BS Outer frame

Comparison of deformation with and without reinforcement

Create: 2021.9.17
Update: 2021.9.24

Contents

内容

Corrections on 2021.9.24

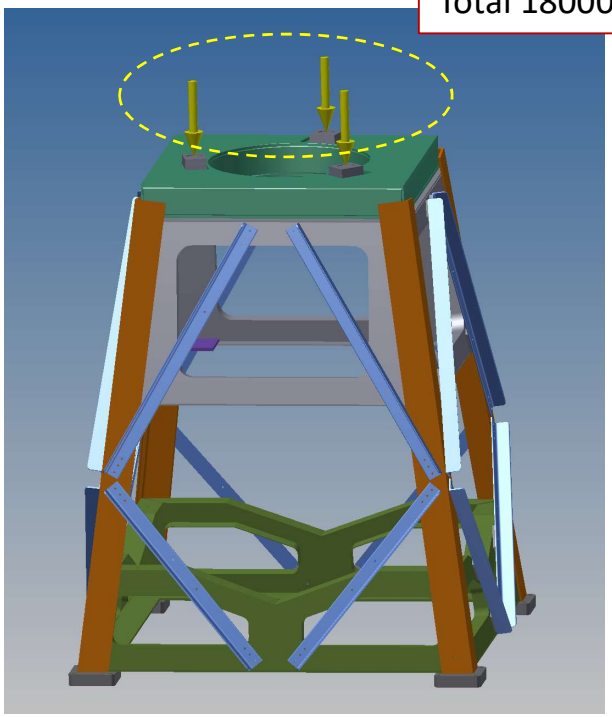
1. In the reinforced analysis model, three connections between parts were lost. So the reinforced model was modified and the calculation was redone.

2. The direction of the load in the analysis of the case where a human's weight putting on it was slightly off from vertical. So, the calculation was redone for both models.

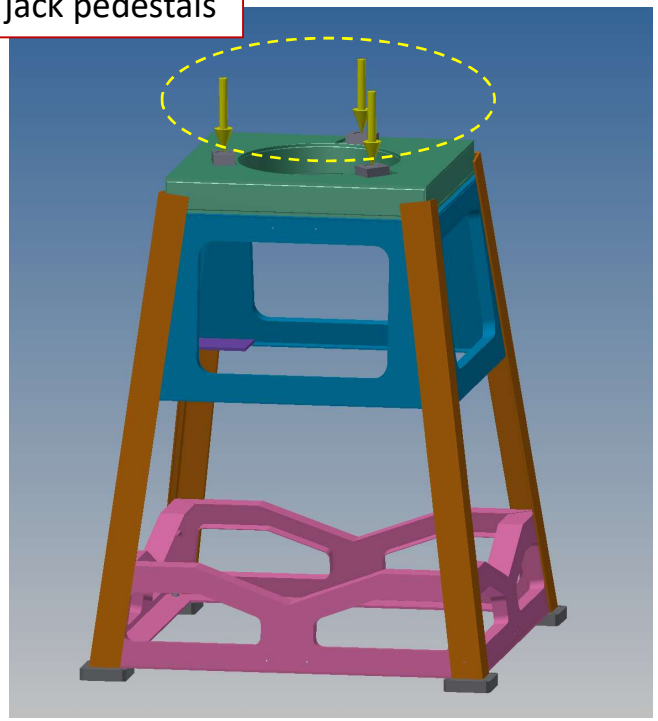
1. Deformation due to BS body load

Analysis model, load conditions

Total 18000N (BS tower) on jack pedestals



Outer frame with reinforcement



Current outer frame

1. Deformation due to BS body load

Result (amount of sinker)

