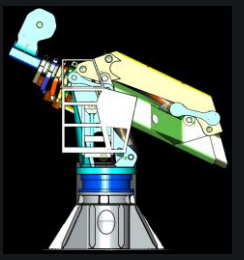
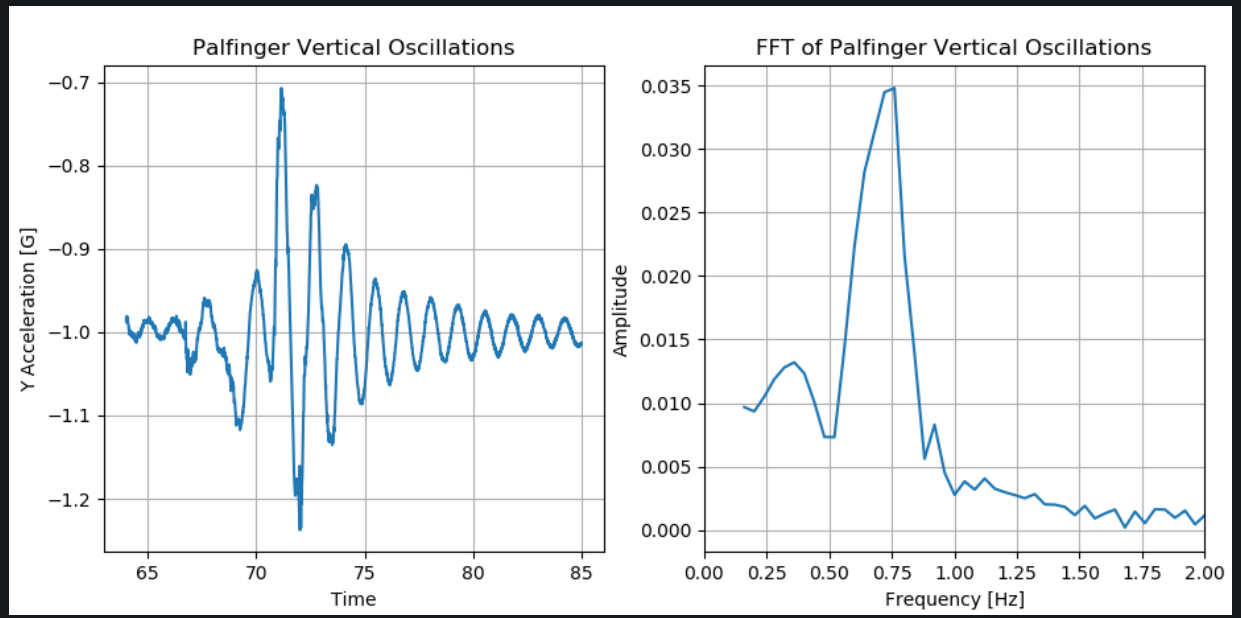
Palfinger Test Results



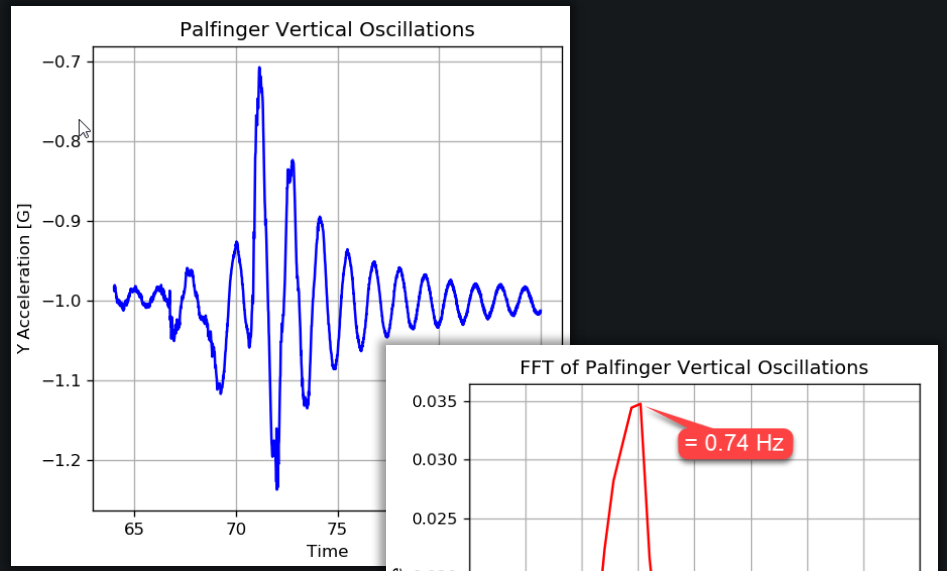
Deployment and Oscillation tests for FEDEM TWIN model validation:

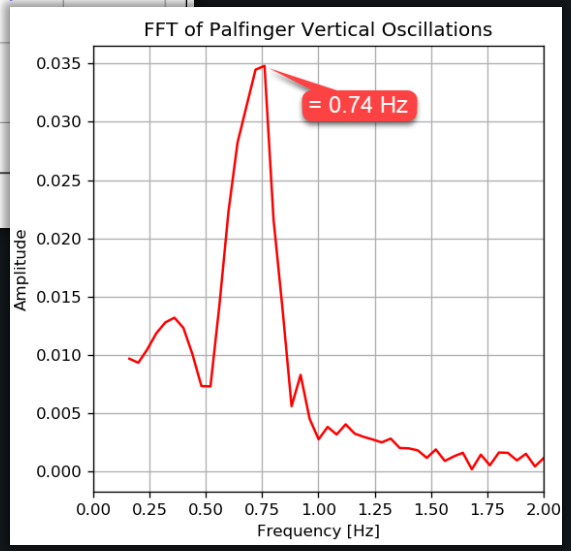


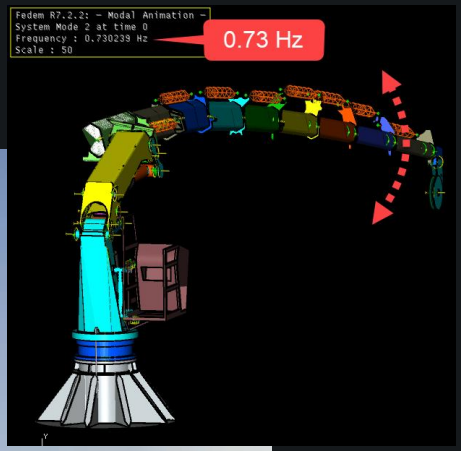
Palfinger Test Results

Close match
7.4 versus 7.3
Hz

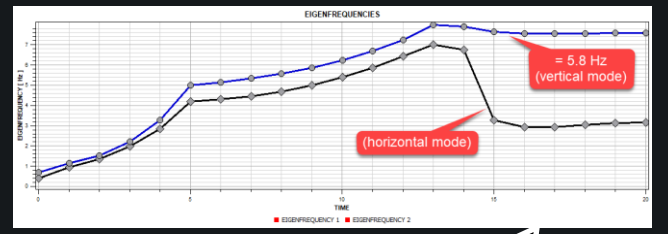
Measured eigenfrequency at maximum extension (L=18m):





