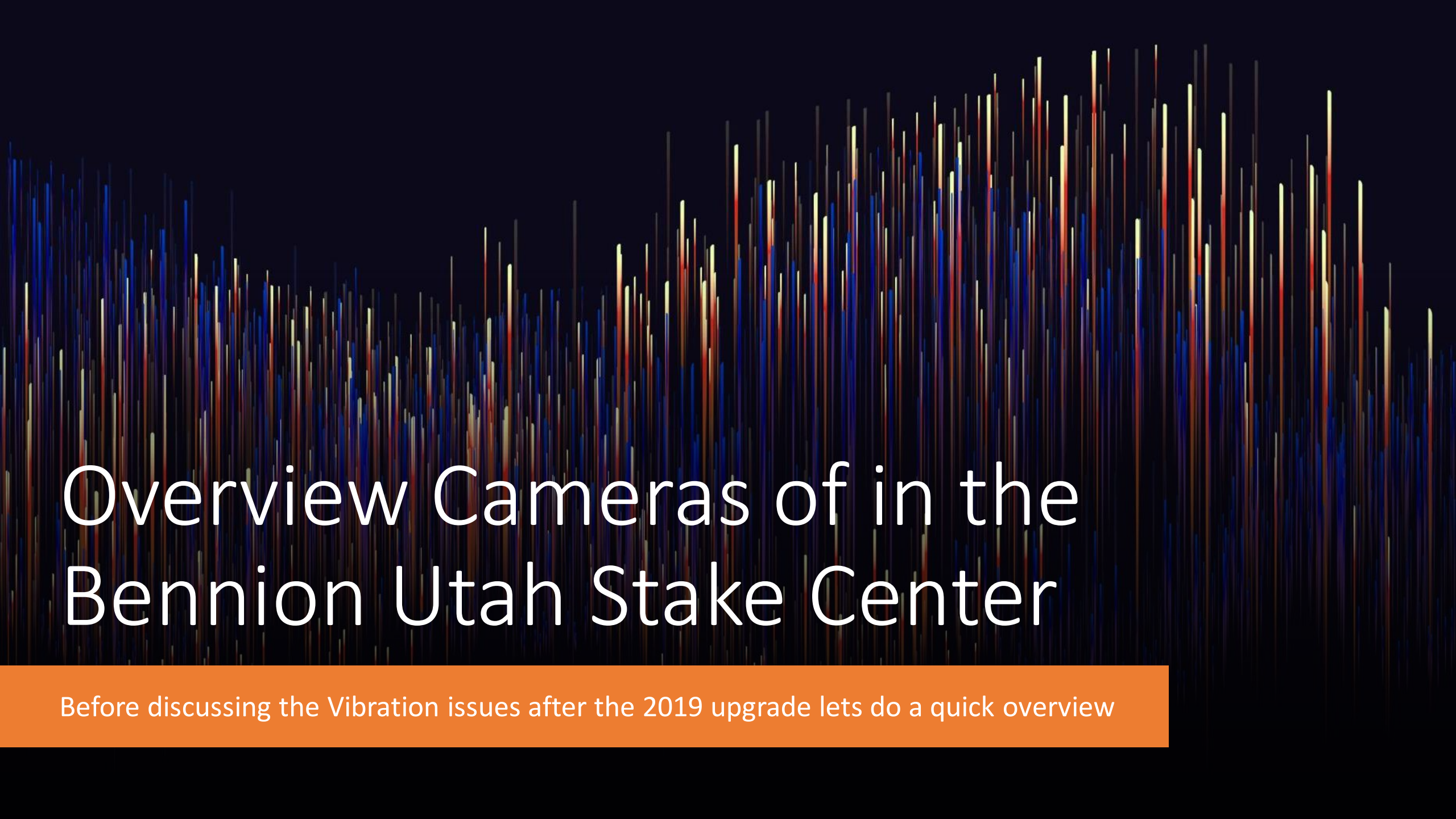
# Bennion Stake Center ASL Center Camera Vibration mitigation

Bennion Stake Technology Specialists
Allen Luker & Dustin Silfvast



# Overview Cameras of in the Bennion Utah Stake Center

Before discussing the Vibration issues after the 2019 upgrade lets do a quick overview

