

IPS Seismic Analysis with Modified Y-Piece

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1. Introduction

For the operation and maintenance works of In-Chimney in HANARO, the bottom of Y-piece supporting the IPS had been cut-off by 100mm, Ref. [1], as shown in Fig. 1. This modification needs for the additional finite element calculation following an earlier study, Ref. [2], which showed the seismic analysis.

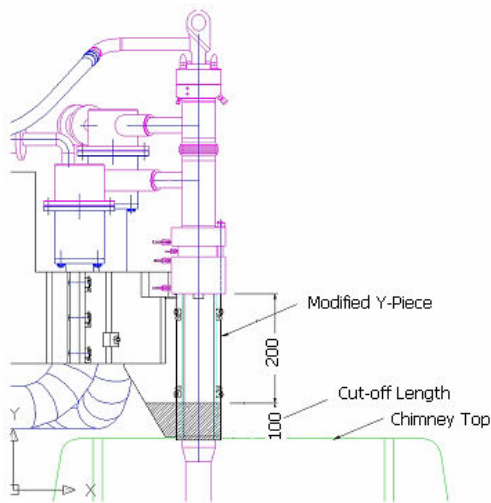


Fig. 1 Modified Support Structure (Y-Piece)

2. Input Parameters

2.1 FE Model

Modified model includes the effect of the fuel basket on the support structure and Support tube which changed its dimensions. Table 1 show that parameters.

Table 1 Modified modeling

Parts	Previous	Modified
Support tube ID/OD	83/120 mm	92/120 mm
Support tube length	400 mm	300 mm
Added mass of Fuel Basket	-	120 kg

IPS seismic model is shown in Fig. 2. Element type is S4R and CONN3D2.

2.2 Response Spectrum Method

The required inputs are SSE with 2% damping and OBE with 1% damping. Following the guidelines in Ref. [3], the procedure used is:

- Combination of the direction SRSS
- Combination of the modes 10% method

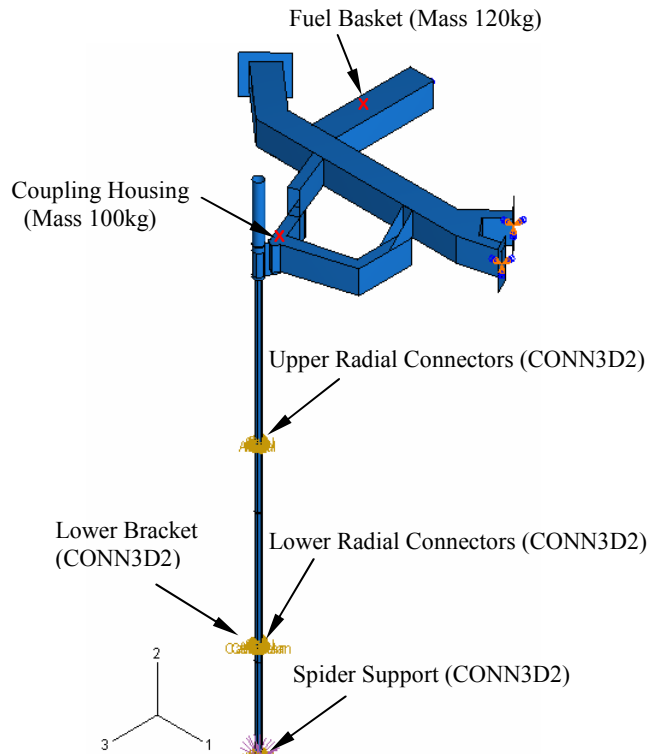


Fig. 2 Extent of IPS Seismic Model

3. Results

3.1 Natural Frequency Results

Table 2 gives the results of the natural frequency analysis for both model cases for the significant modes below 100 Hz by listing the mode frequencies and participating masses.

Table 2 Natural Frequency Results

Mode	Natural Frequency		Participating mass (kg)		
	Previous	Modified	X	Y	Z
1	11.6	11.5	2	2	100
2	11.6	11.6	99	0	2
3	26.5	26.6	0	181	0
4	27.2	27.5	1	0	0
5	29.8	29.9	1	491	8
7	33.3	33.0	0	16	1
10	44.1	44.9	65	0	2
11	44.6	45.5	0	16	22
12	55.4	55.9	344	7	29
Last	93.3	93.3	33	802	50
Total	-	-	546	1516	215

This result follows from the fractions of total mass which participate in modes up to 100 Hz and these are 25% in X, 70% in Y and 10% in Z (the total model mass is 2153 kg). Fig. 3 shows the deflected shape for the first two modes and Fig 4 shows modes 3 and 5 which are the modes with significant vertical moment.

