NSRP 2025 Panel Project: DSSM Latch Adjustment Mechanism

2025 NSRP SWSI Panel Meeting

July 17, 2025

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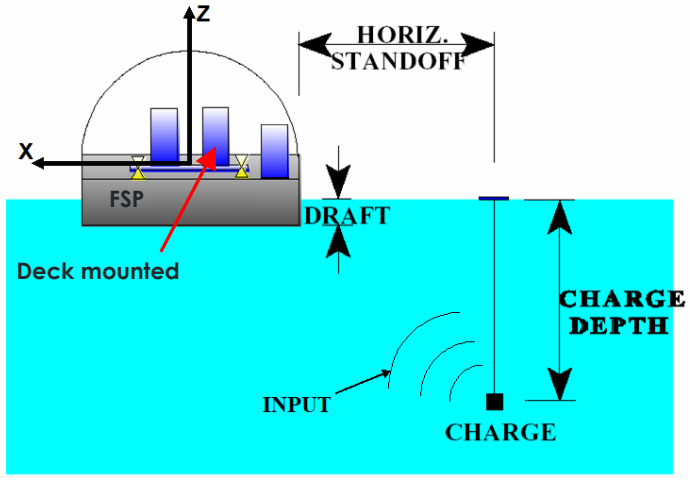
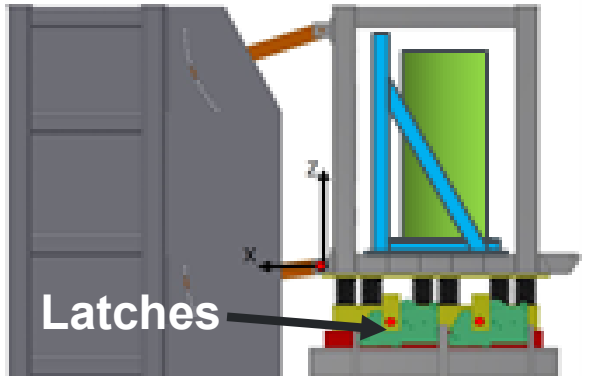
Opportunity Statement for Panel Project

- MIL-DTL-901E permits heavyweight qualification testing of class II deck mounted items having 18Hz < Shock Response Frequency (SRF) <= 37Hz on a deck simulator fixture (DSF) tuned to target frequency of 25 Hz (±4 Hz) in the vertical direction
- A savings of ~$60K per qualification can be realized if the deck simulating shock machine (DSSM) can be tuned to higher target frequencies to allow testing of class II deck items with SRFs>18Hz on the DSSM instead a DSF



DSF Heavyweight Testing

Savings of ~$60K



DSSM Testing

Problem Statement for Panel Project

- DSSM target frequency has dropped from 21.7Hz to 20Hz between 2015 to 2024
- Measurements and visual evidence during 2024 drops indicates latch play to be between 1/8 to 3/16 of an inch
- June 2025 video below shows play in latch system causing a gap between the impact pad and spring tray after latching

Gap reduces DSSM target frequency

Note: All videos and pictures in this presentation were obtained via HII-NNS purchase orders with Element, U.S. Space & Defense

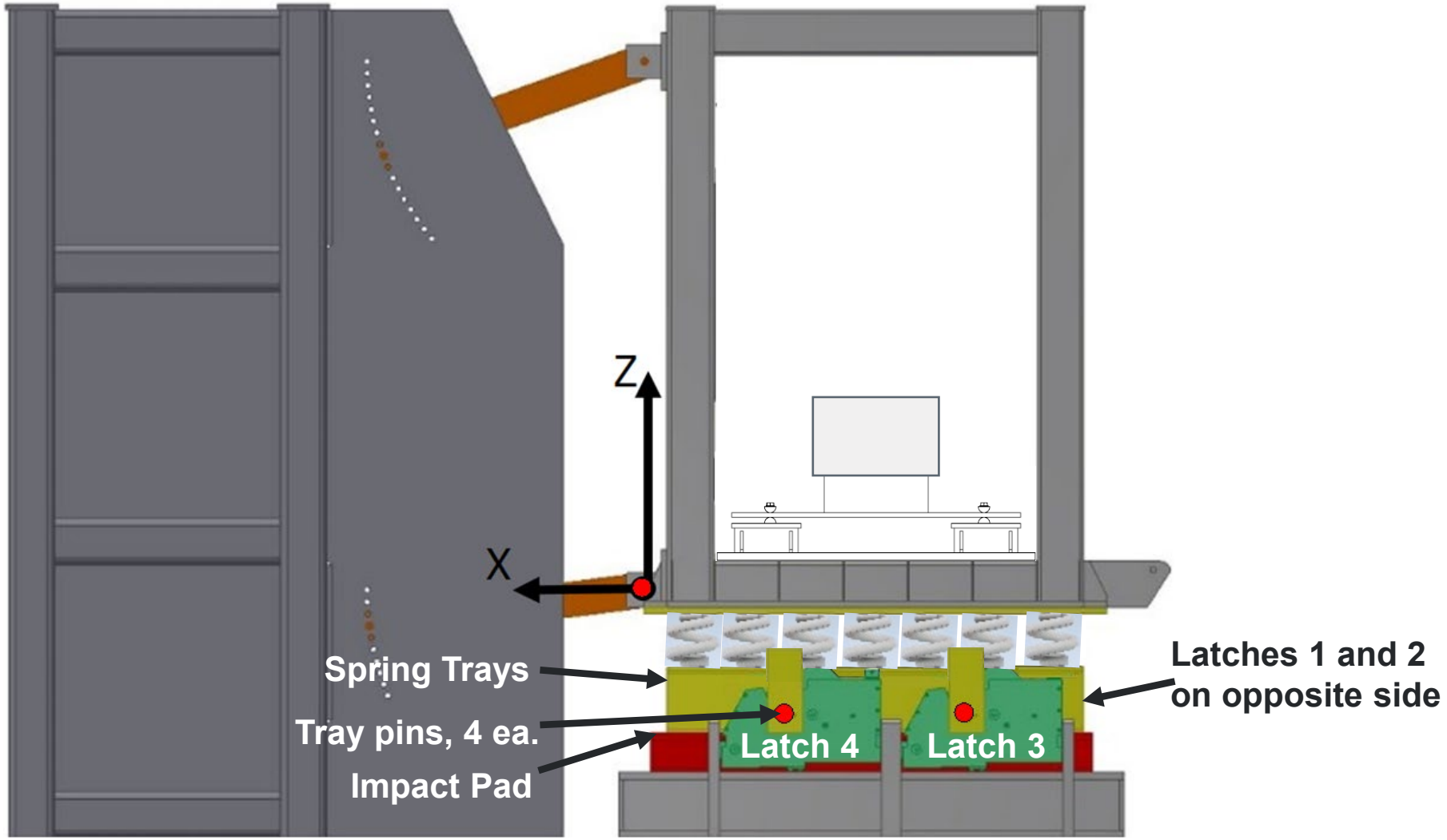
NSRP 2025 Panel Project: DSSM Latch Adjustment Mechanism

