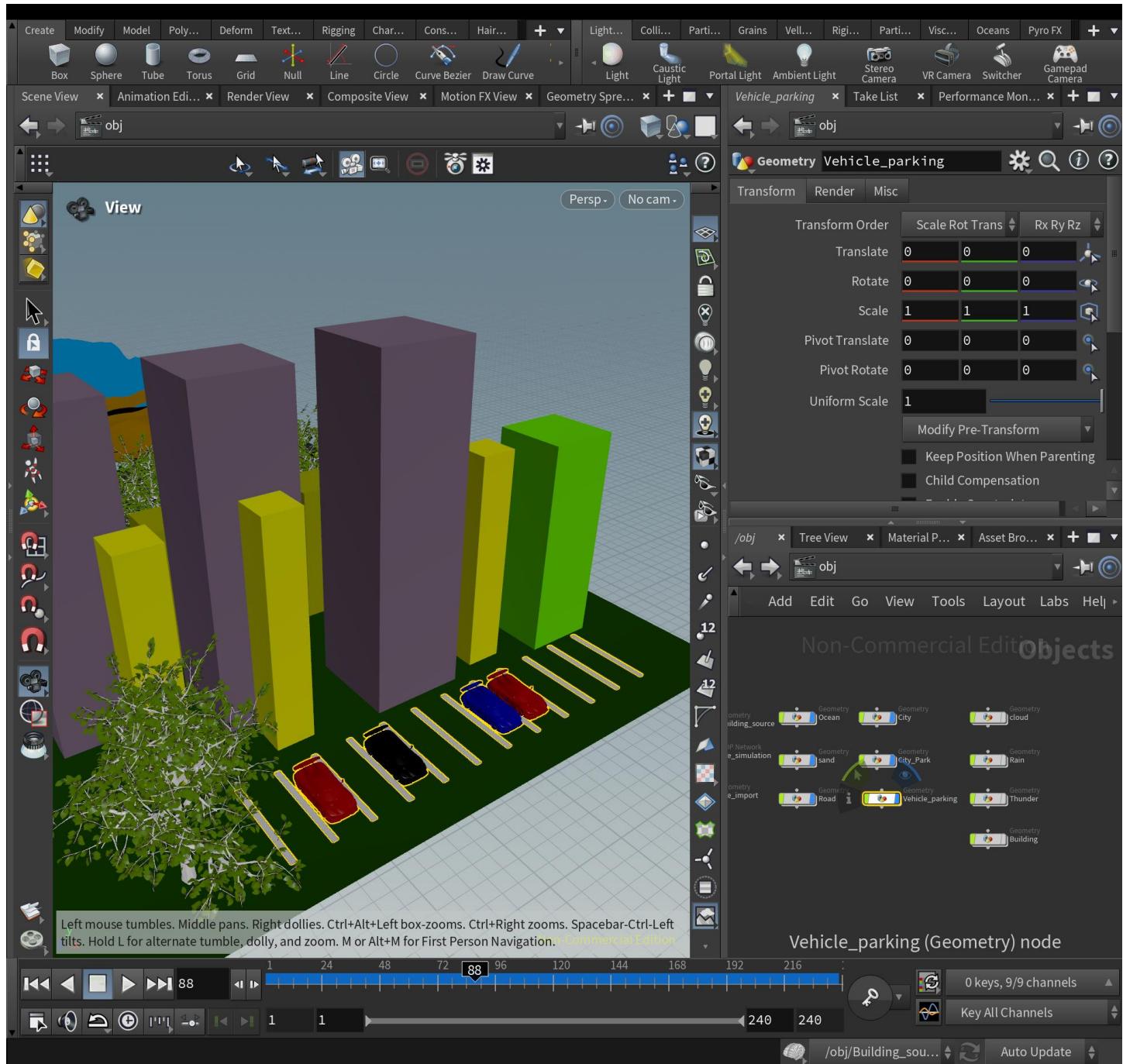


Now insert car objects of .obj file add color via color node and transform to a particular position between the parking lanes. Similarly create four file nodes add colors and perform transform on this. Create a merge node and connect all the nodes to the merge node.

# PROJECT DOCUMENTATION



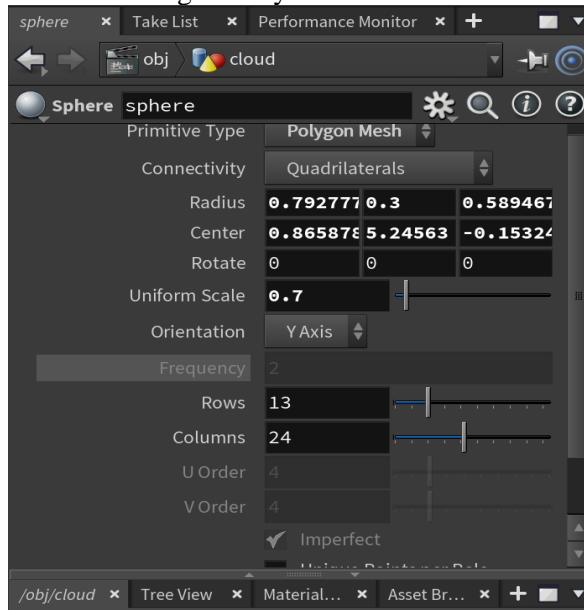
# PROJECT DOCUMENTATION



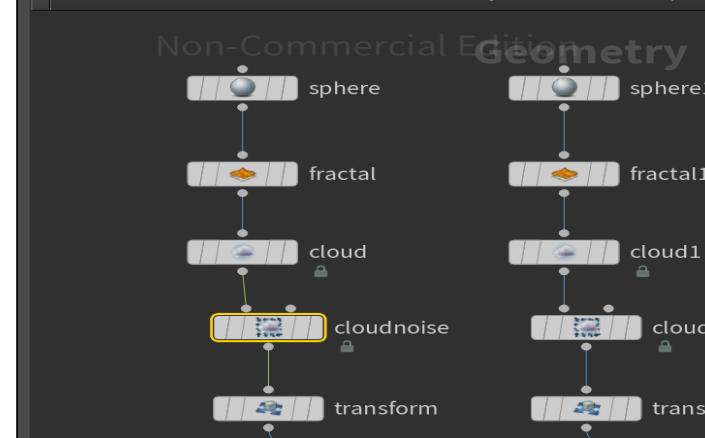
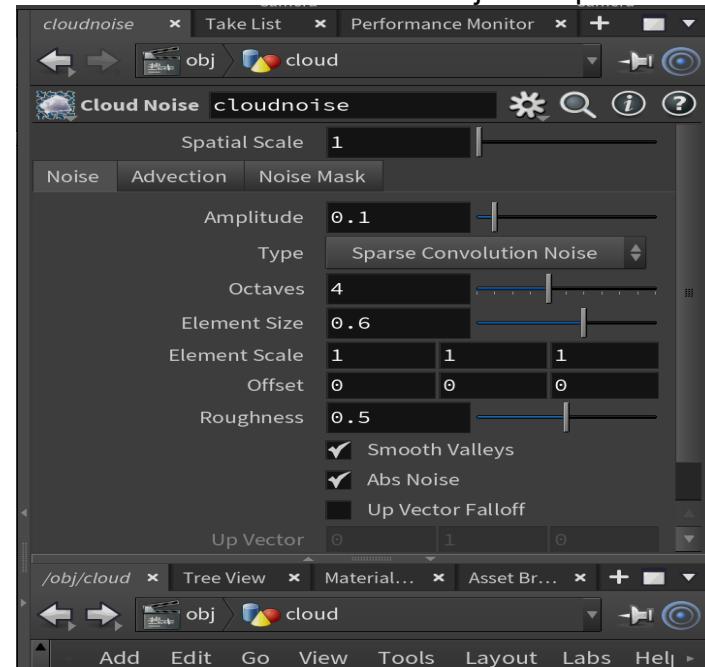
## Geometry Cloud:

# PROJECT DOCUMENTATION

Now create a geometry name it as cloud. Inside it create a sphere node. Parameters below:

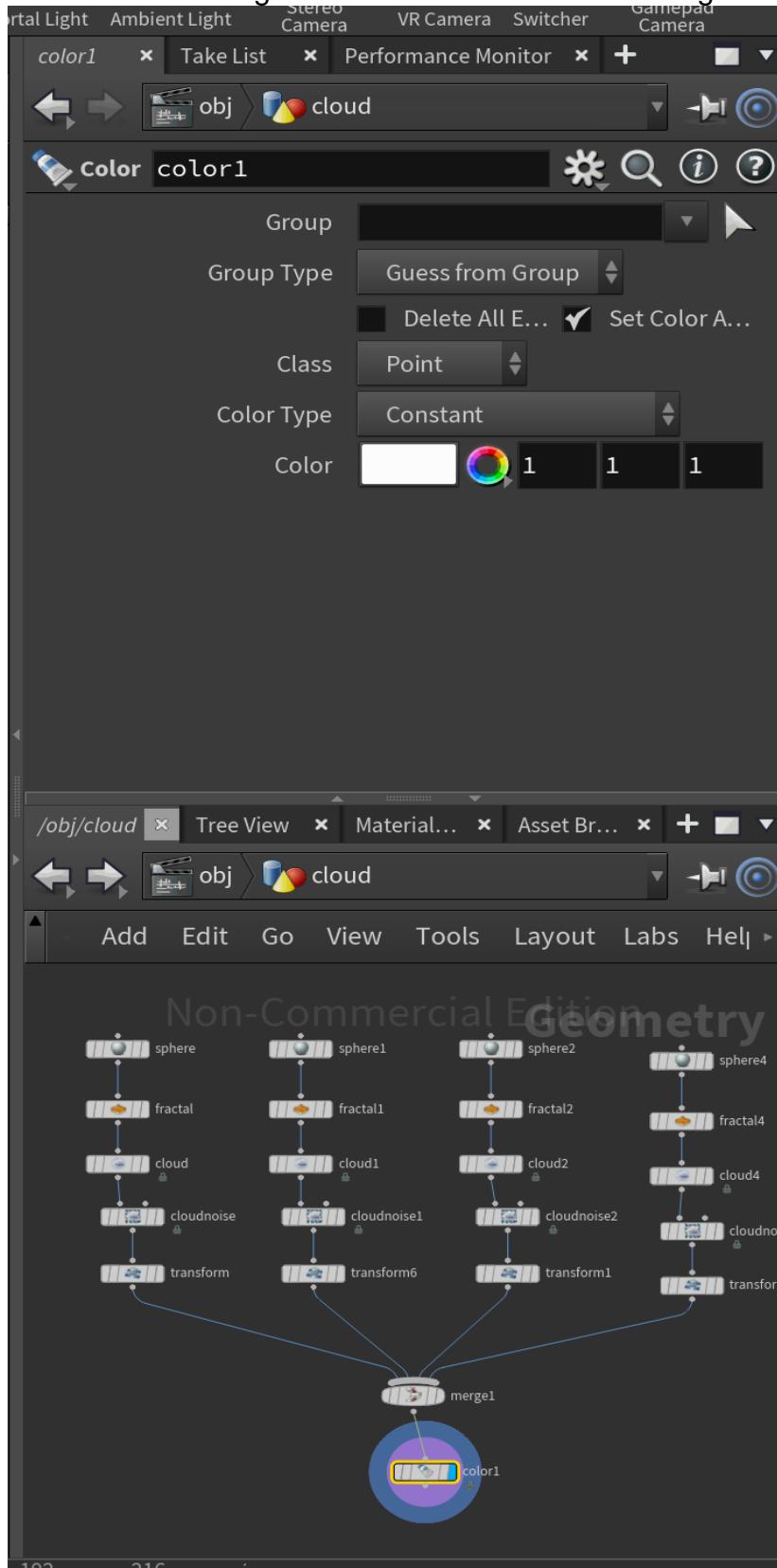


Create a fractal node and join to the sphere. Create a cloud node and join to fractal. Create cloud noise. Create a transform and adjust its position according to our previous geometry's.

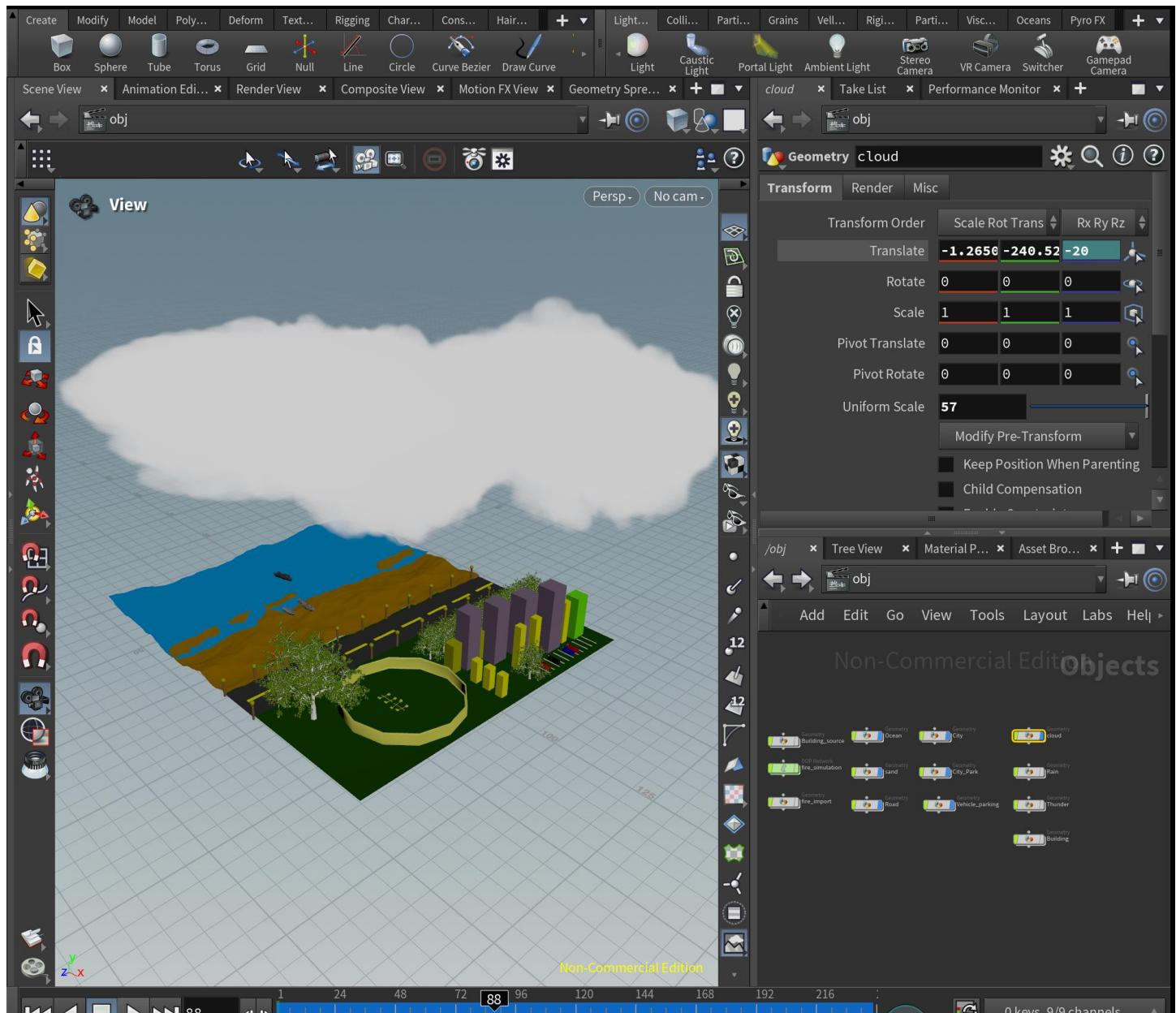


# PROJECT DOCUMENTATION

Similarly we create four clouds using four sphere nodes and join them using merge node. And finally add color to it using color node. Turn on the blue flag on the color node to visualize the clouds.