(SSE) and 0.9 mm (OBE) are well within the allowable limit 3.2 mm.

Table 3 Seismic results for deflection

Maximum Deflection	SSE	OBE
At position of flow tube (mm)	1.0	0.9
At lower bracket support (mm)	1.3	1.1
Maximum deflection (mm)	4.8	4.2

4. Conclusion

1. Modified Y-Piece and added mass of Fuel Basket does not cause substantial changes to the IPS natural frequency.
2. Reduction in Y-Piece length does not impact on maximum displacement of the IPS at the point of IR-1 Flow Tube.

REFERENCES

- [1] Y-Piece Cutting, HAN-FL-400-PB-002, Rev.0, 27 December 2006.
- [2] Seismic Analysis of the KAERI IPS with Lower Bracket Support. HAN-FL-E-310-RT-R002, Rev.1 Appendix G, 26 May 2006.
- [3] ABAQUS v6.4 User Manuals, ABAQUS Inc., 2003

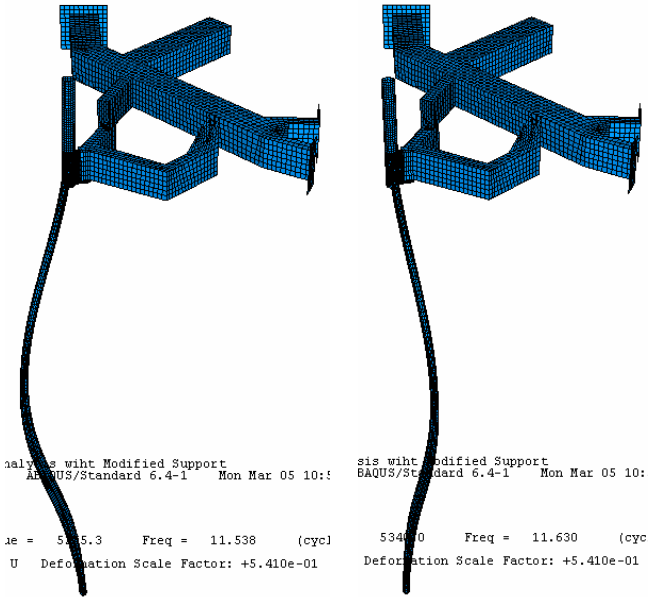


Fig. 3 First Two Vibration Modes (Freq. 11.6 Hz)

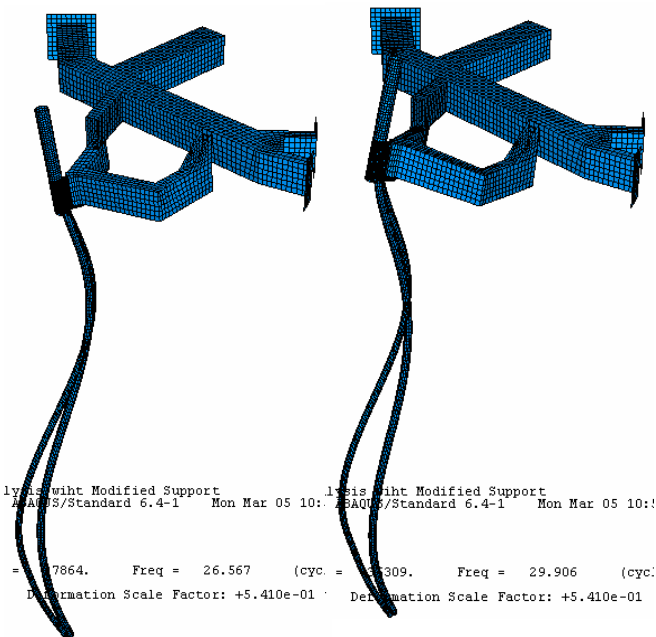


Fig. 4 Vibration Modes 3 and 5 (26.6 Hz and 29.9 Hz)

3.2 Seismic Results for Deflection

Table 3 gives the results of the seismic response analysis for the peak deflection at the position of the top of the IR-1 Flow Tube. Maximum deflection 1.0 mm