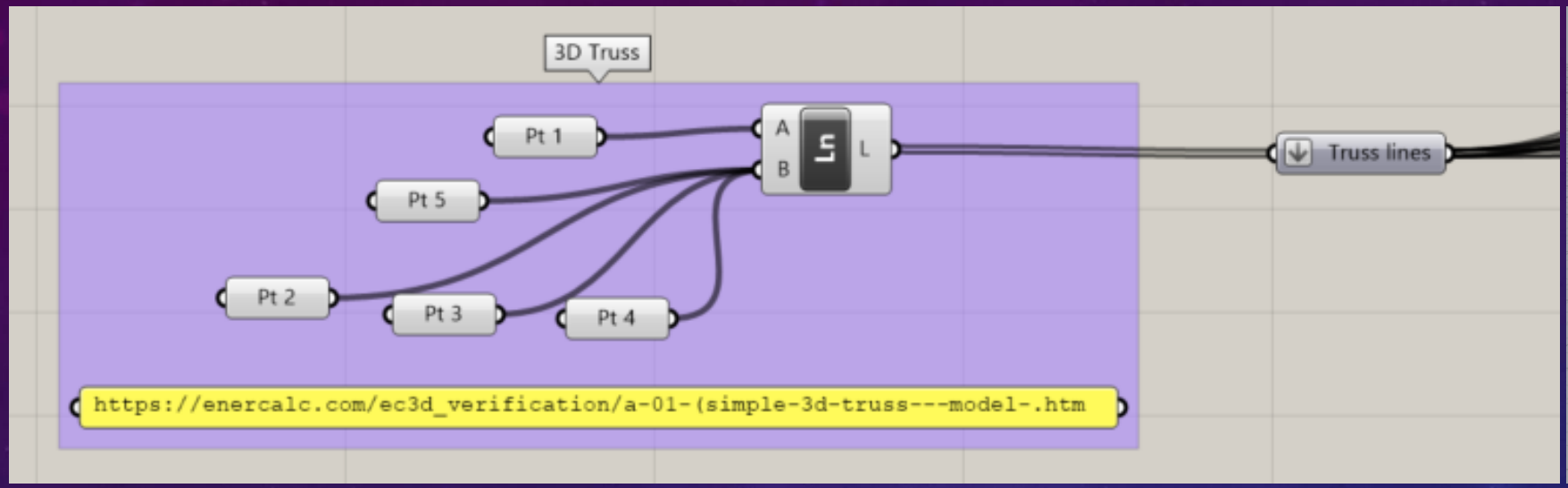
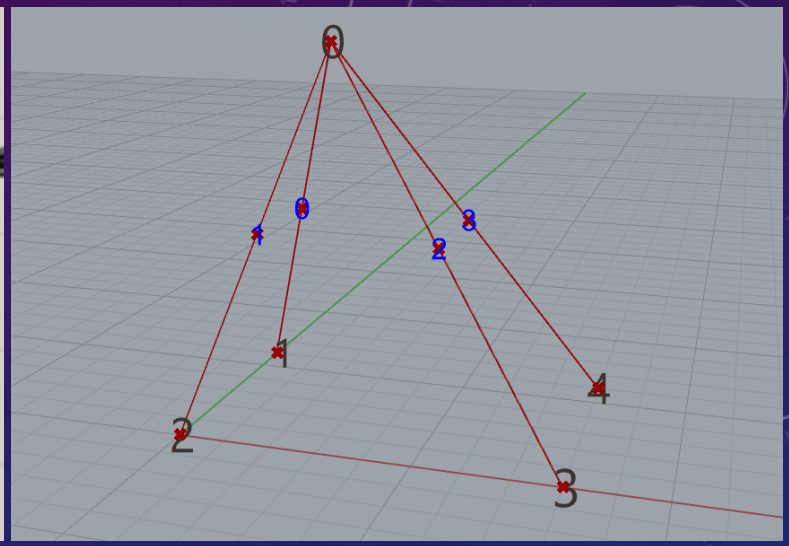
TRUSS ANALYSIS

GRASSHOPPER + PYTHON SCRIPT

1. Create the 3D truss model in Grasshopper and connect to the component “Truss lines”:



Grasshopper (code)