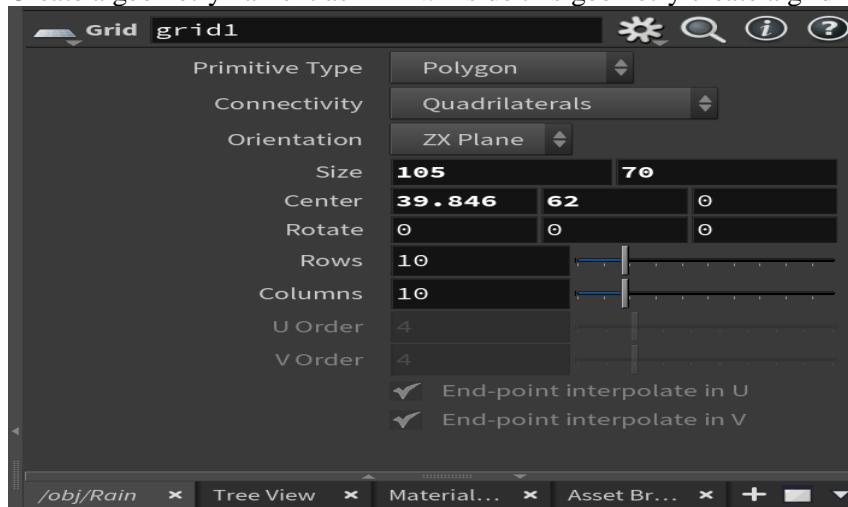


# PROJECT DOCUMENTATION



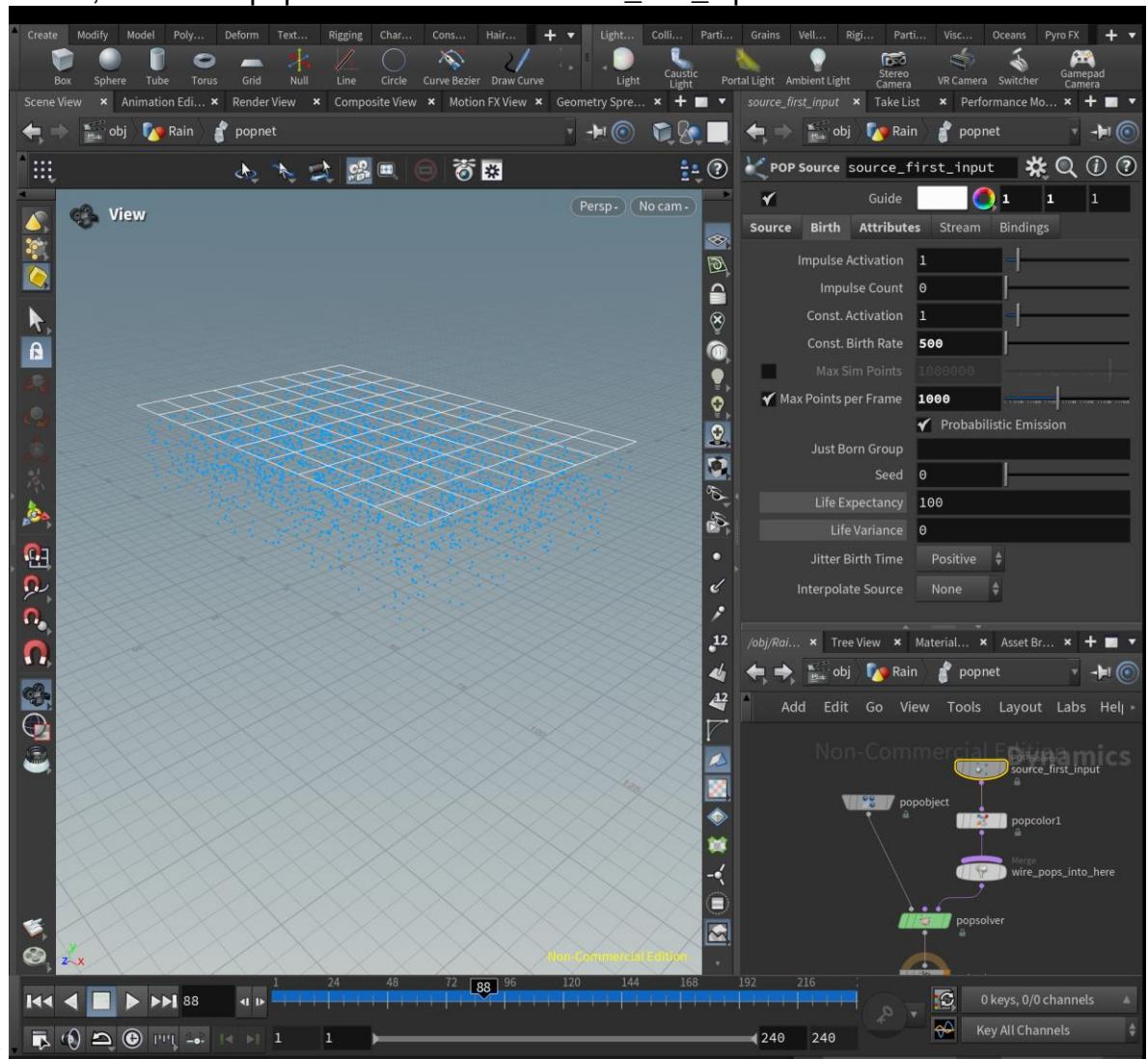
## Geometry Rain:

Create a geometry name it as RAIN. Inside this geometry create a grid node of size 105\*70.



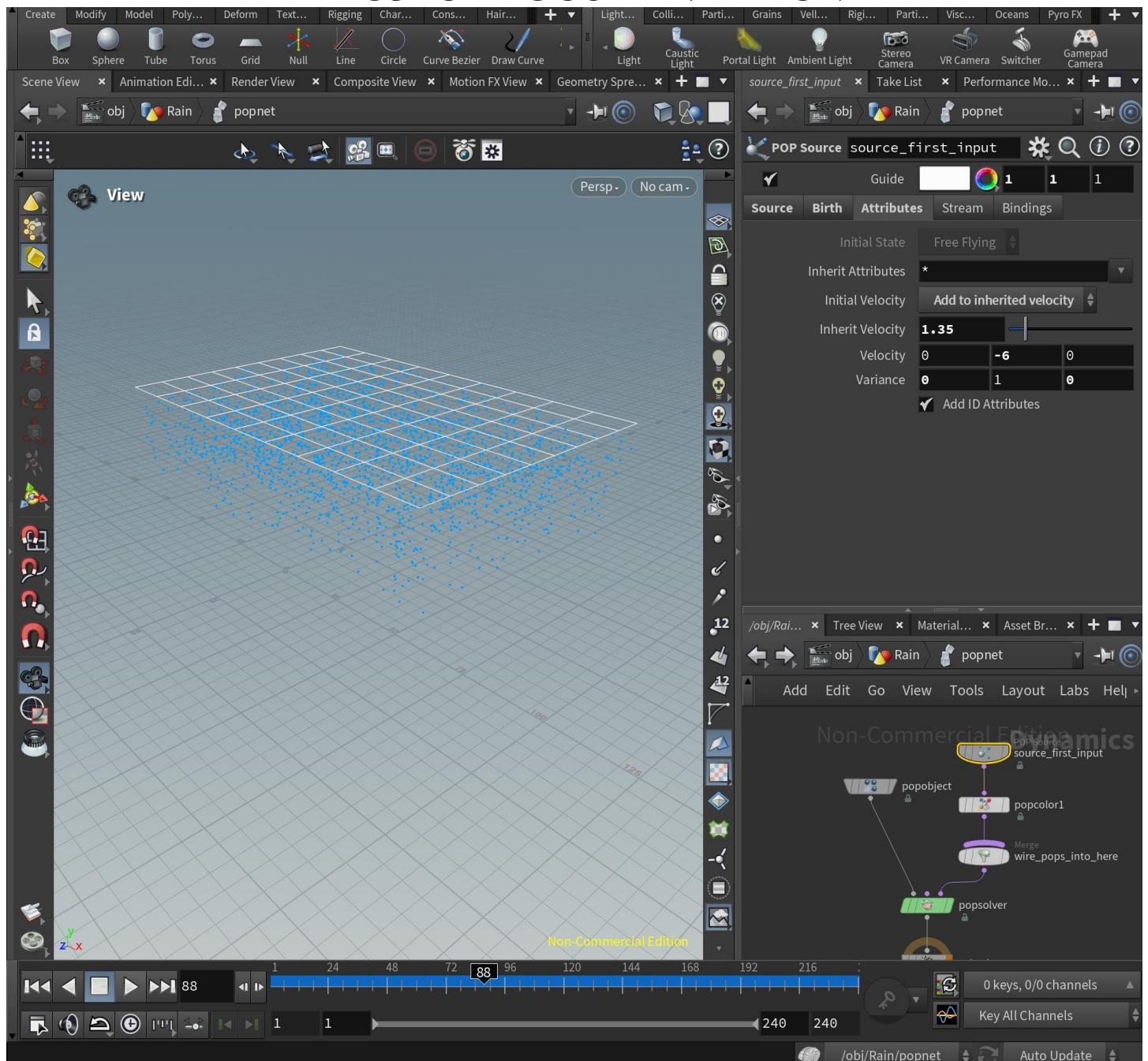
# PROJECT DOCUMENTATION

Create a popnet node, inside the popnet node. Select source\_first\_input node. Provide details as



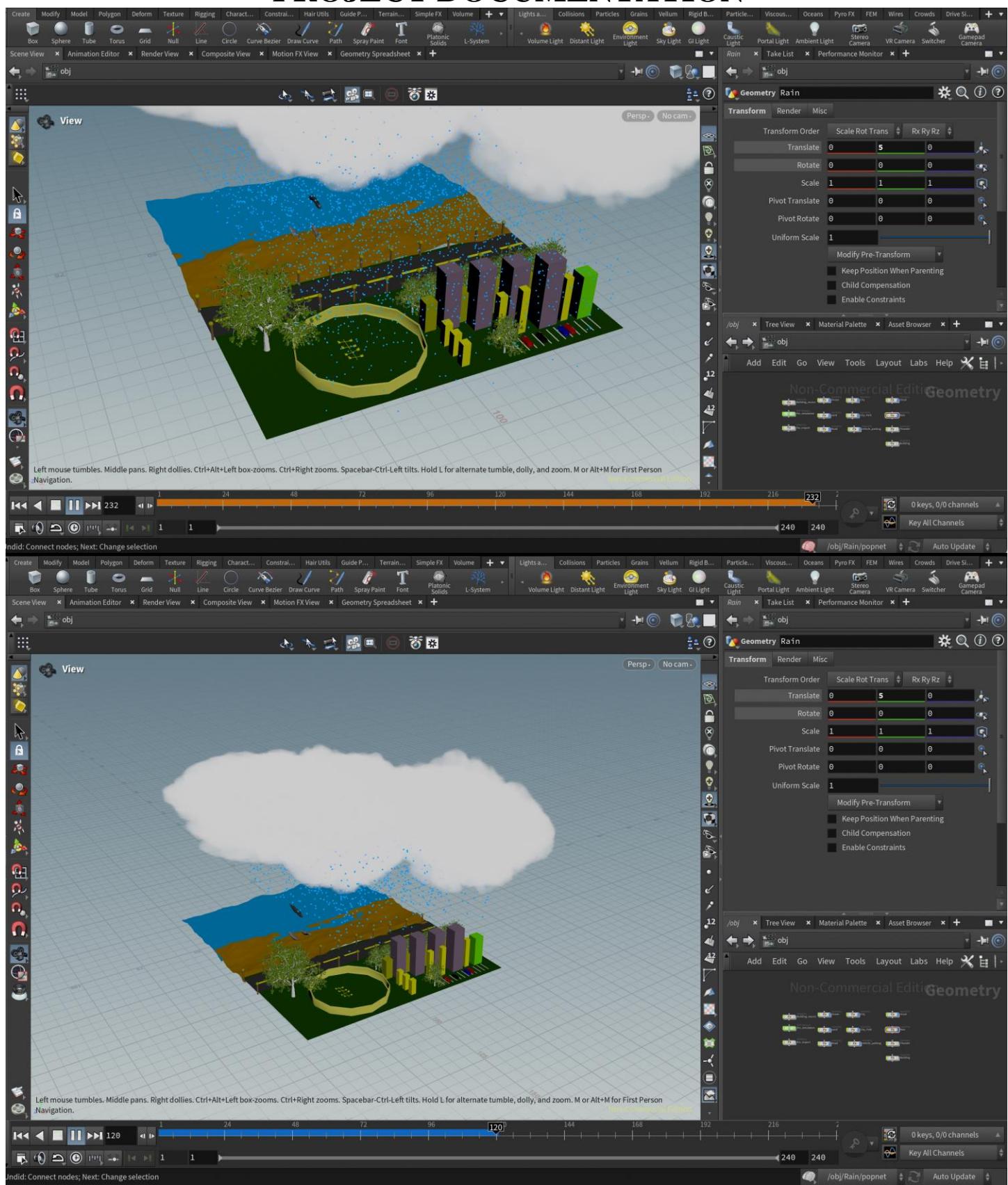
attached below.

