Full Girder Modal Analysis

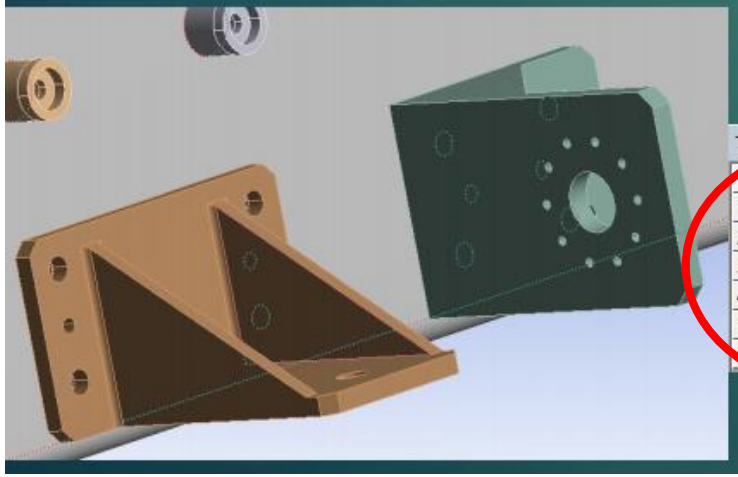
07-08-19

Feedback from Henri's Analysis:

- Current design appears to show a natural frequency at or around 50Hz
- Changing the position of the brackets on the girder can have a significant effect on the natural frequencies
  - Increasing the height of the brackets was shown to be significant
- The additional mass added to the Accelerating Structures (e.g. vacuum pumps, waveguides, manifolds) also has a significant effect and should be accounted for