- Participants:
  - Lead: HII-NNS, Michael Talley, D.Sc.
  - Element, U.S. Space & Defense, Calvin Milam
  - NAVSEA 05P1, Tom Brodrick
- This project seeks to:
  - Design, fabricate, and test a latch adjustment mechanism that will achieve optimum latch grip using existing DSSM spring trays
  - Provide inspection procedures to obtain objective quality evidence for latch maintenance and replacement actions

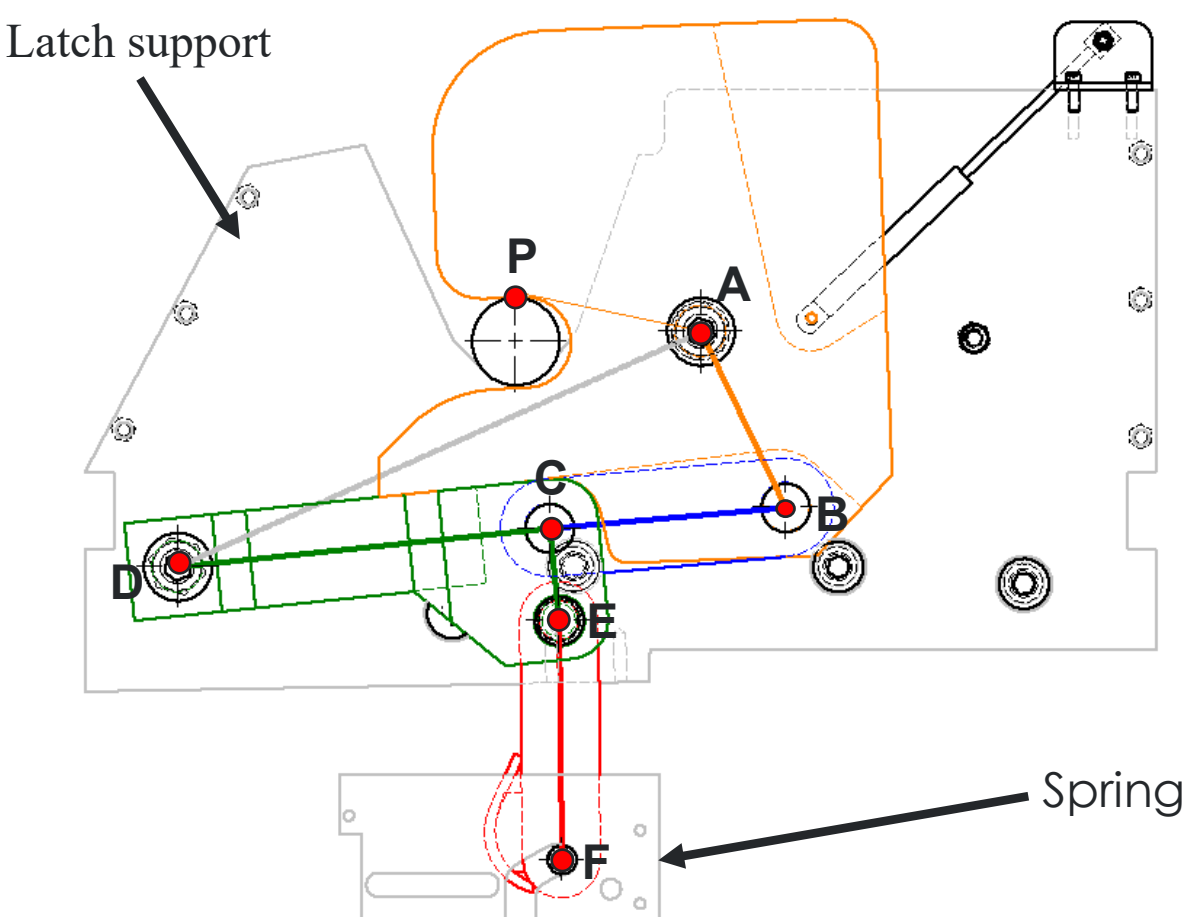
Summary of Methods and Procedures

- Inspect and document dimensions, degradation, and play associated with the DSSM latch mechanism parts *(90% complete)*
- Design, produce sketches, and fabricate latch adjustment mechanisms for four DSSM latches *(Design ongoing)*
- Perform DSSM drops with accelerometers on each drop and a means to monitor gaps between the spring tray bottom and impact pad *(Initial baseline drops complete)*
- Document results of drop testing and effect of latch adjustment mechanism
- Collect information to support development of inspection procedures to obtain objective quality evidence for latch maintenance and replacement actions
- Develop and submit inspection procedures for NAVSEA 05P1 approval