# PROJECT DOCUMENTATION



Now create a popcolor node and join as you can see in the above image. Go back to the popnet level and turn on the blue flag. If we play the animation here we can see the rain coming from the clouds.

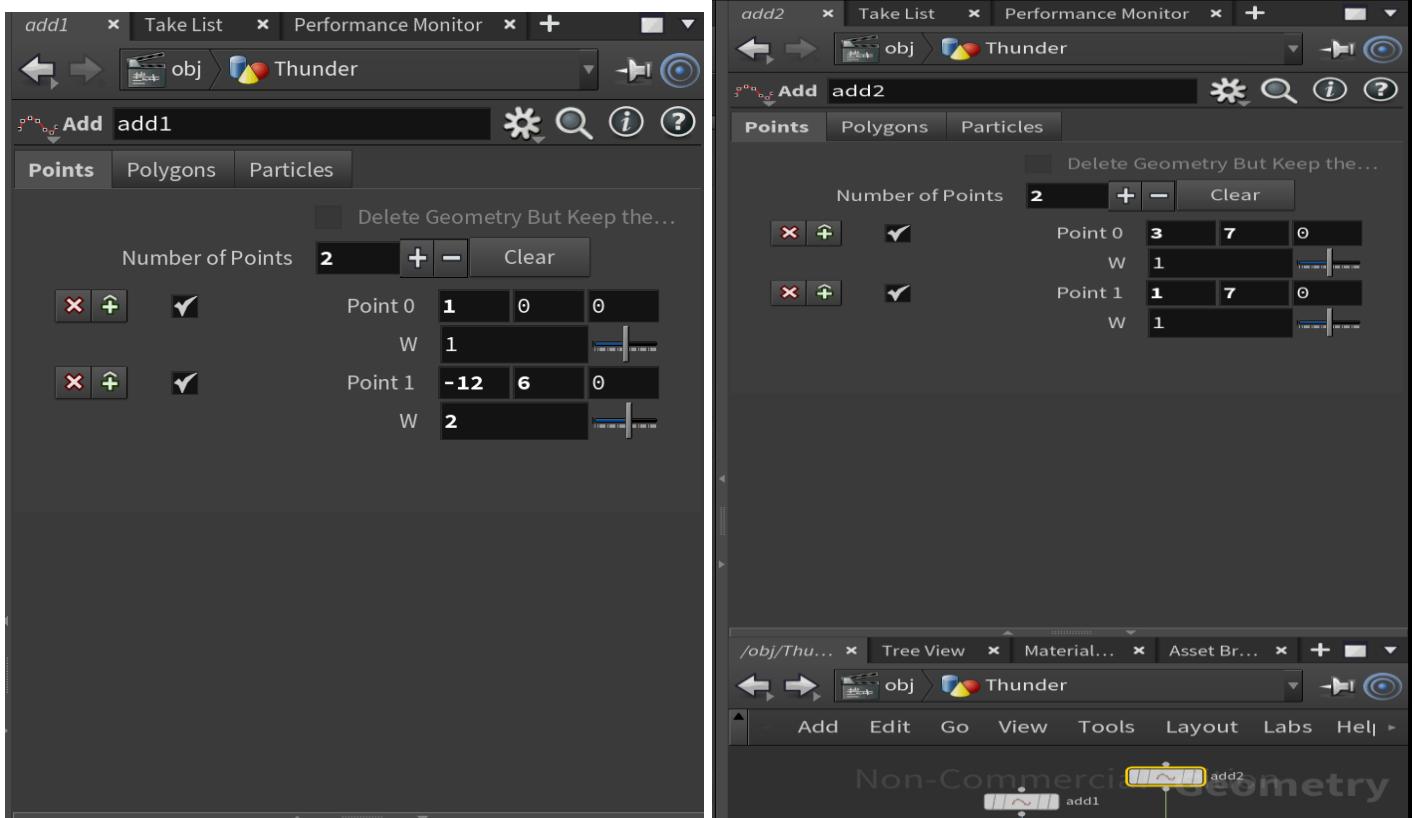
# PROJECT DOCUMENTATION



**Geometry Thunder:**

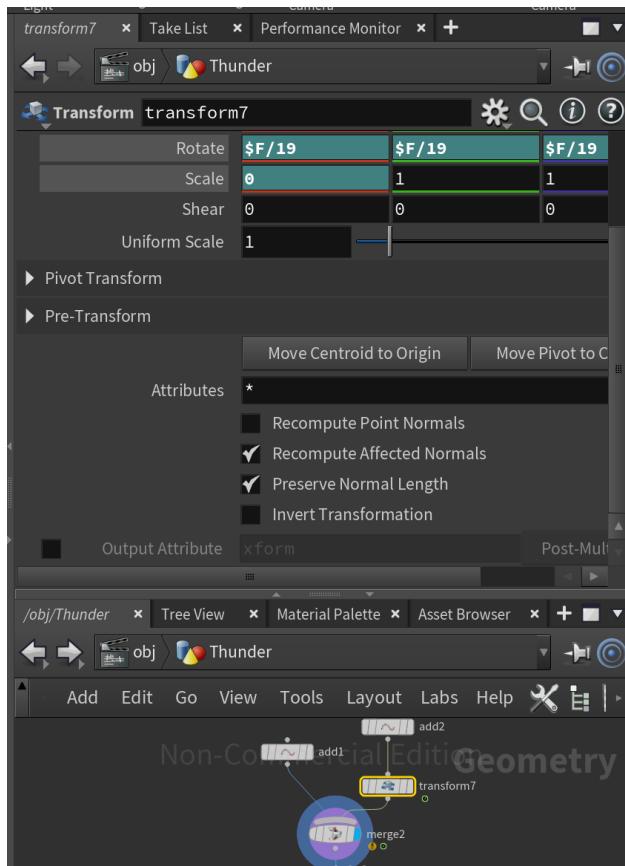
# PROJECT DOCUMENTATION

In this geometry we are going to create a thunder. Firstly creat a add1 node and also add2 node. Parameters as below:

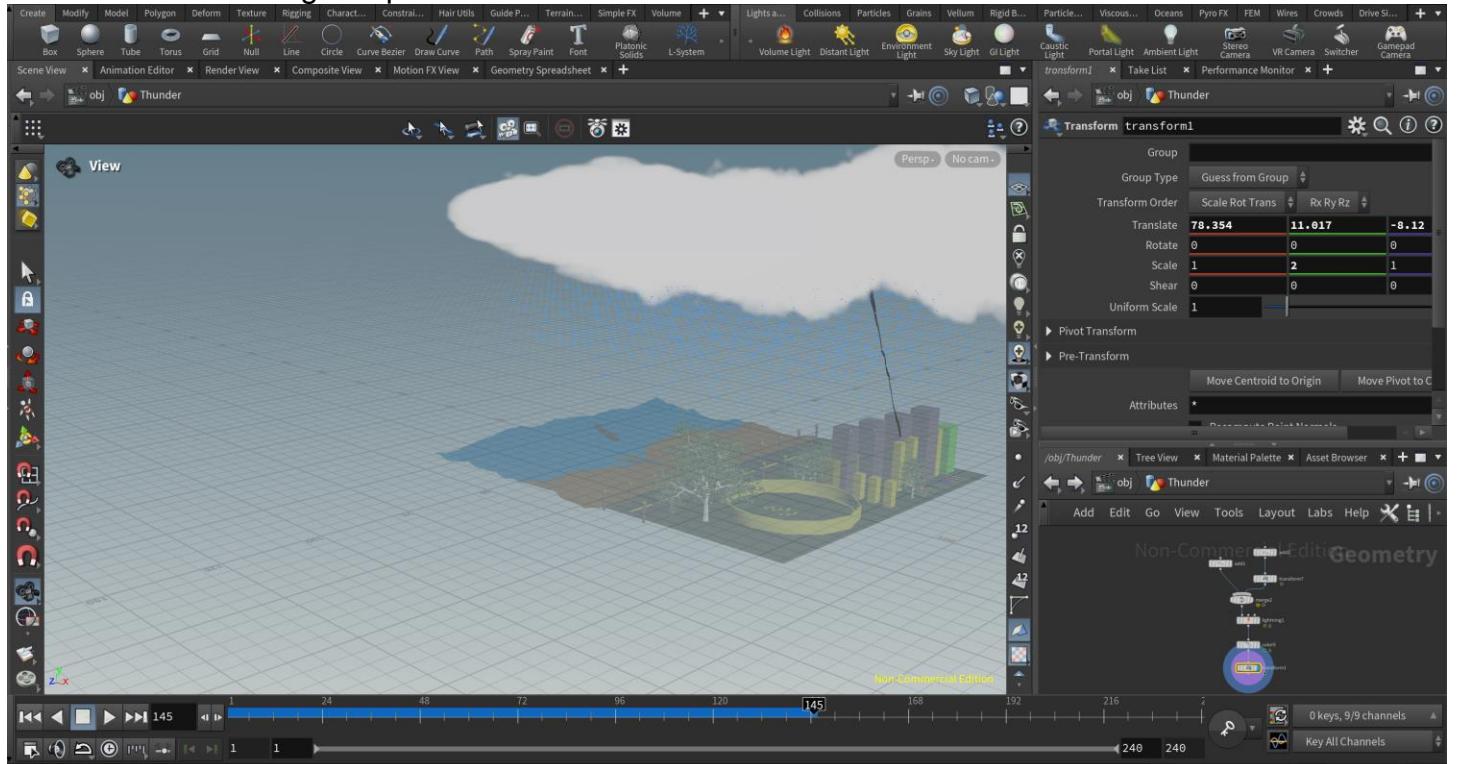


Create a tranform and connect to add2 node. Now merge and connect both add1 & add2 to merge node.

# PROJECT DOCUMENTATION

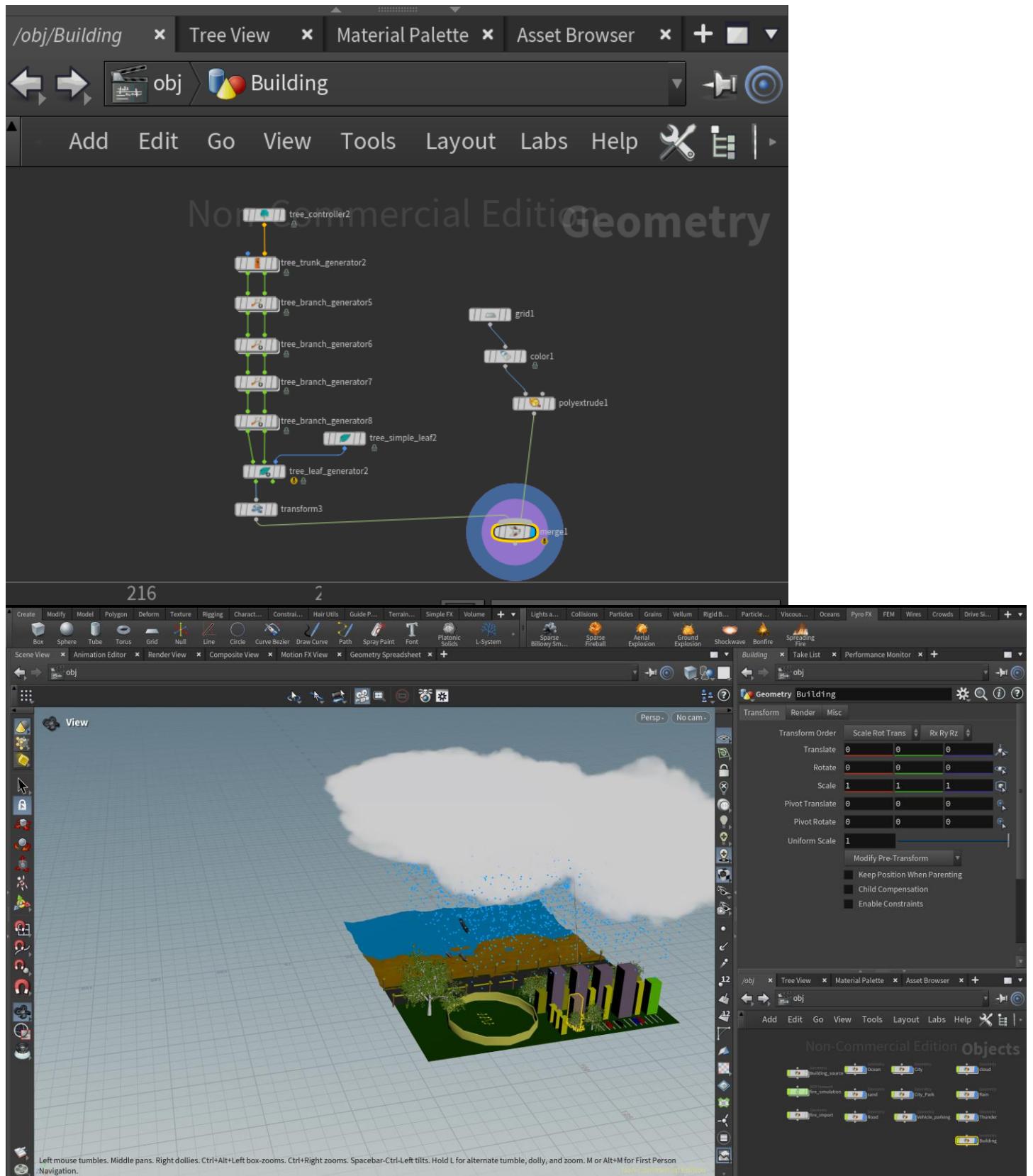


Now create the lightning node connect to the merge add color to the thunder created and using the transform node change its position as needed.



Now create a geometry building , in this I have created a tree and a building. This geometry I have used to perform the fire accident action. Create a merge and join. And then position them according to the necessity

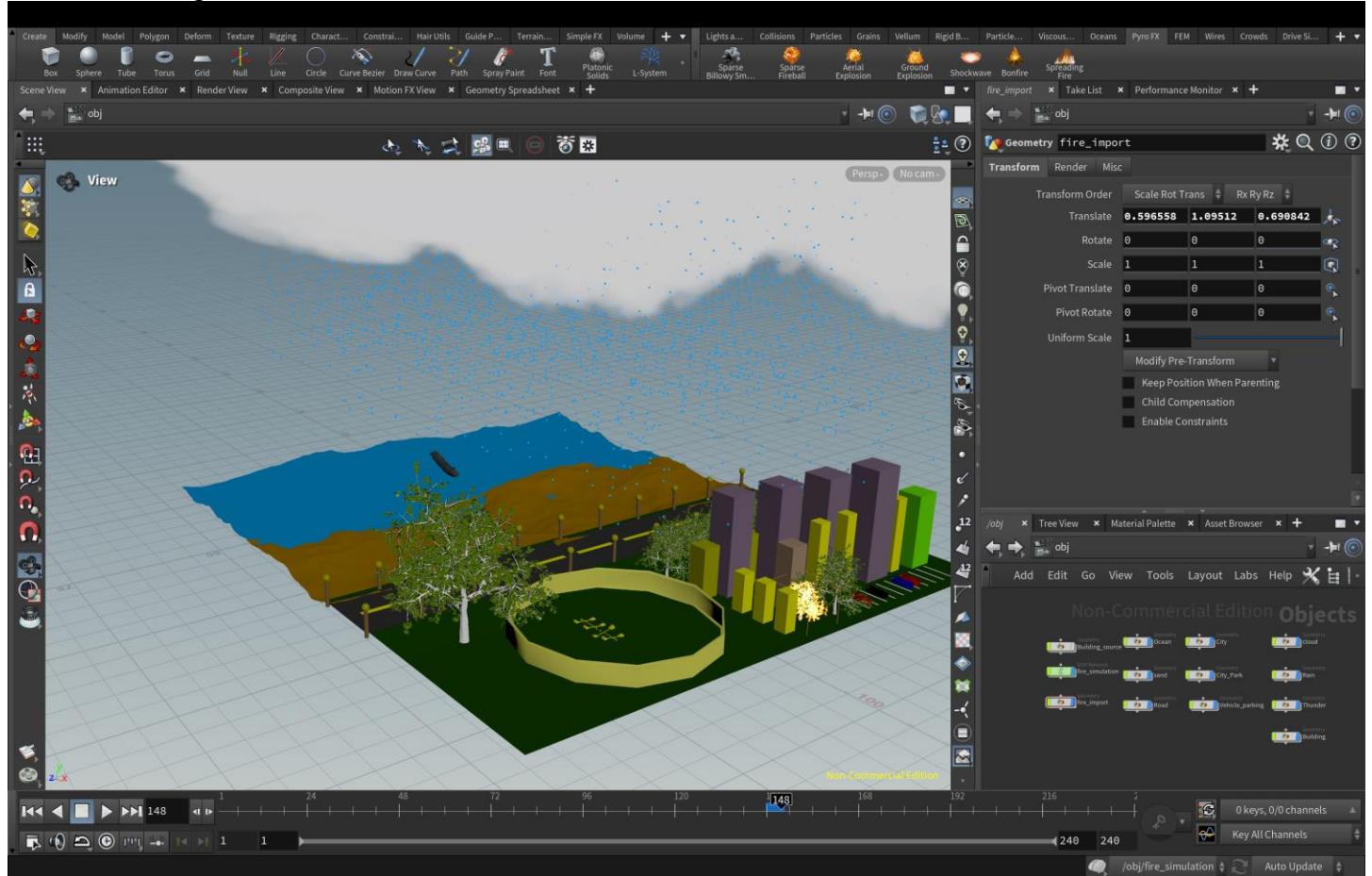
# PROJECT DOCUMENTATION



Now from the top menu goto the PyroFX and select on the spreading fire. After that select a geometry where the fire has to be caused. So here I have aimed at producing fire at a building and a tree. So I