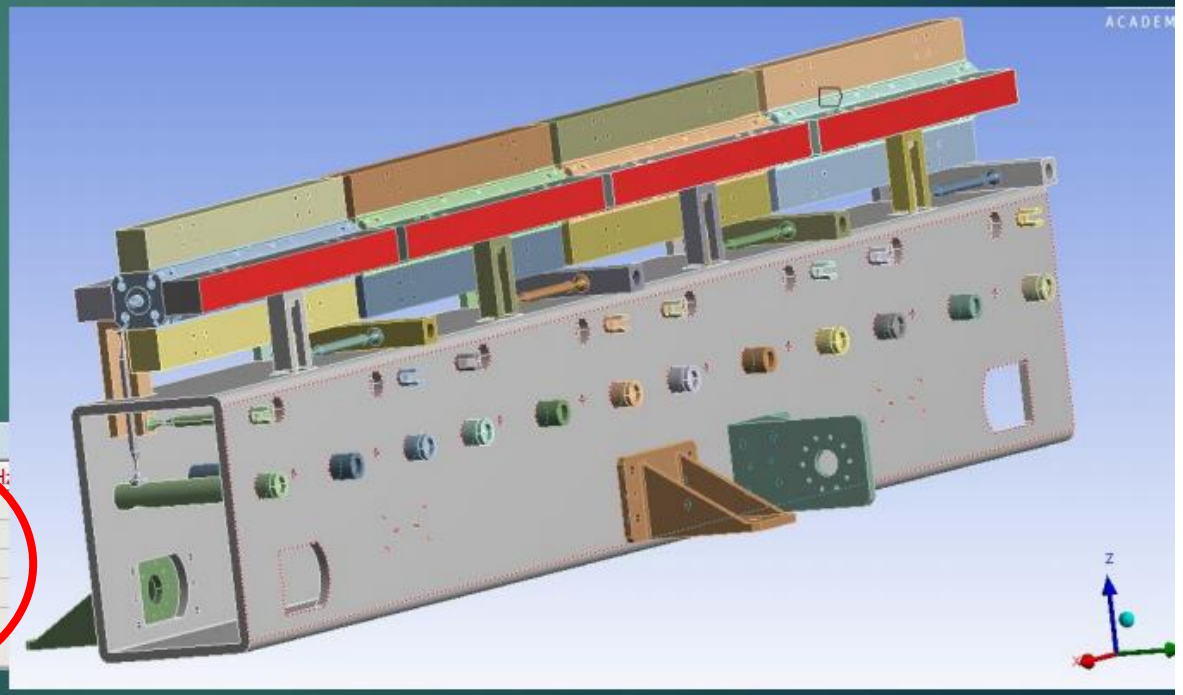
Improved bracket

- 1. twisting around X axis
- 2. X direction
- 3. Z direction



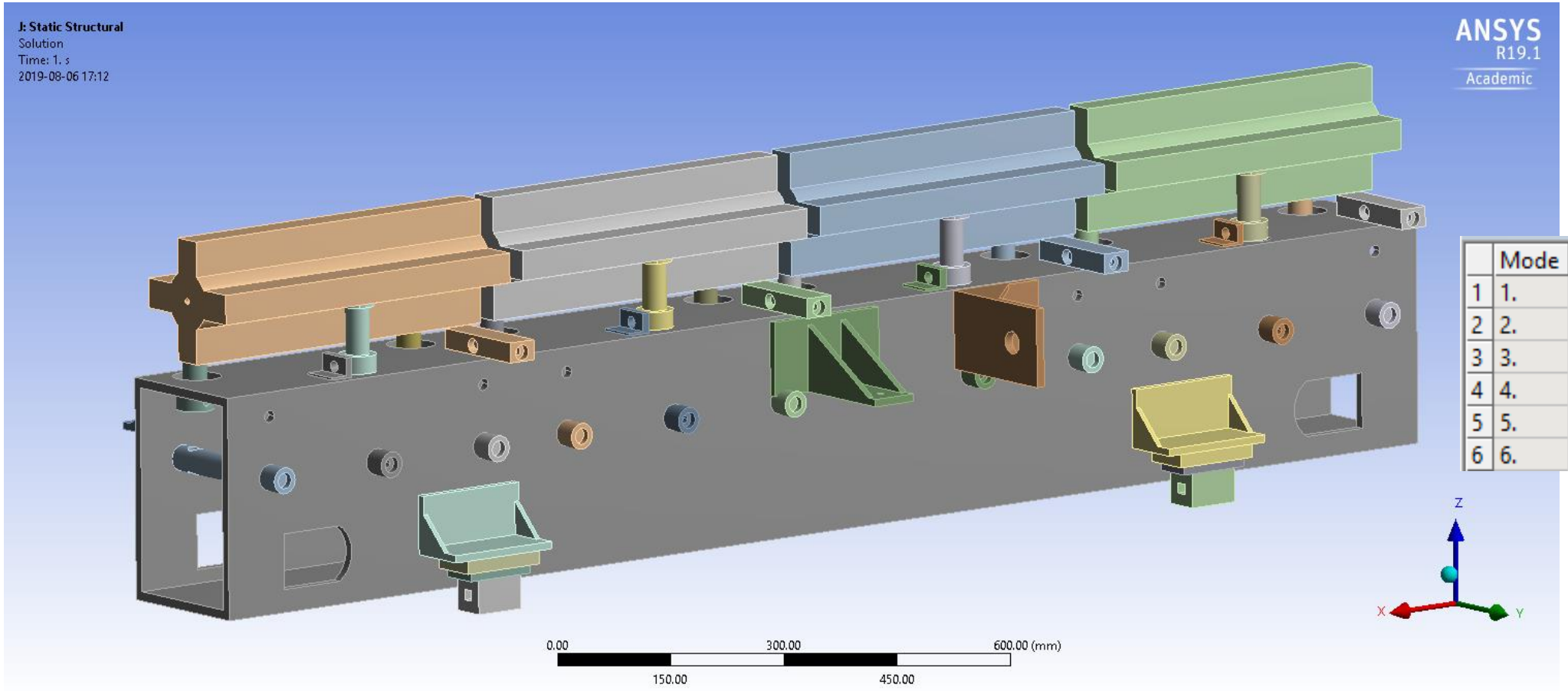
Tabular Data

	Mode	Frequency [H:
1	1,	42,019
2	2,	53,641
3	3,	72,248
4	4,	90,006
5	5,	98,709
6	6,	124,61