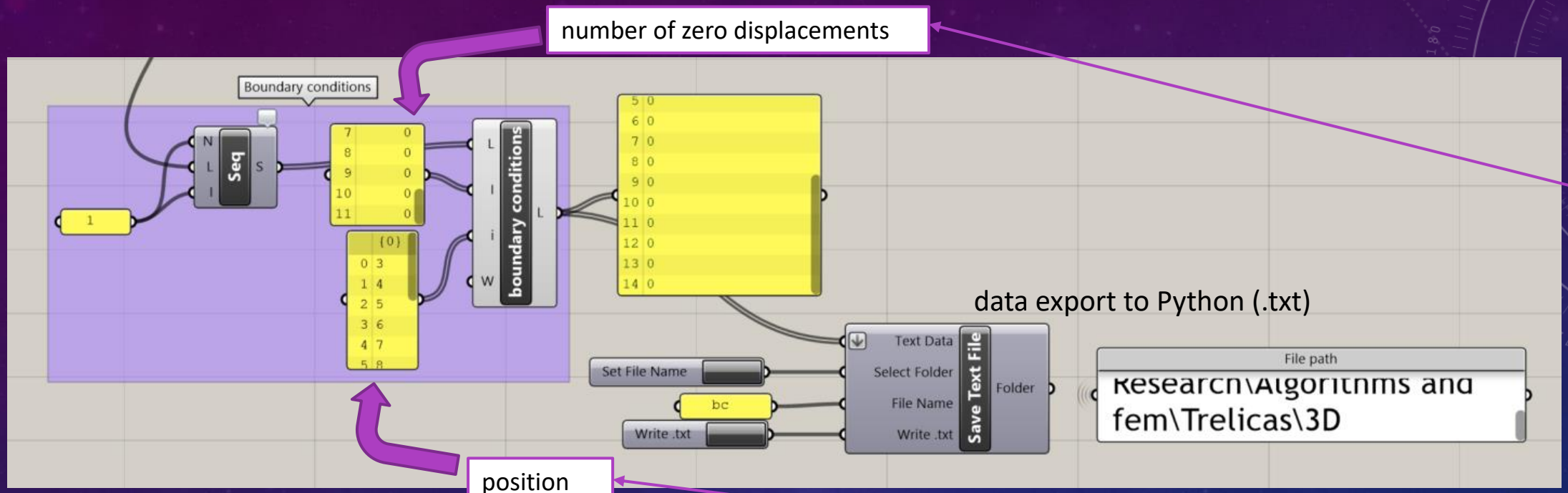


Rhinoceros (view)

- The program automatticaly number the truss lines and points.

2. Define the boundary conditions (supports):

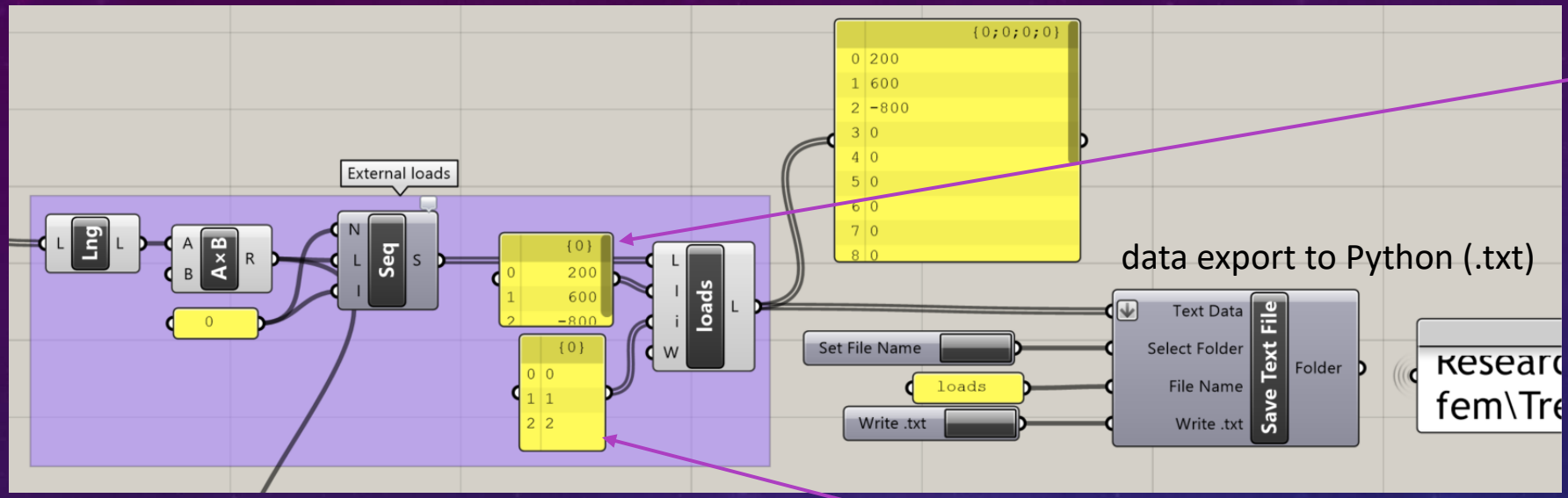
displacement vector



$$\delta = \begin{pmatrix} x1 \\ x2 \\ x3 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \\ 11 \\ 12 \\ 13 \\ 14 \end{matrix}$$

- Define the nodal displacement constraints (x,y in 2D model or x,y,z in 3D model) according to the position of the supports.
- The two lists marked above describe the global displacements according to the displacement vector.
- In the example, nodes 1, 2, 3 and 4 are restrained (fixed) in x,y,z. Thus, there are 12 zeros (4x3) located in the positions 3 to 14.