# PROJECT DOCUMENTATION

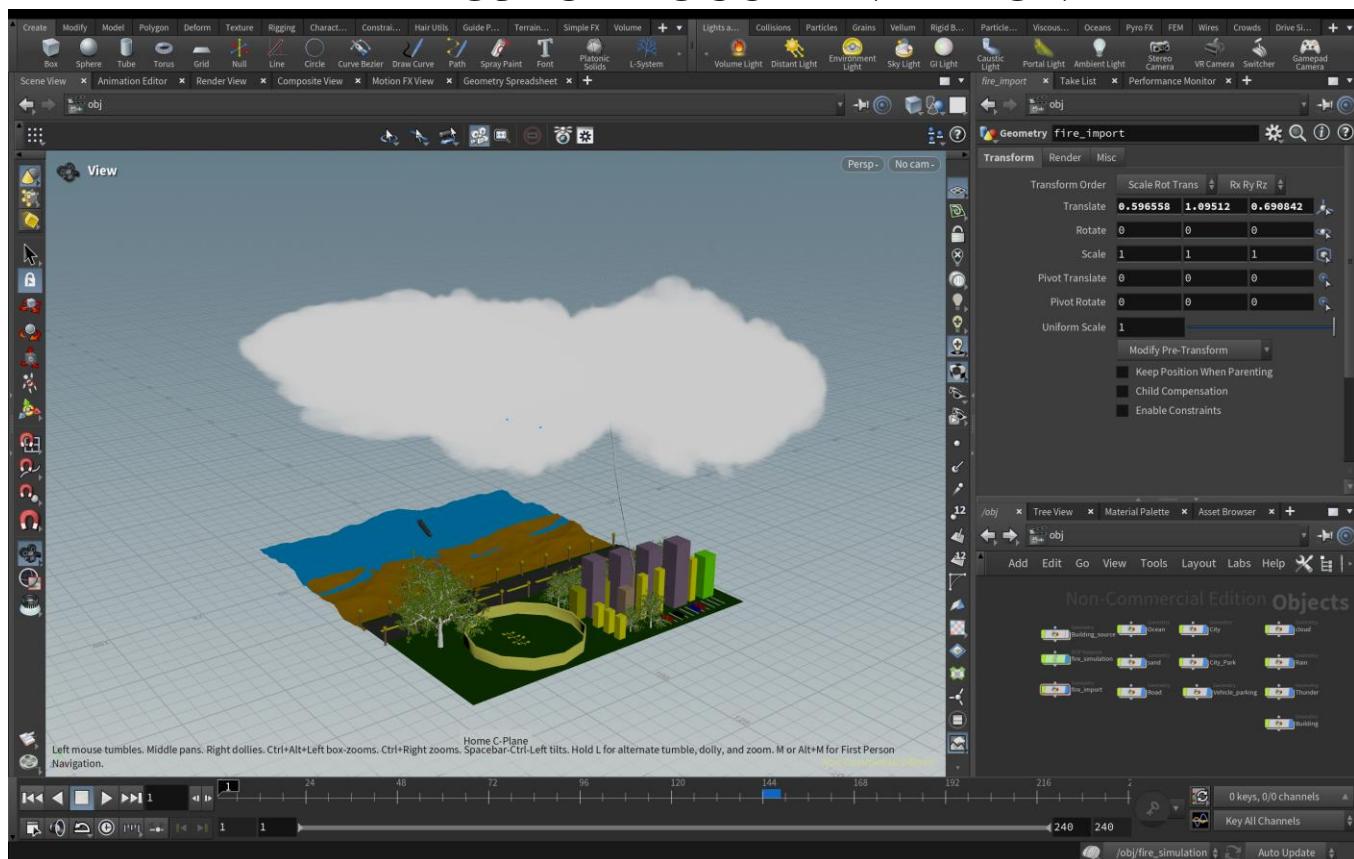
have proceeded by selecting the geometry Building. And then click enter. It takes few minutes to load the fire and it gets created after some time.



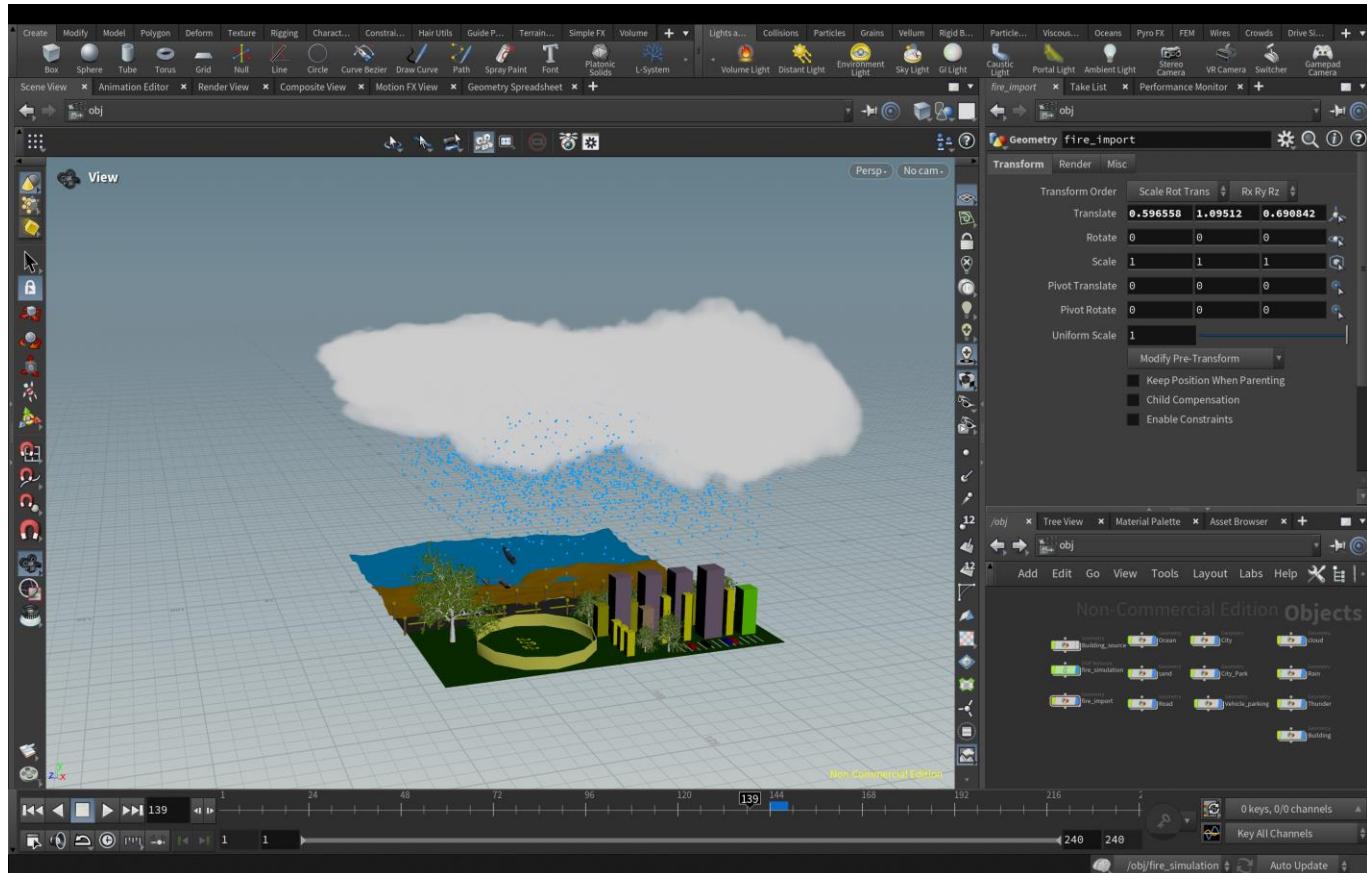
Once the fire is created we can also change the frame. From when and at which particular frame the fire has to explode and all. Now turn on blue flag for all the geometry's created till now. And adjust the axis if anything seems to be in place is all fine. Now start playing the animation, It takes some time to load the cookies and perform the animation.