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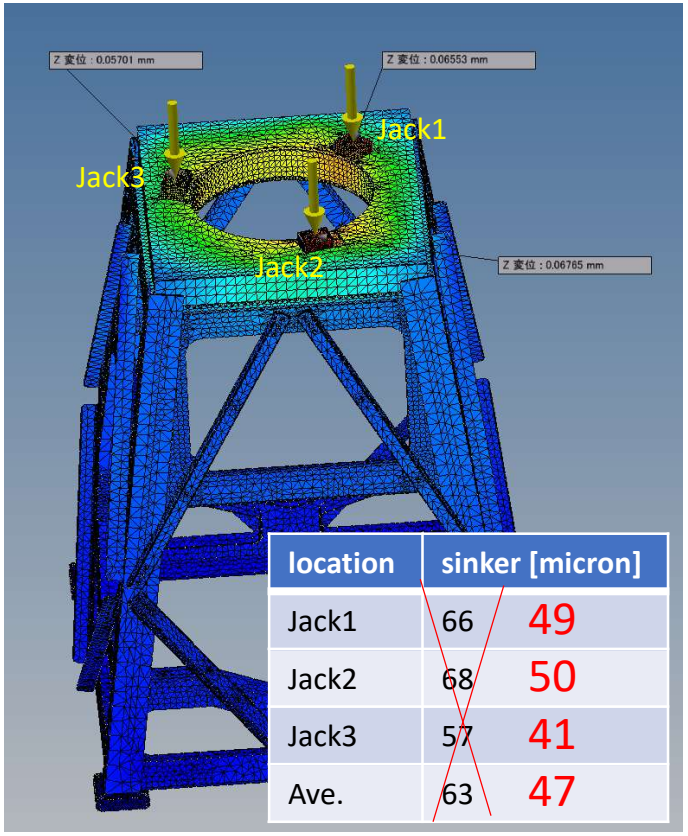
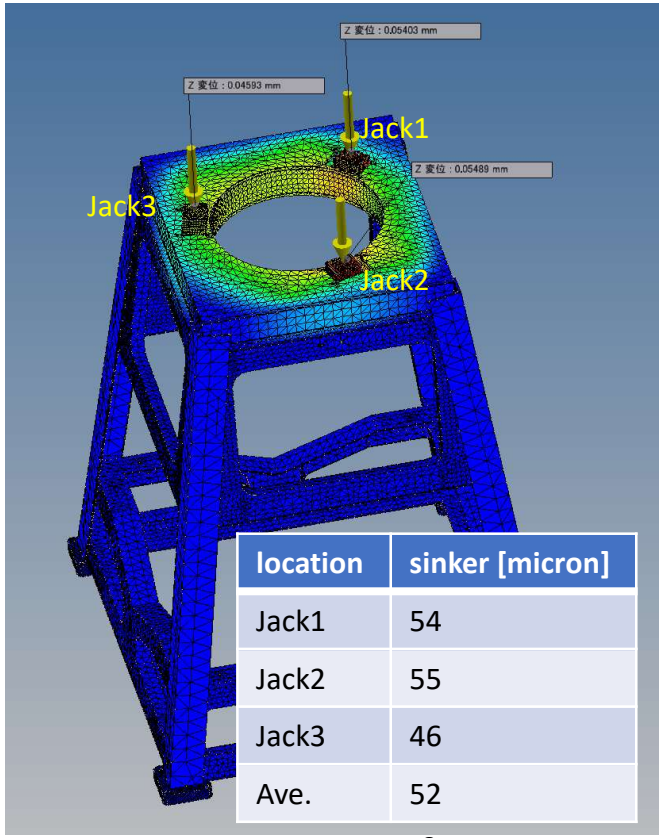


location	sinker [micron]	
Jack1	66	49
Jack2	68	50
Jack3	57	41
Ave.	63	47

Outer frame with reinforcement



location	sinker [micron]
Jack1	54
Jack2	55
Jack3	46
Ave.	52

Current outer frame

~~For some reason, the deformations were larger when the model was reinforced. No obvious flaws found in the model.~~

2. Natural frequency

Result (primary mode)

