Laboratoire d'Annecy de Physique des Particules

WP1 ET coordination meeting

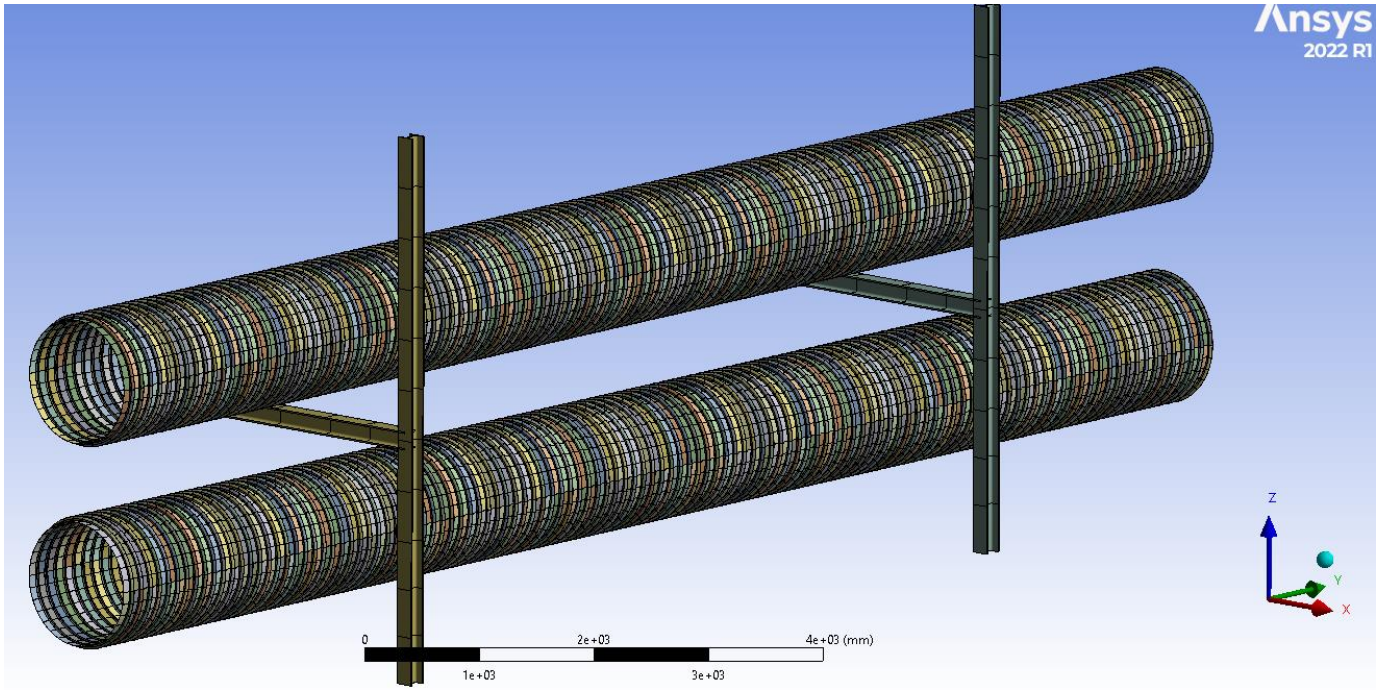
Dynamic simulations of corrugated solution

Friday 20th January 2023

cnrs

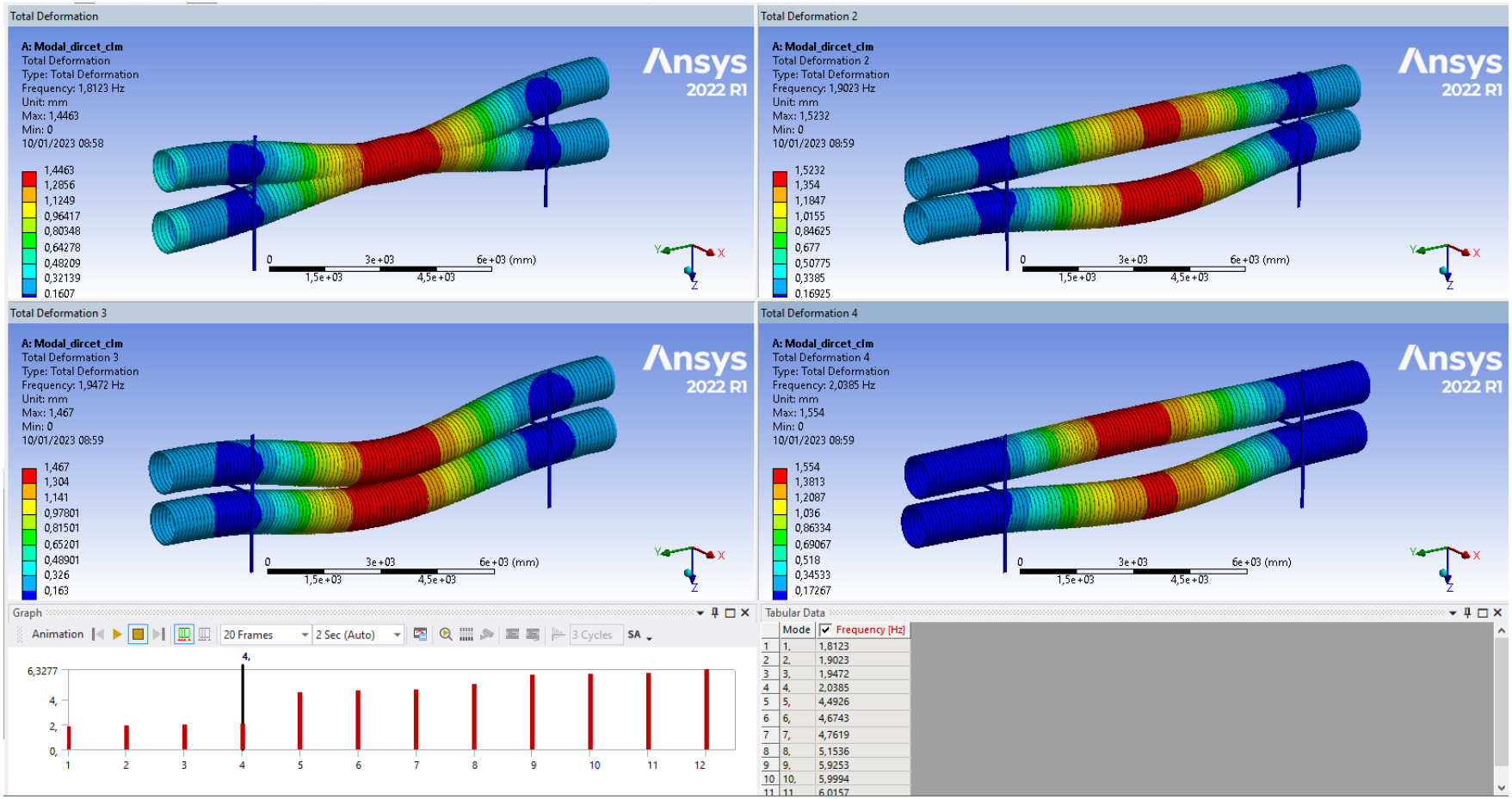
UNIVERSITÉ SAVOIE MONT BLANC

- A first shell and beam FEM realized
- Influence of various supports :
  - concepts
  - locations
  - numbers
- Static loads influence :
  - Gravity
  - Vacuum

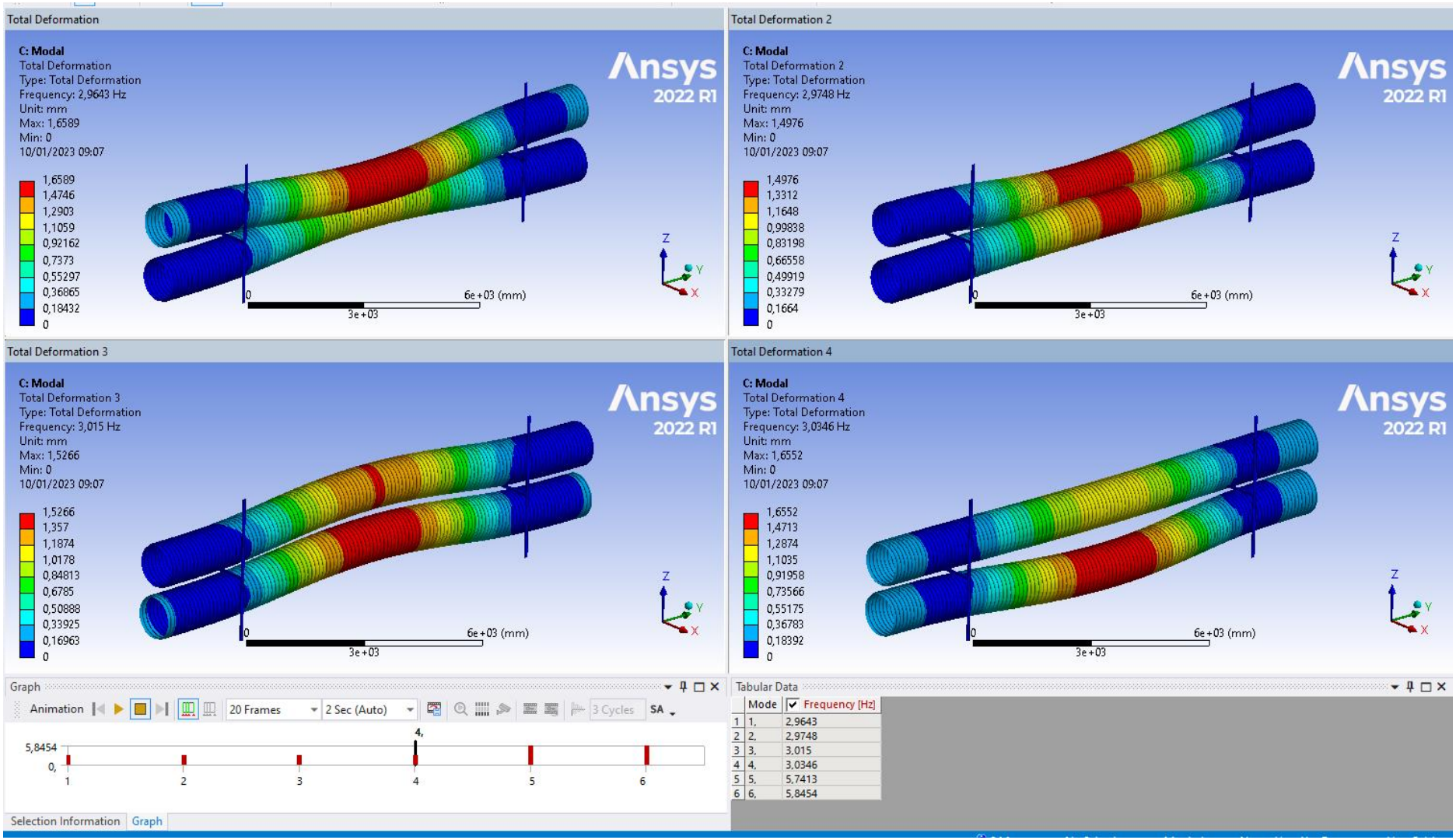


- Corrugated tube in shell elements
- Supports beam elements
- Rigid connections

Modal FEA without influence of static loads



Static loads influence on first modes (gravity & vacuum)