Location of Components Affecting Latching



4-Bar Link Latch Assembly



Nomenclature:

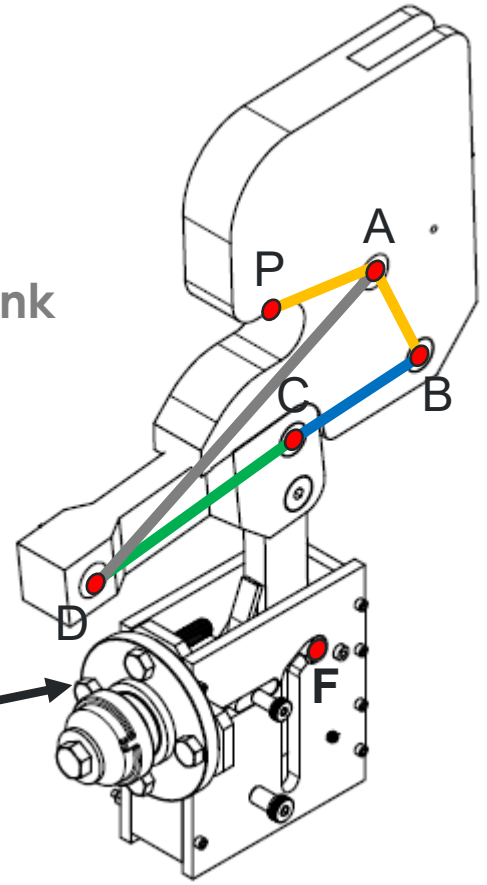
AB = Latch Fork Link

BC = Latch Link

CD = Yoke Link

DA = Virtual Support Link

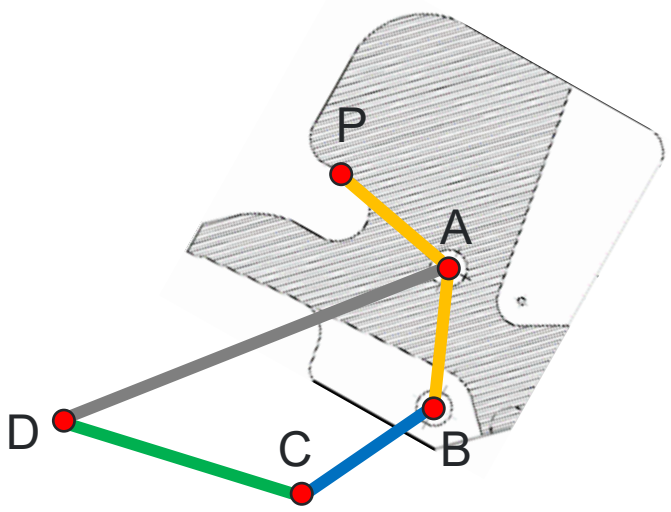
EF = Cam Link



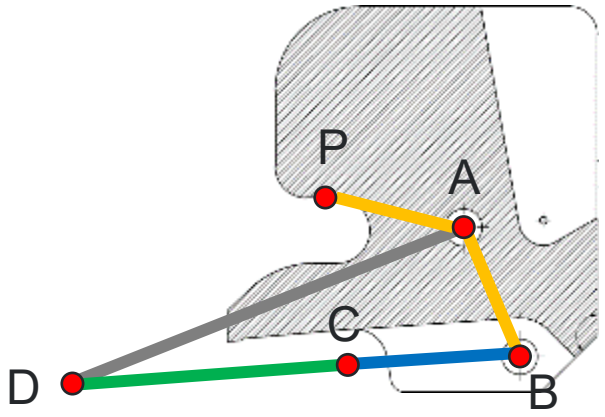
Spring Box

Inspection and Measurement of Link Connections at Points A, B, C, and D

DSSM Lifted



DSSM Latched



Link Lengths

Link	Length, in.
AB	5.000
BC	6.063
CD	9.563
DA	14.672
AP	4.815
BC+CD	15.626

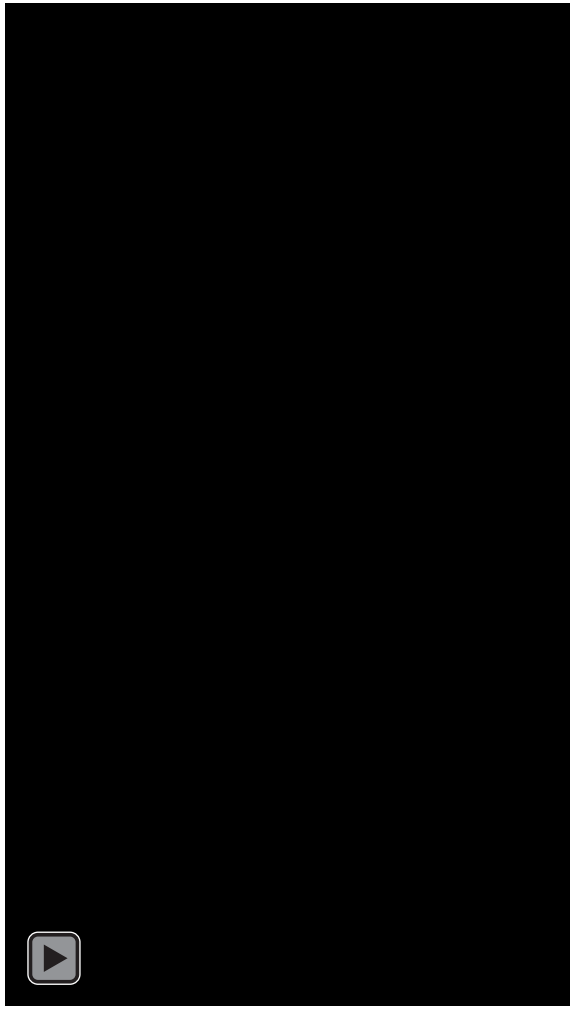
Inspect and measure the actual hole and pin/shoulder bolt dimensions to three decimal places at Points A, B, C, and D