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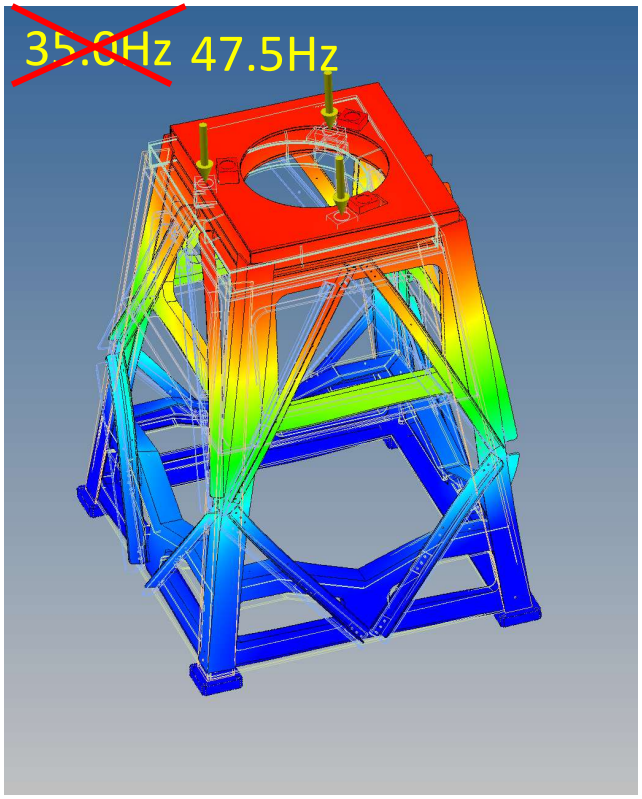
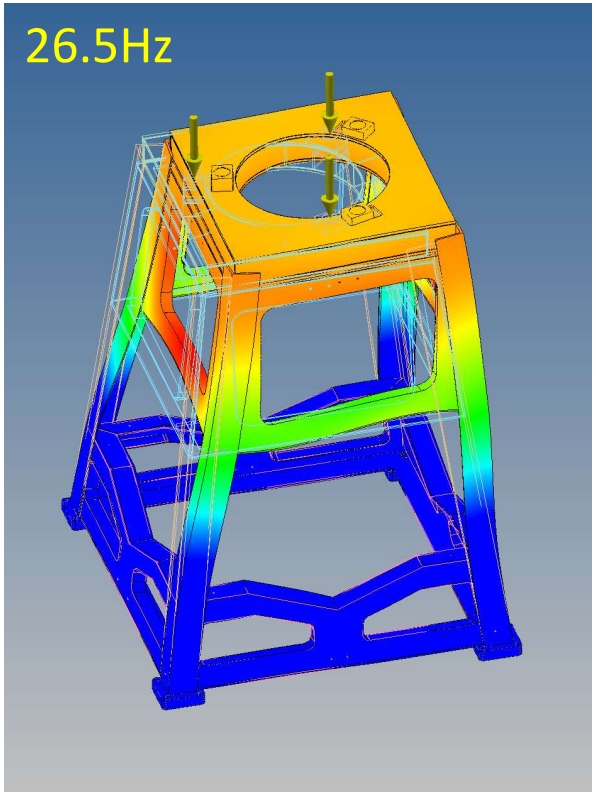