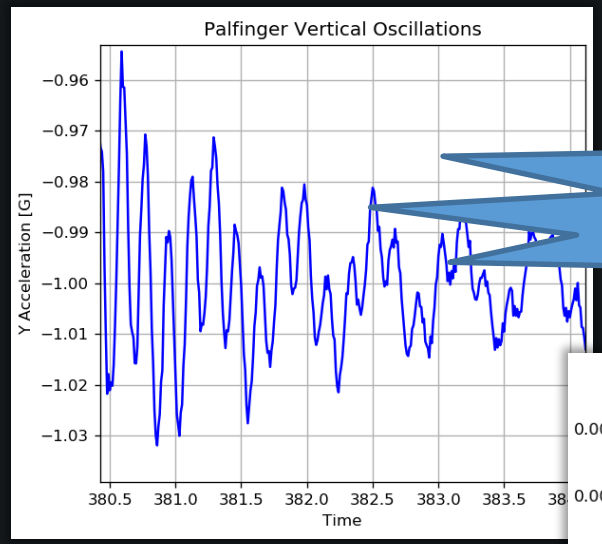


Palfinger Test Results

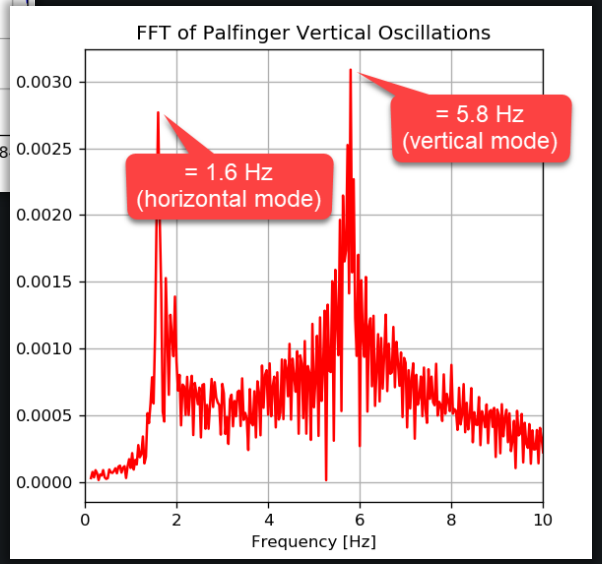


FEDEM mode = 7 Hz

Measured eigenfrequency at minimum extension:

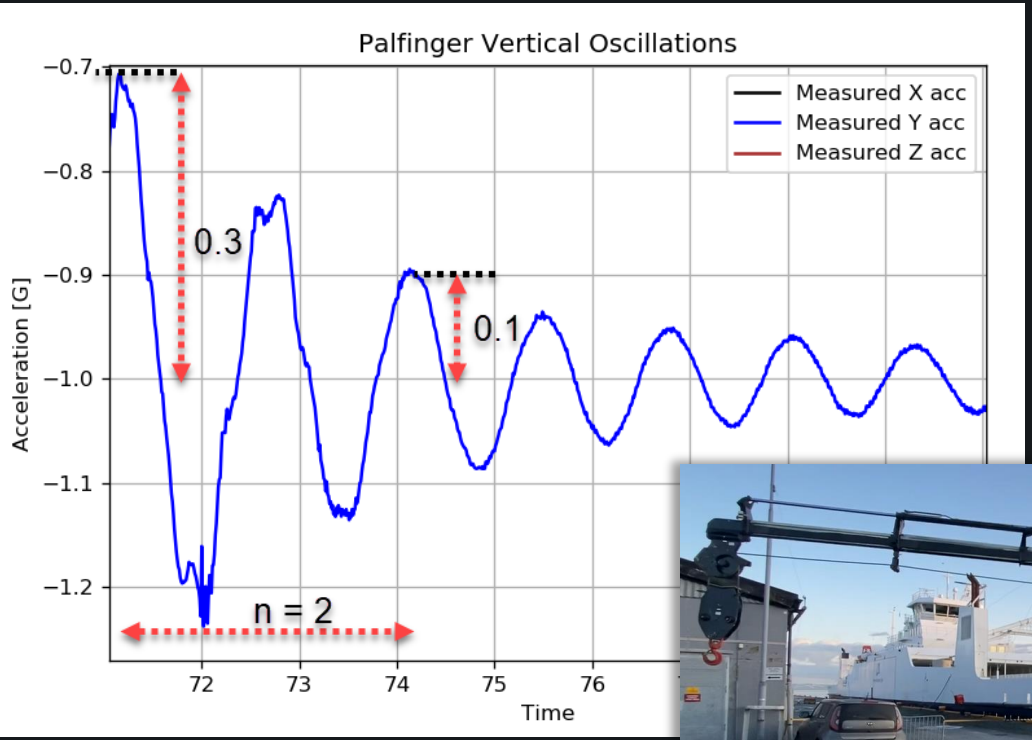


Ok match (5.8 versus 7 Hz)



Palfinger Test Results

Estimated Damping (L=18m / Vertical mode at 0.7 Hz):