Videos of Play

Yoke Hole Play

Fork Hole Play

Fork-Latch Link-Yoke Play



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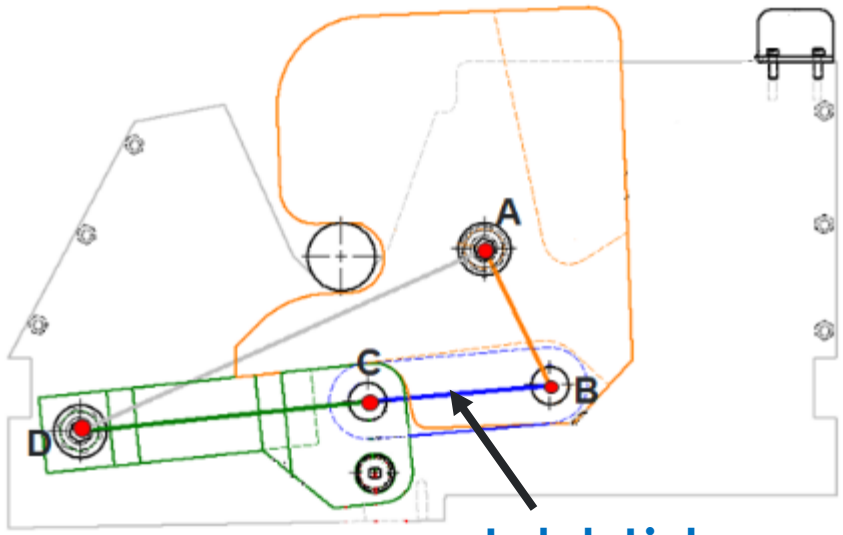
Measurements

All measurements are in inches



Average play measured:

- 0.094 between points B and C
- 0.071 at latch fork hole
- 0.067 at yoke link hole
- 0.033-0.044 at latch plate holes

Latch Link play	Latch 1	Latch 2	Latch 3	Latch 4	Average
Between Points B and C	0.125	0.0625	0.125	0.0625	0.094

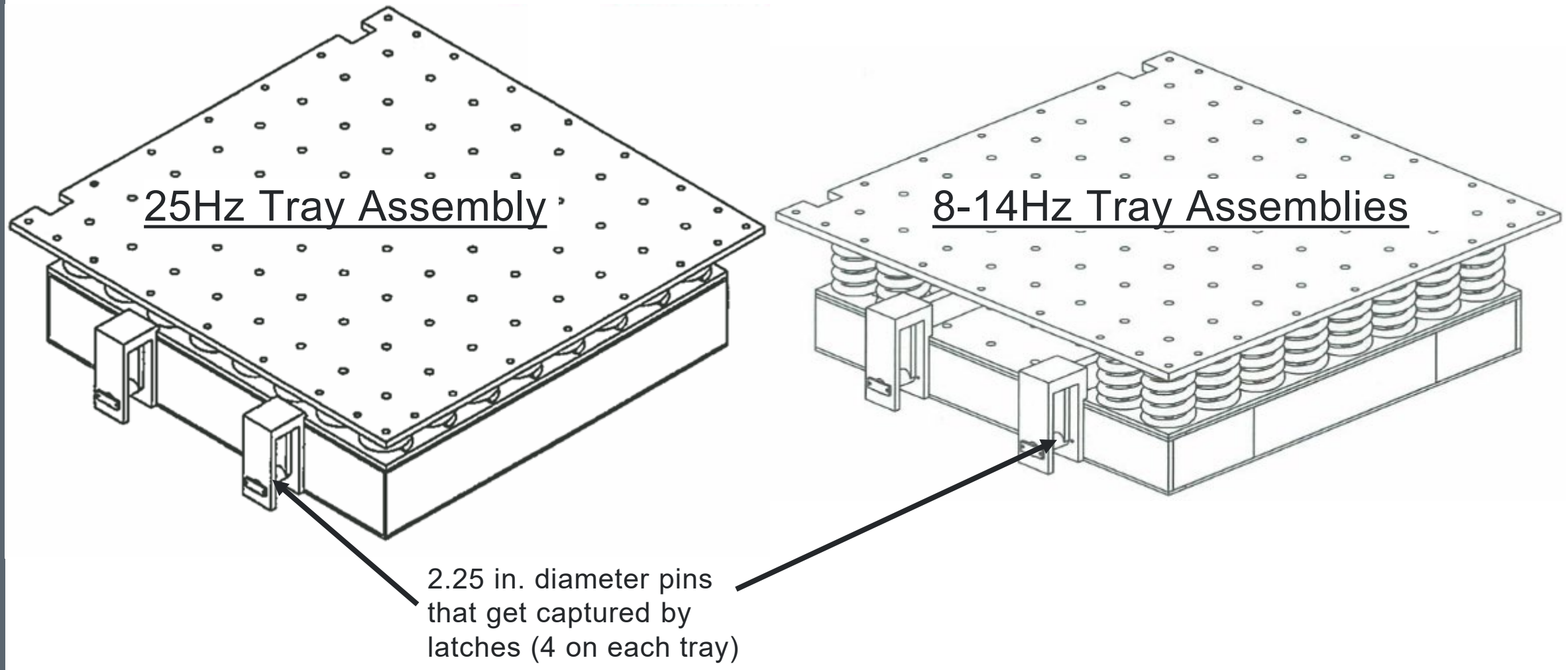
Diameters at Point A	Latch 1	Latch 2	Latch 3	Latch 4	Average
Latch Fork Hole DIA	1.319	1.315	1.316	1.311	1.315
Latch Fork Pin DIA	1.243	1.245	1.244	1.243	1.244
Latch Plate Inboard DIA	1.291	1.285	1.288	1.287	1.288
Latch Plate Outboard DIA	1.286	1.281	1.280	1.277	1.281