Outer frame with reinforcement



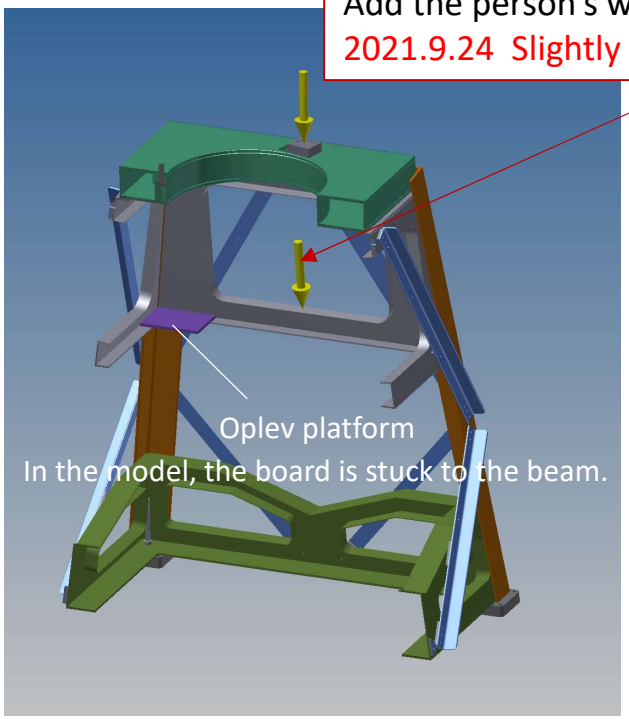
Current outer frame

The natural frequency shows the effect of reinforcement.

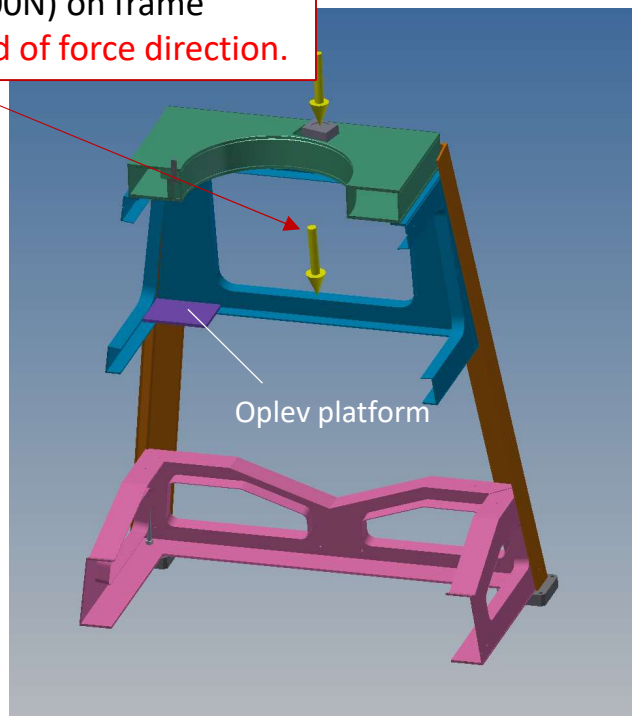
3. Tilt of the oplev platform when weight is applied to the frame

Analysis model, load conditions

Add the person's weight (700N) on frame
2021.9.24 Slightly corrected of force direction.



Outer frame with reinforcement



Current outer frame

3. Tilt of the oplev platform when weight is applied to the frame

Result

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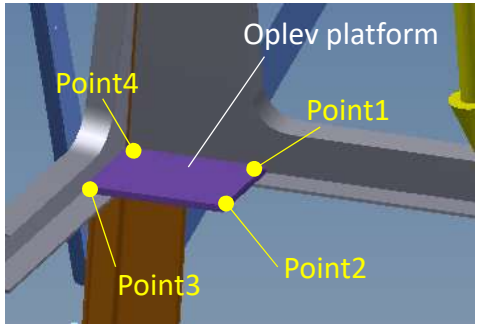
Change in the amount of sinkage when a load is applied by a person

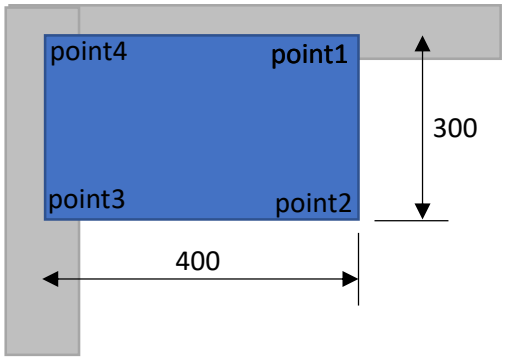
Outer frame with reinforcement

location		sinker [micron]	
Oplev	Point1	2.4	1.9
	Point2	5.2	5.3
	Point3	1.6	0.6
	Point4	1.5	0.4
Jack	Jack1	0.4	0
	Jack2	0.5	0.1
	Jack3	1.1	0.1