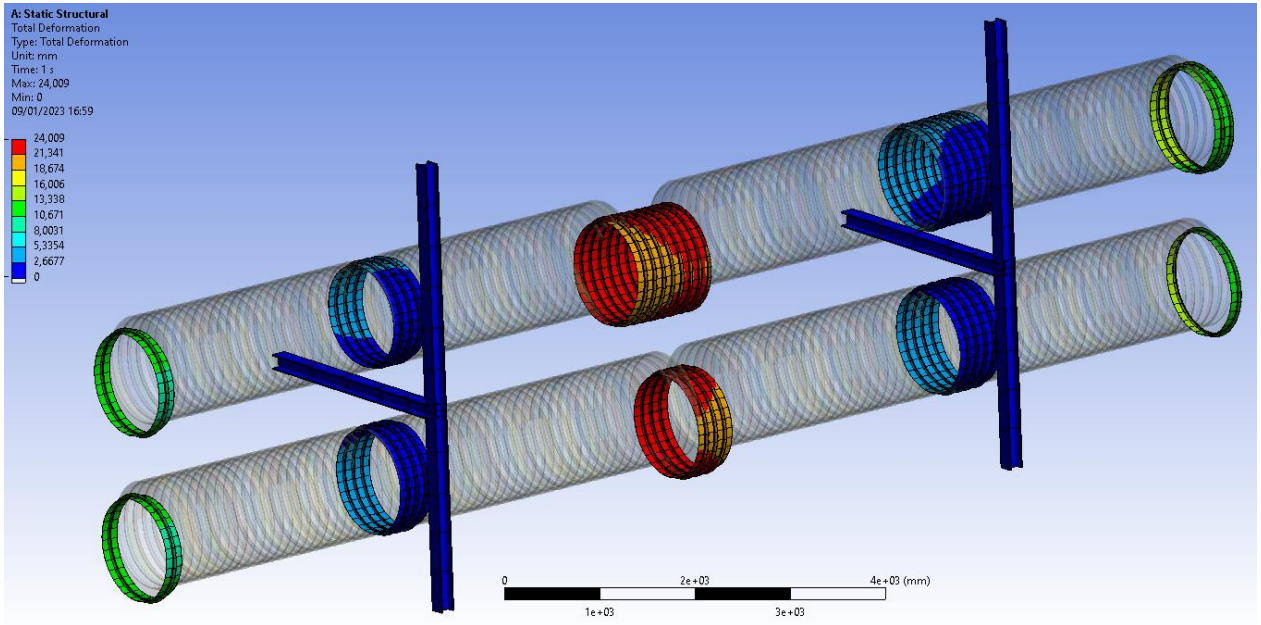
Static loads influence

Mode n°	Frequency [Hz]		
	Without static loads	With static loads	Variation
1	1,8123	2,9659	48%
2	1,9023	2,9753	44%
3	1,9472	3,015	43%
4	2,0385	3,0342	39%
5	4,4926	5,7452	24%
6	4,6743	5,8452	22%

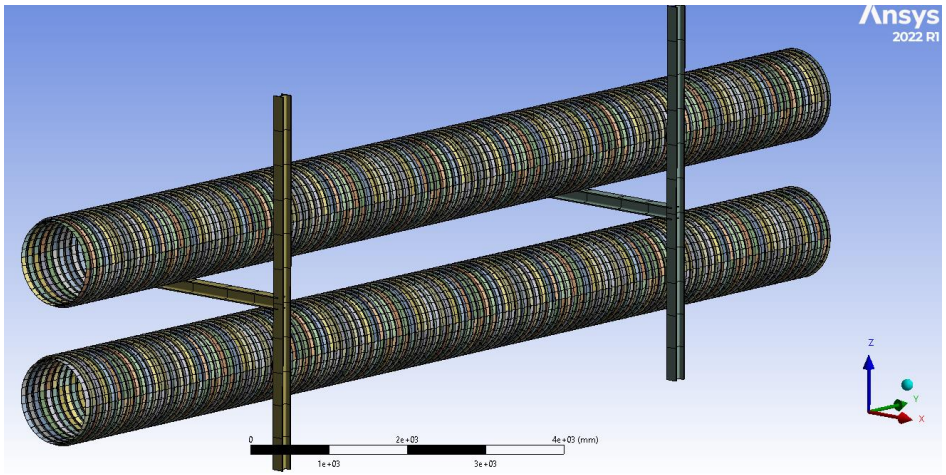
Influence of static load play a significant role
(gravity influence negligible / vacuum)

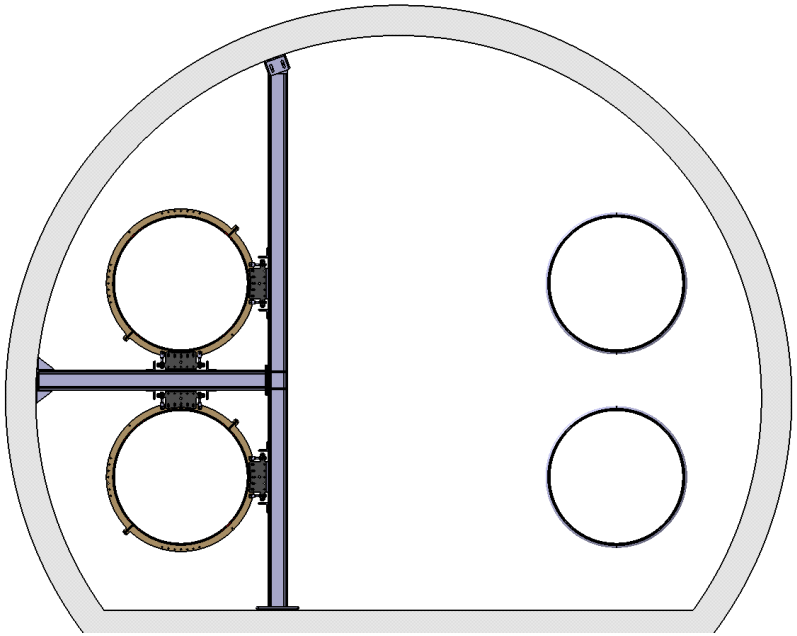
To reduce computing time, some parts of structure are now being condensed :

- This “vacuum stiffing effect” is not taken into account anymore.
- Nevertheless it enable to compare quickly effects of boundary conditions to system ‘s frequency response



2 x HE-160-B Beams

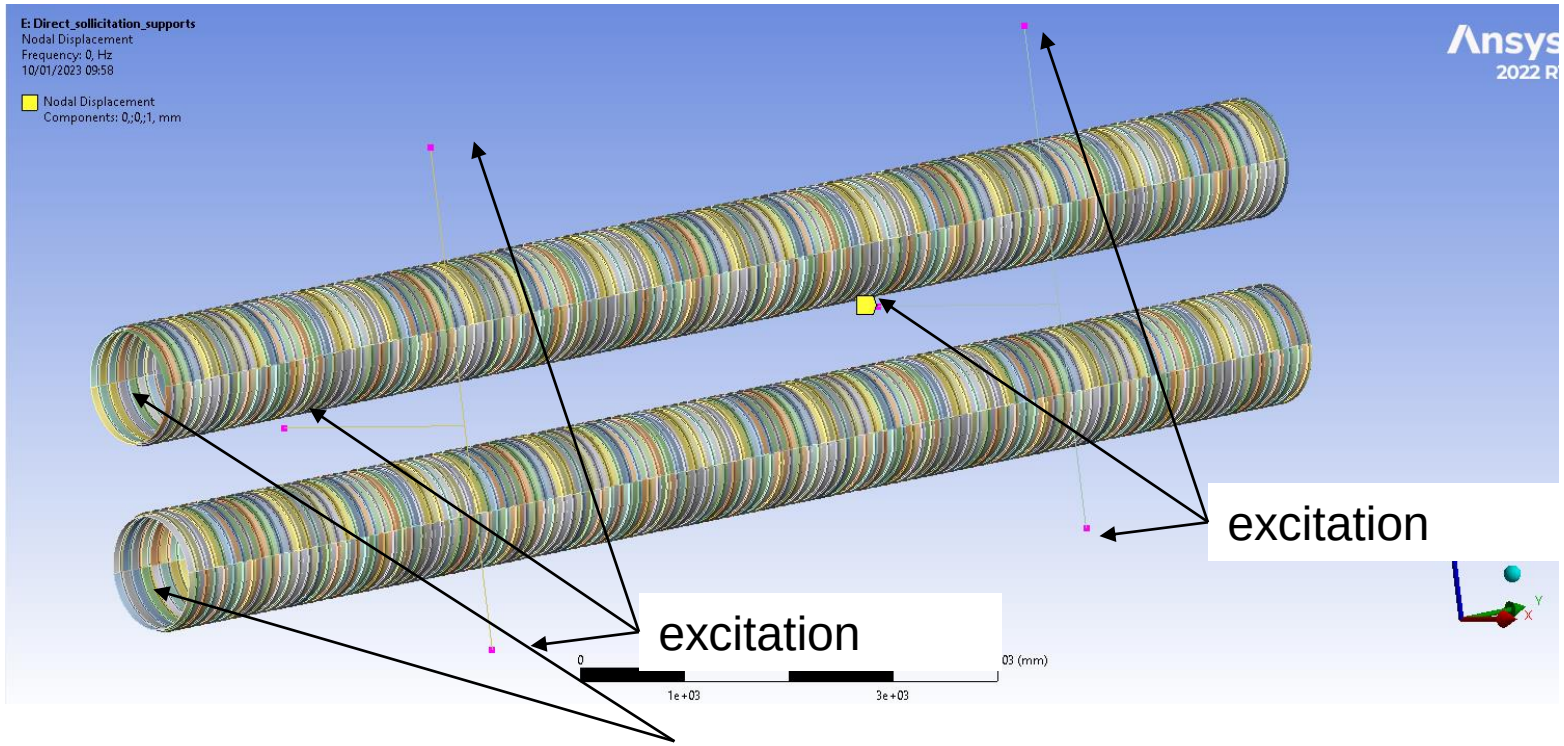




Starting point :

