# TRAC Experience Summary

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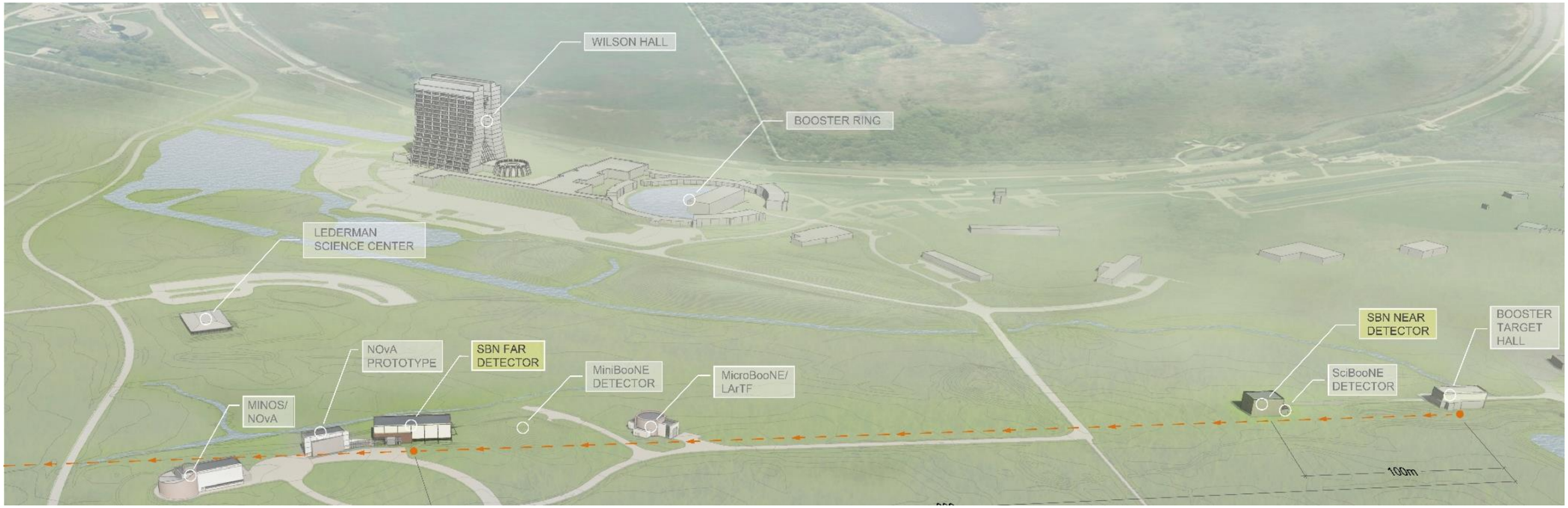
August 6, 2019

# SBN Program Overview




- **Short-Baseline Neutrino (SBN) Program consists of three components: SBN Near Detector, MicroBooNE, and SBN Far Detector**
- **Will be used to measure neutrino oscillations, in search of a fourth kind of neutrino, the sterile neutrino**
- **Project work focused on the SBN-ND**



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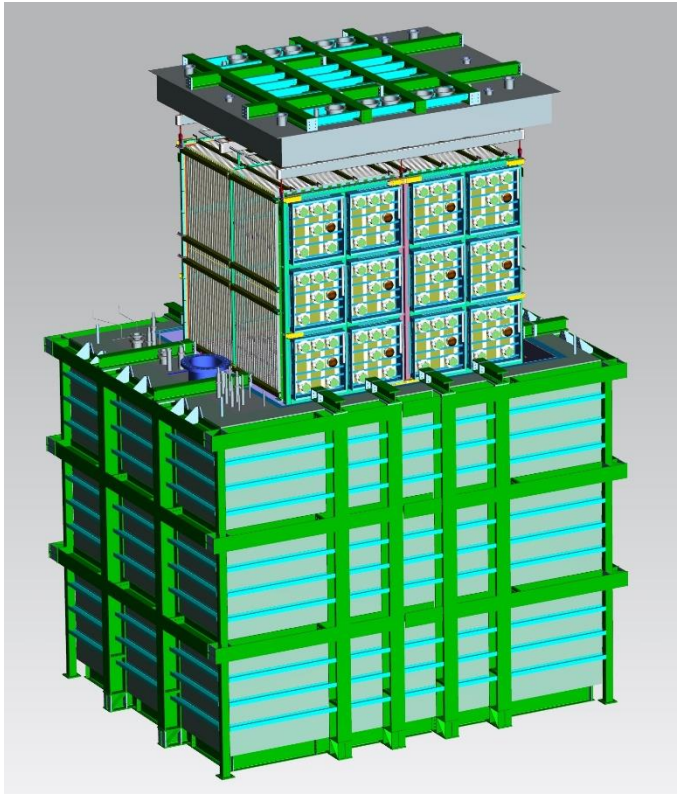
# SBND