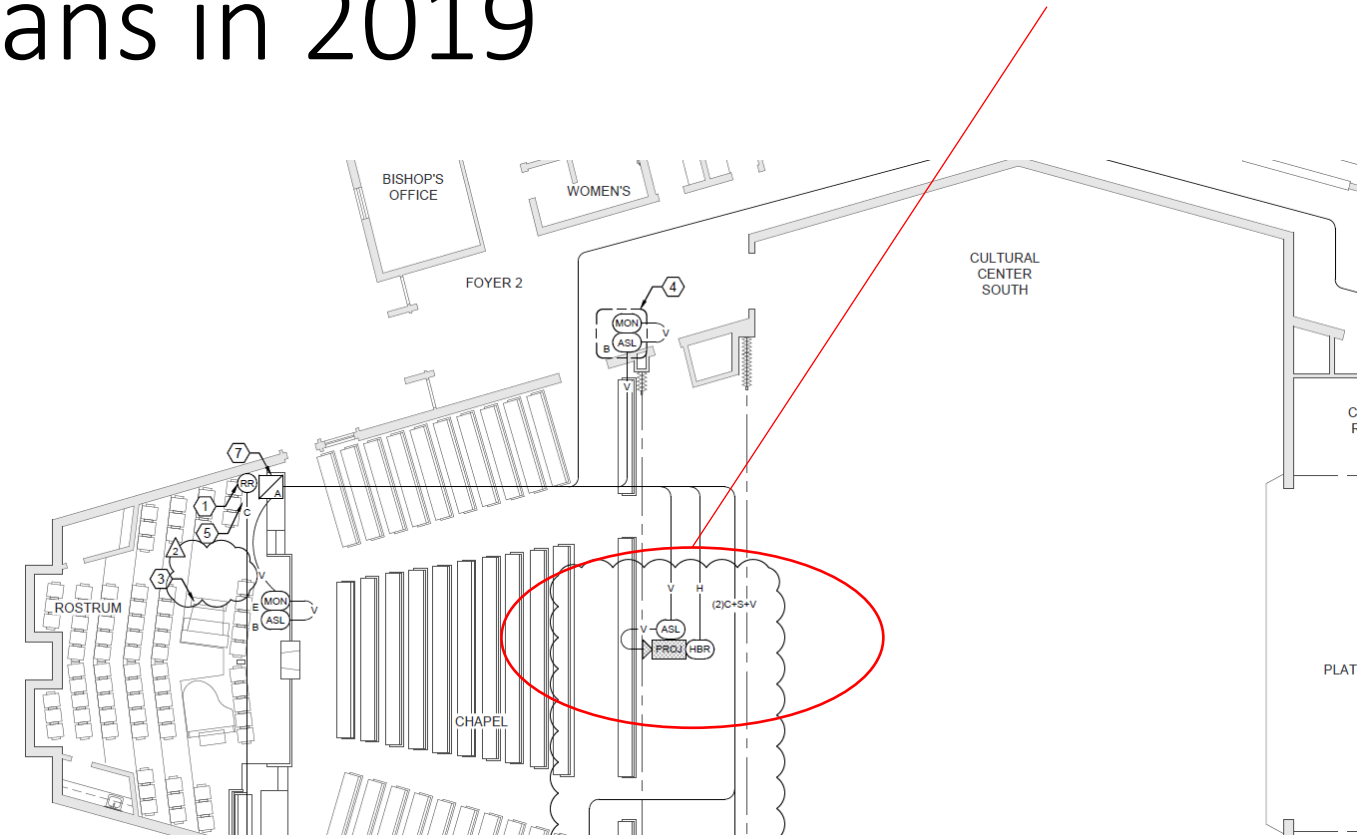


The ASL Camera and Projector in the Bennion Utah Stake Center Chapel

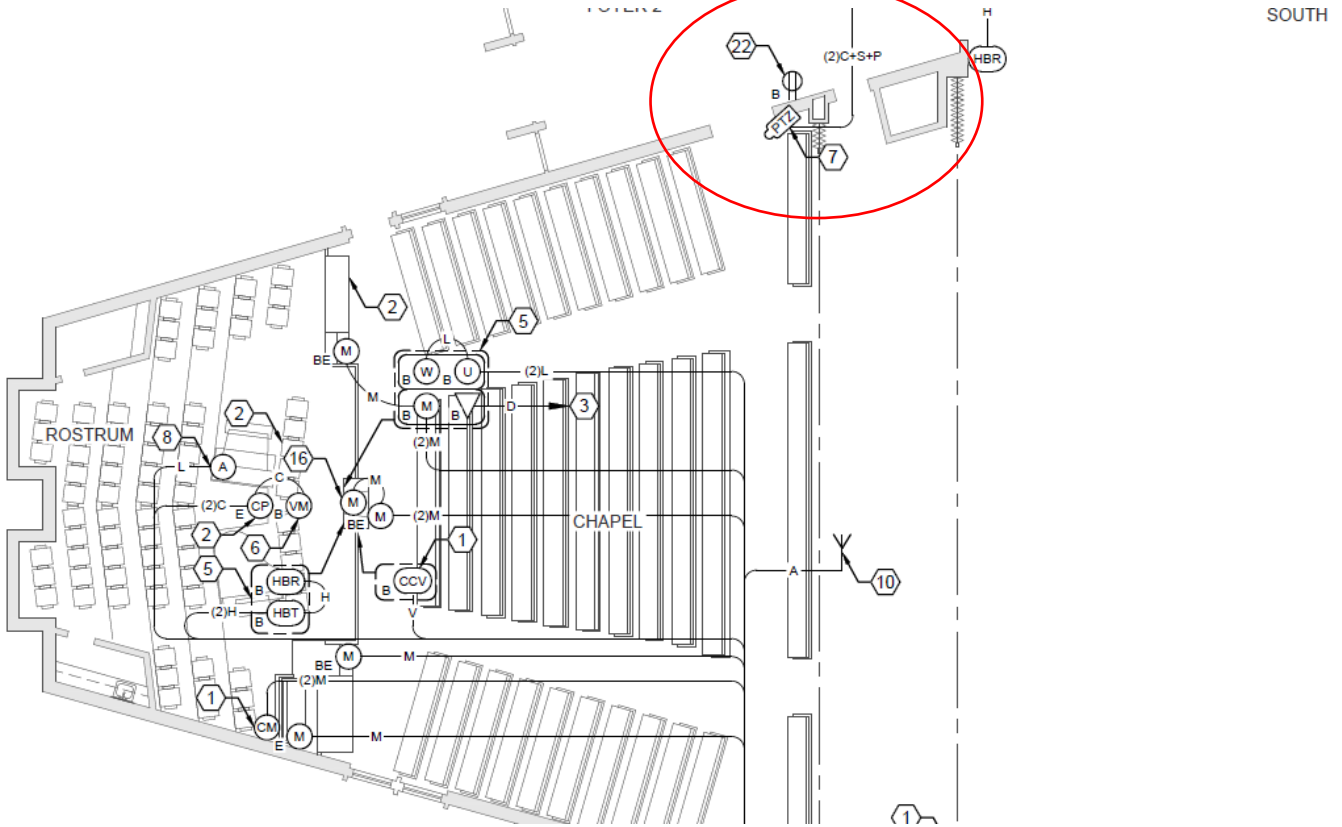
Original design by Dave Drummond 1999
Sound Design

Original Installation by General Communications

# ASL Camera and Projector from AV upgrade Plans in 2019

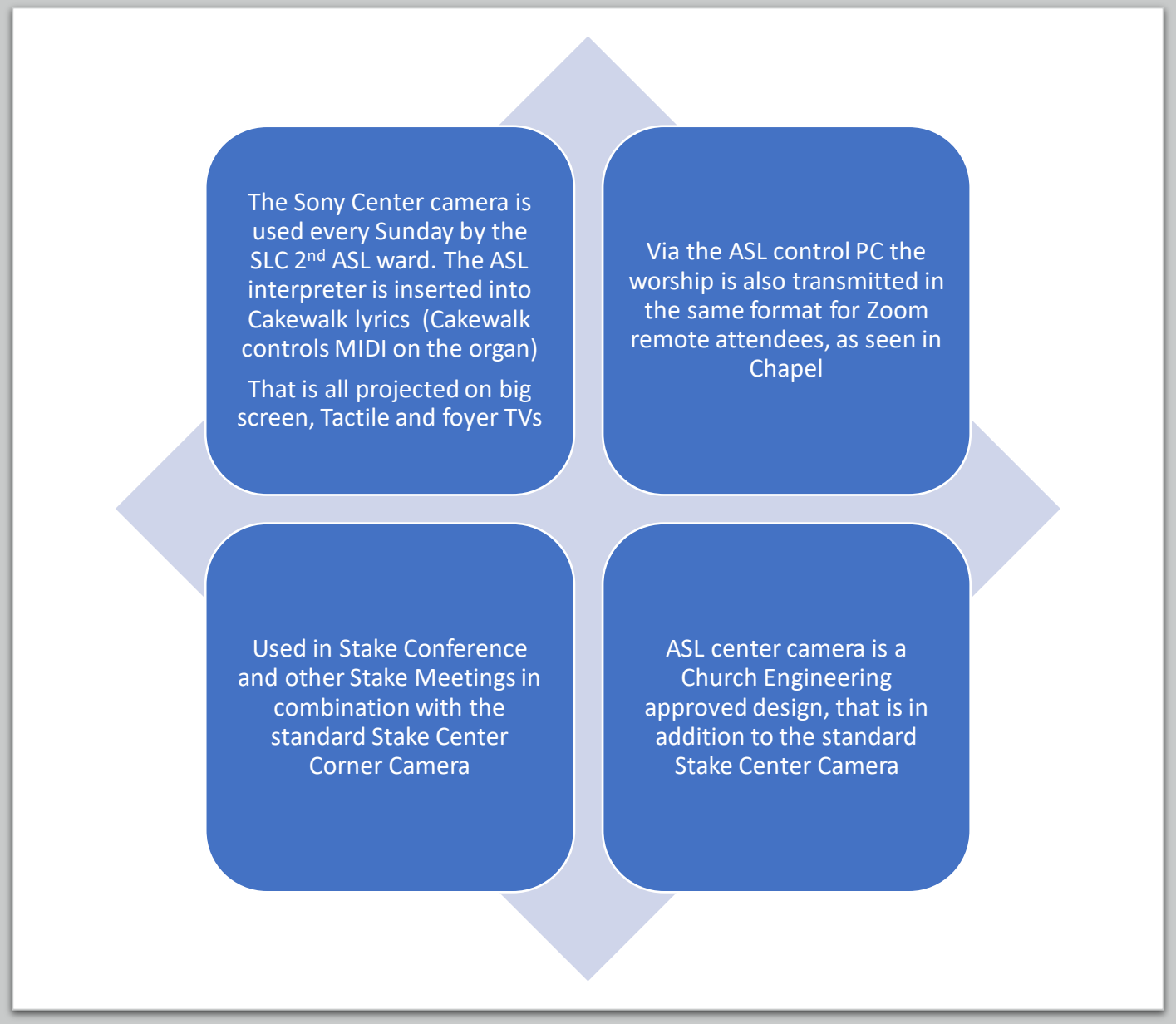


# The standard Stake Center Corner Camera as indicated in the 2019 AV upgrade plans was installed by General Communications



# How the ASL Center Camera is used

The Center Camera is defined as the “ASL camera” in design document: 506-6956
BENNION STAKE CENTER (ASL)
BENNION UT STAKE SOUND SYSTEM UPGRADE August 2019



# ASL control PC

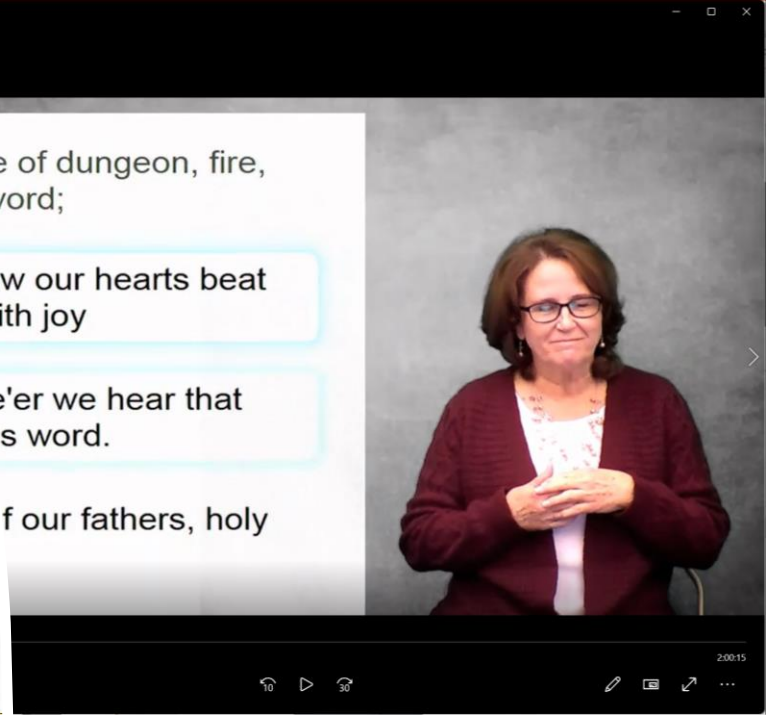
The ASL PC has HDMI inputs:

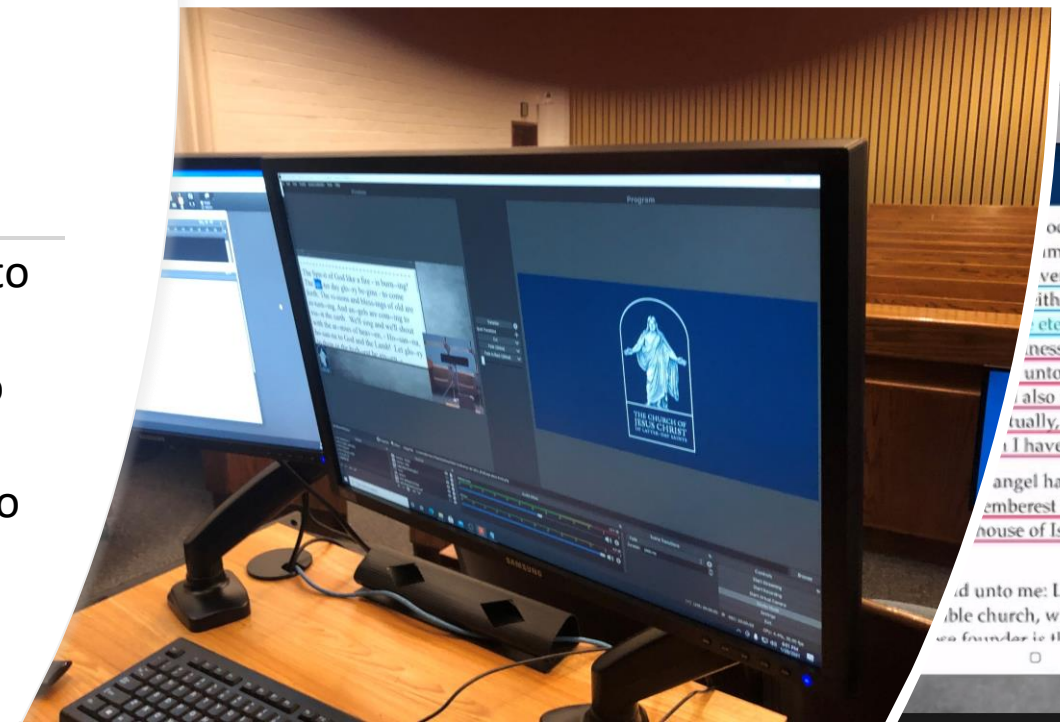
- From both Cameras
- From Pulpit (laptops, iPad, PADs, smart Phones)
- HDMI Outputs to HDMI Video Switches

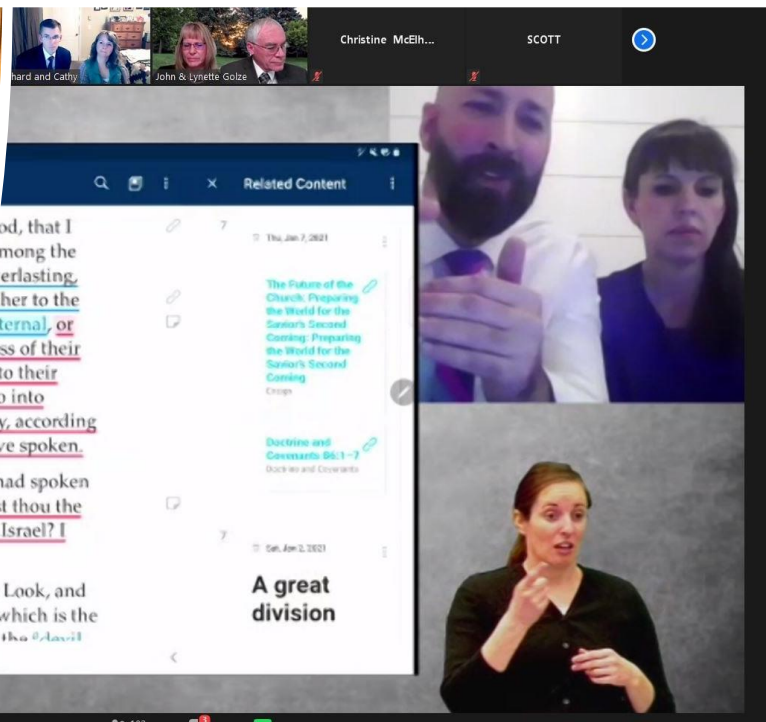
Other connections

- USB connection to Organ MIDI to control Organ
- In and out audio connections to sound system
- Ethernet Network Connection to building network



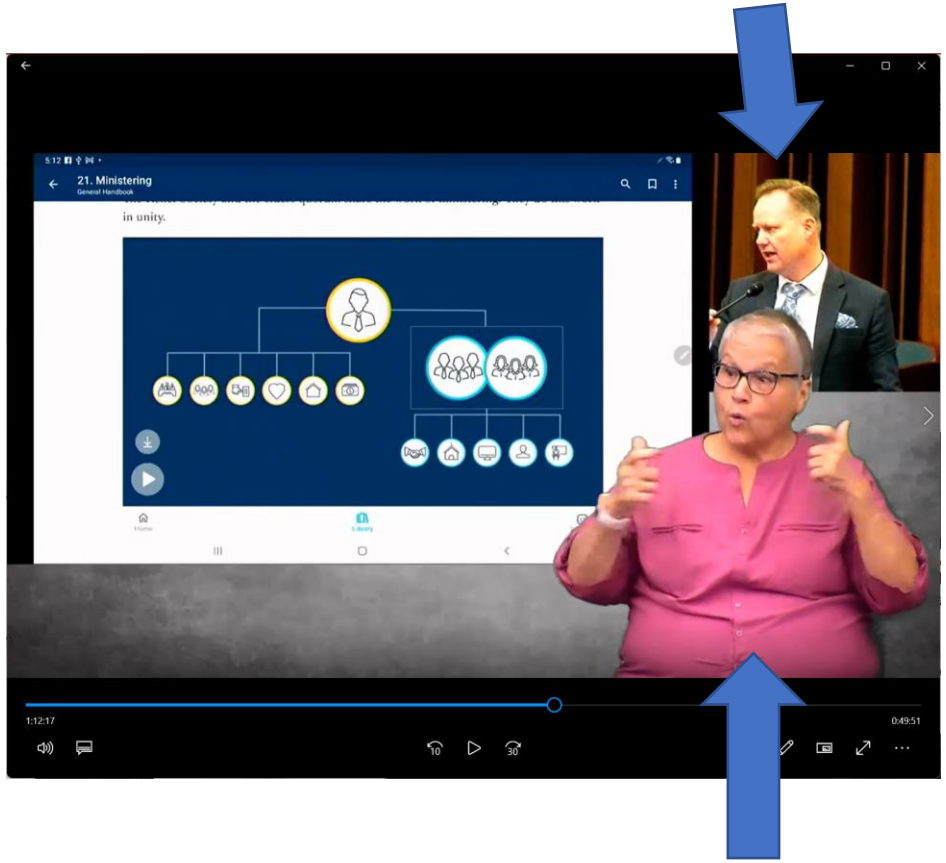




# The ASL Center Camera is used in combination with standard Stake Center corner camera

The standard Stake Center Corner Camera




Center ASL Camera is used for ASL Interpreter

November 2019 it was replaced with a new Sony PTZ 120SDH with an SDI 1080 P output that is converted to HDMI and inserted in the ASL AV HDMI video switch.

This enabled new features that the ASL ward has wanted for many years

The ASL and the Standard Stake Center corner Camera used in Stake Conference and other stake events are connected to ASL PC Via HDMI to USB interfaces this allows use of a Free software called Open Broadcast System

Commonly known as OBS

For stake Conference the ASL interpreters are on the floor in front of clerks' desk with a green background. The height of the Center camera Clears any people walking into to the picture. The Corner camera is too low, and many more people can walk into the path of camera.

We use a feature in OBS called Chroma Key that blocks out the green background and blends the Interpreter into the combined OBS output that goes out over Stake Center HDMI Video distribution system and also Zoom remote viewers

# History of the troubleshooting of the vibration issue



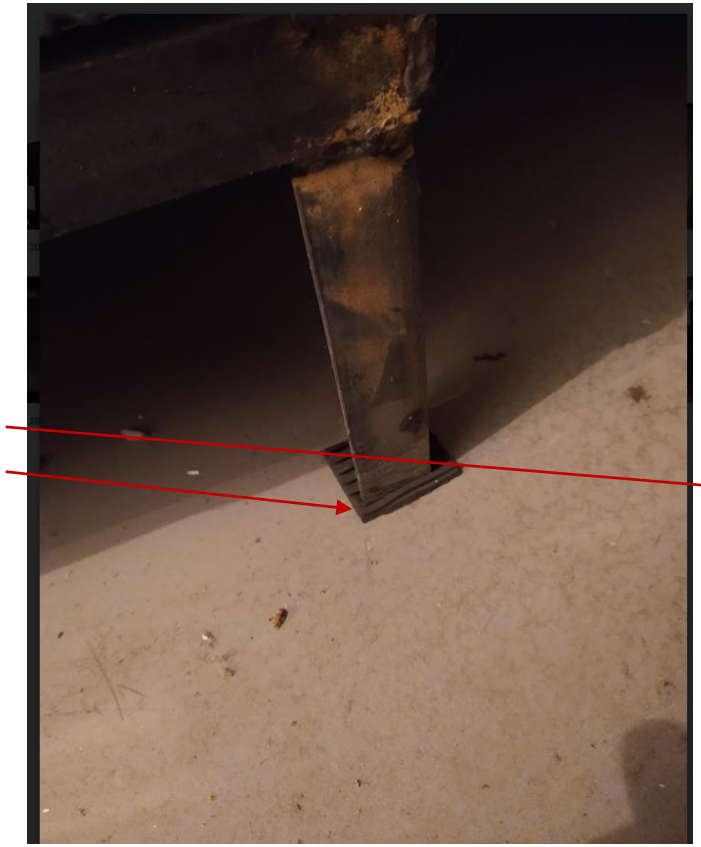
It was 3X10X10 Pad of memory foam that absorbed 70 to 80 % of Vibration.