3. Define the external loads:

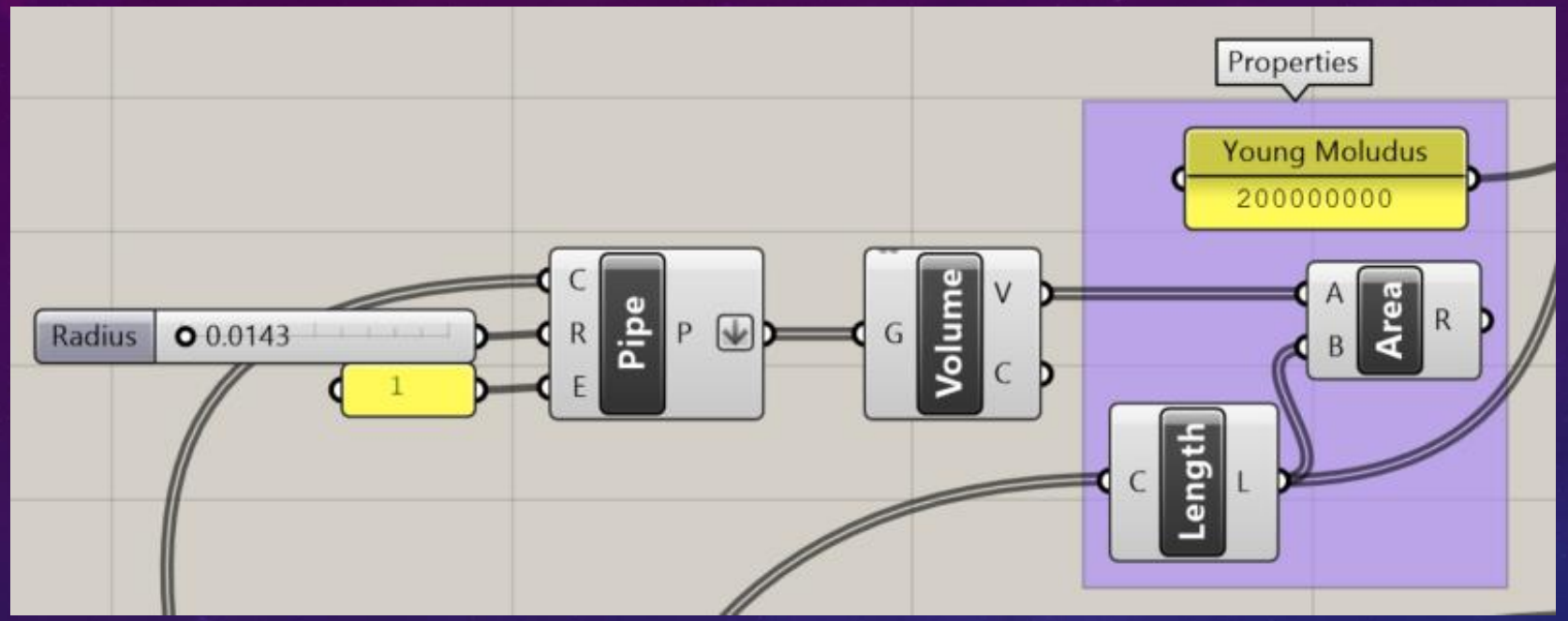


load vector

$$P = \begin{Bmatrix} 200 \\ 600 \\ -800 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{Bmatrix} \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \\ 10 \\ 11 \\ 12 \\ 13 \\ 14 \end{matrix}$$

- Define the nodal forces (x,y in 2D model or x,y,z in 3D model) according to the position of the external loads.
- The two lists marked above describe the applied loads according to the load vector.
- In the example, node 0 is loaded in x (200 kN), y (600 kN)) and z (-800 kN) directions.

4. Define the material properties:



- Define the Young Modulus.
- Define the cross-section area.

5. Run the analysis:

- ❑ Open Python script and click “run”.

Notes:

- The data is automatically exported to Python in .txt files:
  - loads.txt (external loas)
  - bc.txt (boundary conditions)
  - coord.txt (nodes coordinates)
  - stiff.txt (axial stiffness of the members)
  - le_coord (lines coordinates)
  - connect.txt (members connectivity)
- The linear system of equations are solved using Gaussian elimination.

6. Check the results:

“displ” = vector of global displacements;

“ff” = internal forces;

“RV” = reaction values.

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