- The Short-Baseline Near Detector (SBND) will be housed in the new building 110 m away from the neutrino beam source
- 112 ton liquid argon time projection chamber (LArTPC)
- Consists of two anode planes on the ends and one cathode plane in the middle
- Major TPC components assembled at Fermilab
- Will be installed inside a cryostat built at CERN
- Includes cosmic ray tagger (CRT)





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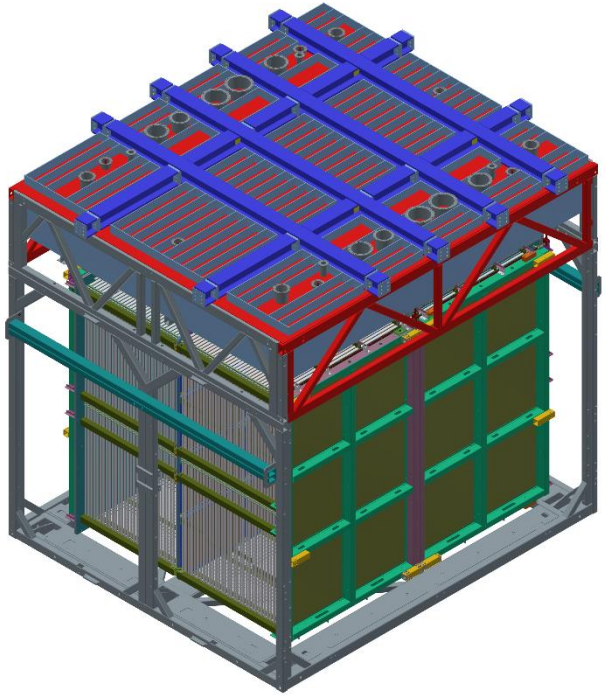
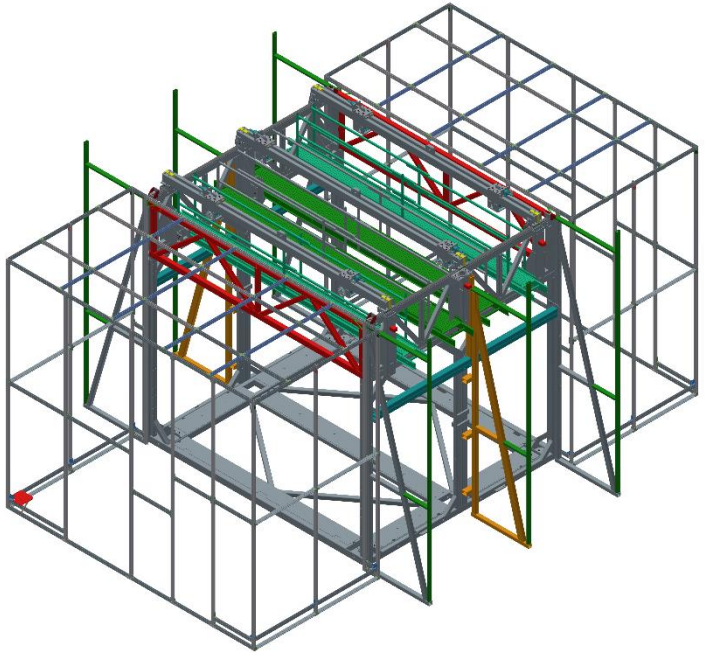
# ATF

- **Assembly Transport Frame will hold all major TPC components for assembly**
- **Current assembly work taking place in DZero Assembly Building (DAB)**
- **Used for transport from DAB to SBN-ND once the cryostat is installed**
- **Task: design an enclosure**
  - Needs to incorporate a clean tent to protect from particulate matter
  - Needs to incorporate UV filtering due to UV sensitive components
  - Needs multiple access points for entry at various locations



