Civil Systems Engineering

Modeling Engineering Products

Individual Assignment II – Parametric Modeling

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1 Design

In the system of concrete office building, I aimed to analyse and compare various column and beam layouts within a building of consistent area for one floor. By employing different configurations of columns and beams while maintaining the same overall building area, my objective was to evaluate the total consumption of concrete and consequently assess the overall mass of the structure. The model allows for the modification of grid configurations, enabling adjustments to the spatial layout and arrangement of structural elements.

The sizes of columns dynamically adjust according to their respective tributary areas. Tributary area, or sometimes referred to as influence area, is the area surrounding the column that absorbs the load (Emil 2022). For the sizing of the beams, the formula which is stated in the Turkish regulations (TS 500) is used. Depth of the beams depends on the length of the beam by 0.1.

2 Modeling System with Dynamo

In learning the modeling system within Dynamo, I relied on tutorials from Firas Noori YouTube channel and the course tutorials which are provided.
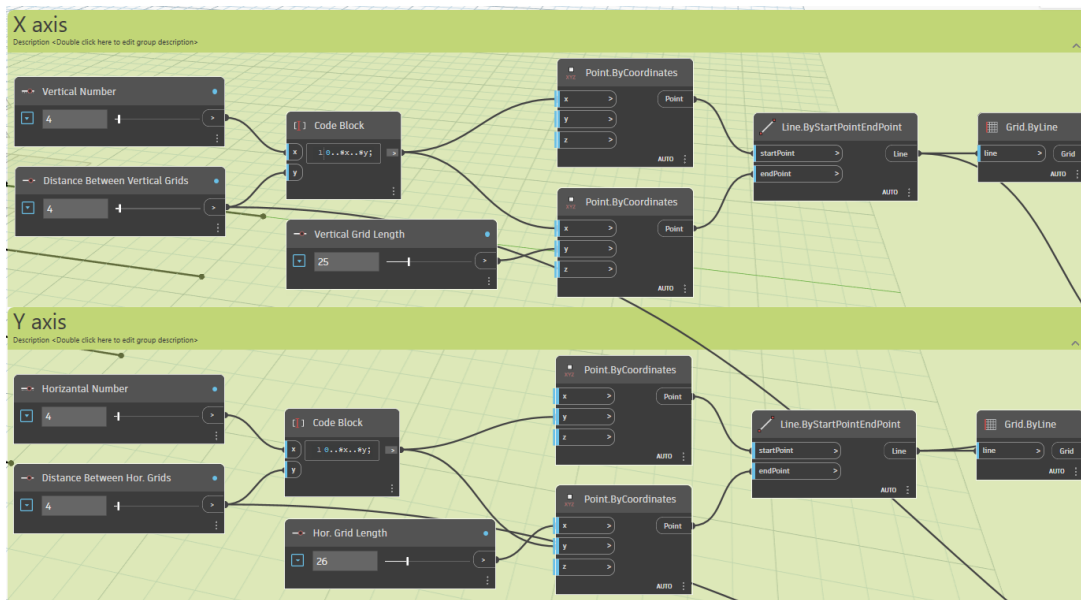
2.1 Grid System

Figure 1: Grid Systems Nodes

The nodes for the setting grid system are shown in Figure 1. For making comparison between different layouts, consistent area is chosen as 12x12 meter. Two different layouts for

the columns and beams are shown in Figure 2 and Figure 3. The distances between columns are 6 meters and 4 meters respectively. The number of the columns and beams are dependent on the intersection points of the axis.
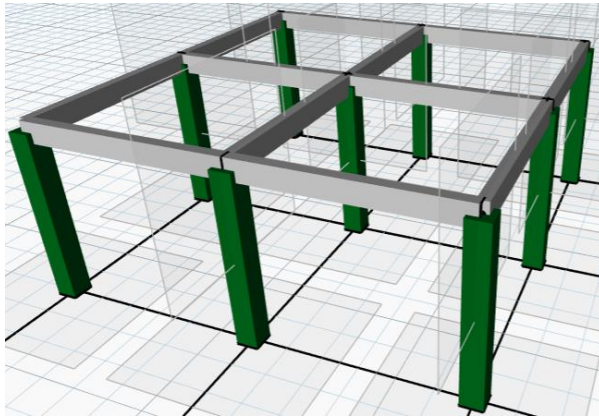