- 2 beams at “best location”
- Symmetry boundary conditions at both ends
- Further plots refers to baffle center displacements :
  - not modeled
  - No mass
  - For top & bottom tubes

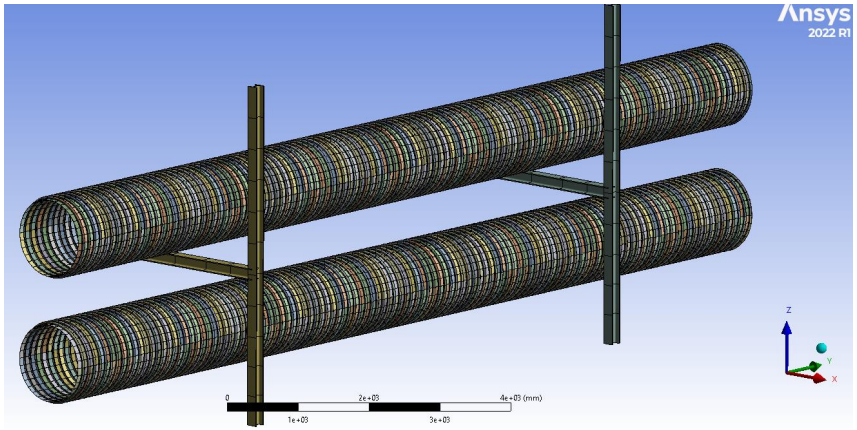
Boundary conditions imposed sinusoidal displacement
Steady state