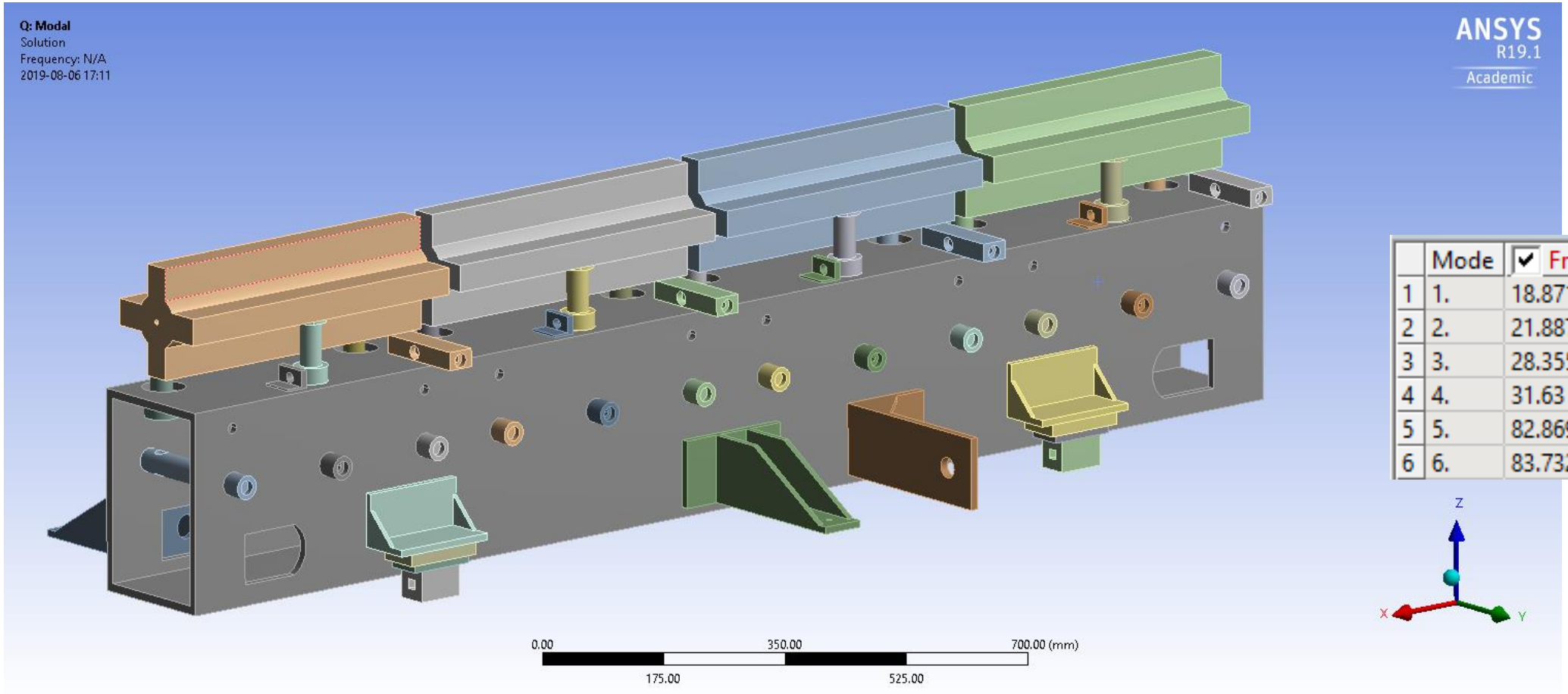
Credit: Henri Berg, 31/07/2019

Increasing Mounting Height



	Mode	Frequency [Hz]
1	1.	34.643
2	2.	70.592
3	3.	79.424
4	4.	81.581
5	5.	83.641
6	6.	84.946

Increasing Mounting Width



	Mode	Frequency [Hz]
1	1.	18.871
2	2.	21.887
3	3.	28.355
4	4.	31.63
5	5.	82.869
6	6.	83.732