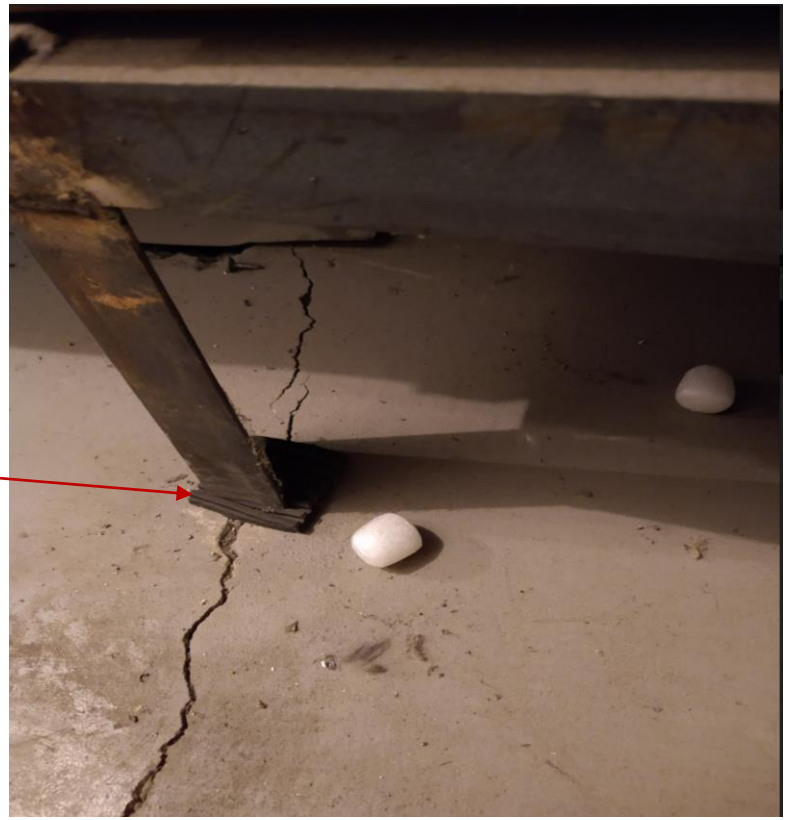
At the commissioning of the new AV in December 2019 there were two outstanding issues:

- Vibration or Shaking of the ASL Camera
- The blanking out of the color in camera and when HVAC was not running, we were seeing stuttering of video which we thought also a vibration issue
- These two issues were still not solved by General Communications
- Bennion Stake Technologists discovered that the replacement of Cable TV (CATV) grade RG6 coaxial cable was not called out. The use of CATV cable created an impedance mismatch that intermittently black holed the color components and created a stuttering of the video. With a call to General Communications, we split the difference and they gave us back the unused SDI grade RG 6 coaxial cable.
- Bennion Stake Technologists ran new the cable through the tunnel from Clerks desk to the ASL camera in Mechanical room. That solved color Blanking and Video stuttering issue. There was some hope that the correct cable would also solve the vibration issue as the stuttering was like vibration.
- CATV grade coaxial cable has a copper clad center conductor and the higher video Radio Frequencies (RF) only run on the skin of the center conductor (copper cladding). The SDI grade has a solid copper center conductor which allow much lower frequencies to travel on the cable. As lower frequencies will travel more in the core of center conductor, which evidently color components must occasionally travel in those lower frequencies.
- The use of SDI grade coaxial cable with a solid copper center conductor suggests the fact that a much wider bandwidth and many lower frequencies are used in the generation of High-definition video. This likely allows the sensitivity to the analog frequencies generated by vibration from the HVAC system as they these frequencies and/or their harmonics cross paths with other.
- In contrast the previous camera was a standard old Analog 520-line TV signal video signal (used the last 22 years) The bandwidth is narrower with frequencies much higher, and it becomes apparent that it is less sensitive to the analog frequencies generated by the HVAC system. In other words, the frequencies and associated harmonics did not croos paths/ Thus, the old camera did not have any vibration issues or complaints over those 22 years
- Other MFG's HD cameras would also be susceptible to vibrations unless the camera has vibration cancelation schemes added to the software/firmware
- At this point General Communications claimed no responsibility for Vibration issue
- After several days and hours working on it, Bennion Stake Technologists found that placing the camera on two anti-vibration pads and 3 inches memory foam mitigated 70 to 80 % of Vibration.

# Places where the HVAC TECHS put vibration pads in 2019 after A/V Upgrade

The FM group had these Anti-Vibration installed on these two legs of the HVAC system in an attempt mitigate the Vibration issue with the new camera
It had no effect, but more vibration mitigation could be done on the HVAC system





# It was suggested to move the Center Camera to the Northwest corner, reason for not doing that:

- The recent implementation negates most of the reason to that as ASL members report “no shaking of camera when HVAC is on”
- The ASL camera is used every week by the ASL ward. The direct Focus from the Center Camera location provides the best coverage of the ASL translator standing next to a non ASL speaker. It also more effective shot for ASL speakers
- As previously stated, when using ASL PC OBS to insert the ASL interpreter the corner camera is too low, and many more people can walk into the path of camera. The ASL camera works much better as it is higher, and we can eliminate people inadvertently walking into the field of the camera
- The Center Camera has been in Service since 1998 the Prior Camera was a Sony PTZ with a CVBS (Analog TV output) in the same box with no vibration issue.
- The cost to move camera in contractor labor time would probably be equal to replacing the Sony camera with another Camera that has Vibration cancelation features
- Moving the camera would require replacing/rerouting many cables.
  Specifically, the SDI RG6, the Visca Control Cables and power
- The Camera does not require any routine maintenance so there is no need for frequent member access to Mechanical room.
- When FM group arranges a contractor to do service on the Projector. An Eyeglass cleaning wipe could be used on the camera lens. Other that there nothing else to maintain

# Next Step, can we further reduce the vibration?

- We have left the camera on the memory foam for the last 3 years, until we started getting some complaints about the vibration again in the fall of 2022.
- We have felt that NB-AVCB-W was an expensive boat anchor the NB-AVCB-W cost 495.00. But is was a back burner item that we wanted to install the Anti-vibration camera mount
- After some study we realized that we had used the NB-AVCB-W incorrectly
- The next step would be installing Anti Vibration Camera mount by either extending 1 ½ pipe mounted to the ceiling and adding an additional pole mount. But it was realized that a main steel beam support in between camera box and the projector box
- Dustin Silfvast fabricated and welded from 1/8 in hot rolled steel plate ¾ x ¾ Angle iron
- The extension bracket was attached to steel beam with C Clamps and then passed thru a 2 in x 10 in opening in the camera box were NB-AVCB IS connected
- Using C Clamps had no impact on structural integrity of building steel as there was no drilling of any mounting holes

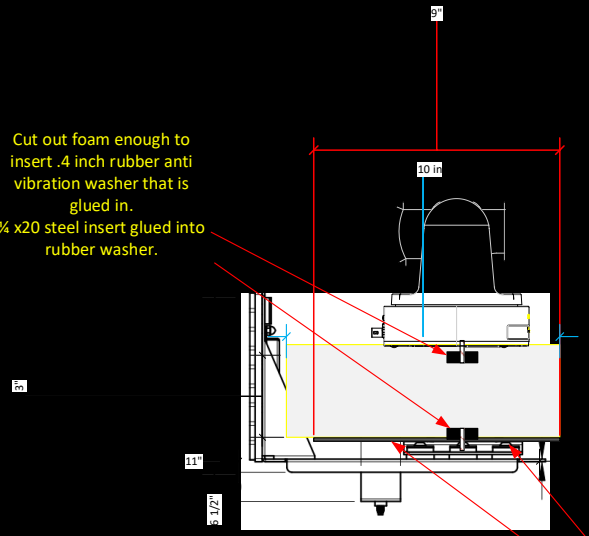
# The first implementation of the NB-AVCB-W was in the first week of December of 2022

The ASL ward (Salt Lake Valley 2nd Deaf ward)  has given feedback that there is now no noticeable vibration or shaking in the Center Camera.