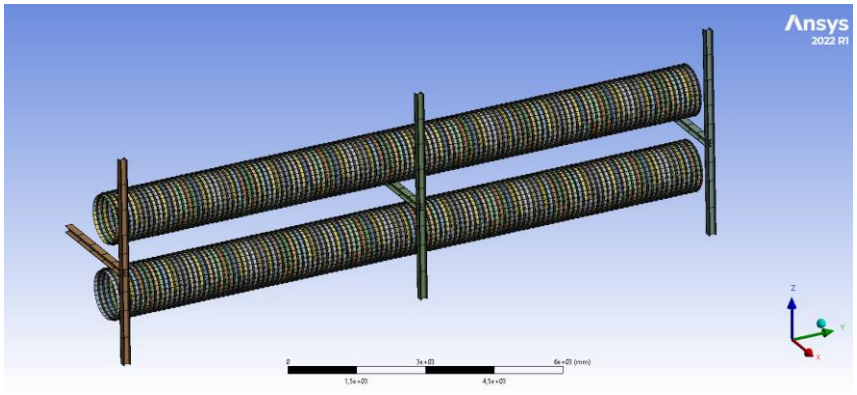
Results : displacements amplitude

Next plots compares following FEM

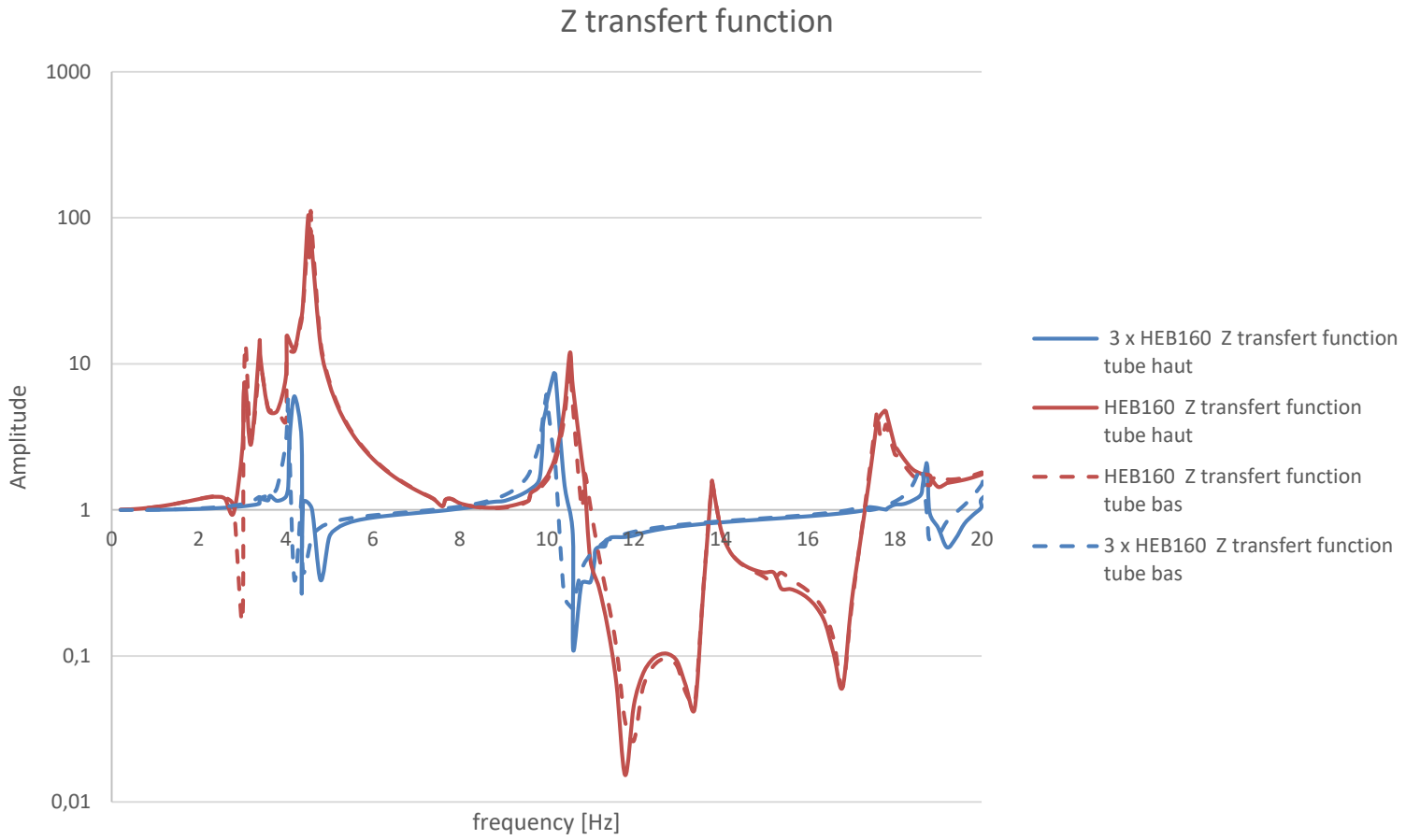
2 supports



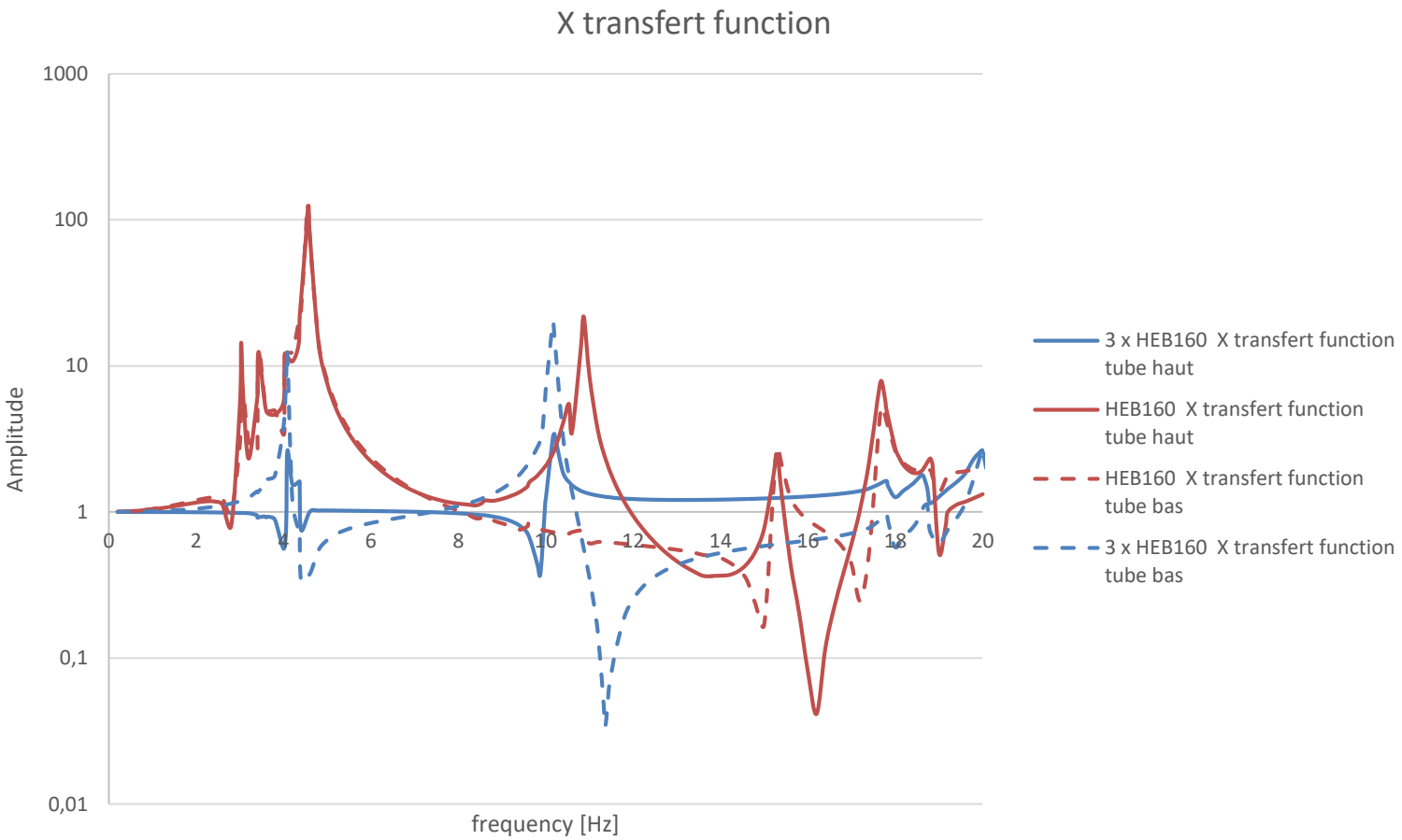
3 supports



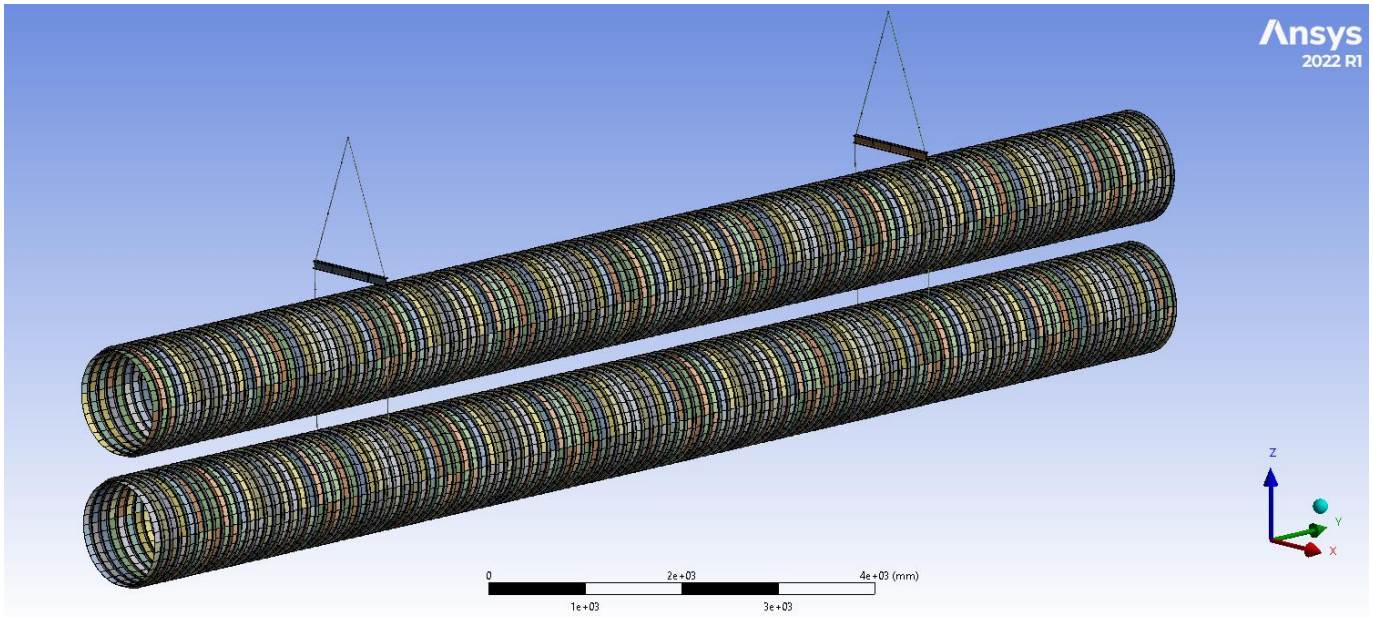
2 Vs 3 supports comparison