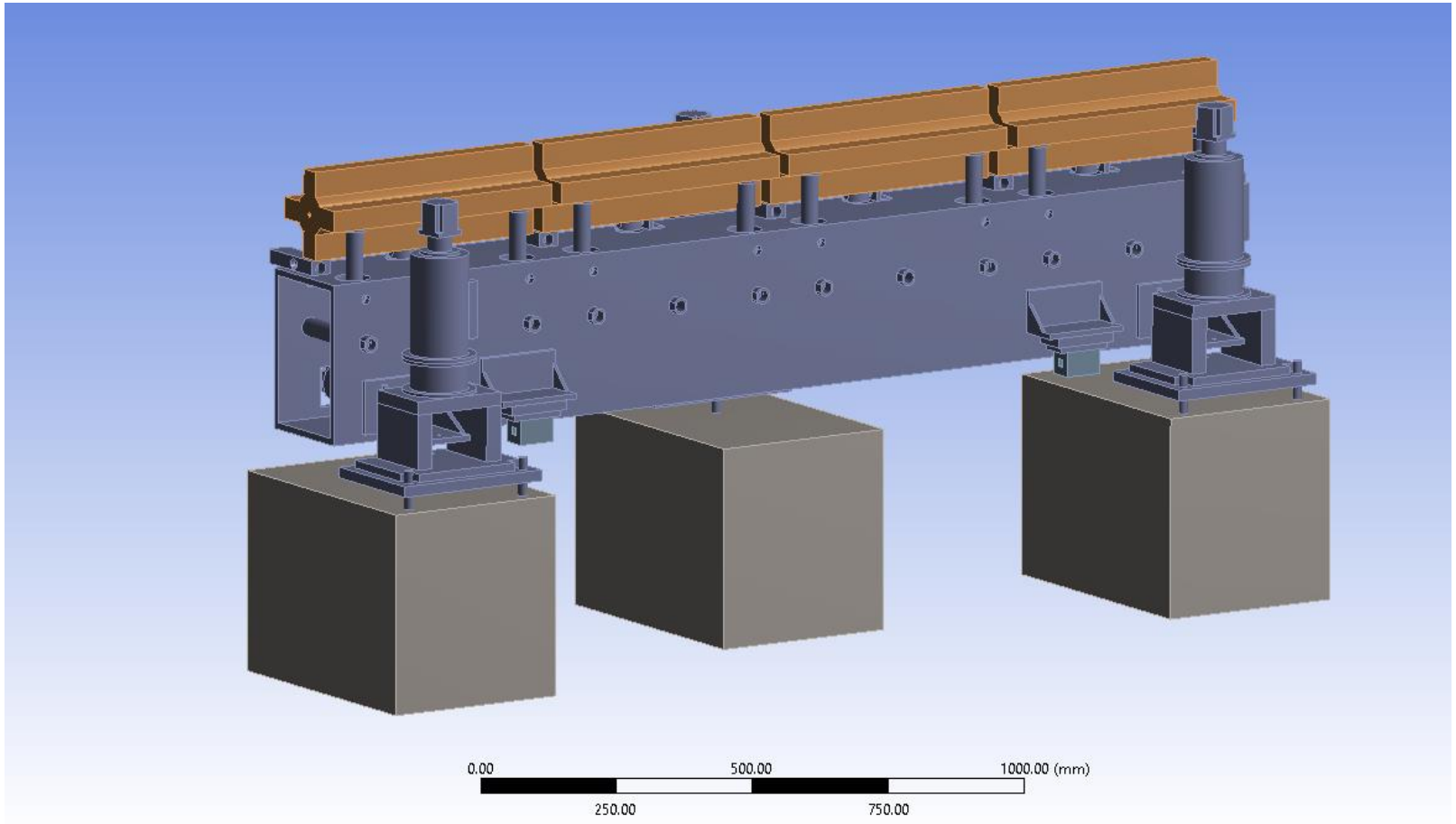
Bracket Position/Design Affect

- The natural frequencies can be tuned away from 50Hz by altering the height/width of the mounting brackets
- However this is highly dependent on the additional mass added to the Accelerating Structures
  - More accurate models including more the vacuum pumps and wave guides should be used