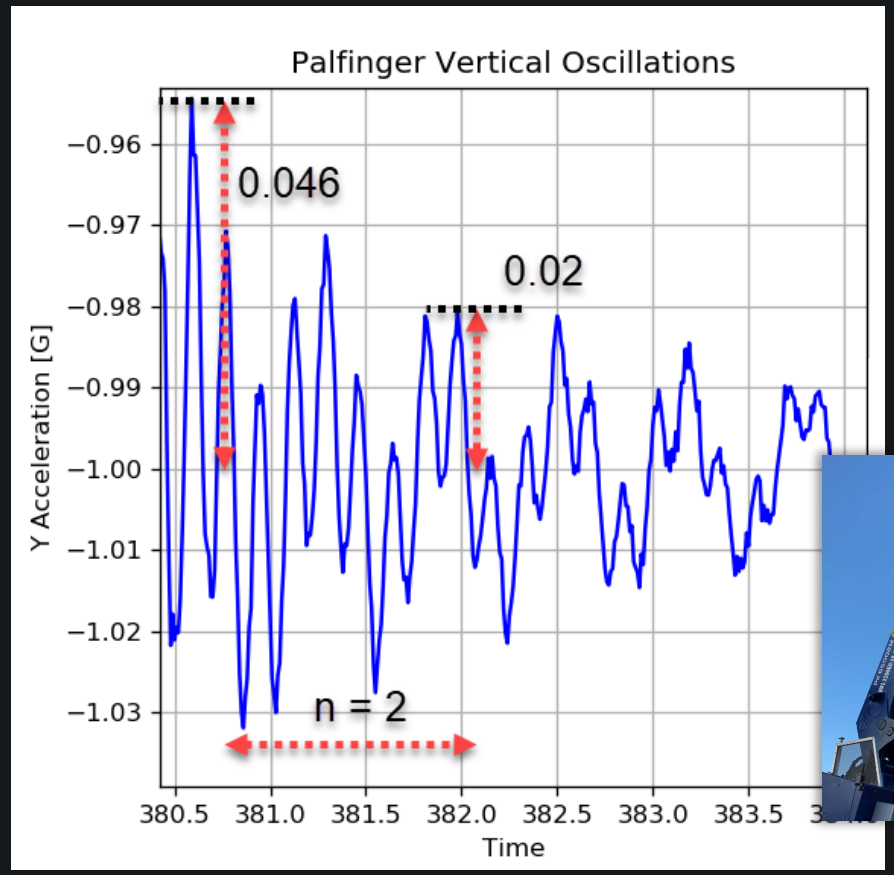


Logaritmic decrement $\delta = \frac{1}{2}\ln\left(\frac{0.3}{0.1}\right) = 0.55$

Damping ratio $\zeta = \frac{\delta}{\sqrt{4\pi^2+\delta^2}} = 0.087\ (8.7\%)$

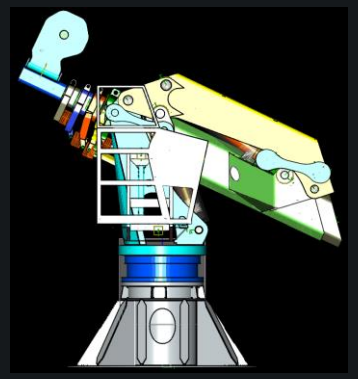
Palfinger Test Results

Estimated Damping at minimum extension (Horizontal Mode at 1.6 Hz):



Logaritmic decrement $\delta = \frac{1}{2}\ln\left(\frac{0.046}{0.02}\right) = 0.42$