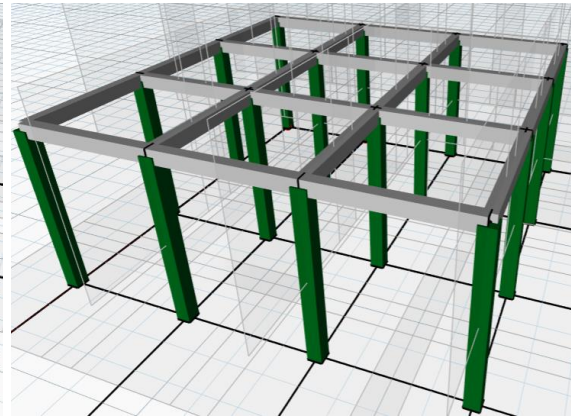*Figure 2: Column spacing for 6 meters, Option 1.*   *Figure 3: Column spacing for 4 meters, Option 2*
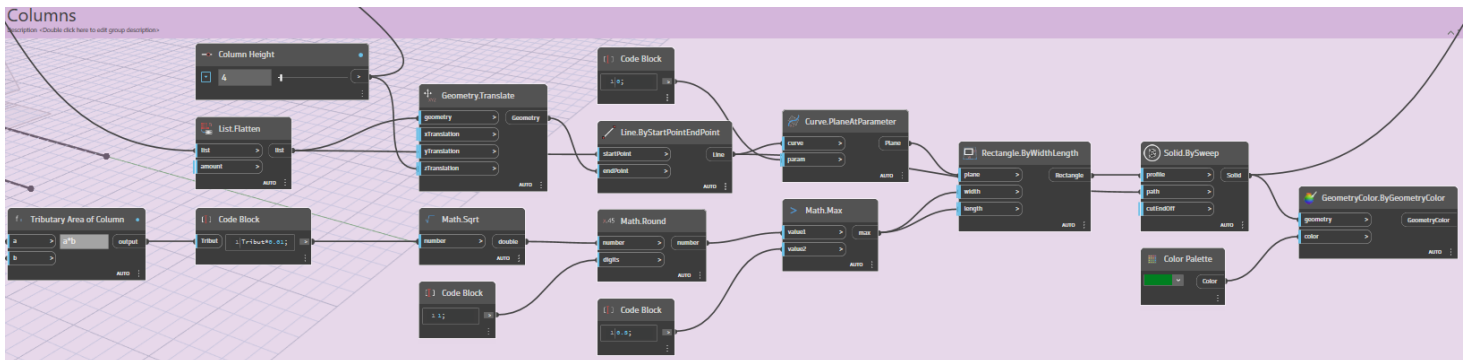
2.2   Columns

Figure 4: Nodes for columns.

As mentioned before for the sizing of the columns the tributary area method is used (Figure 5). For a simplification all the sizes of all the columns base on the tributary area of the base column. Since the sizing also needs a load which we don't have in our case that acting on the columns, this assumption is made: The area of the columns must be 1 percent of their tributary area. Columns heights are set to 4 meters.
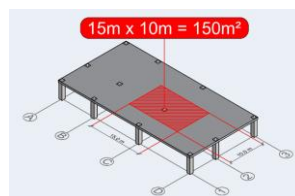

Figure 5: Example of tributary area of a column.

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2.3 Beams

For the modelling of the beams a custom node which is "grid points to horizontal and vertical lines" is generated to obtain lines for the beams in both directions. The Firas Noori's guide is used for this custom node. As mentioned before the depth of the beams are dependent on the length of the beam by 0.1 to avoid deflection checks. Also, it is stated that it cannot be smaller than 30 centimetres. The width of the beams is set to 30 centimetres.
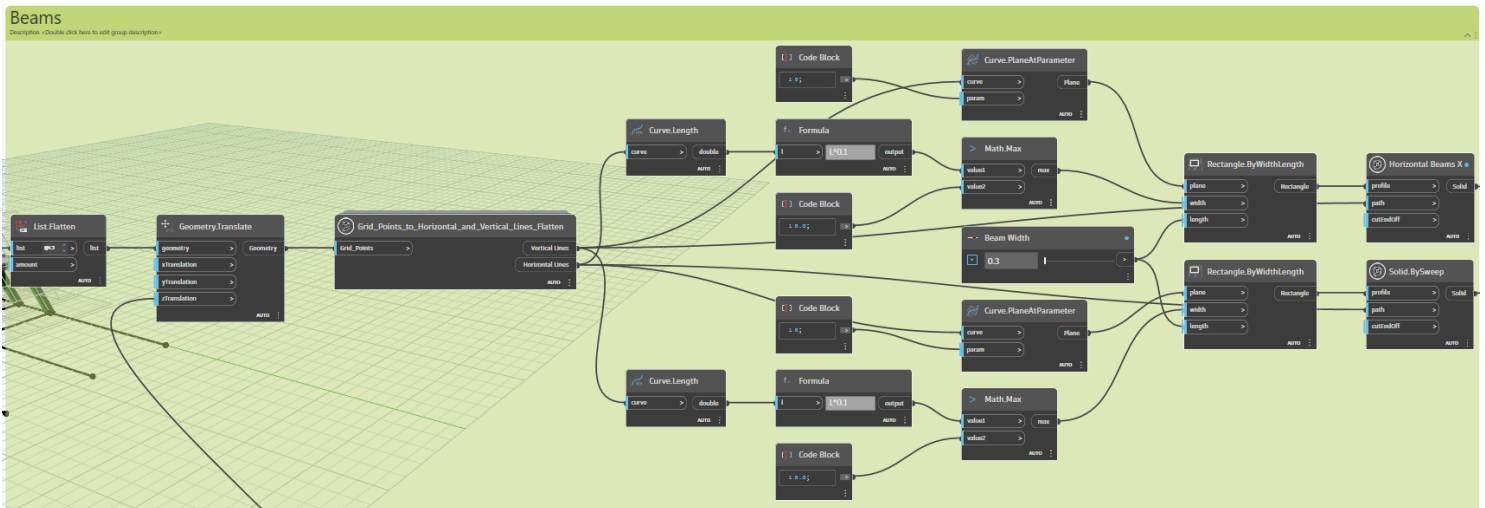