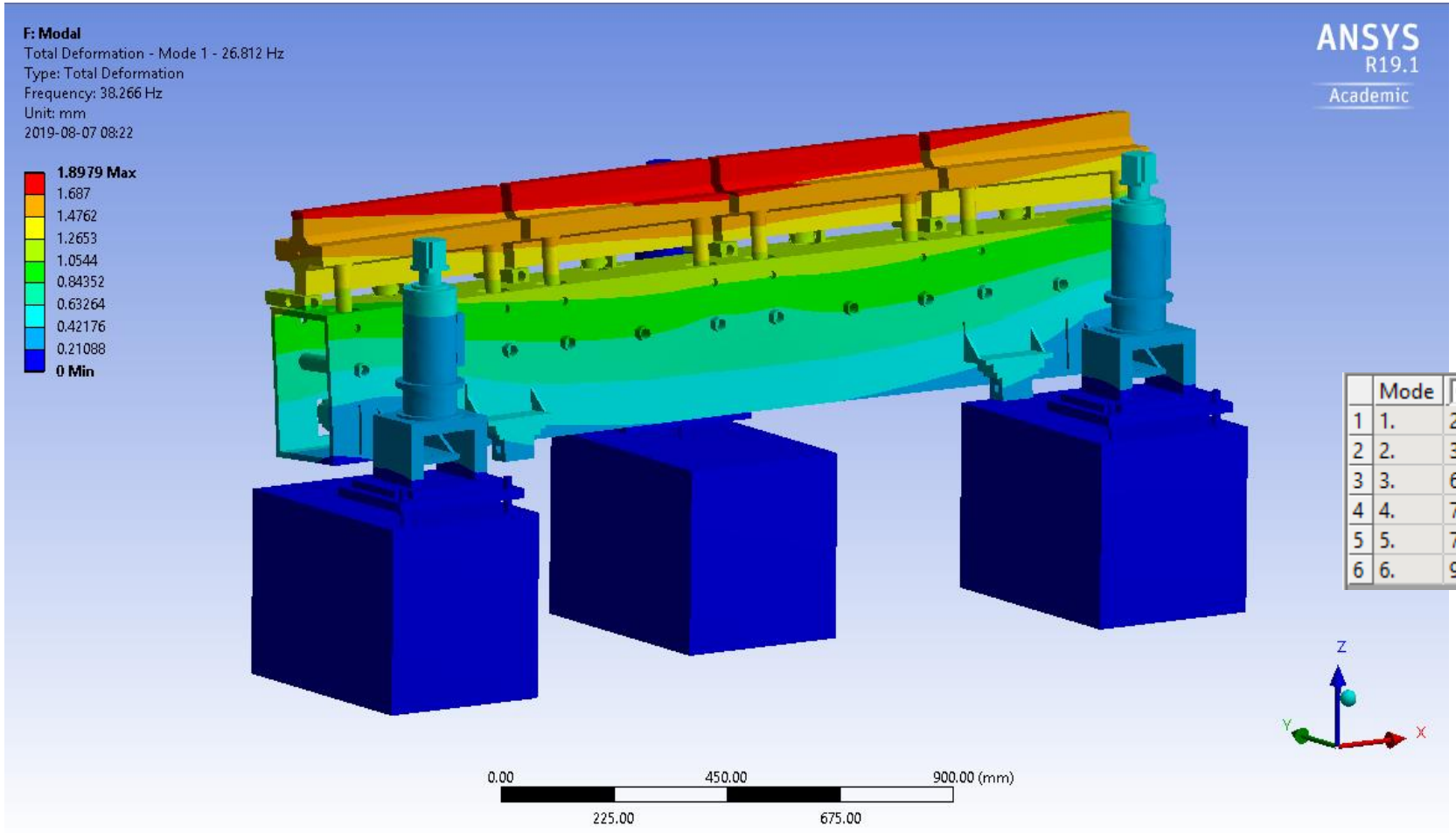
Feedback from Juha’s MBQ Analysis:

- The dominant frequencies were highly dependent upon the stiffness's of the base and supporting structures
- Some of the frequencies were not identified until they carried out an Experimental Modal Analysis
  - The tunnel floor
  - The levelling wedge mounts