Radial play at Point A	Latch 1	Latch 2	Latch 3	Latch 4	Average
Latch Fork Hole	0.076	0.070	0.071	0.068	0.071
Latch Plate Inboard	0.049	0.040	0.044	0.044	0.044
Latch Plate Outboard	0.043	0.036	0.036	0.034	0.037

Diameters at Point D	Latch 1	Latch 2	Latch 3	Latch 4	Average
Yoke Link Hole DIA	1.315	1.313	1.312	1.311	1.313
Latch Plate Inboard DIA	1.278	1.285	1.279	1.273	1.279
Latch Plate Outboard DIA	1.277	1.279	1.276	1.281	1.278
Yoke Link Pin DIA	1.243	1.245	1.249	1.246	1.246

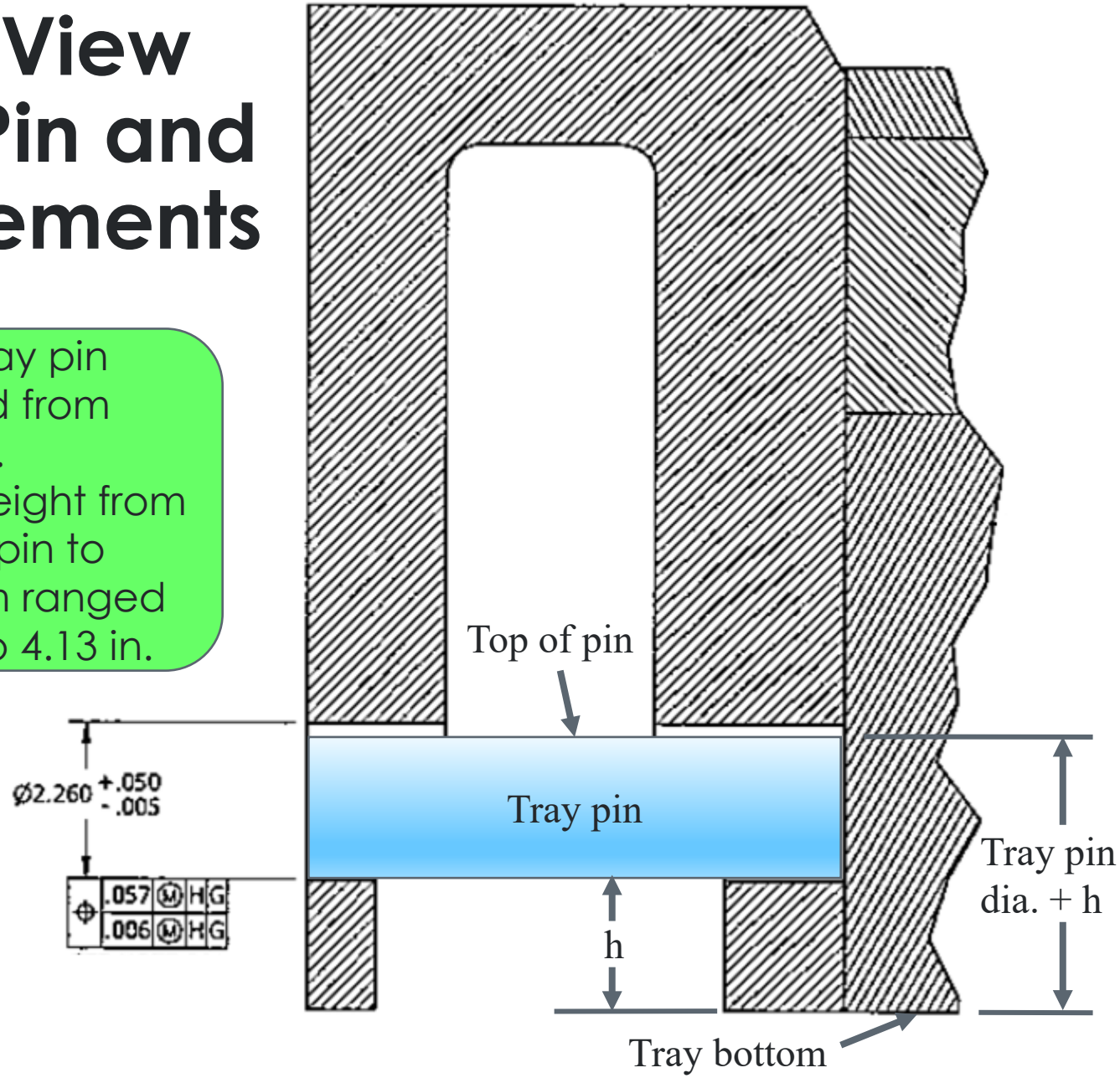
Radial play at Point D	Latch 1	Latch 2	Latch 3	Latch 4	Average
Yoke Link Hole	0.072	0.068	0.064	0.066	0.067
Latch Plate Inboard	0.035	0.040	0.031	0.028	0.033
Latch Plate Outboard	0.033	0.034	0.028	0.035	0.033

Spring tray Assemblies Showing Tray Pins



Section View of Tray Pin and Measurements

- Average tray pin dia. ranged from 2.25-2.26 in.
- Average height from top of tray pin to tray bottom ranged from 4.10 to 4.13 in.