# ATF Components

- Consists of the base frame that the TPC components will be mounted to
- Has a removable upper side brace
- Includes six outriggers to provide structural integrity when the upper side brace is removed
- Existing clean tent from ANNIE will be modified to fit the desired dimensions of the ATF
- Clean tent made from Unistrut members
- Dimensions of frame without clean tent are approximately 19.75’ high, 32’ wide (including outriggers), and 17.75’ deep



# Current ATF State



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# UV Filter Sheets

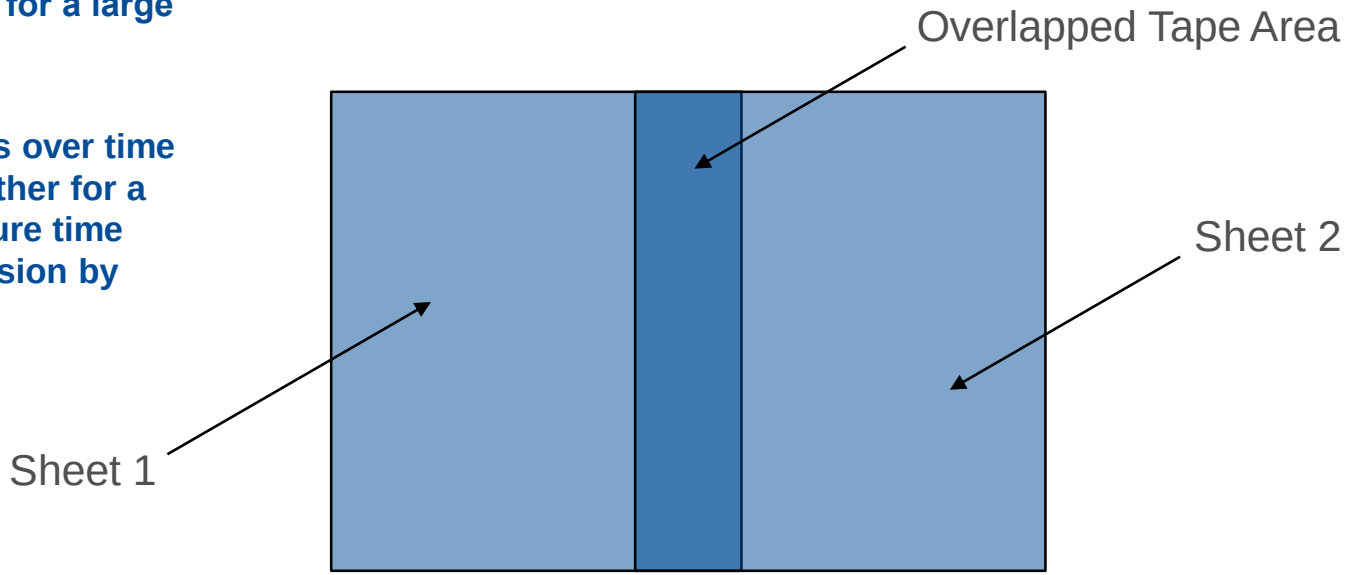
- 2 mil polyester sheets
- 48” wide, 25’ long rolls

Design Goals:

- Prioritize vertical over horizontal orientation of sheets
- Need to create permanent seams to join sheets
- Need to create removable seams for access points
- Must adhere to painted steel surface of the ATF
- Must adhere to surface of Unistrut members
- Include a secondary attachment method at areas of critical importance (the tops of most sheets)
- Must be completely sealed and cannot have any gaps/holes

# Sheet Permanent Seam Concept

- 3M 9472LE adhesive transfer tape
- Best option for bonding polyester to either polyester, steel, or painted surfaces
- Purchased 1” wide tape for a large surface contact
- Acrylic adhesive
- Bond strength increases over time (e.g. bonding steel together for a 15 minute vs. 72 hour cure time increases 90° peel adhesion by 28.5%)