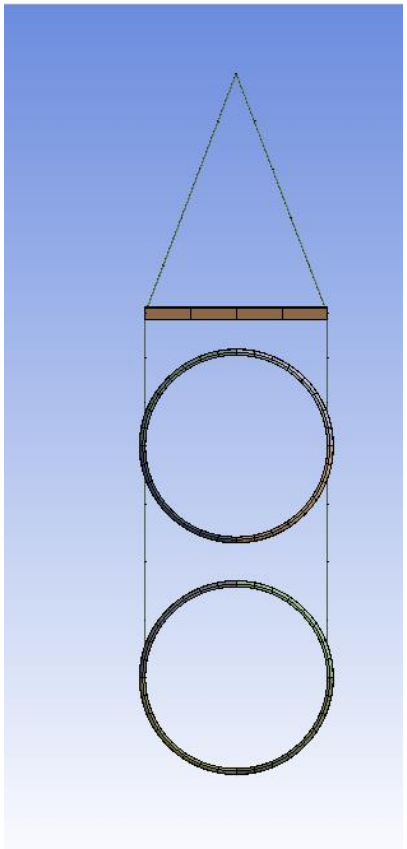


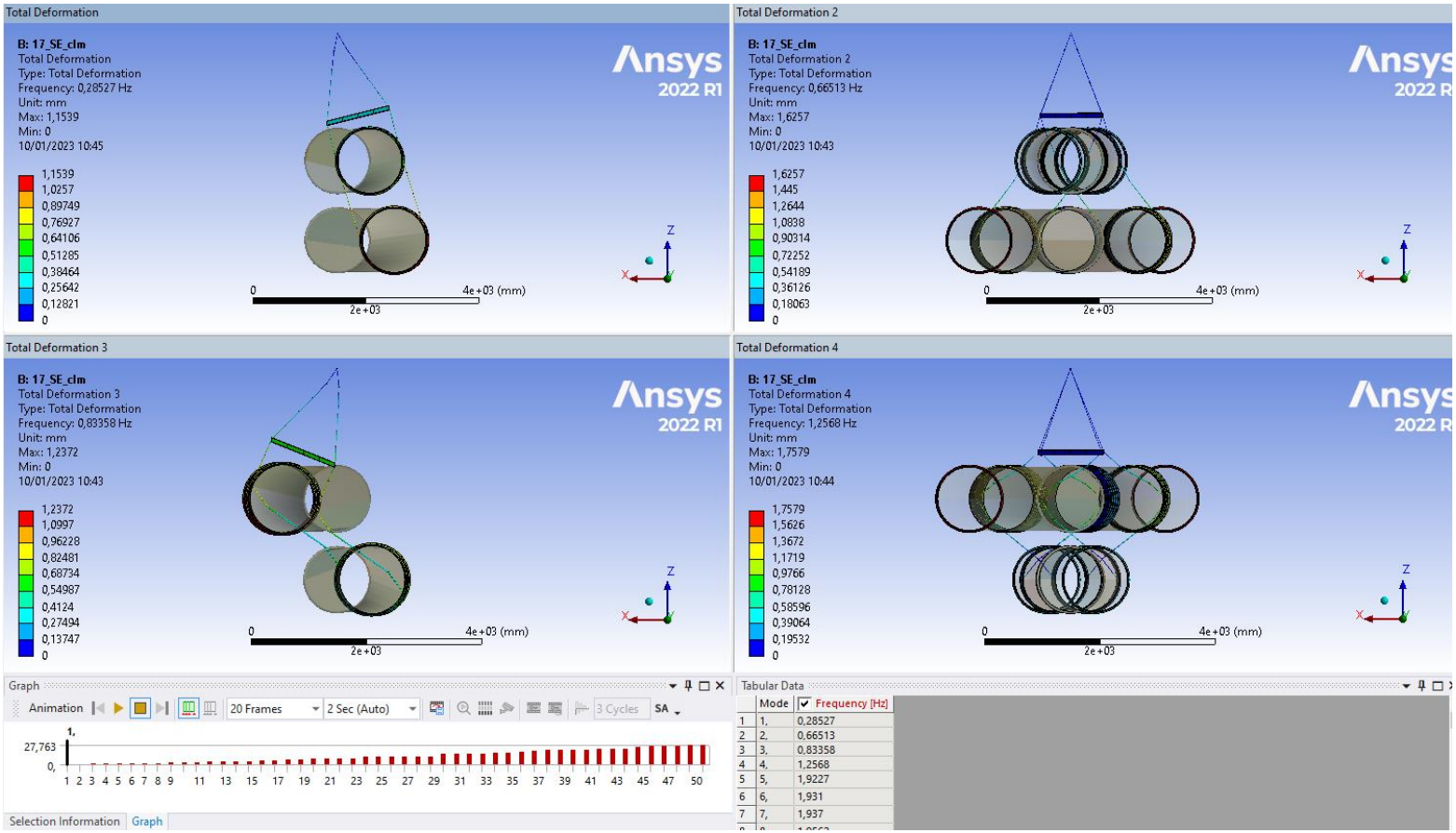
2 Vs 3 supports comparison



Suspended at same locations

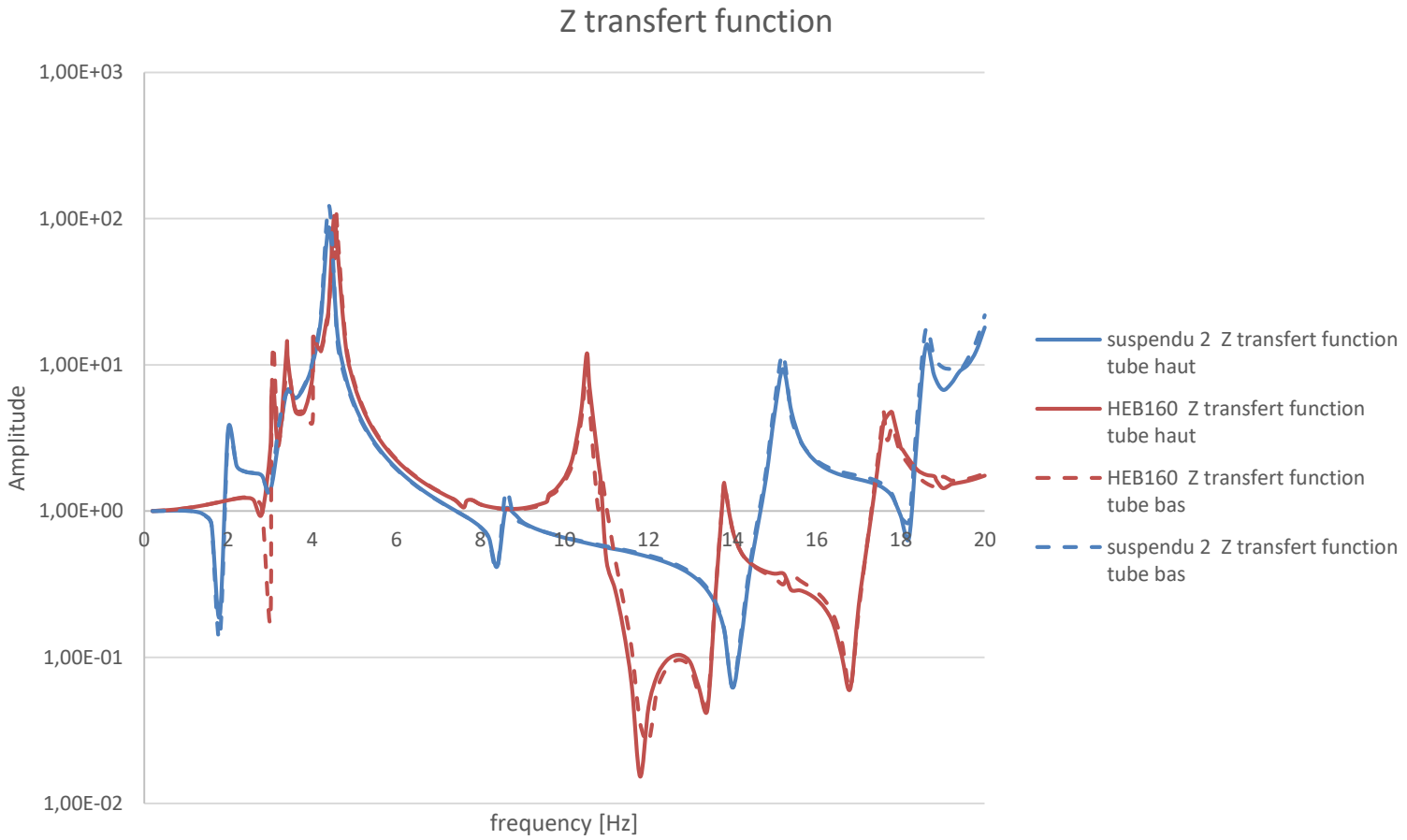




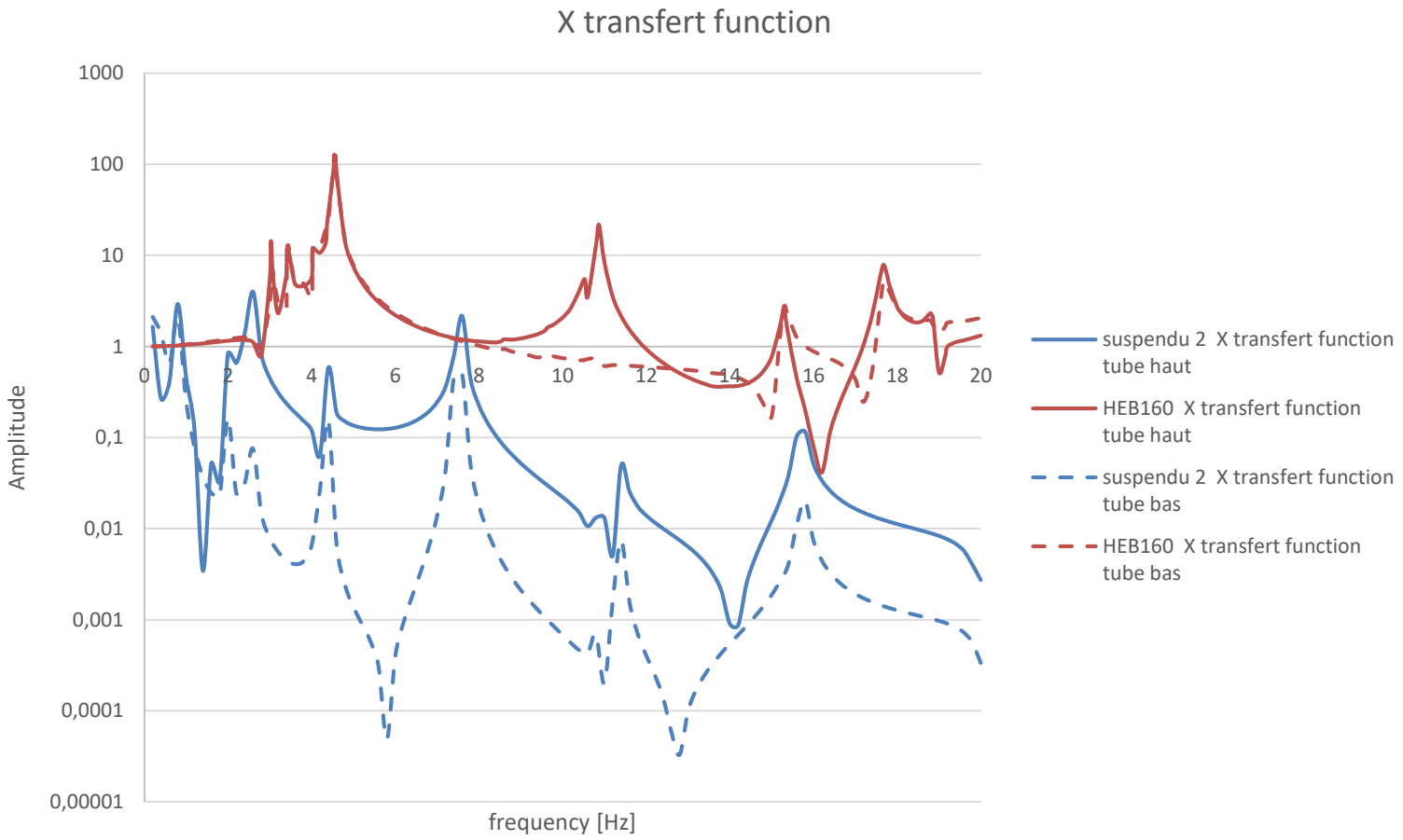


Various pendulum modes at low frequency