At this point we could leave the implementation as is. But there are some tune-ups and tweaks to eliminate vibration that can still be seen if camera is Zoomed in very close to the pulpit for example.

# NB-AVCB-W camera mount to the Dustin Silfvast fabricated extension bracket and attached to the adjacent steel beam

Unfortunately, Low Frequency vibrations (about 60-120 Hz) were still making it past the  Anti-vibration pad installed between the mount extension and the NB-AVCB-W back plate.
We had to install memory foam to get a satisfactory reduction

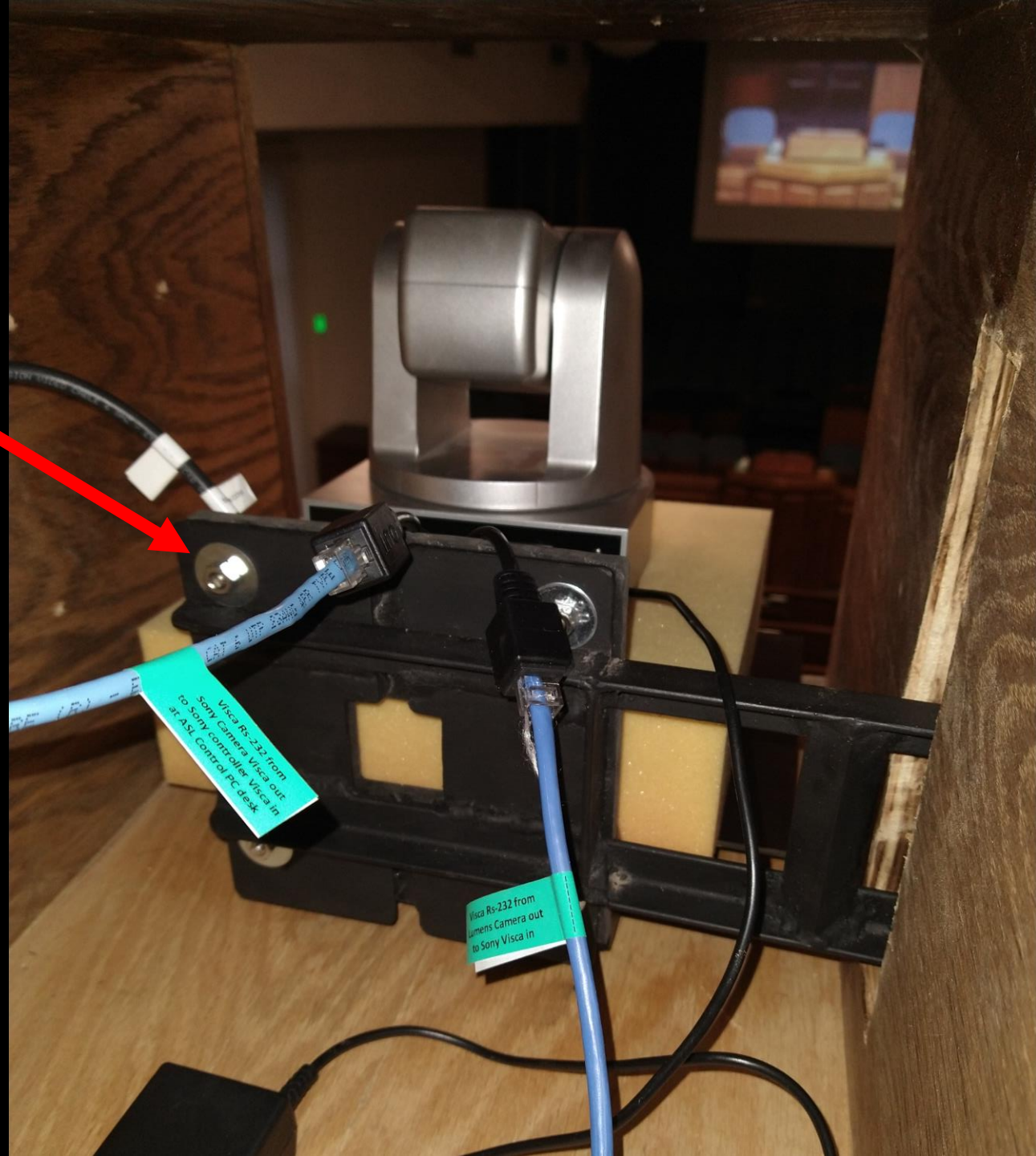



Cut out foam enough to insert .4 inch rubber anti vibration washer that is glued in.
¼ x20 steel insert glued into rubber washer.

10x3 in piece of black poster board glued to front memory foam

9X12 in 1/8 in pizza plate painted with black Flexseal rubber

Bolt pizza plate using ¼.20 bolts connected at each camera mounting slot



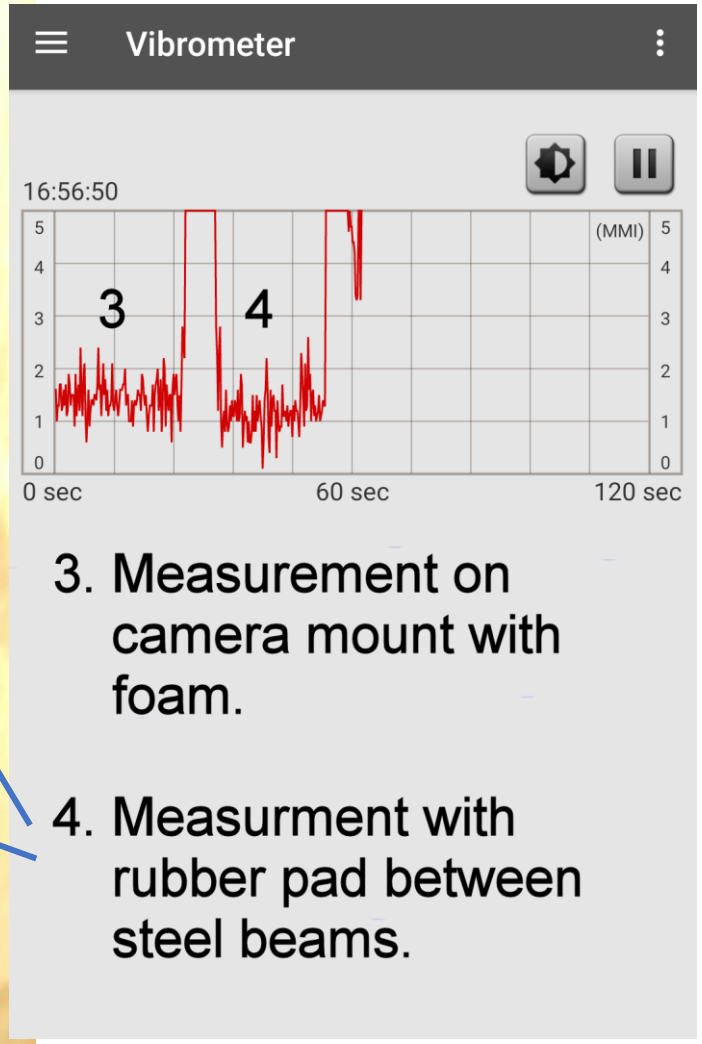
Much to our surprise we found in We had in-correctly assumed that vibration was stronger in the camera box and would be less in the building steel.

There are some tune-ups

- We decided that Dustin would modify the camera bracket extension and mount it directly camera box as it is absorbing less vibration energy than the 2 ½ in angle steel beam.