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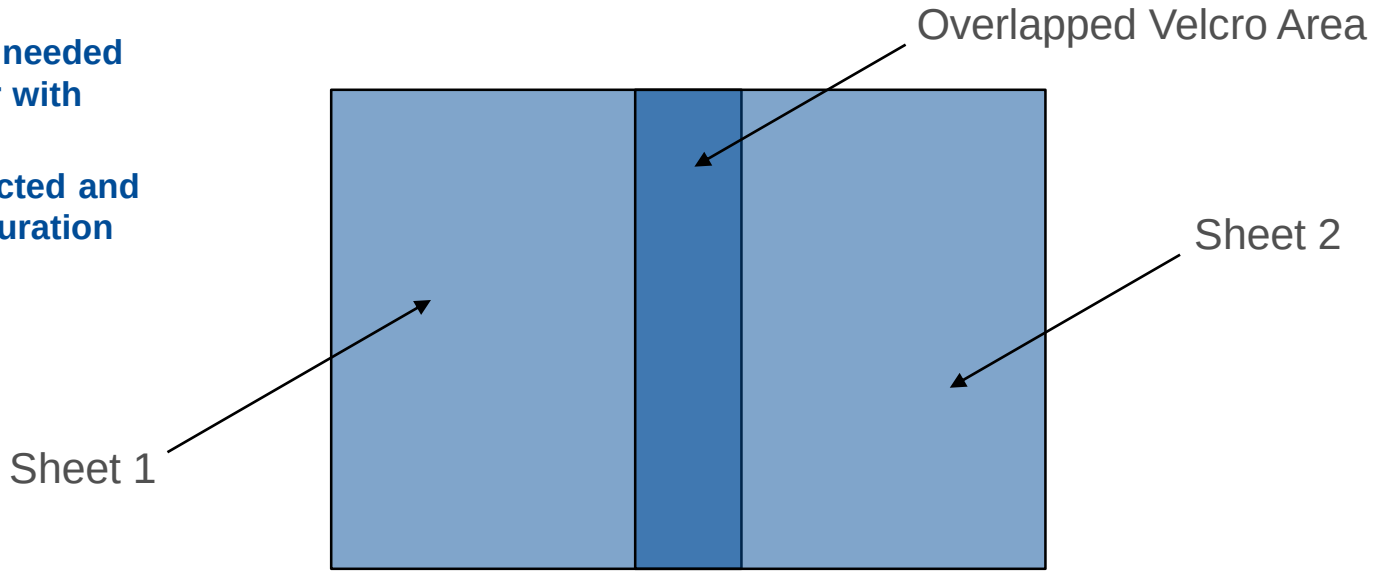
# Sheet Removable Seam Concept 1

- McMaster-Carr 9273K14 hook and loop with adhesive backing
- Purchased 1” wide Velcro for a large surface contact
- Acrylic adhesive
- Sheets where access is needed will be secured together with Velcro strips
- Sheets will be disconnected and rolled up when longer duration access is needed