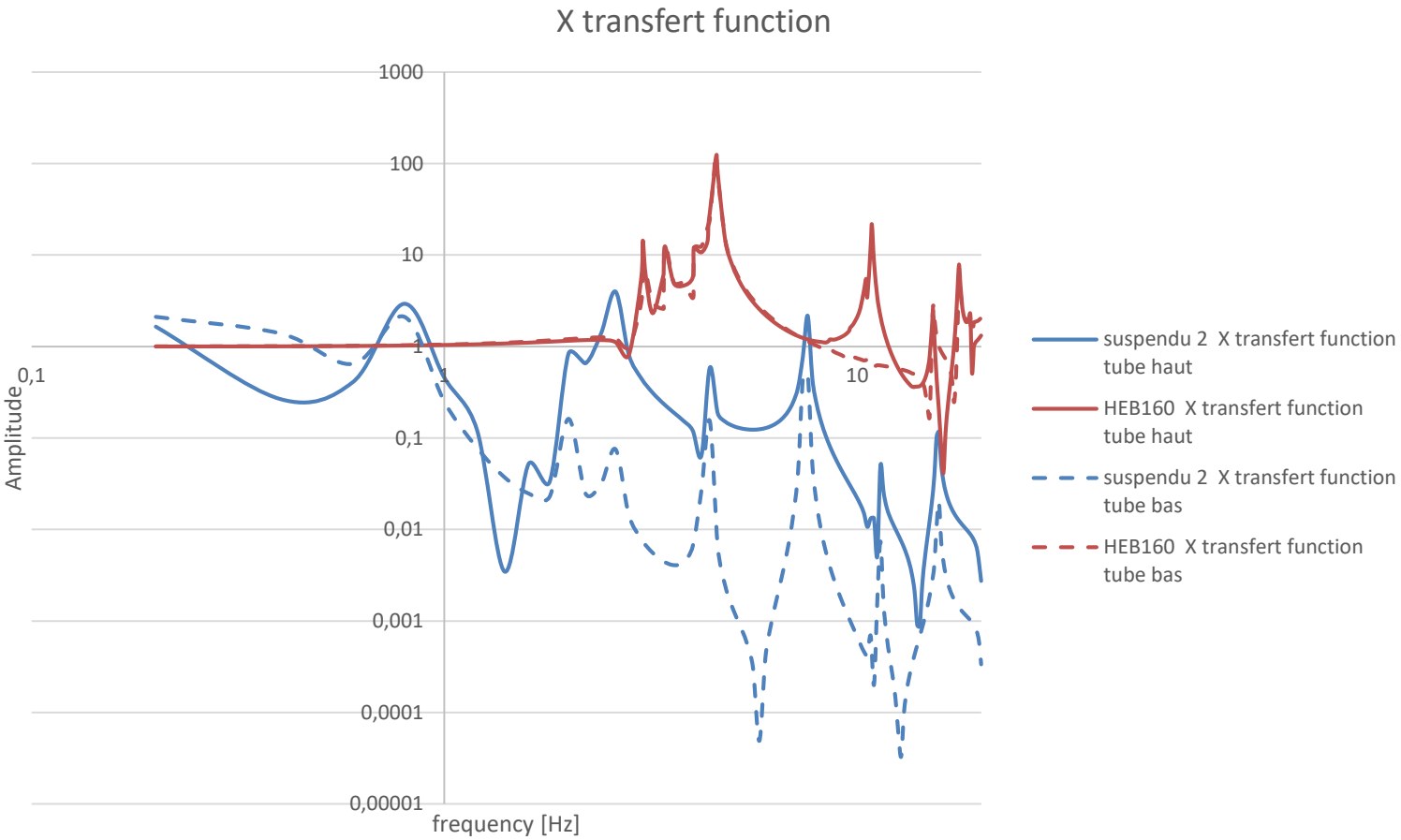
Beams Vs suspended comparison



Beams Vs suspended comparison

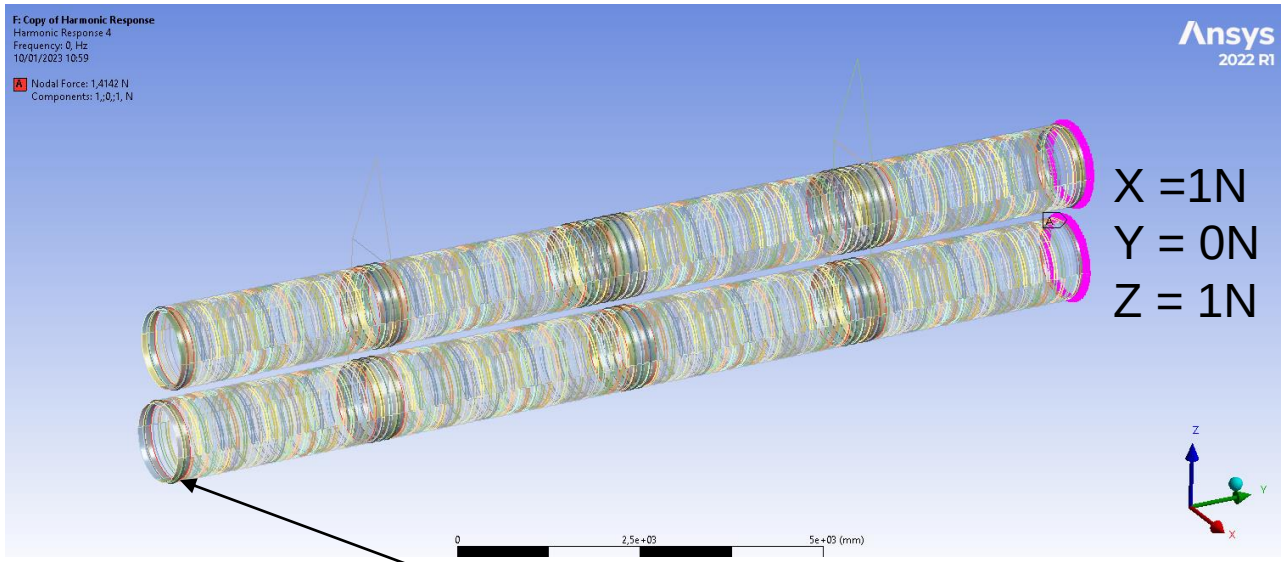


2 Beams Vs suspended comparison



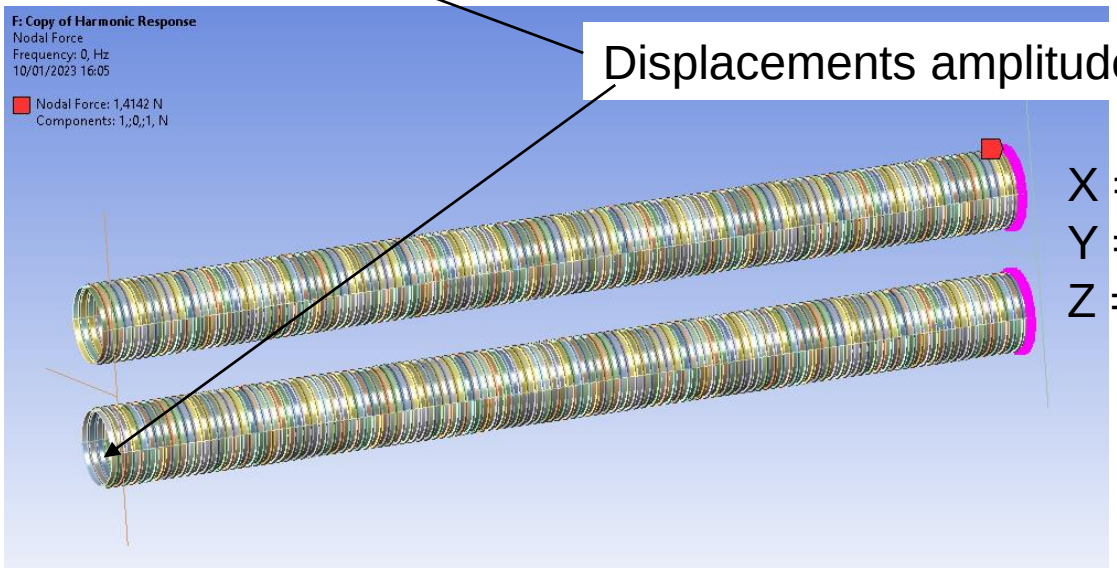
Same plot, frequency log scale
"X low pass filter"