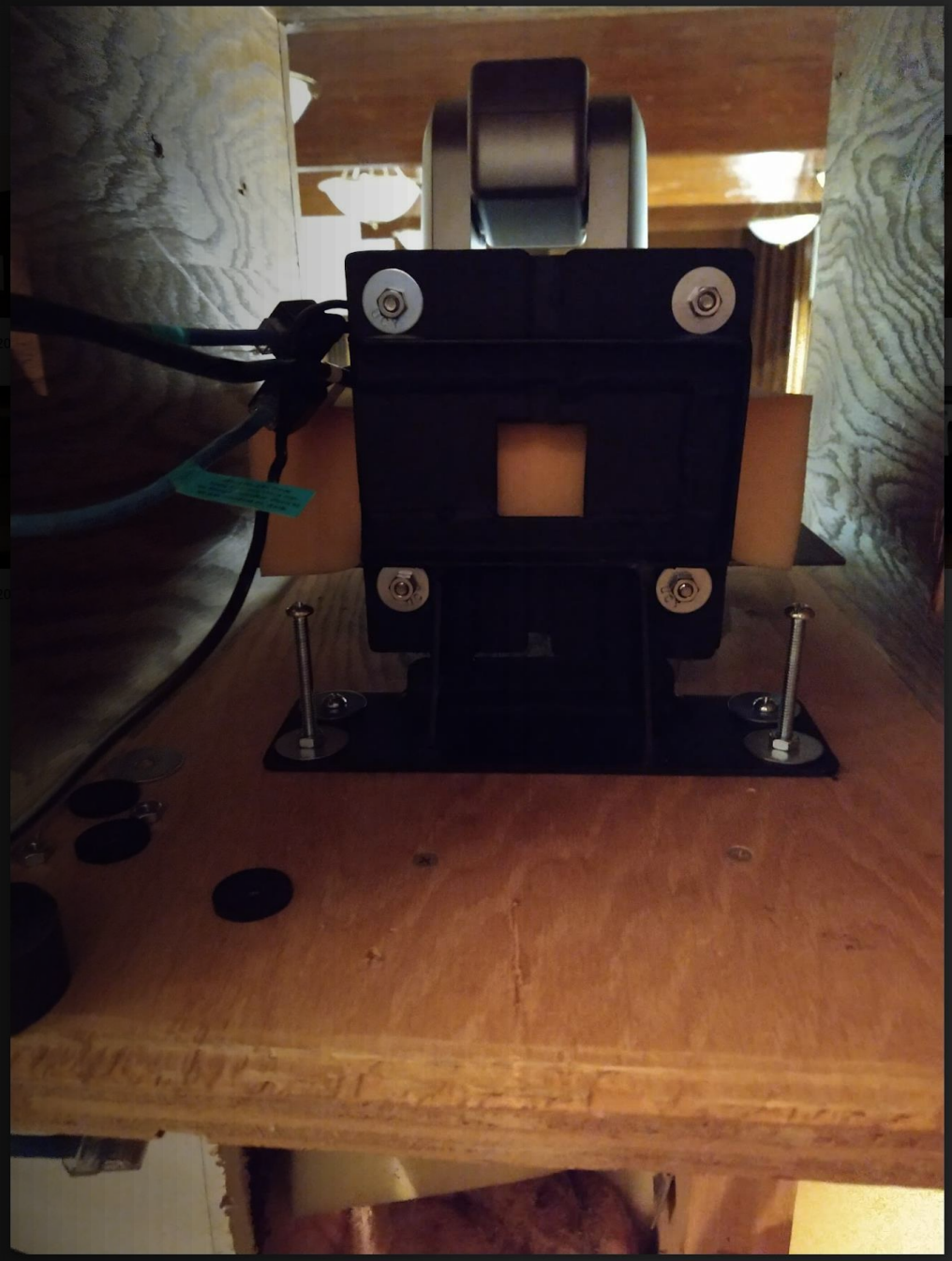
- The 2 ½ in angle steel beam has some play in it (which maybe by design)
- We put in some spray foam on the chapel facing side
- And added 5” thick memory foam under camera box and between camera and projector box





# Second implementation

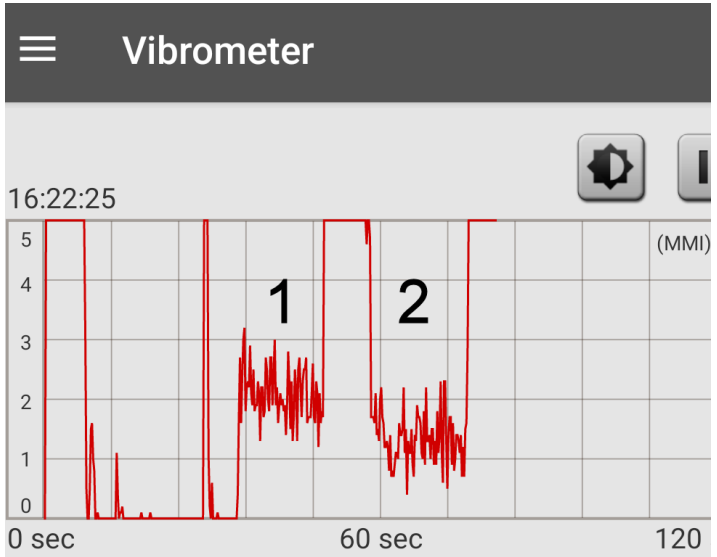
The modified Camera bracket extension now bolted on the Camera Box. And then bolted the extension to the **NB-AVCB-W back plate.** After trying several different scenarios using Sorbothane accessories. We had to install memory foam to get a satisfactory reduction. We suspect Sorbothane sheet product could be found to replace but would be more expensive (about 400.00) to use rather than using the memory foam.



# Study of Vibration source

Early on in Dec 2019-Jan 2020, thru process of elimination it revealed that the HVAC vibration was primarily transferred from the Wood framed wall that Camera box is sitting on.

In our 2019 attempt we just put the Niels B anti-vibration camera mount directly on the camera box, which was the incorrect installation. After installing correctly, we found a 2 G reduction in Vibration. But we still needed to use 3” 10X10 memory foam to remove the low frequency vibrations that come from the HVAC.

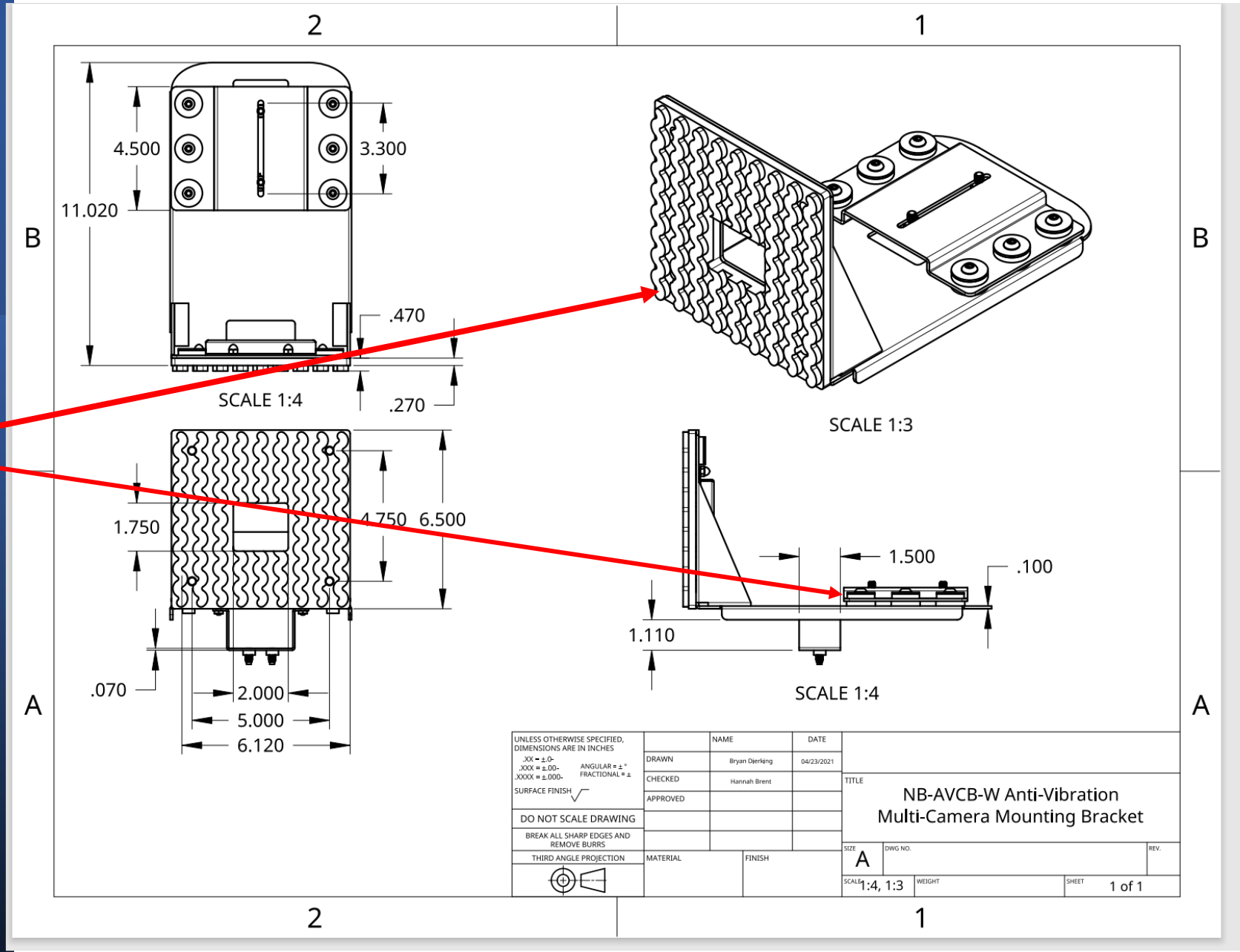



1. Measurement on box.
2. Measurement on camera mount with foam.

# Manufacture Drawing of anti-vibration Camera Mount

Sorbothane vibration absorbing material

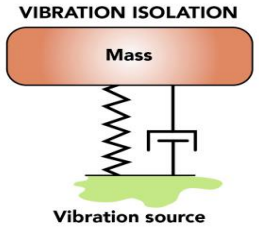
Once we installed NB-AVCB-W and bolted to the fabricated mount connected to the building steel. The camera was isolated from the camera box. We found the measured vibration was reduced to half on the camera mount as opposed to camera box itself.
So, the NB-AVCB-W does reduce vibration



# From Sorbothane web site

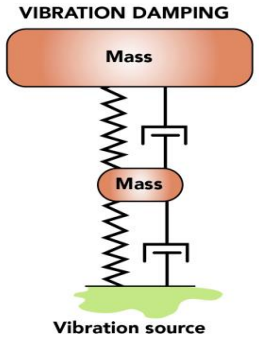
## WHAT IS THE DIFFERENCE BETWEEN A VIBRATION ISOLATOR AND A VIBRATION DAMPER?