Current outer frame

location	sinker [micron]	
Point1	1.5	2.5
Point2	6.8	10.1
Point3	0.5	0.6
Point4	0.7	0.9
Jack1	0.1	-0.3
Jack2	0.1	0.1
Jack3	0.2	0.2





4. Summary and comment

Comparison results with and without reinforcement

- The reinforcement reduces the displacement, both of the jack and of the oplev plate. The amount is about a few microns.
- The natural frequency will be higher with reinforcement.
- When a person's weight is applied, only very small changes (a few microns) are seen in both Jack and Oplev.
- The model is supposed to be a bit more rigid than the real thing, as the parts are properly connected to each other.

5. Reference

Detail of change in the displacement due to BS body load (no weight of person)

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Direction X

dX	With reinforced	~~With reinforced~~	Current frame
Jack1	8.5	~~10.8~~	7.6
Jack2	3.1	~~4.6~~	2.4
Jack3	2	~~4.2~~	1.3

[micron]

Direction Y

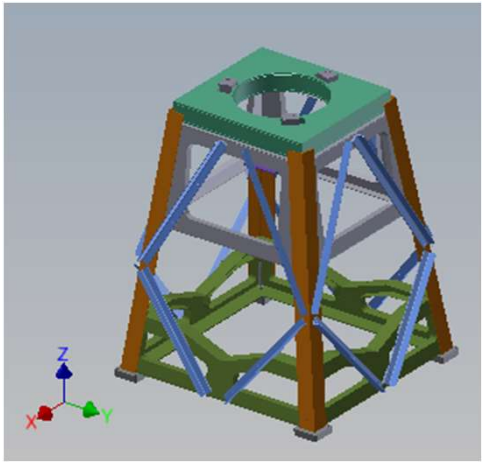
dY	With reinforced	~~With reinforced~~	Current frame
Jack1	11.5	~~11.3~~	11
Jack2	7.8	~~8.5~~	8
Jack3	2.3	~~2.9~~	1.5

[micron]

Direction Z

dZ	With reinforced	~~With reinforced~~	Current frame
Jack1	49.2	~~65.5~~	54
Jack2	50.4	~~67.7~~	54.9
Jack3	40.7	~~57~~	45.9
Ave.	46.8	~~63.4~~	51.6

[micron]



5. Reference

Detail of change in the displacement when a load is applied by a person

2021.9.24
Revised

補強無し Current frame						補強あり with reinforcement					
		基本荷重	体重あり	移動量				基本荷重	体重あり	移動量	
		Only BS	Add person's weitght	displacement				Only BS	Add person's weitght	displacement	
point1	dx	3.3	0.4	-2.9	[micron]	point1	dx	4.9	3.8	-1.1	[mi
	dy	0.1	0.9	0.8			dy	1.4	1.3	-0.1	
	dz	3.9	6.4	2.5			dz	3.5	5.4	1.9	
point2	dx	3.3	0.7	-2.6		point2	dx	4.8	3.8	-1	
	dy	0.3	0.4	0.1			dy	0.7	0.8	0.1	
	dz	2.9	13	10.1			dz	1.8	7.1	5.3	
point3	dx	1.1	0.5	-0.6		point3	dx	1.3	0.8	-0.5	
	dy	0.3	0.1	-0.2			dy	0.7	0.6	-0.1	
	dz	5	5.6	0.6			dz	4.1	4.7	0.6	
point4	dx	1.1	0.5	-0.6		point4	dx	1.3	0.9	-0.4	
	dy	1.3	0.9	-0.4			dy	1.6	1.3	-0.3	
	dz	4.6	5.5	0.9			dz	4.2	4.6	0.4	
フレーム	z		42.3	42.3		フレーム	z	0.7	32.4	31.7	
Jack1	z	54	53.7	-0.3		Jack1	z	49.2	49.2	0	
Jack2	z	54.9	55	0.1		Jack2	z	50.4	50.5	0.1	
Jack3	z	45.9	46.1	0.2		Jack3	z	40.7	40.8	0.1