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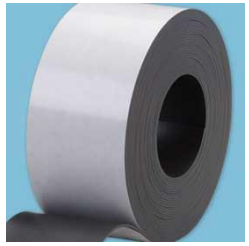
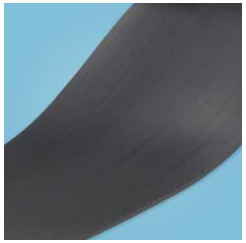
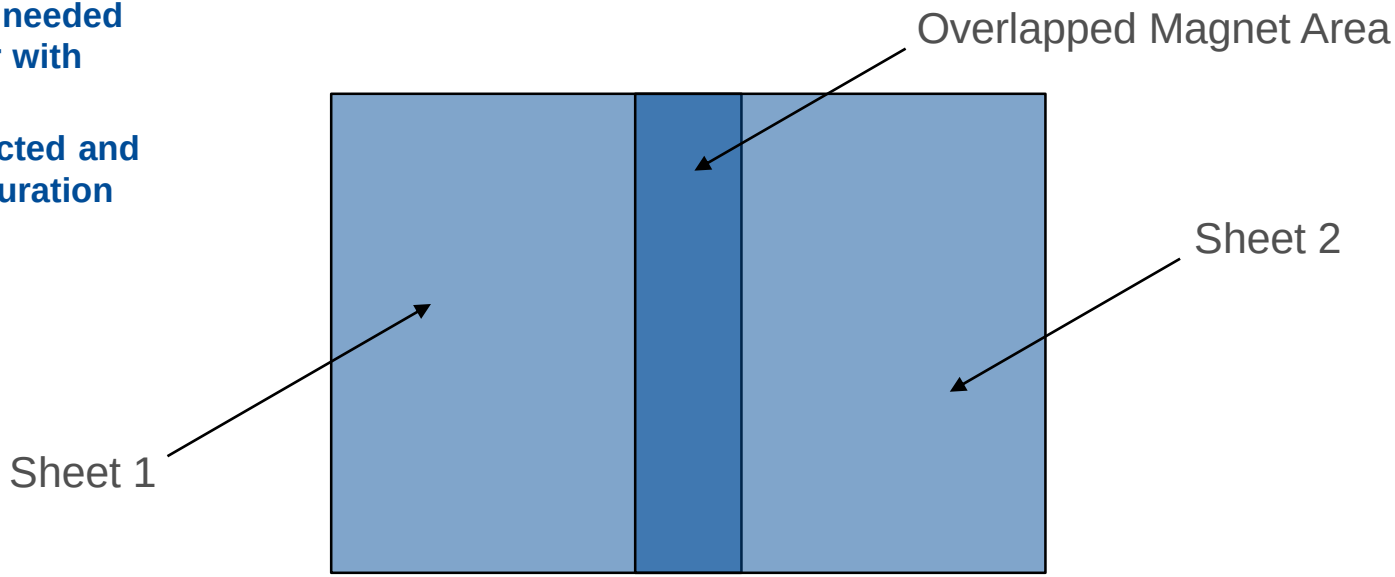
# Sheet Removable Seam Concept 2

- Duraco 473105 magnetic tape with adhesive backing
- Tested .06” thick, .5” wide sample
- Acrylic adhesive
- Sheets where access is needed will be secured together with magnet strips
- Sheets will be disconnected and rolled up when longer duration access is needed







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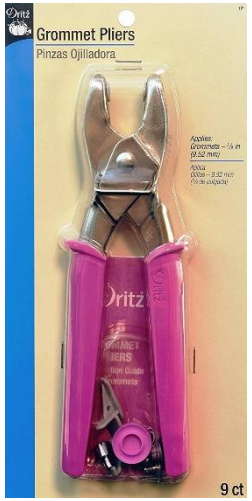
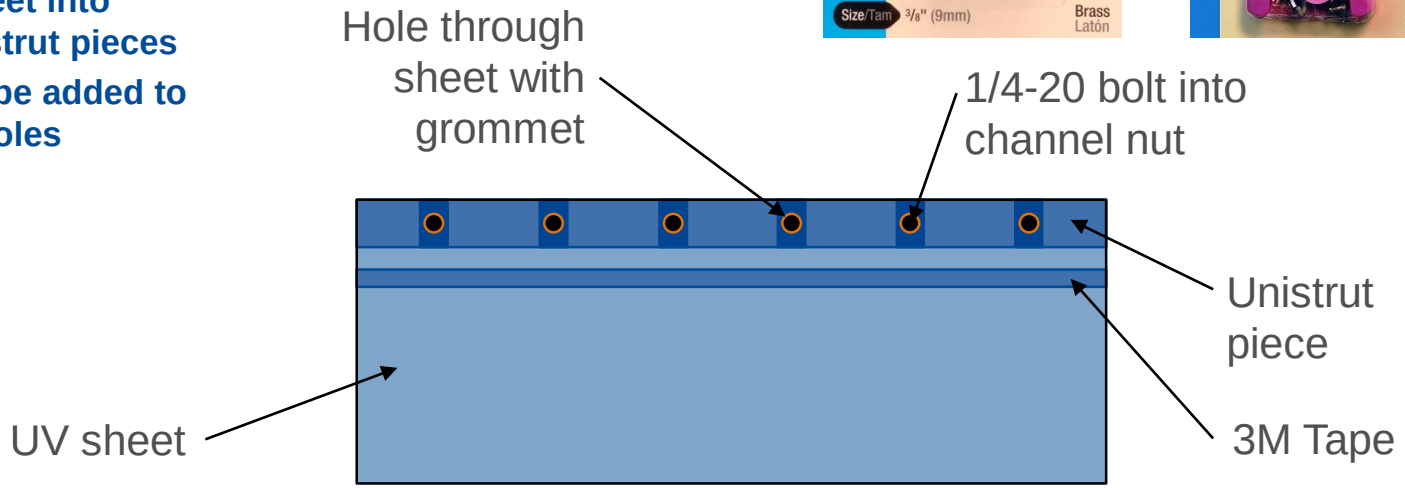
# Secondary Attachment Concept