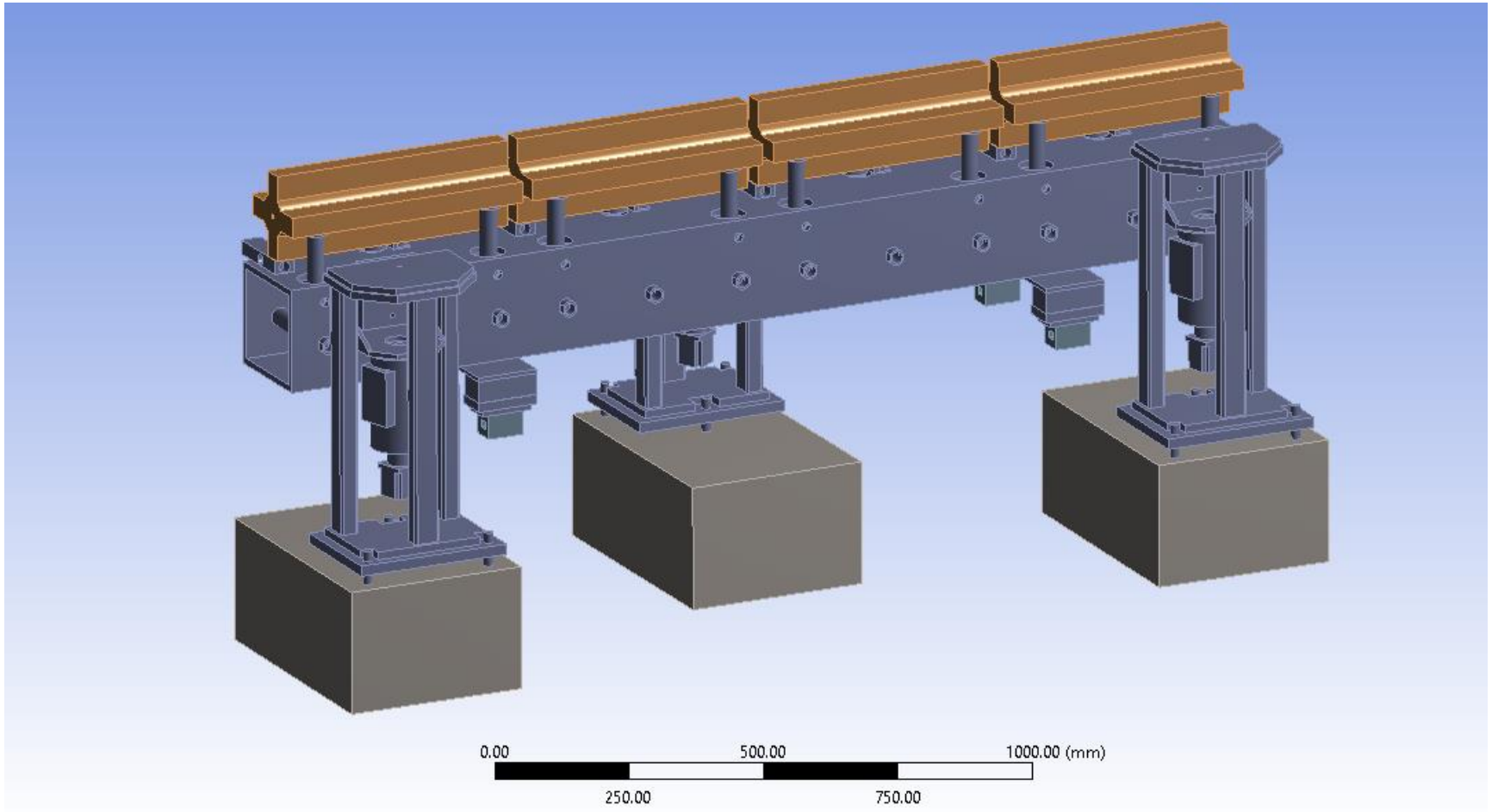
Effect of the Base Design on Natural Frequencies - Current