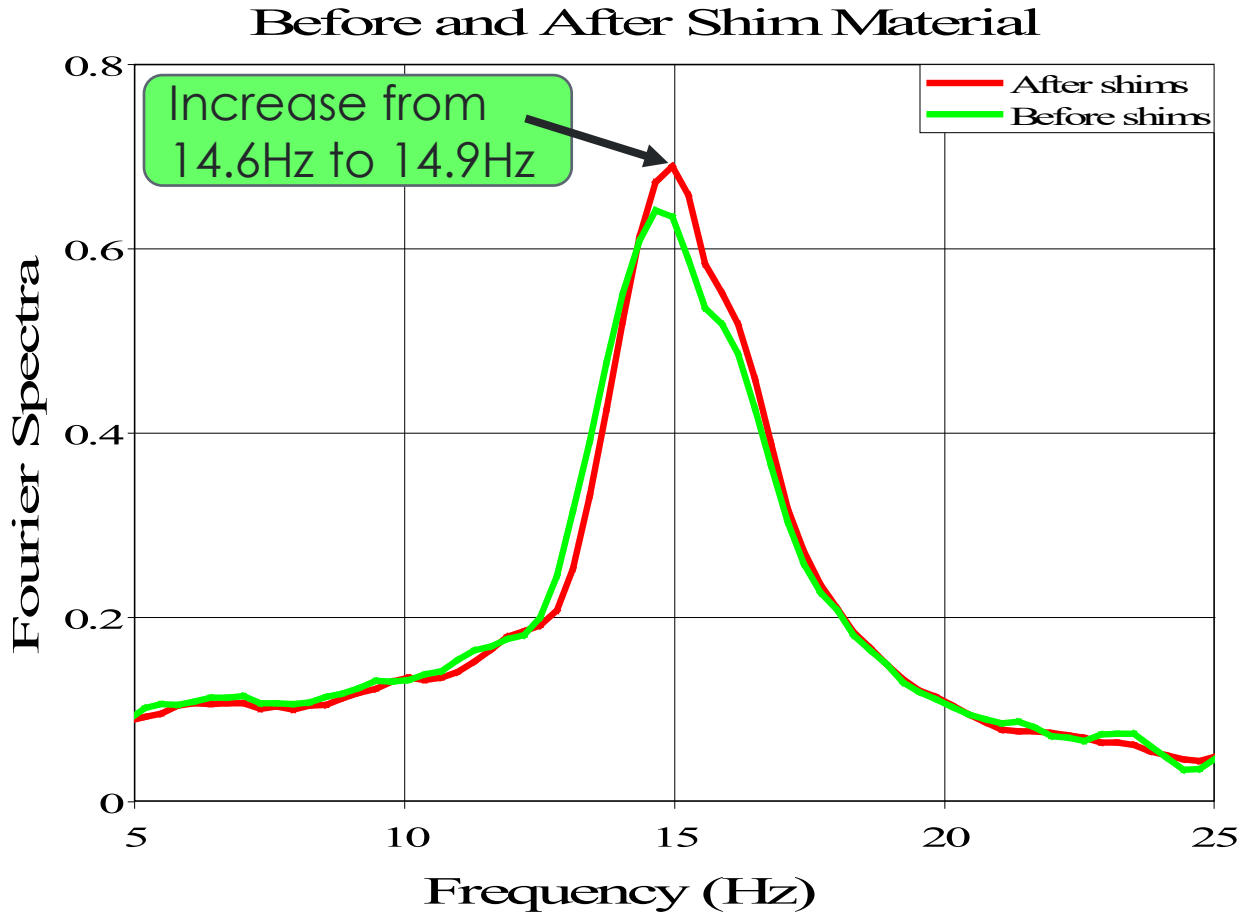


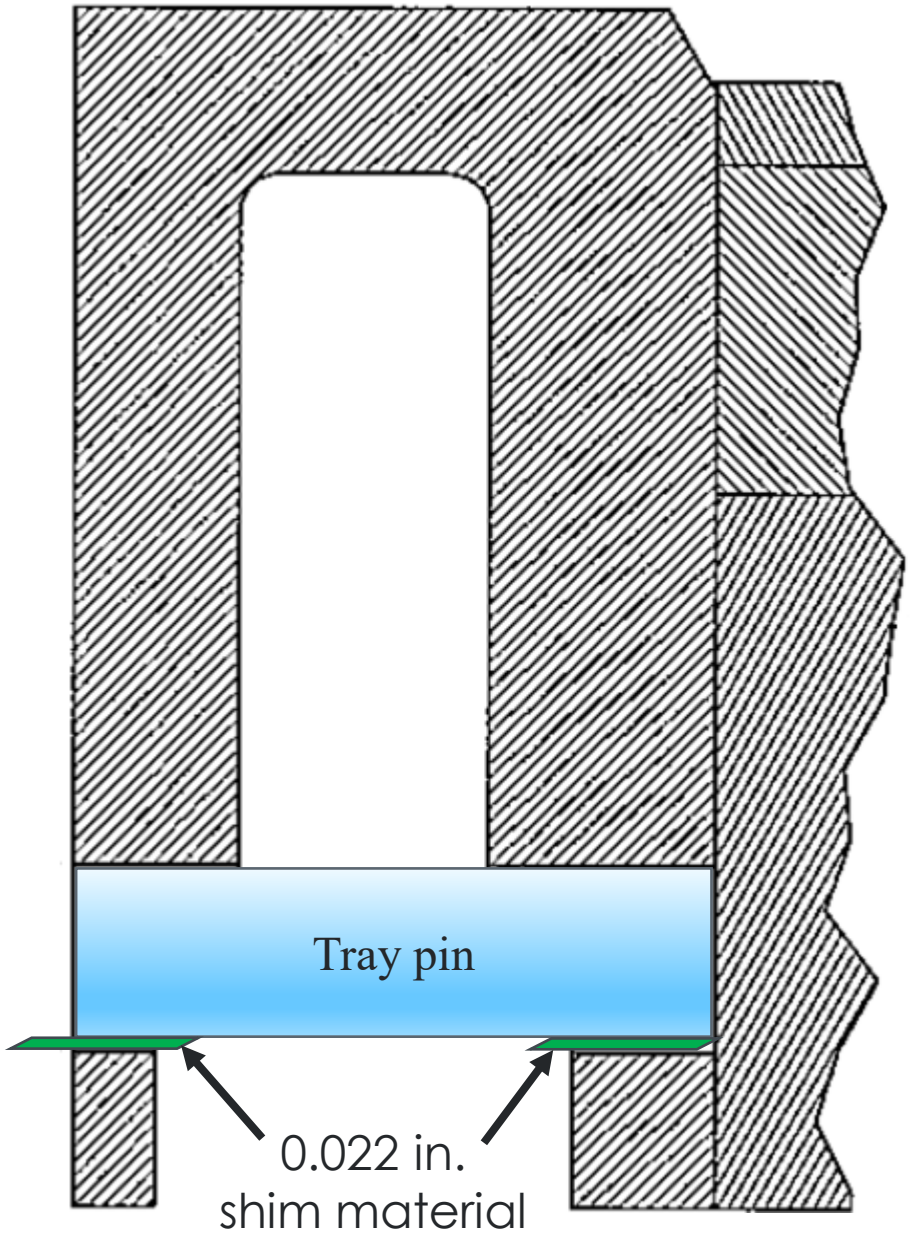
Latch No.	25Hz Spring Tray		
	Pin Dia.	h	Dia. + h
1	2.25	1.84	4.09
2	2.25	1.85	4.10
3	2.26	1.85	4.11
4	2.26	1.85	4.10
Avg	2.25	1.85	4.10

Latch No.	14Hz Spring Tray		
	Pin Dia.	h	Dia. + h
1	2.26	1.88	4.13
2	2.25	1.88	4.13
3	2.25	1.88	4.13
4	2.25	1.89	4.14
Avg	2.25	1.88	4.13

Latch No.	8Hz Spring Tray		
	Pin Dia.	h	Dia. + h
1	2.26	1.85	4.12
2	2.27	1.85	4.12
3	2.25	1.85	4.10
4	2.27	1.85	4.13
Avg	2.26	1.85	4.11