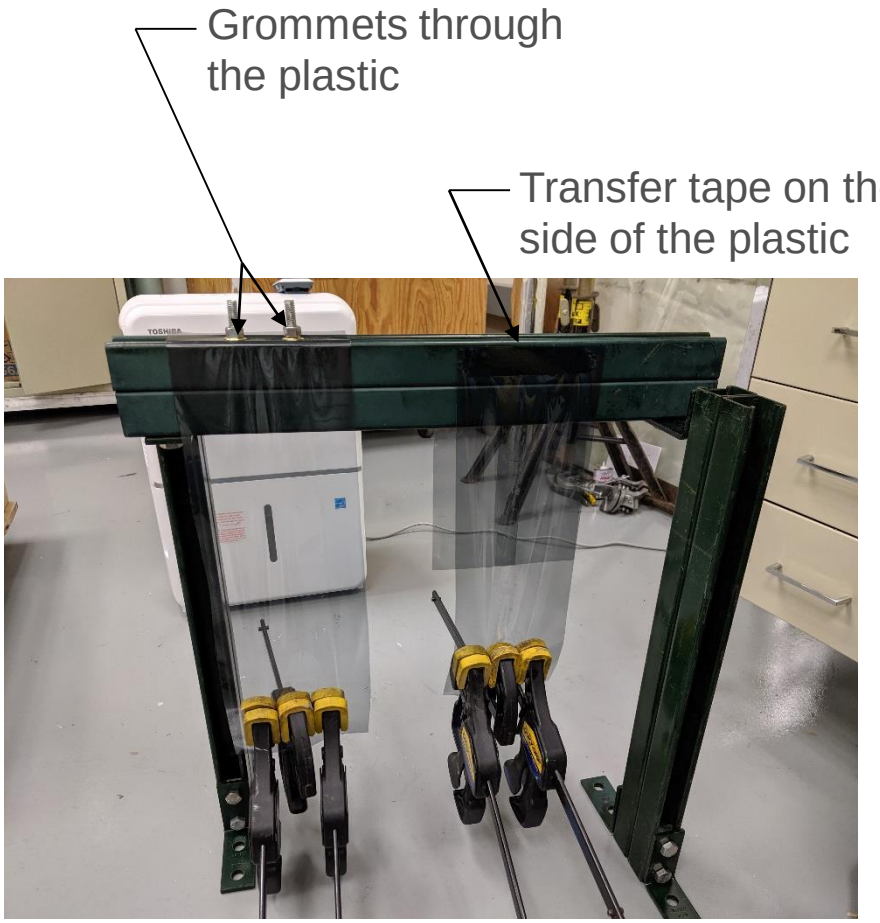
- Connections at top will have two attachment methods, providing extra insurance against the sheets falling off
- Primary attachment will be via 3M 9472LE transfer tape
- Secondary attachment will be via bolts through the sheet into channel nuts on Unistrut pieces
- Metal grommets will be added to sheets to reinforce holes

# Testing Summary

- A test frame was built to hang the plastic with weights for durability testing
- Orientation 1 had two grommets on the Unistrut in a horizontal orientation
- Orientation 2 had transfer tape on the Unistrut in a vertical orientation
- The mass of each 25’ long roll of plastic, including the cardboard tube, was 865 g
- A total clamp mass of around 2060 g was hung from the plastic
- The plastic remained attached and the connections unaffected for the duration of the one week test
- Pulling off both sheets was very difficult at the conclusion of the test