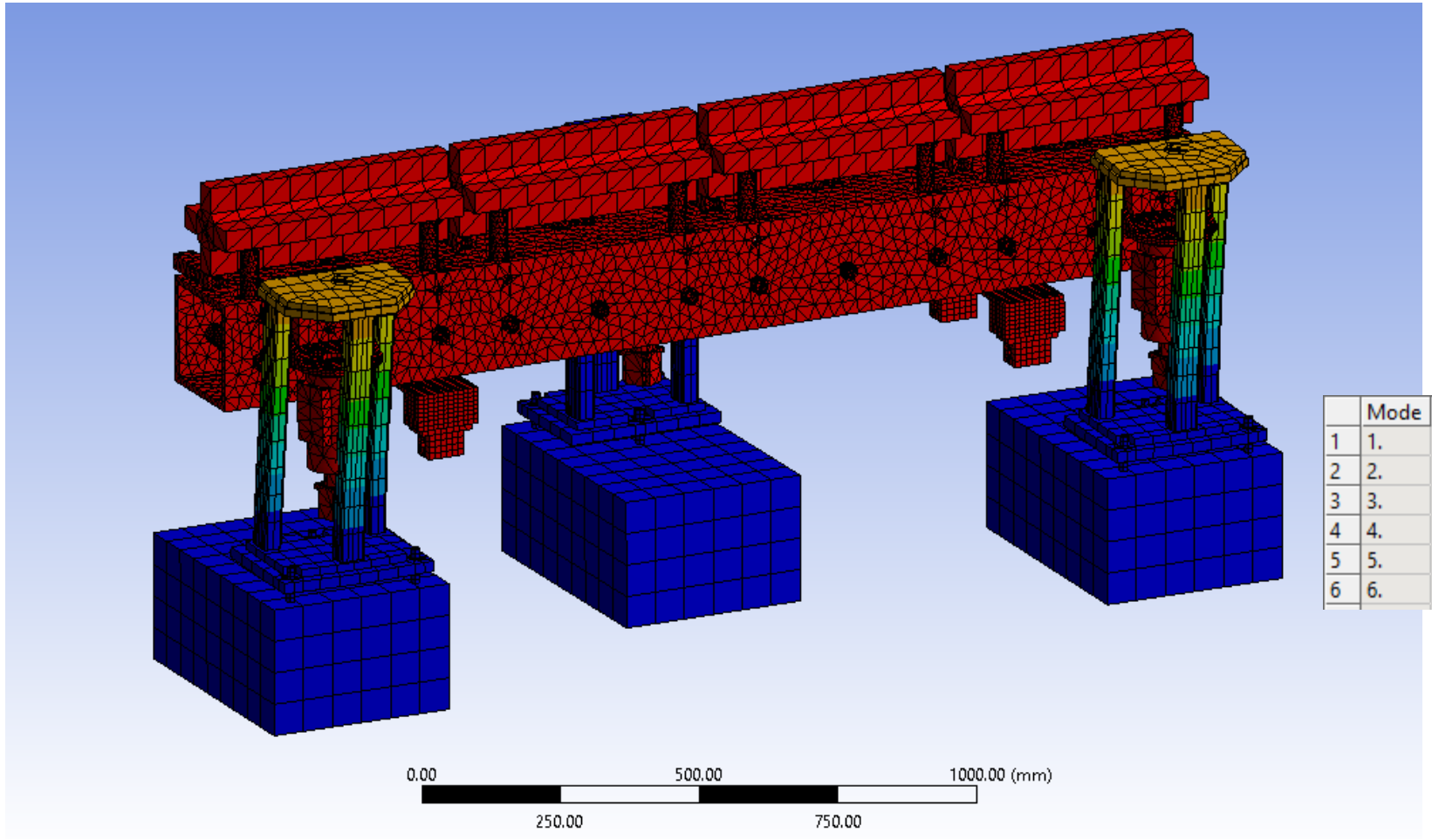
Effect of the Base Design on Natural Frequencies - Current



Effect of the Base Design on Natural Frequencies – High Brackets



Effect of the Base Design on Natural Frequencies – High Brackets



	Mode	Frequency [Hz]
1	1.	11.377
2	2.	18.263
3	3.	25.278
4	4.	63.416
5	5.	74.419
6	6.	74.42

Notes About Analysis

- Using a relatively simple models:
  - Flexures are modelled as 1-dimensionally-rigid joints, and are not meshed.
    - SAS adjustment flexures
    - Girder level flexures
  - Springs are included as Ansys ‘springs’

- Following Henri’s assumption of 150kg distributed mass across the accelerating structure sides