Damping ratio $\zeta = \frac{\delta}{\sqrt{4\pi^2+\delta}} = 0.066\ (6{,}6\%)$

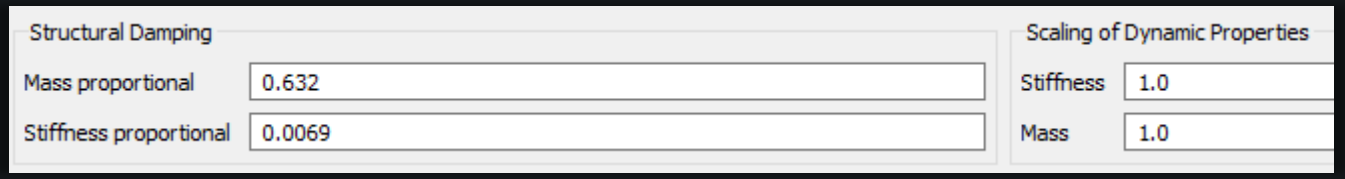


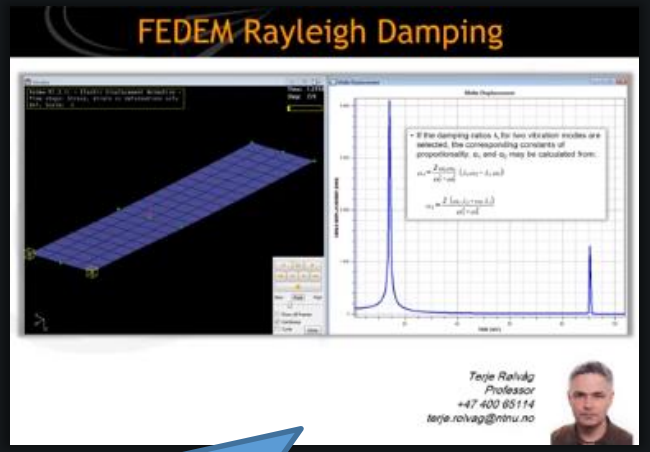
Palfinger Test Results

Which gives a mass and stiffness proportional damping based on 0.7 Hz (vertical mode at max extention) and 1.6 Hz (Horizontal mode at stowed position):

Mass proportional damping (α_1) $= 0.632$

Stiffness proportional damping (α_2) $= 0.0069$





Click for more info

Palfinger Test Results

FEDEM runs faster than
real time with 3.6 mill DOFs!

Crane deployment takes 130 seconds:

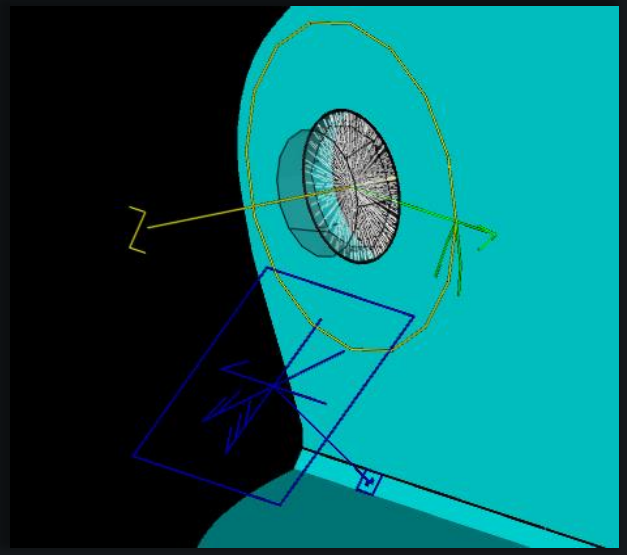
FEDEM simulation takes 75 seconds:

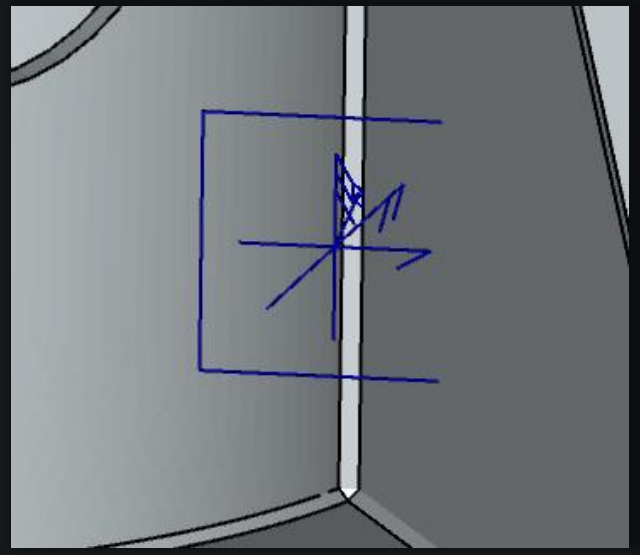
```
-------------------------------------
Elapsed time :    0 days 00:01:30.38
CPU time     :    0 days 00:01:15.06
-------------------------------------

Simulation successfully completed :-)
```

