

TEST MODULES in the LAB

DB girders (epucuret) for T1 & T4:

Optimization of the V-shaped supports

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1. Aim of the Study & Boundary Conditions
2. Simulation results (1st approach)
3. Intermediate result analysis
4. Further simulation results
5. Conclusions

Introduction

After machining of V-supports which equip the Epucet girder DB02E, the dimensional control found location defaults 10 times higher than the tolerances.

The V-support adjustments were planned by the design, so we wanted to test the performance of this shimming by a test in a CMM.

We chose to test the shimming on the $\varnothing 27$ V-support because it only supports beam tube: no critical tolerance.

All the results are available in a report and in an Excel file (EDMS n° 1221024).

Conclusion

The shimming along the vertical direction provides expected and repeatable results. Laterally, the tightening of the screw occasions defaults and a lack of repeatability. This phenomena is due to a lever arm effect.

On the girder, the defaults were mainly along the vertical direction.

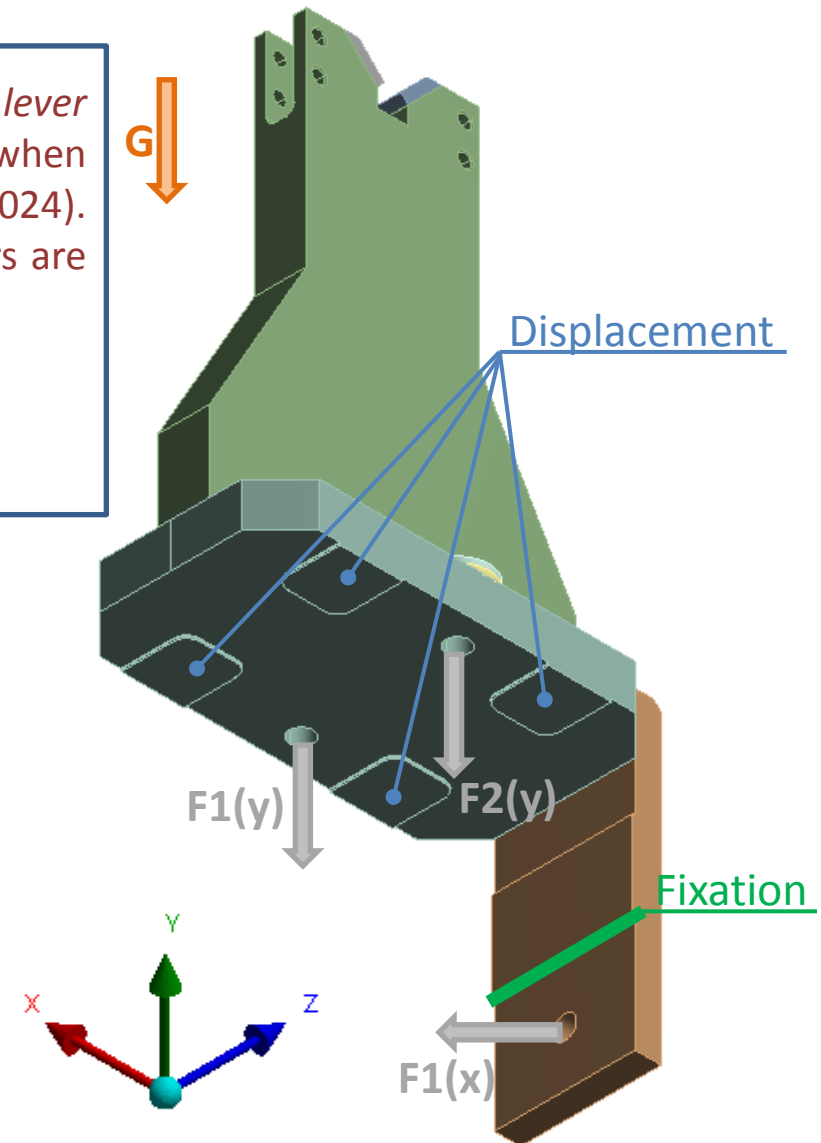
Several possibilities are possible :