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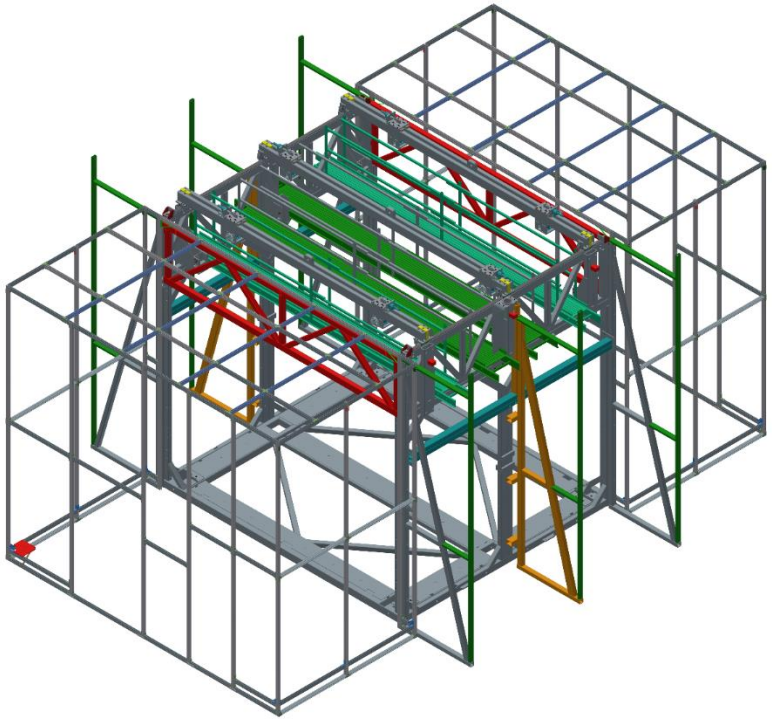
# Clean Tent Design Decisions

- UV plastic sheets in a vertical orientation when possible
- Supported on the top with both transfer tape and grommets for a redundant attachment method
- Access panels removable with magnetic tape on the sides of the plastic sheets (2 strips needed for each interface)
- Adjacent, nonremovable plastic connected with transfer tape
- Grommets placed every 6” where utilized (this could be modified if needed)
- Transfer tape at all floor interfaces
- ANNIE frame design still in progress





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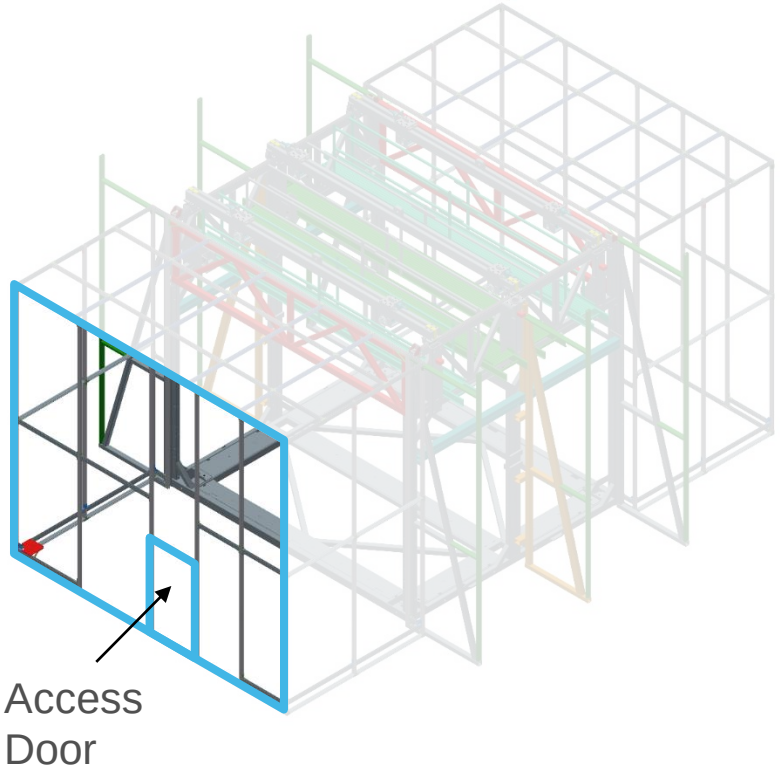
# Design – ANNIE Outside

- **UV plastic: 5 rolls cut to 20', 1 cut to 20' & trimmed for door and above**
- **Transfer tape: 58.8 yards**
- **Magnetic tape: 15.7 yards**
- **Grommets: 47**
- **Unistrut: 0'**
- **2 sets**