Damping vibration is dissipation of energy. Isolating vibration is the prevention of vibration transmission.




A good **vibration isolator** lowers the natural frequency of a system to below the excitation (or disturbing) frequency. Keeping these two frequencies "out of sync" greatly reduces the problems of vibration.

As some in industry define it, common isolators separate the vibration source by flexible slabs that in a definition of the system in dynamic physics act as damper, spring, and mass. Many isolators exhibit some inherent damping, though the latter can degrade their isolation ability by magnifying transmitted vibrational forces.




In contrast, a good **vibration damper** takes mechanical energy out of the system. Properly designed metal springs and rubber mounts can be good isolators but have almost no damping capability.

As some in industry define it, common vibration absorbers separate the vibration source by damping as well as a second mass attached to the system through other dampers.

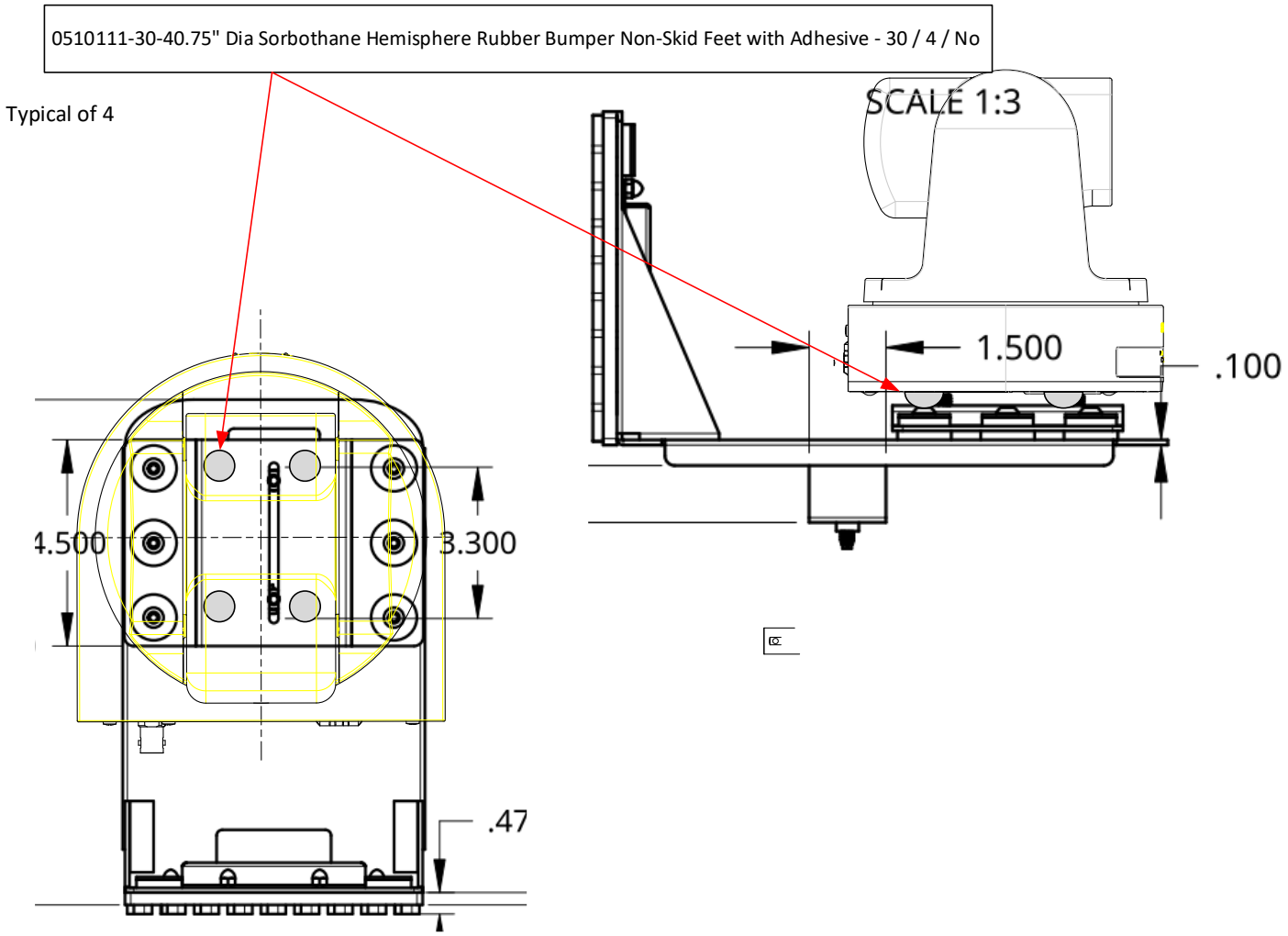
Oil dampers (dashpots) have good damping capability but no isolation capability.

Foam products can be good isolators but have limited life.

### WHAT ARE THE MAIN CHARACTERISTICS OF A VIBRATION DAMPER?

- Good damping coefficient
- Wide temperature range stability
- Long fatigue life

Will this Work? Sorbothane Rubber bumpers to replace 10X10 memory foam. Either we will get even more vibration reduction or equal. We found that they worked but not enough eliminate strong low frequencies



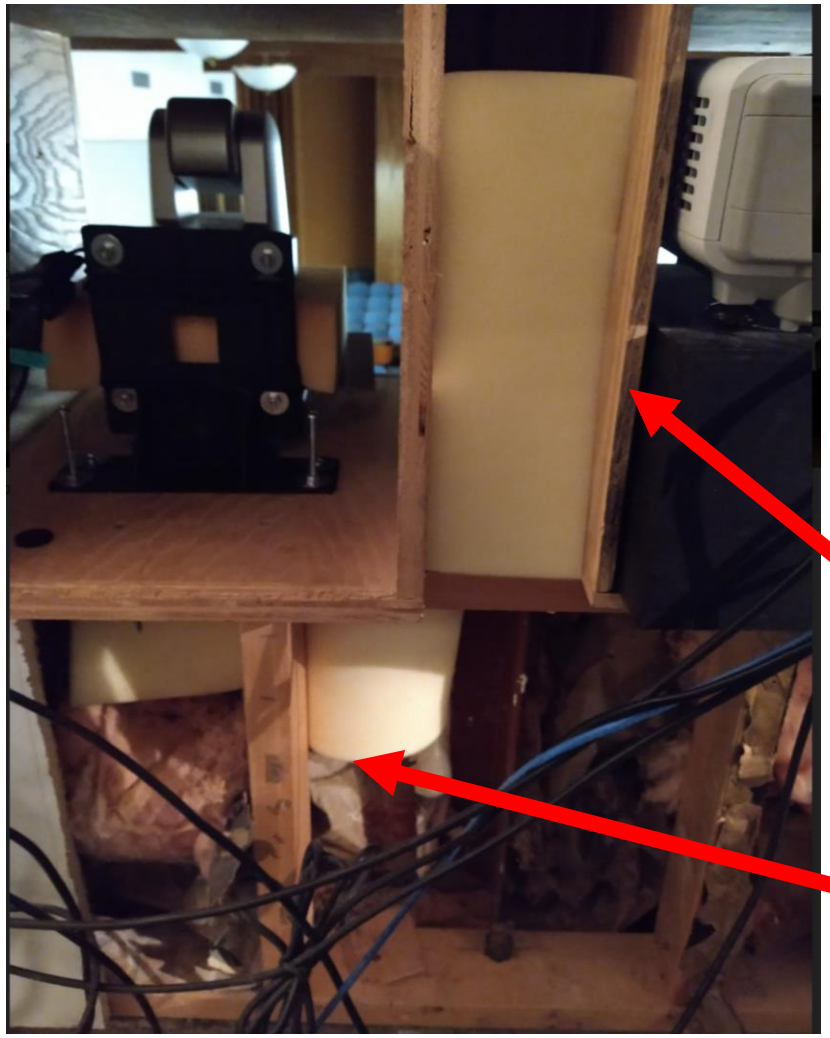
# Why Does the Memory Foam work so well ?