- Try to adjust all the V-supports along the vertical direction → risk of damaging the lateral adjustment and at least 5 days of work (cf. D. Pugnât).
- Try to machine again the V-supports on the new AP machine → fiducialisation and dimensional will have to be performed again.
- We can consider that the location defaults are acceptable for a mock-up → Ok for PETS but on this girder, it was decided to align 2 BPM on $\varnothing 99$ V-Supports (the vertical default on these 2 V-supports is about $50 \mu\text{m}$).

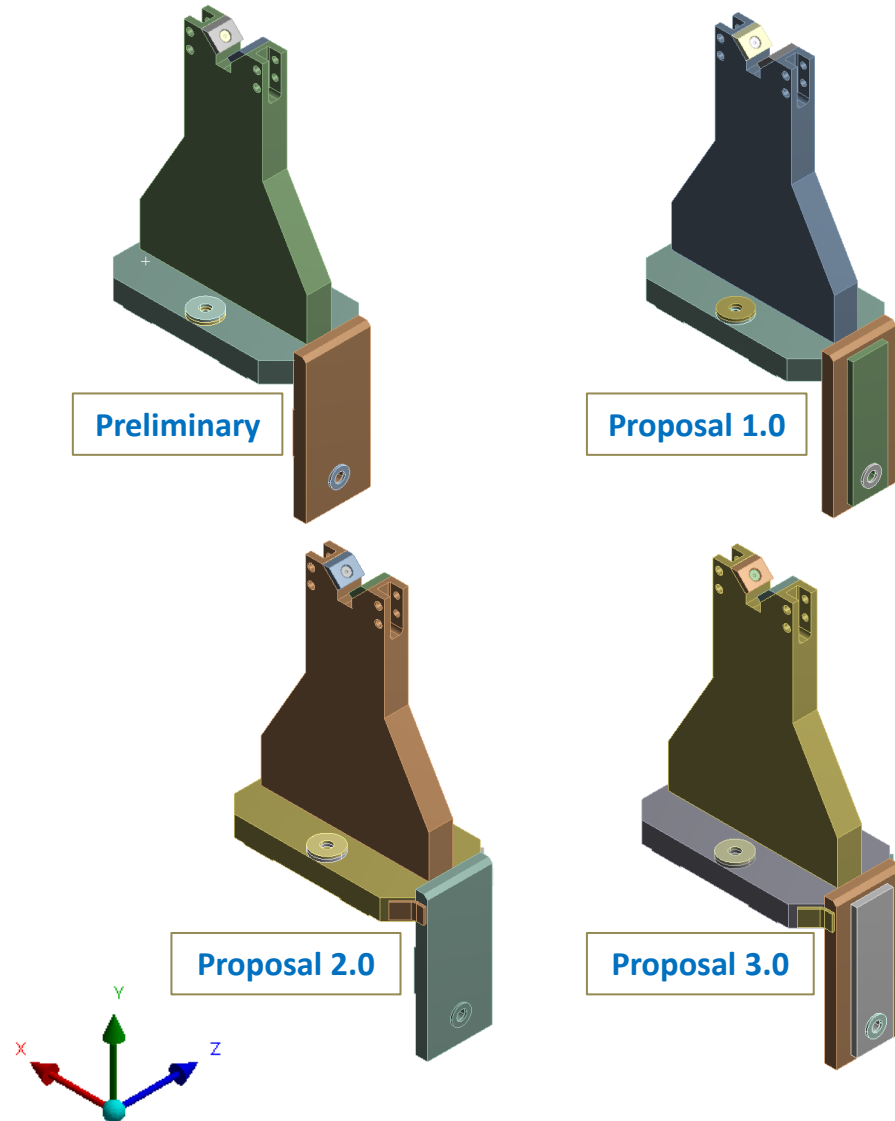
The aim of the optimization study was to eliminate the *lever arm effect* on the axis of the V-shaped supports when tightening the screws during the assembly (EDMS 1221024). By achieving our primary goal the following parameters are optimized for the V-shaped supports:

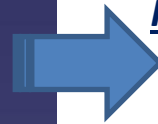
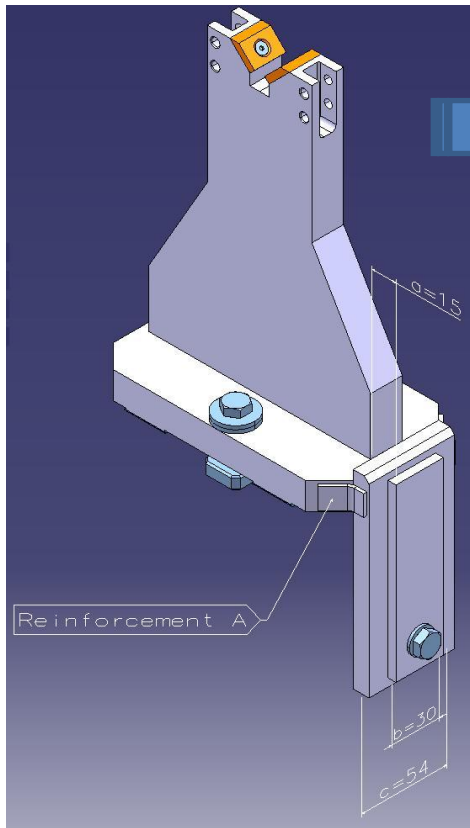
- ✓ Repeatability of their assembly on the girders,
- ✓ Adjustability of their positions,
- ✓ Alignment of their axes.

- **G: Gravity**
- **$F1(y)$ and $F2(y)$: Vertical fixation forces**
- **$F1(x)$: Lateral fixation force** (playing a major role on the lever arm affect)
- **Fixation boundary** (representing the horizontal contact of the reference surface of the V-shaped support to the girder)
 - NO transposition allowed along the x, y and z axes,
 - NO rotation allowed around x, y and z axes.
- **Sliding** (representing the vertical contact of the reference surface of the V-shaped support to the girder)
 - NO: transposition allowed along the y axis



<u>Configurations</u>		Max Directional Deformations for Stainless Steel [μm]	Max Stresses for Stainless Steel [MPa]
Preliminary	X	24.29	23.22
	Y	1.71	
	Z	16.83	
Proposal 1.0	X	17.72	25.30
	Y	1.77	
	Z	14.83	
Proposal 2.0	X	23.72	26.35
	Y	1.59	
	Z	15.34	
Proposal 3.0	X	16.94	39.55
	Y	1.62	
	Z	14.70	





Reinforcement A: Needs to be further magnified so as to have a better influence on the overall stability