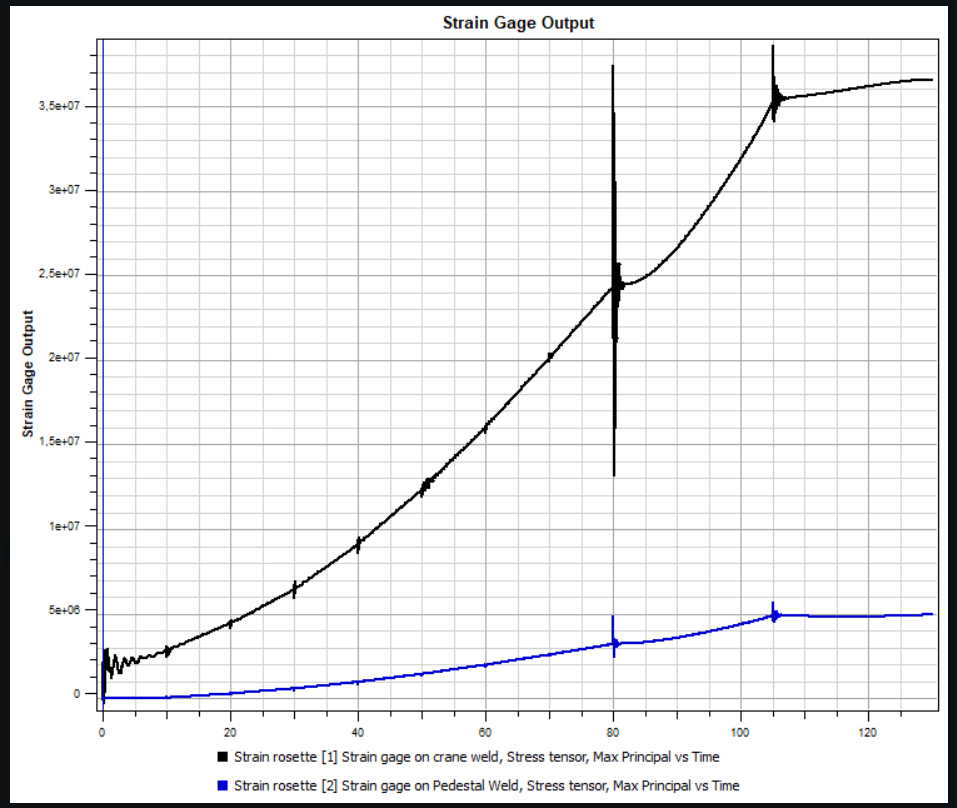
Palfinger Test Results

```
-----------------------------------
Elapsed time :    0 days 00:01:30.38
CPU time     :    0 days 00:01:15.06
-----------------------------------

Simulation successfully completed :-)
```

Strain and stress time histories are calculated simultaneously:







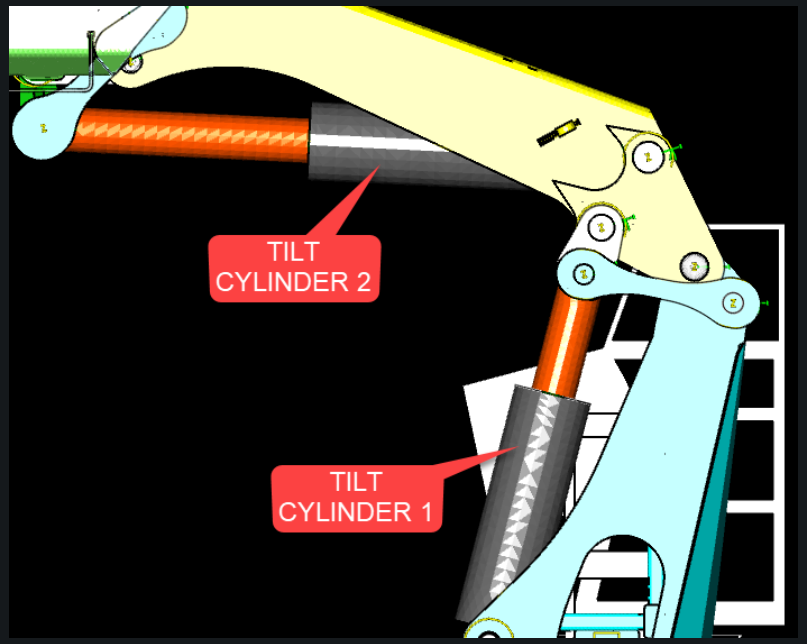
Description: Strain gage on crane weld
Rosette type: Triple gage 45 — Set start strains to zero
Nodes: 11879, 11878, 11946, 11945 — Edit
Orientation
Angle offset [Deg]: 0.0
Layer position
Use thickness from FE Mesh
Height: 0.0
Change side
Material
Use material from FE Mesh
E-Module: 2.06e+11
Poissons ratio: 0.3