AT FRAME1:

# PROJECT DOCUMENTATION

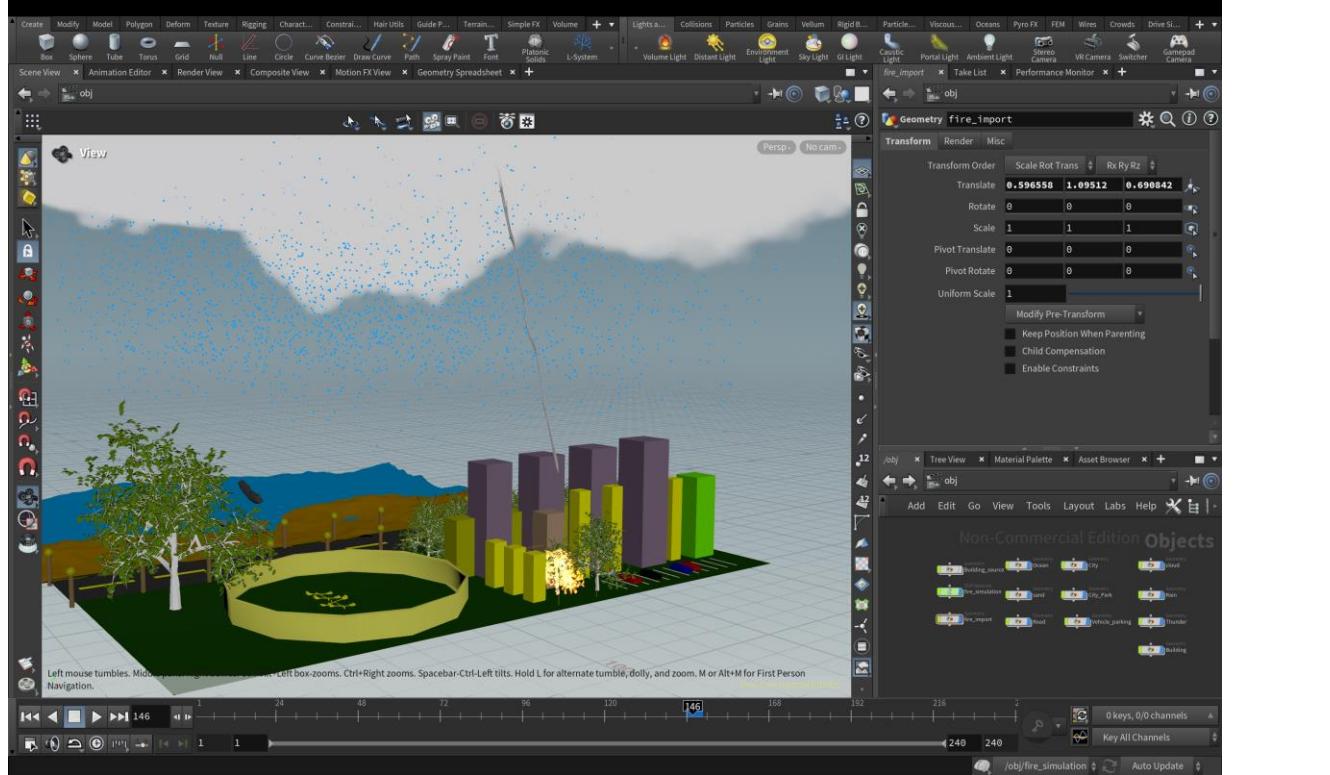
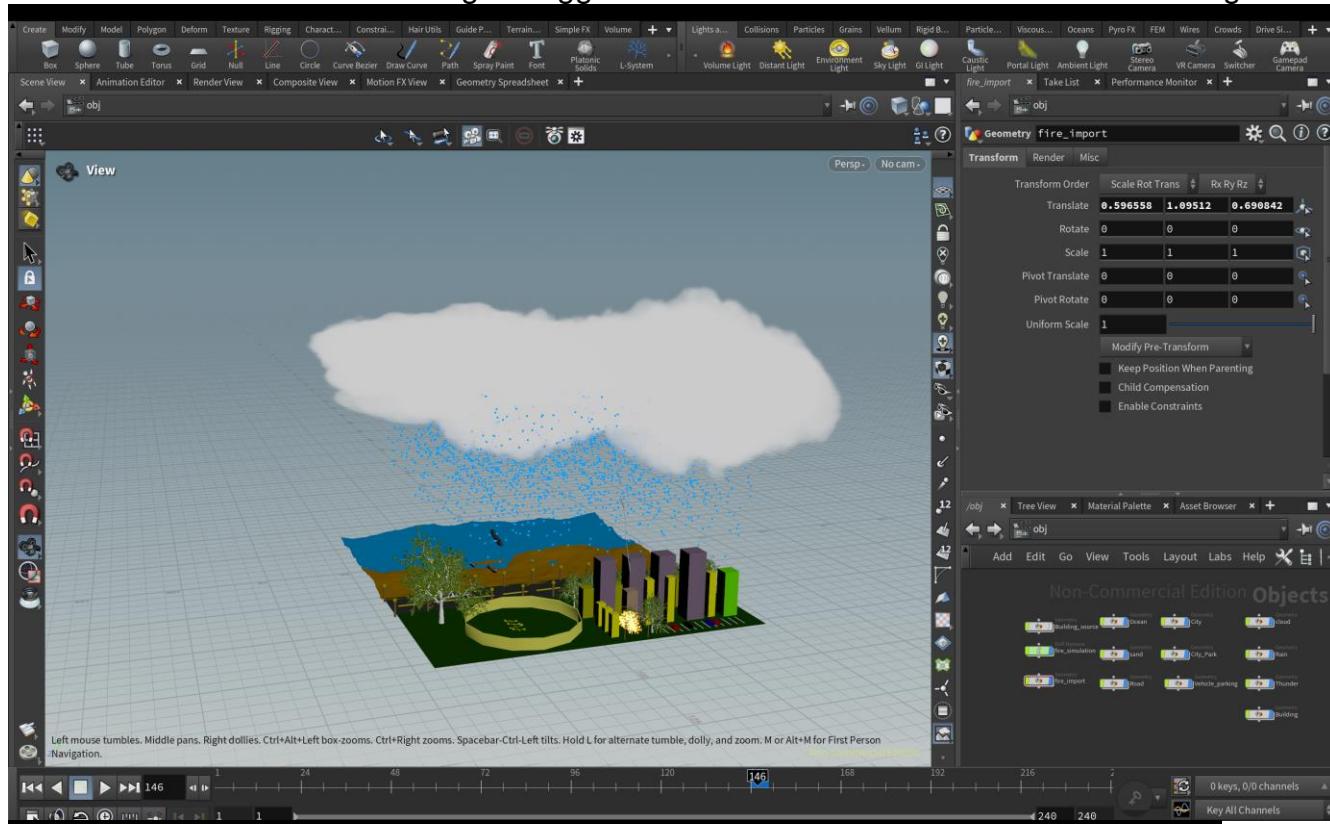


**FRAME139**



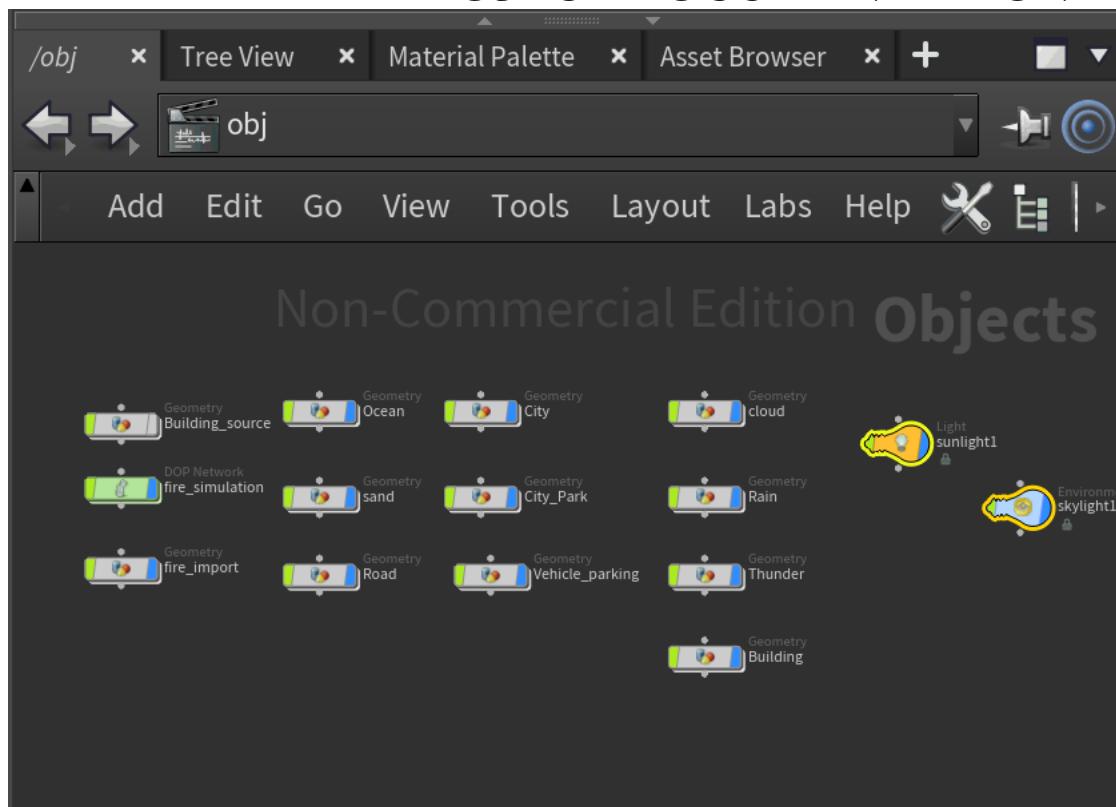
# PROJECT DOCUMENTATION

FRAME 146: It is where the fire gets triggered as the thunder is attacked to the building at frame 144

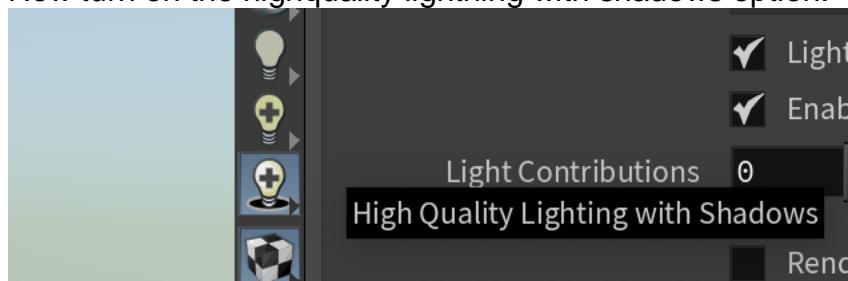


NOW from the lights menu, create a sky light, by just clicking on it. A skylight as well as SUN light both are created.