Research indicates it has this property:

- An elastic material deforms under load and returns to its original shape when the load is removed

According to a White Paper “The Basics of Vibration and Damping in Engineered Designs”

- Foam products can be good isolators but have limited life
- A good vibration isolator lowers the natural frequency of a system to below the excitation (or disturbing) frequency.
- Which seems to be exactly what the 10x10x4 Memory foam does.



In the Second implementation Memory foam was all around camera box. The Camera box was pulled out from the front and the memory foam was installed in the voids all around the box and under the trim pieces. This included putting in behind the decorative oak panel on each side of the box. Vibration measured was reduced to just under 1 G

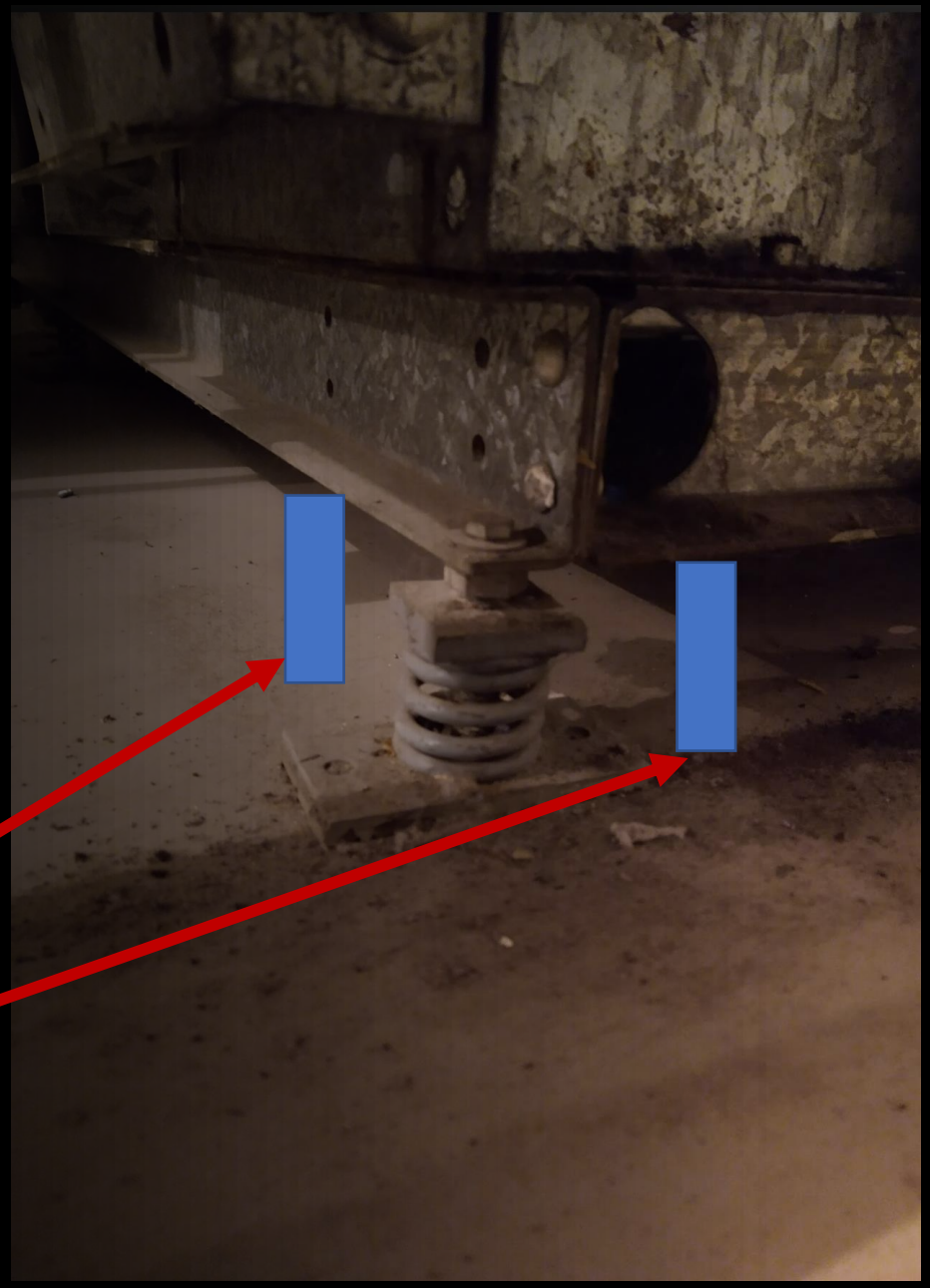
Fill 2x6x16 wall area
Fill in with 24X24” 5-inch-thick memory foam

# Analysis of HVAC System

What are the big offenders Generating the offending low Frequencies that we are trying to defend against and neutralize.

The low Frequency sources

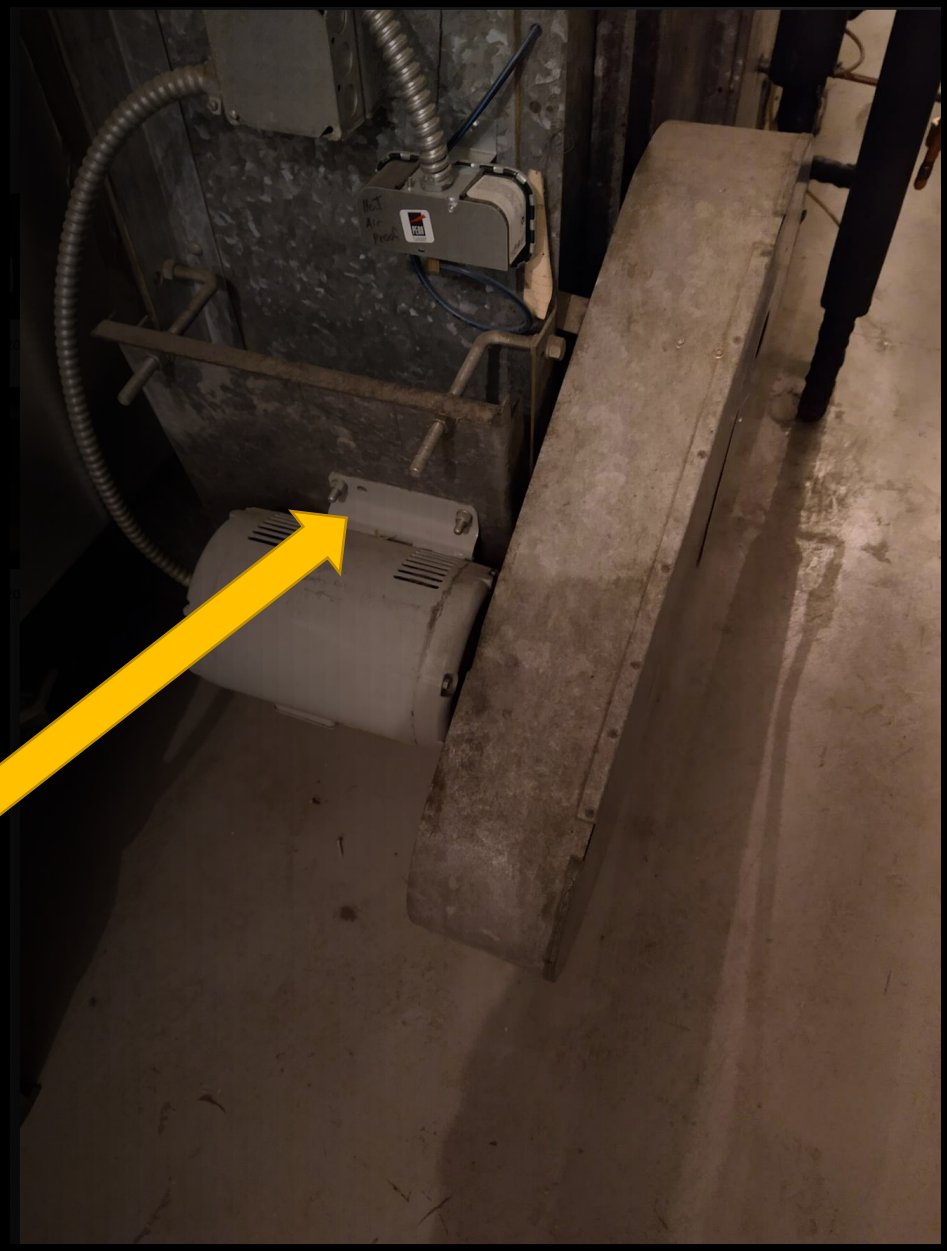
# This Spring suspension of the HVAC system



Viscoelastic polymer type rubberized Vibration Isolators.
To displace or dampen  low frequency vibration

# The Blower motor running at 60 Hz

**Possibly install a** Sorbothane of sufficient rating to reduce Vibration transfer



# In conclusion it seems we have mitigated the ASL camera Vibration issue enough that is no longer a major irritant?

There are items that the FM group could do, that could further reduce Vibration. These vibration efforts would not only benefit ASL camera but also the HVAC equipment life would be increased