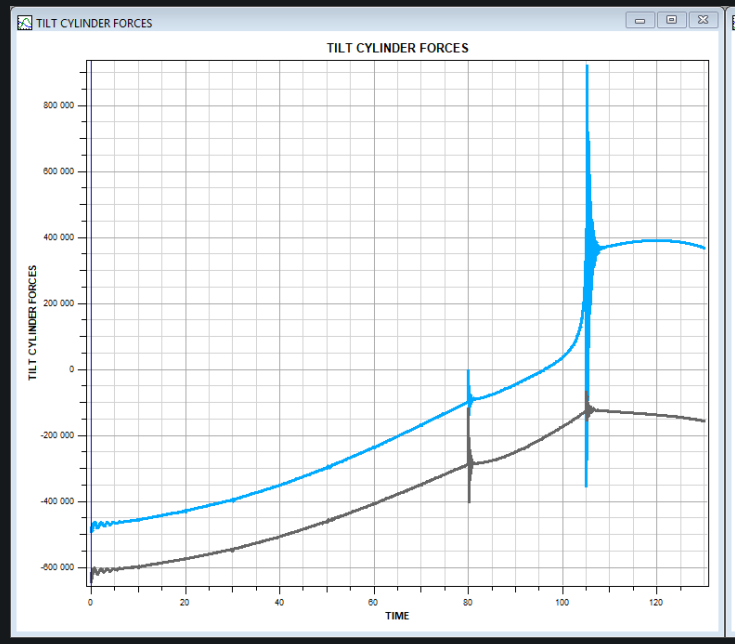
Description: Strain gage on Pedestal Weld
Rosette type: Triple gage 45 — Set start strains to zero
Nodes: 11102, 11101, 103371, 103374 — Edit
Orientation
Angle offset [Deg]: 0.0
Layer position
Use thickness from FE Mesh
Height: 0.0
Change side
Material
Use material from FE Mesh
E-Module: 2.06e+11
Poissons ratio: 0.3

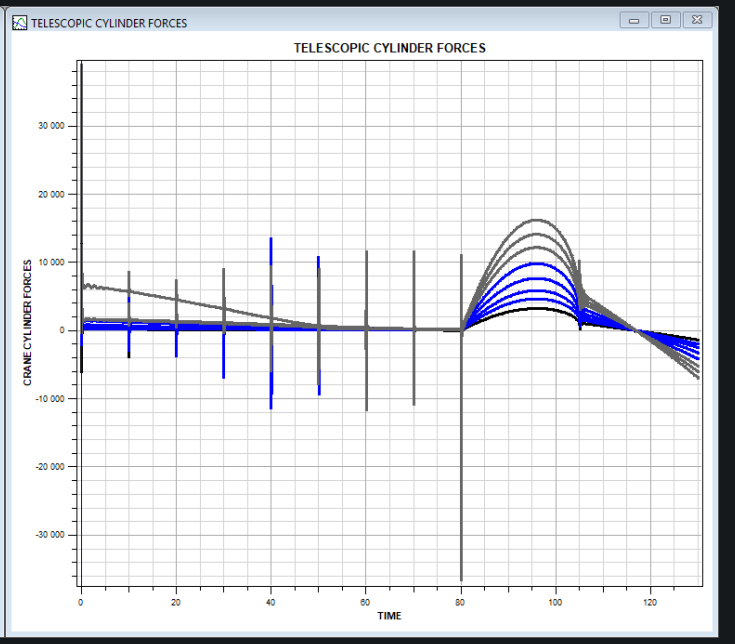
Palfinger Test Results

```
-----------------------------------
Elapsed time :    0 days 00:01:30.38
CPU time     :    0 days 00:01:15.06
-----------------------------------

Simulation successfully completed :-)
```