Direct excitation force excitation



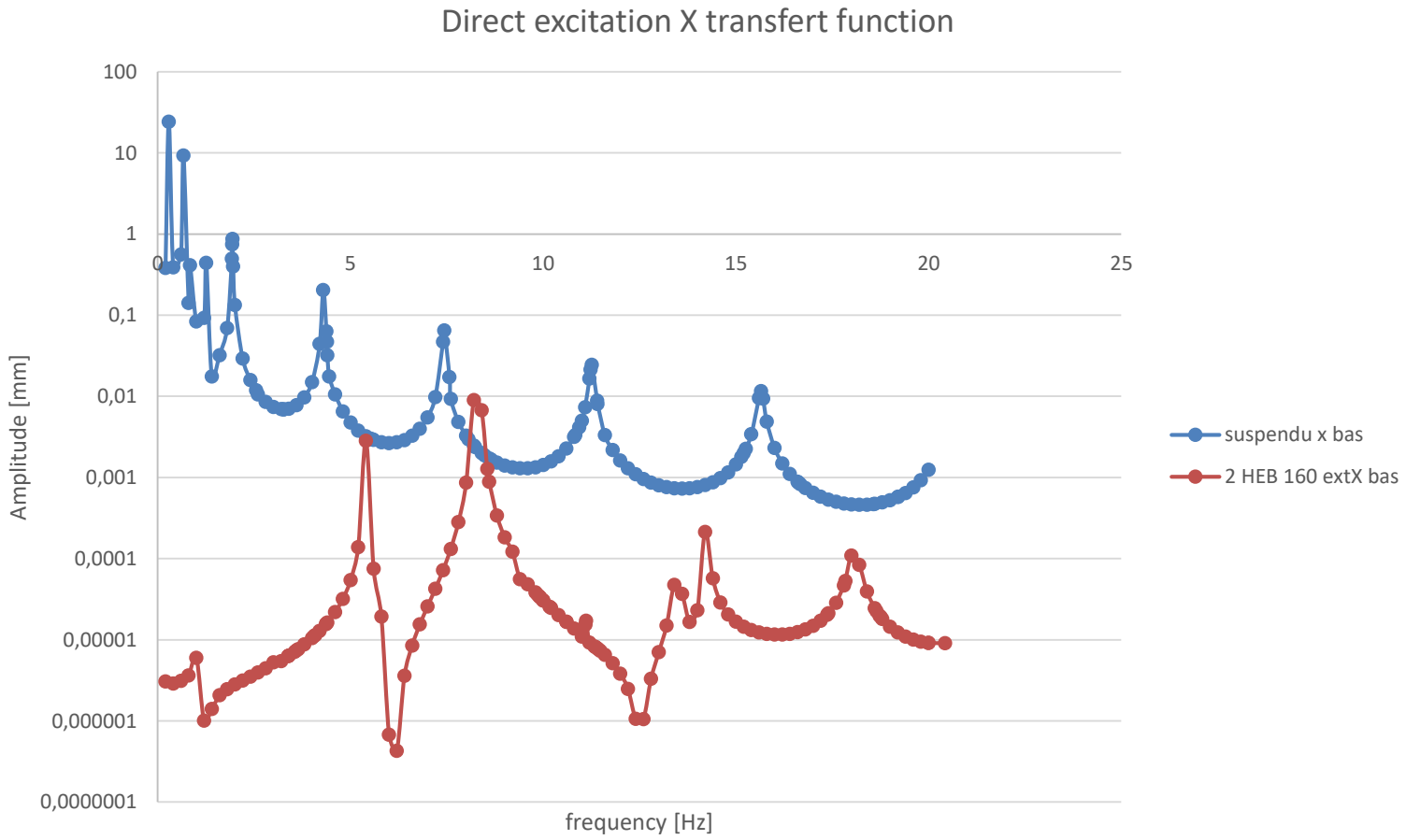
Suspended

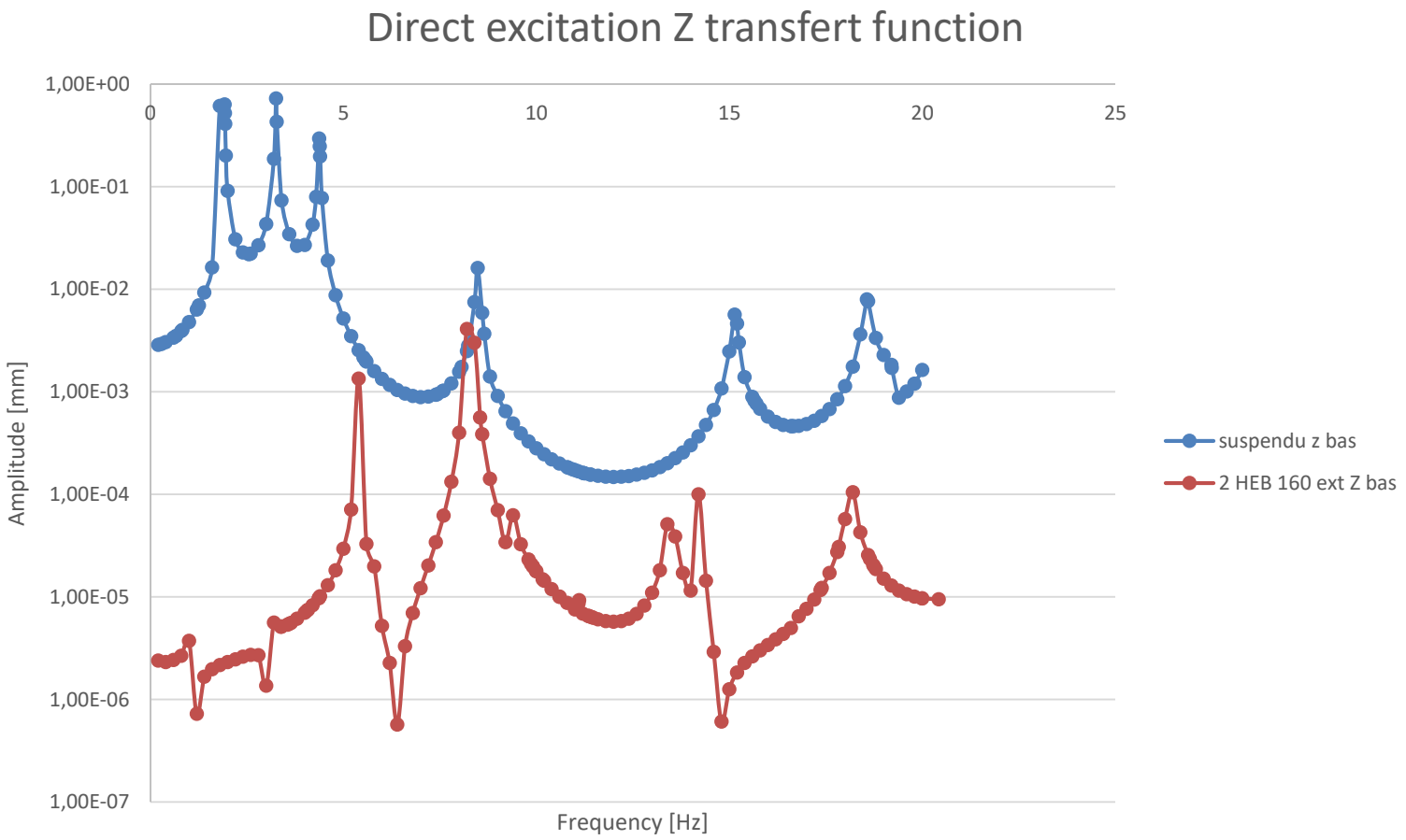
Displacements amplitude



Beams at etremities

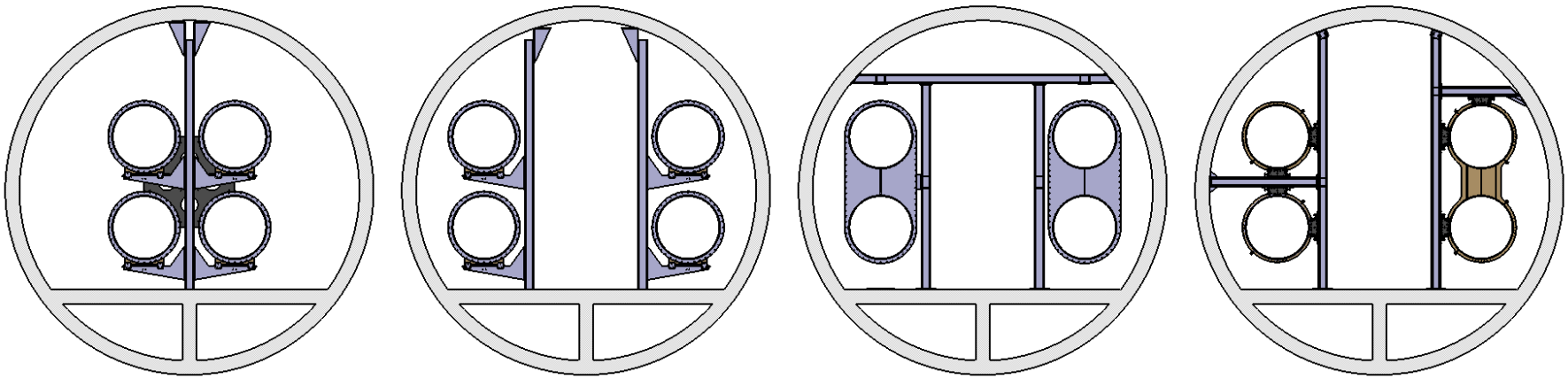
Direct excitation force excitation



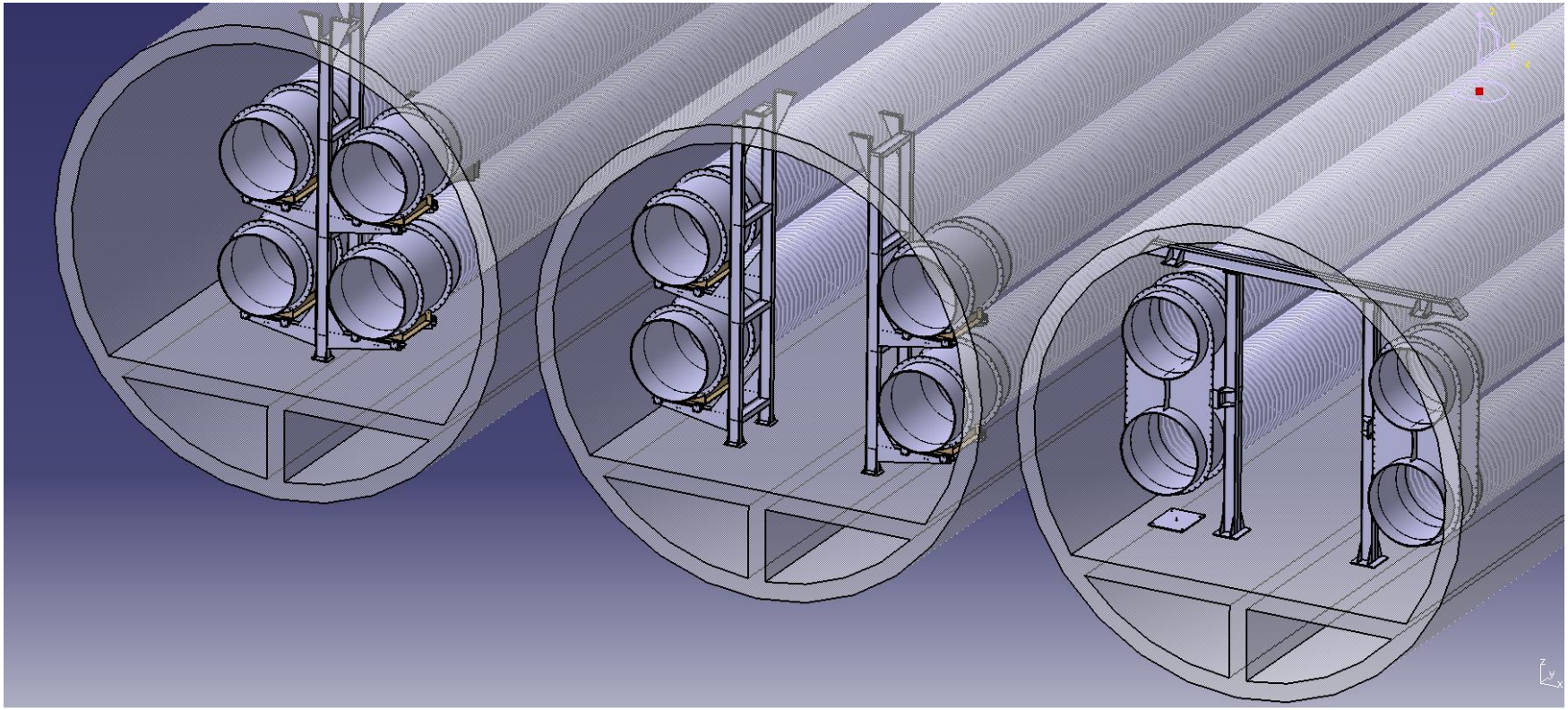

Direct excitation Z transfert function
1,00E+00
1,00E-01
1,00E-02
1,00E-03
1,00E-04
1,00E-05
1,00E-06
1,00E-07
Amplitude [mm]
0
5
10
15
20
25
Frequency [Hz]
suspendu z bas
2 HEB 160 ext Z bas

In parallel, more detailed support ‘s design started

Different solution illustrated by Bruno



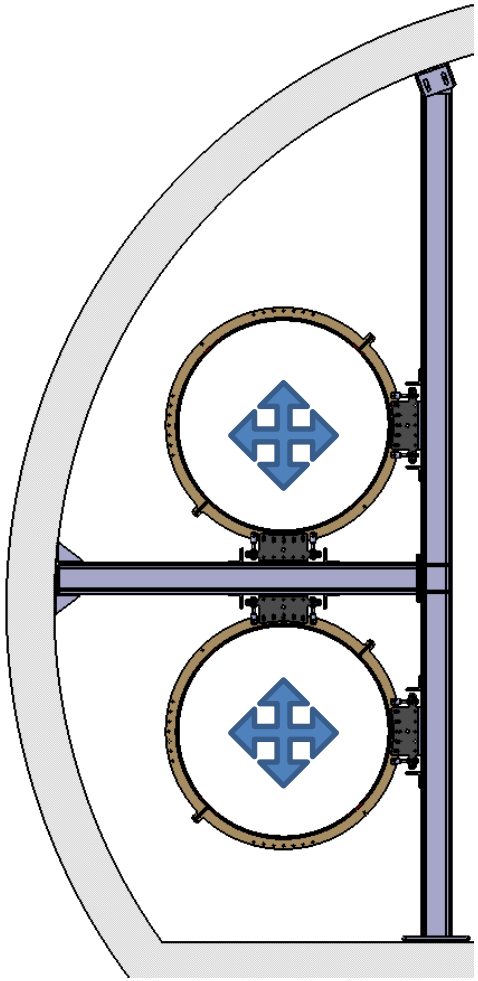
First solution family : cylindrical flanges at extremities



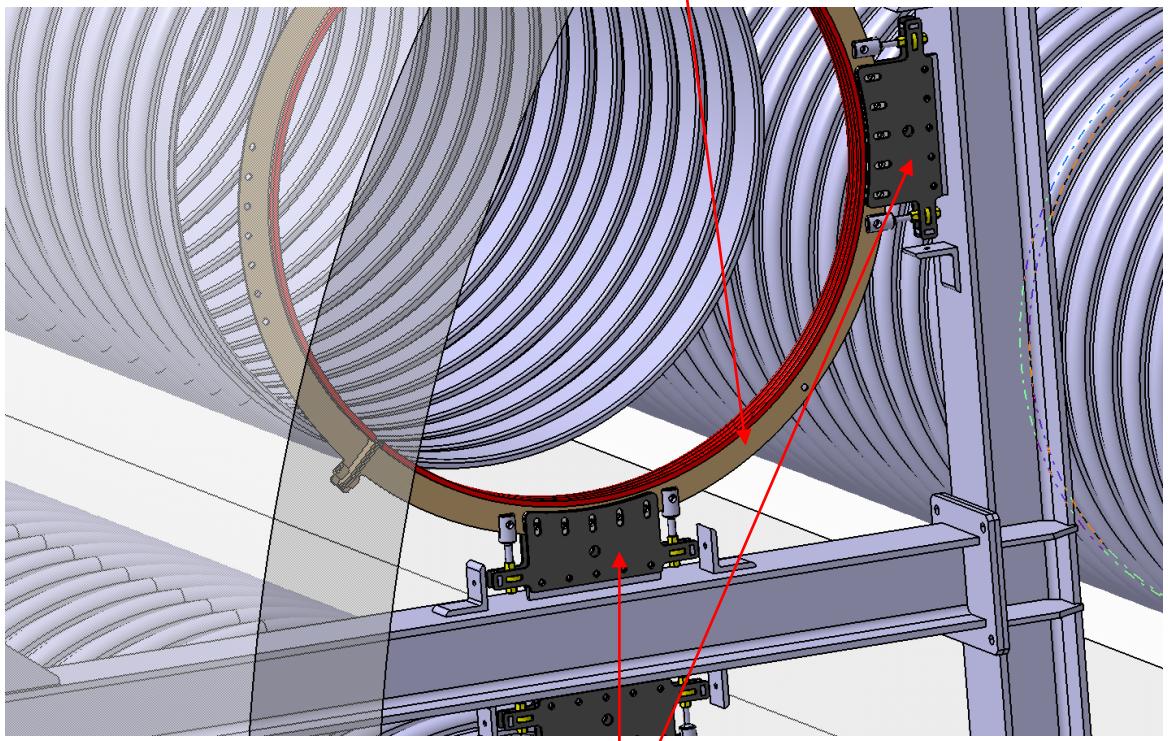
First solution family based on use of cylindrical flanges to perform fixation