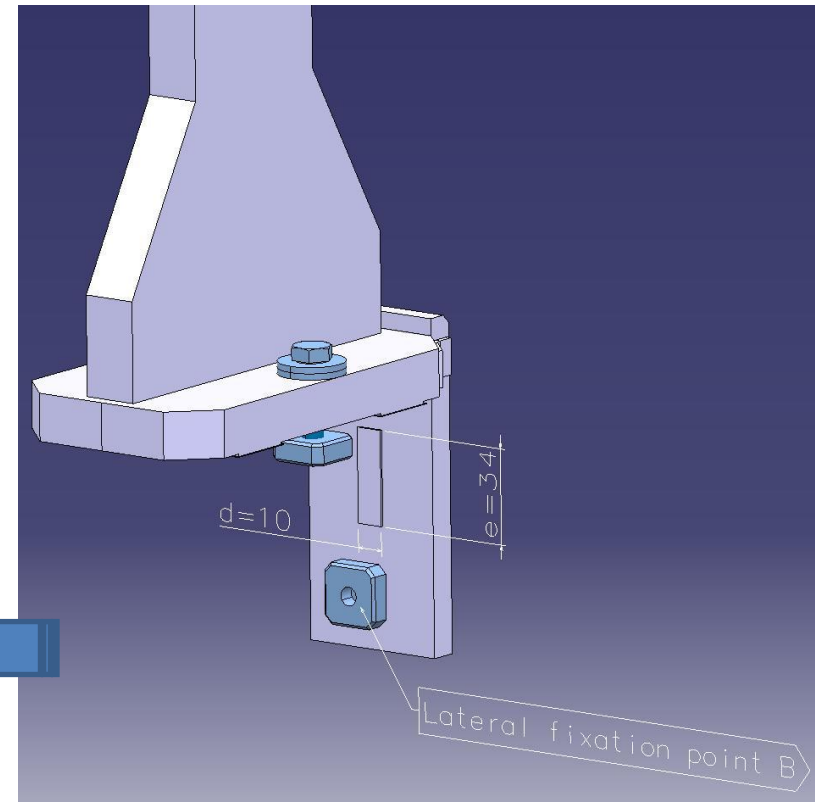
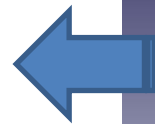
Dimension a: Needs to be magnified (thickness)

Lateral fixation point B:

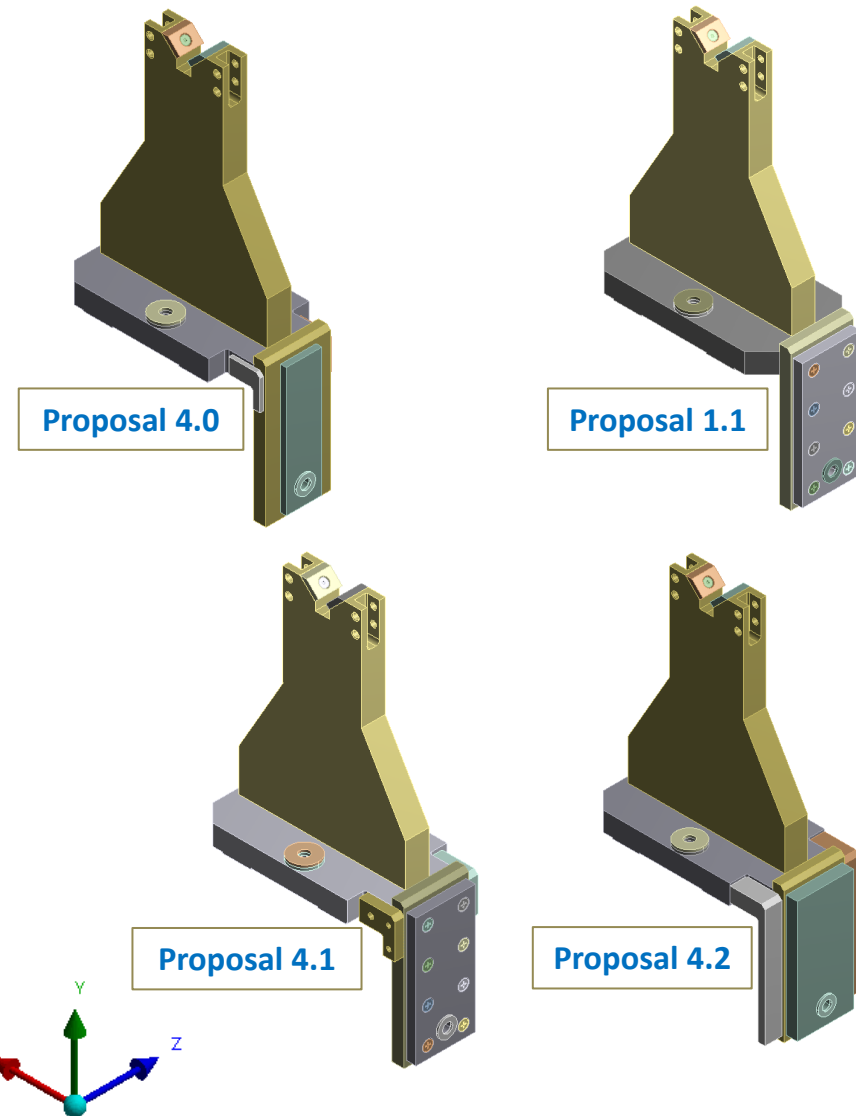
The fixation/screwing at this point is essential and cannot be avoided

Dimension d: It was minimized so as to have the less possible influence on the lever arm effect.