Structural and control variables are calculated simultaneously:



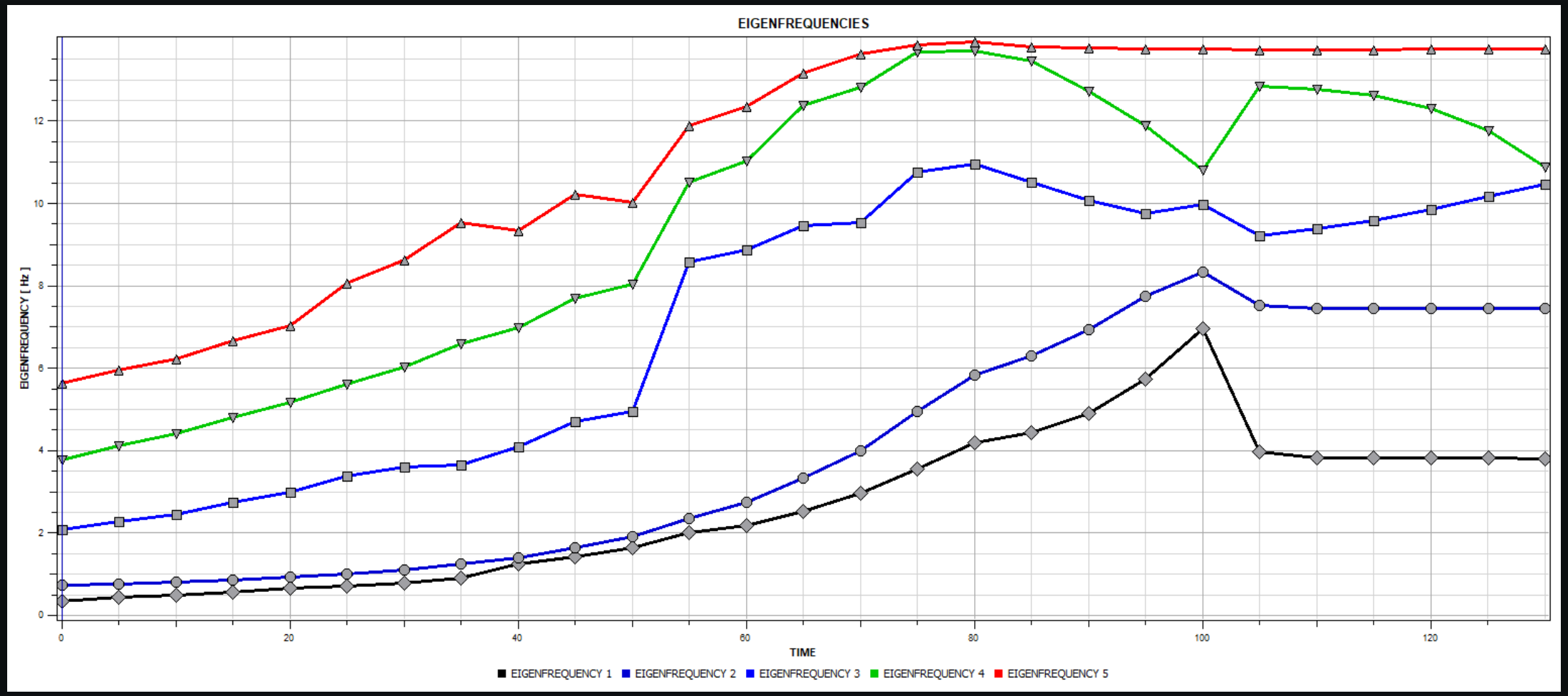




Palfinger Test Results

```
-----------------------------------
Elapsed time :    0 days 00:01:30.38
CPU time     :    0 days 00:01:15.06
-----------------------------------

Simulation successfully completed :-)
```

Eigenfrequencies are calculated simultaneously:



Palfinger Test Conclusion

The FEDEM model is waiting for its Physical Twin (sensor inputs):

From Physical Inspections

To Digital Inspections