- Could expensive
- Could be interesting locally for baffle / pumps implantations

Second solution family : Collars squeezing tube

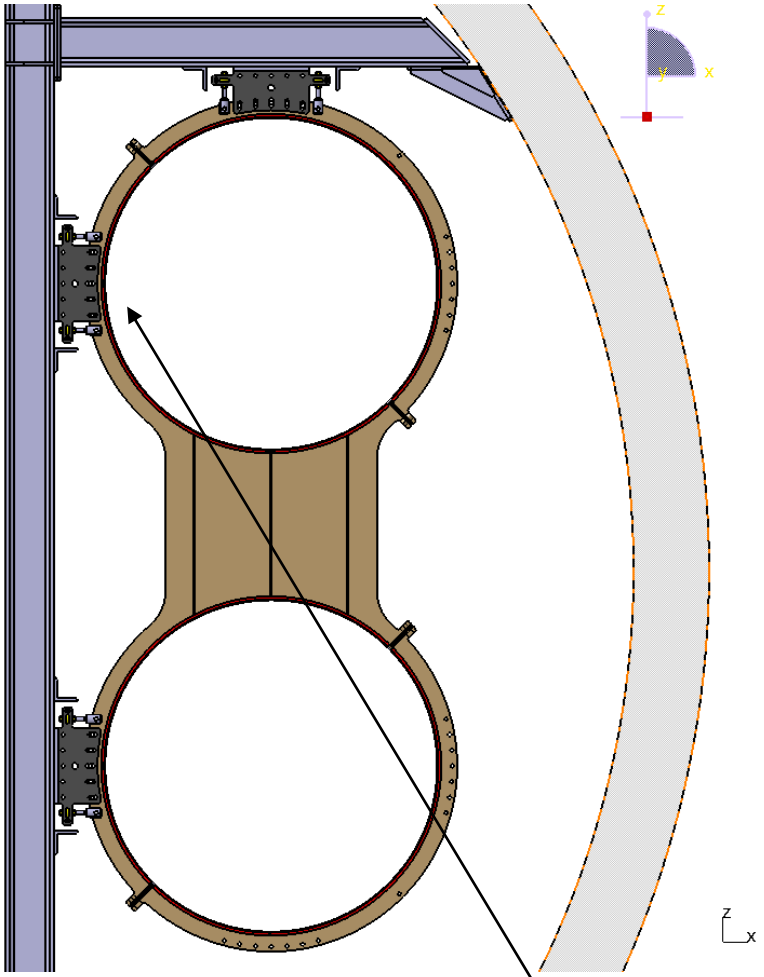


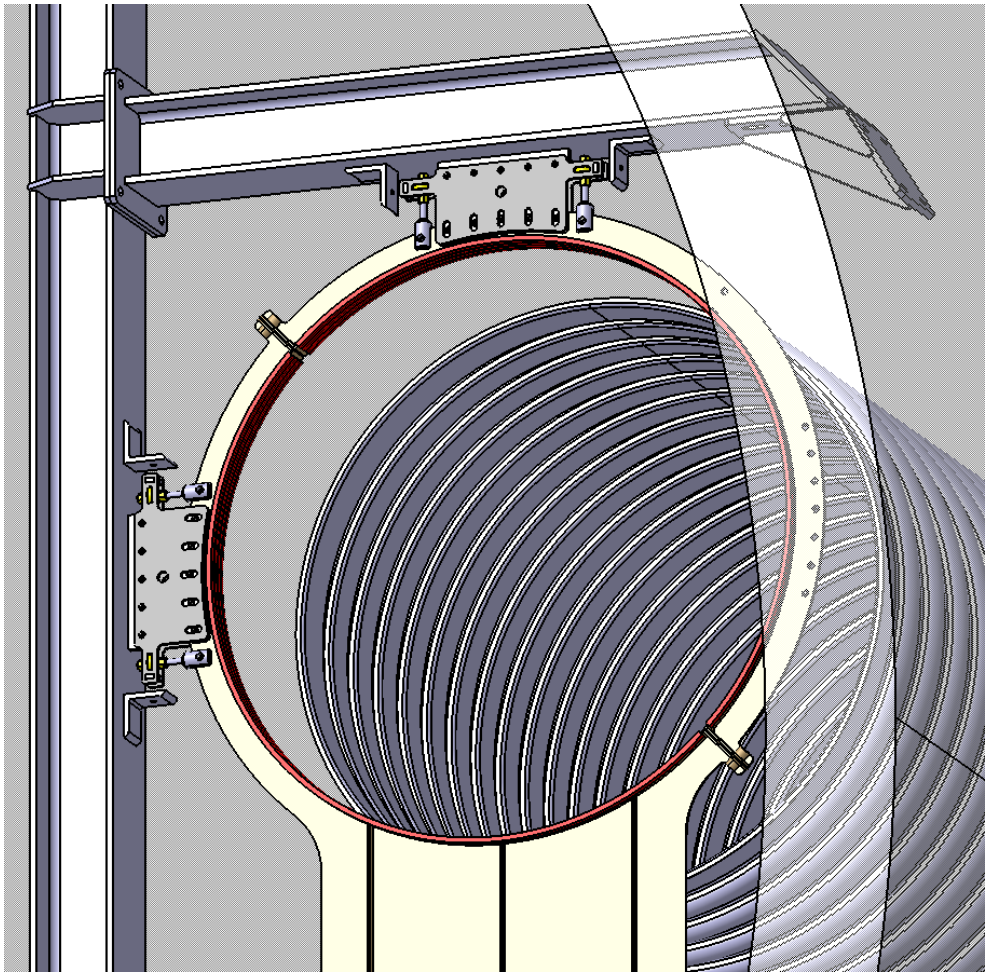
Collar (between two corrugations)



Positioning and fixing devices

Collars & tubes coupling version





This support can eventually be saved

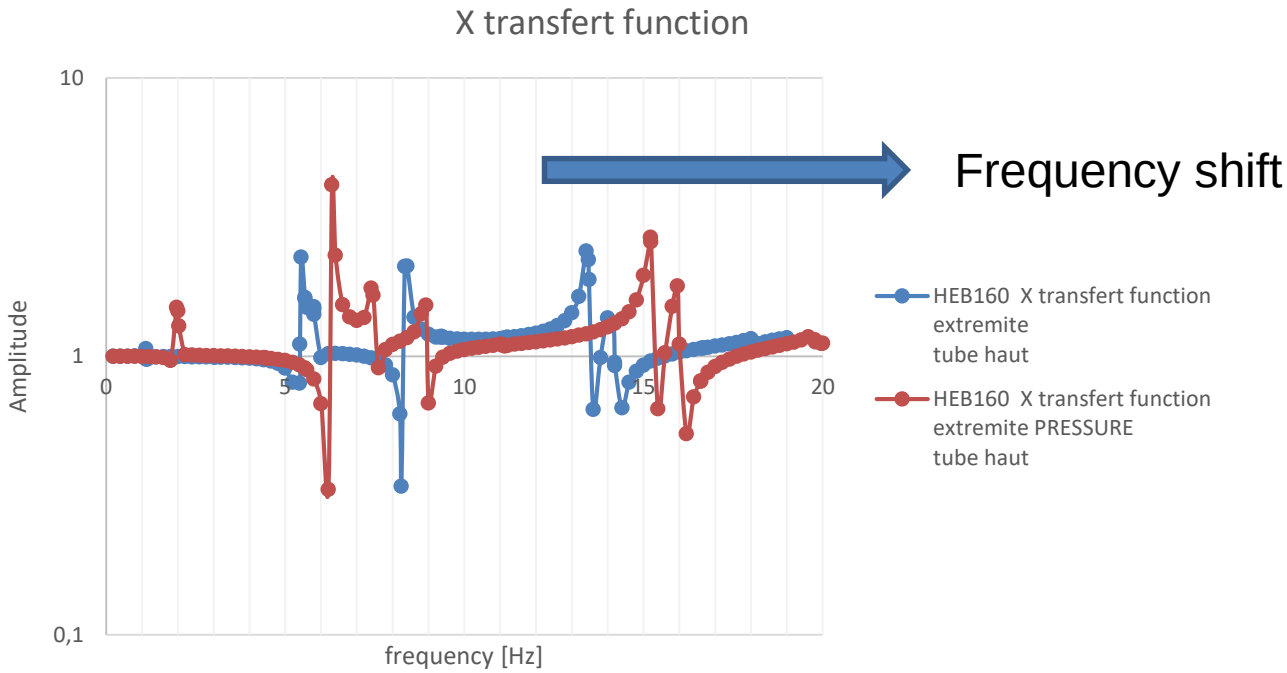
Conclusion 1 / 3

- Suspended solution :
  - Low pass filter for lateral basement excitation
  - More sensitive to direct excitation (pumps, air flow , …)
  - More difficult to align ?

- Supporting beams :
  - To minimize baffle vibrations it worth to put supports close to tube extremities
  - A third support (at least vertical) in the middle of tubes could be necessary to mitigate sag (~250 mm)
  - More detailed FEM to be build to have a more realistic representation of support's stiffness

- Vacuum has a significant influence on dynamic behavior :
  - Solutions to implement it in an efficient way (computing resources) to be investigated

Conclusion 2 / 3: Vacuum effect on X transfer function



Used Super element approach does not enable pressure application
One single tube direct simulation performed for illustration purpose

To be taken into account in future simulations
Especially with more realistic (non flat) excitation spectrums

Conclusion 3/3

- Are baffle vibrations the only dynamic criterion ?
- We should introduce at least baffle weight in FEM
- Computed transfer function should be introduced in optical budget and compared to specifications
- I am interested to have slides presented by Mario Martinez-Perez & all on this topic

I think supporting beams solution is more suitable regarding baffle vibrations
To be confirmed using true excitation spectrums (direct forces & ground)