Figure 6: Nodes for beams

2.4 Calculation of the Total Volume and Mass of Concrete

To observe total volume of concrete usage, the volumes of total columns and beams is calculated. After the calculation, the total volume is multiplied with the self-weight of the concrete which is 2,4 t/m^3. The nodes for the calculations are shown in Figure 7.
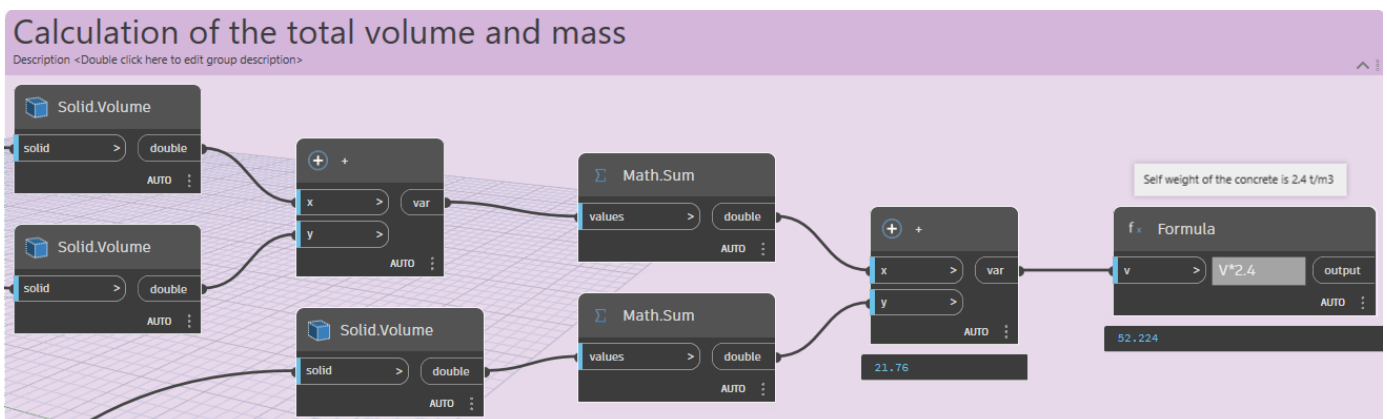

Figure 7: Calculation nodes.

3 Conclusion

This model aims to identify the most efficient arrangement that minimizes concrete usage. For a consistent area which is chosen as 12x12 meter two different layouts is chosen (Figures 2 and 3). The total volume (m^3) and mass (tones) of concrete for Option 1 (6 meters between horizontal and vertical grids) is shown in Figure 8 and for Option 2 (4 meters between horizontal and vertical grids) is shown in Figure 9.
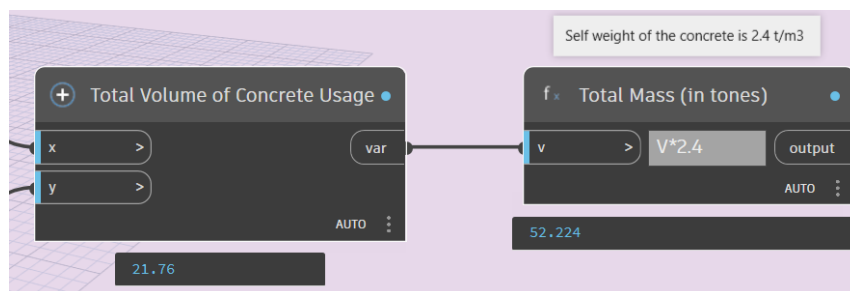

Figure 8: Results for Option 1.

Figure 9: Results for Option 2.

To sum up, in my pursuit of an optimal preliminary design, I sought to explore various column and beam layouts within a defined area, focusing on the efficient utilization of concrete. We can observe the impact of these configurations (grids spacing, sizing of the columns and beams) on the total volume of concrete required with this model.

4 References

Emil. (2022, August 10). *Tributary Areas of Columns and how to Best Calculate them*.

Tribby3d. https://tribby3d.com/blog/tributary-areas-of-columns/

Firas Noori. (2018, March 9). *Points types in Dynamo _ Reference V.S abstract points*

[Video]. YouTube. https://www.youtube.com/watch?v=lMrD6arcZho

TÜRK STANDARDI TS 500 BETONARME YAPILARIN TASARIM ve YAPIM KURALLARI

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