Effect of Shimming with Banding Material Under Tray Pin on 14Hz Tray





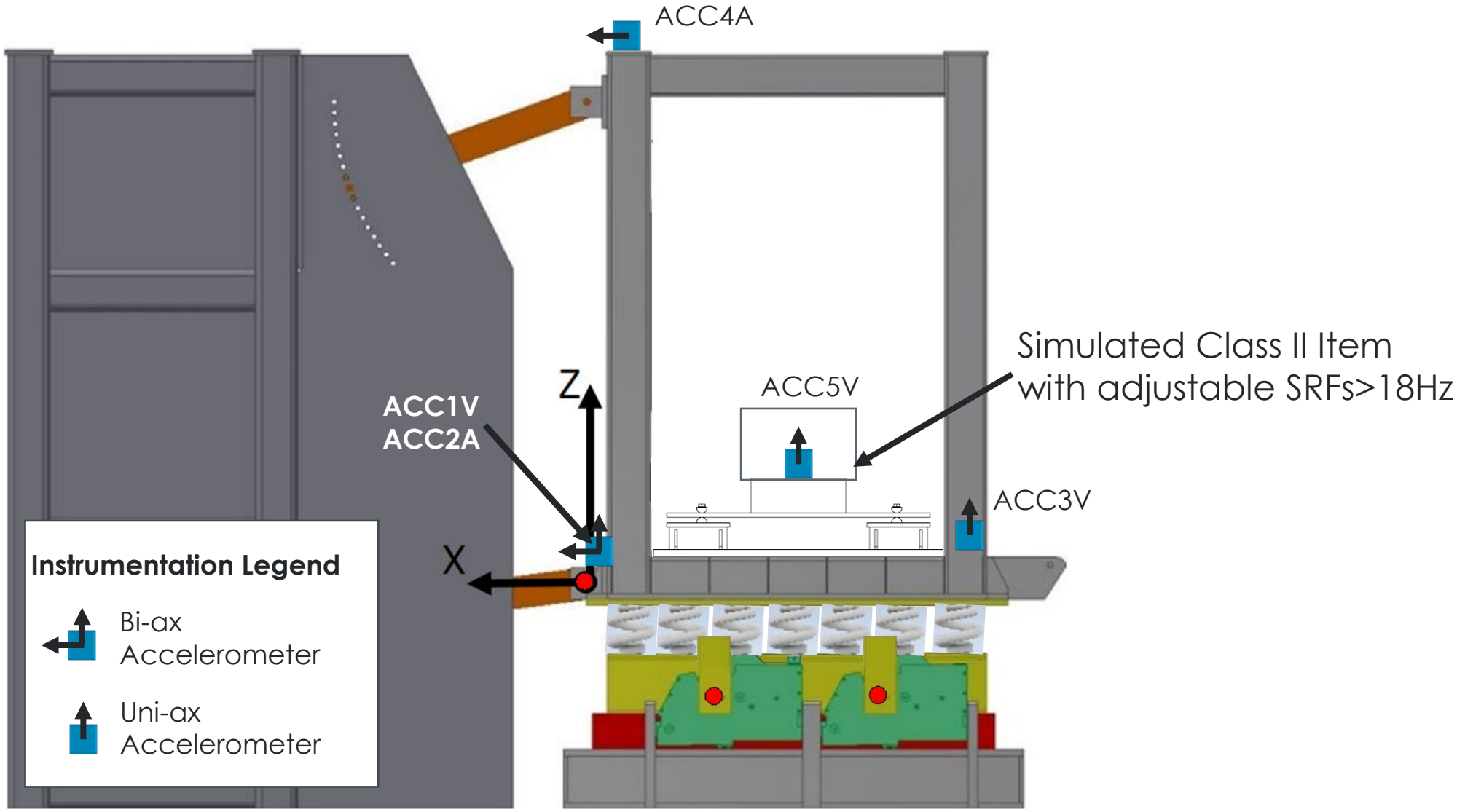
Design Approach

- To support design of the adjustment mechanism, the latch components are being modeled with contact surfaces in ABAQUS
  - Assembly of the components in the model will include play measured during the inspection
  - Same model will be used to perform stress analysis of the design.

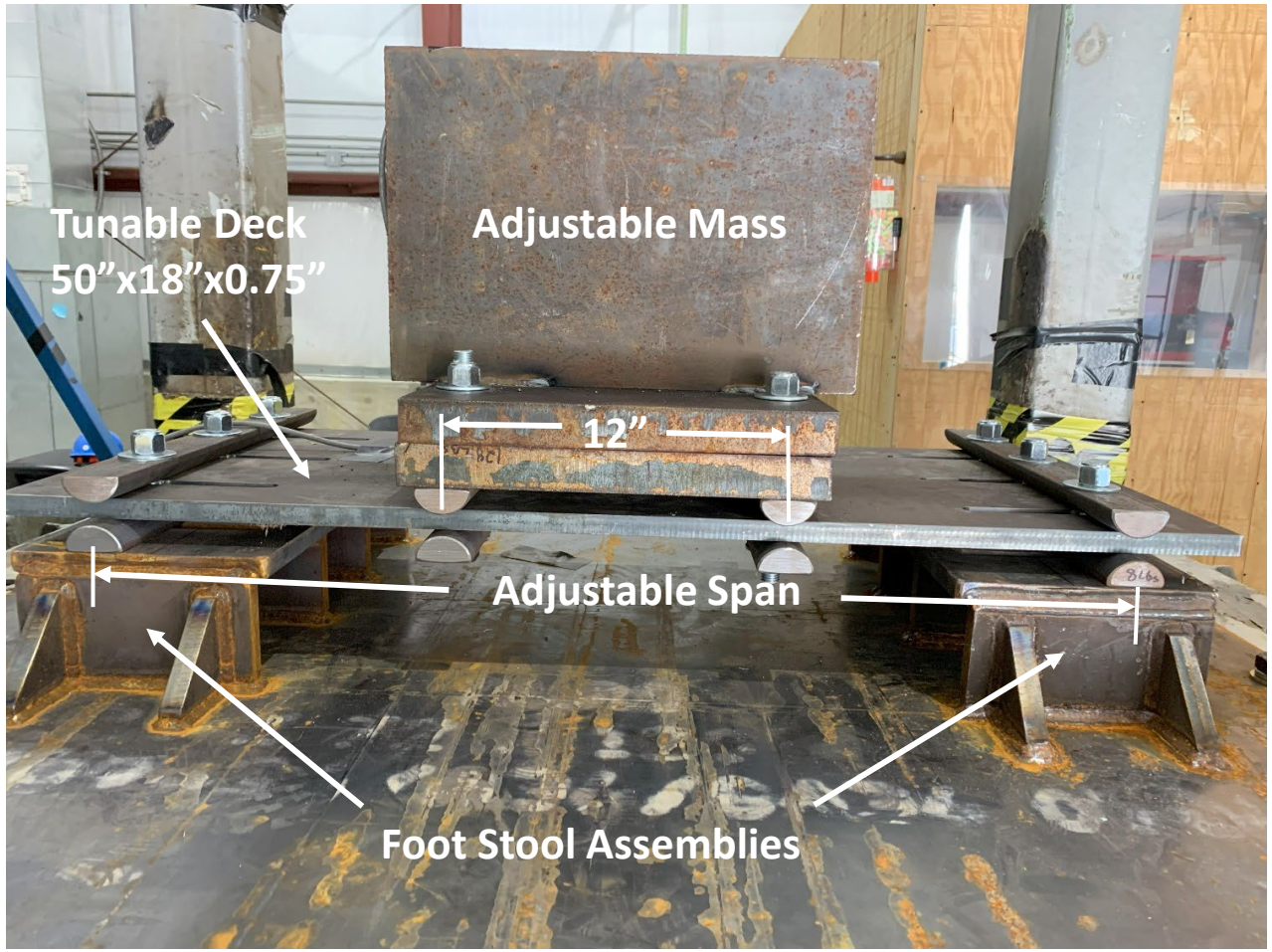
Planned DSSM Drops

- Perform drops to determine baseline responses for 25Hz spring tray and 14Hz spring tray before installing new adjustment mechanisms
- Perform drops with DSSM configured with 25Hz, 14Hz, and 8Hz spring trays with new adjustment mechanism installed
- Perform drops with new adjustment mechanism, 25Hz spring tray, and the tunable frequency deck installed to compare to 2024 test data
  - One drop with 36 inch span
  - One drop with 30 inch span
- Perform ad hoc drops as needed to assess sensitivity of adjustment approaches

Test Instrumentation



Simulated Class II Item with Adjustable SRFs>18Hz



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QUESTIONS