Dimension e: For now it was decided to be kept coherent with the corresponding dimension of the reference surface of the girder.

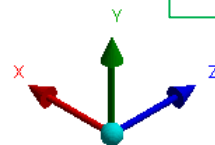
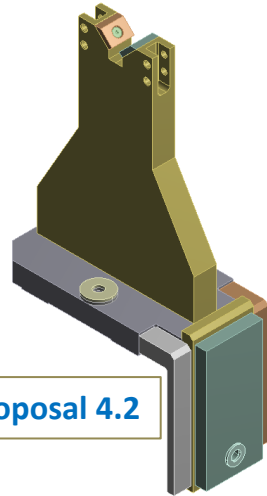
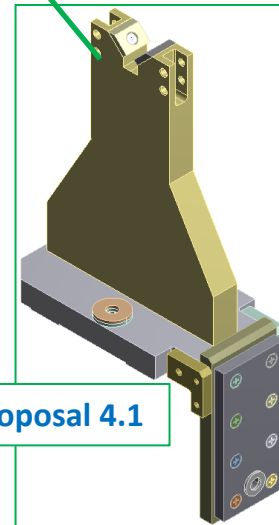
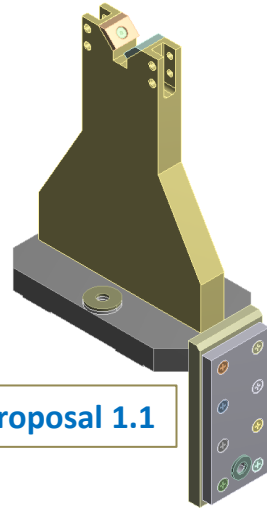
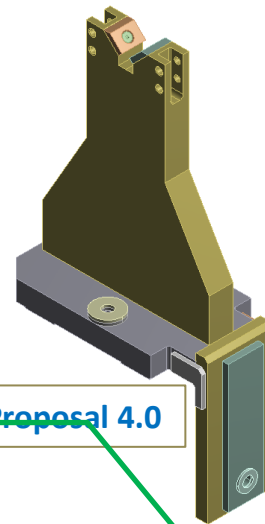


<u>Configurations</u>		Max Directional Deformations for Stainless Steel [μm]	Max Stresses for Stainless Steel [MPa]
Proposal 4.0	X	17.19	37.82
	Y	1.12	
	Z	15.18	
Proposal 1.1	X	15.32	29.50
	Y	1.48	
	Z	10.21	
Proposal 4.1	X	9.06	35.85
	Y	1.43	
	Z	8.19	
Proposal 4.2	X	8.12	41.64
	Y	1.04	
	Z	7.87	



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	Z	7.87	

Best combination of simulation results and modification possibility



- For the existing V-shaped support configuration: It was shown that the lever arm effect can be diminished to deformations inferior to $10\ \mu\text{m}$ so as not to cause issues of misalignment.

- For the existing V-shaped support configuration: The rigidification of the configuration can provide better repeatability results for their assembly.

- Future V-shaped support design: For such non-integrated Vs, all fixation features should be included on 1 “*monolithic*” piece (not assembled pieces)

- Future V-shaped support design: The possibility of casting the Vs into the girder should be further investigated (for the girders made of mineral cast material)

- Future V-shaped support design: The interface of the V-shaped supports to the RF components could be altered to one “*ball-contact*” instead of two “*diagonal-contacts*”