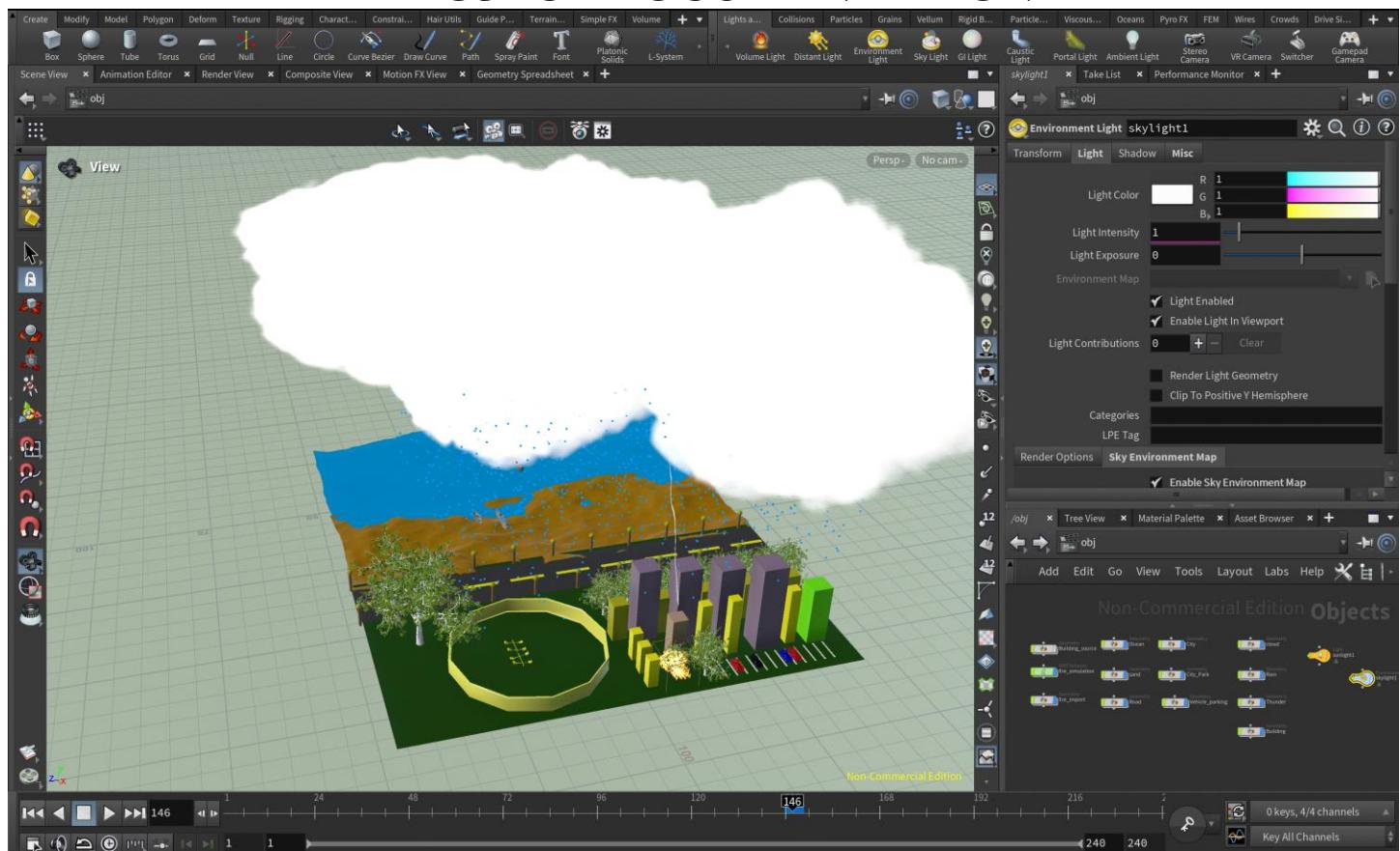
# PROJECT DOCUMENTATION



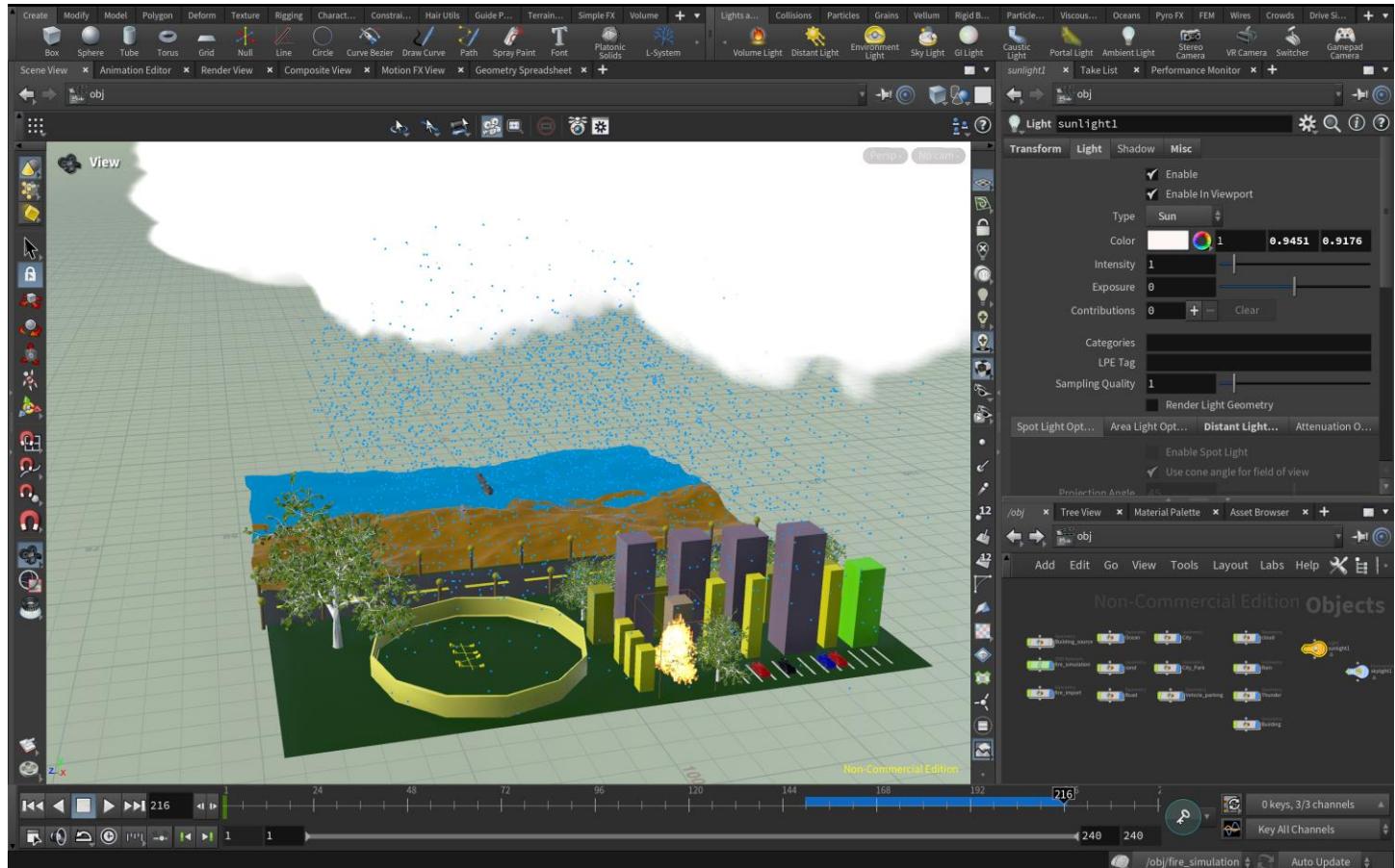
Now turn on the highquality lightning with shadows option.



# PROJECT DOCUMENTATION



At FRAME 146:



## PROJECT DOCUMENTATION

**CONCLUSION:** so now the final view of the project is visible and by playing the animation we can see the live visuals of the scenario that is created.

**Challenges Faced:** While implementing so many geometry's the houdini has eventually became slow. To over come this I have created separate files and have merged all the geometry's at one place at the end. At few steps restart of houdini made the program fatser. Also at few steps the created geomerty was not visible in the scene view at this point of time I have performed the reload of desktop option.

**Reference:** All the nodes used in this project are discussed and learnt during the ADV. VR Classes of Spring 2024 semester at Missouri University of Science and Technology. The object files such as boat, car and see-saw are imported from the external sources. The reference file has been zipped and uploaded in the final project folder. All the work has been done and the content is written by Me(Author- Mubeena Mohammed)