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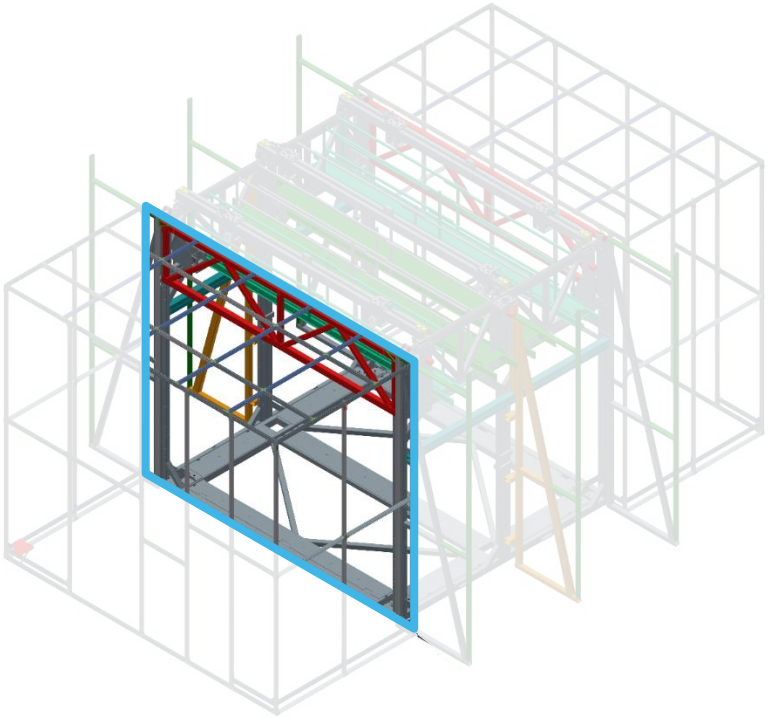
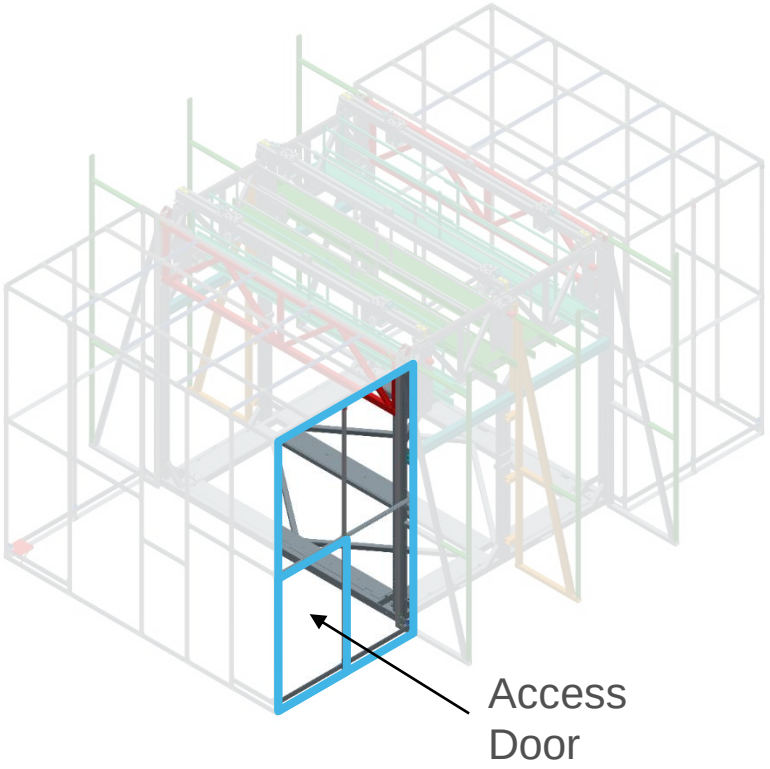
# Design – ANNIE Inside

- UV plastic:  6 rolls cut to 20’
- Transfer tape:  40.2 yards
- Magnetic tape:  41.4 yards
- Grommets:  47
- Unistrut:  23’
- 2 sets
- Wall joined with transfer tape between panels and magnetic tape at edges and bottom
- Attached to the ATF and not ANNIE tent to allow the tent to retract



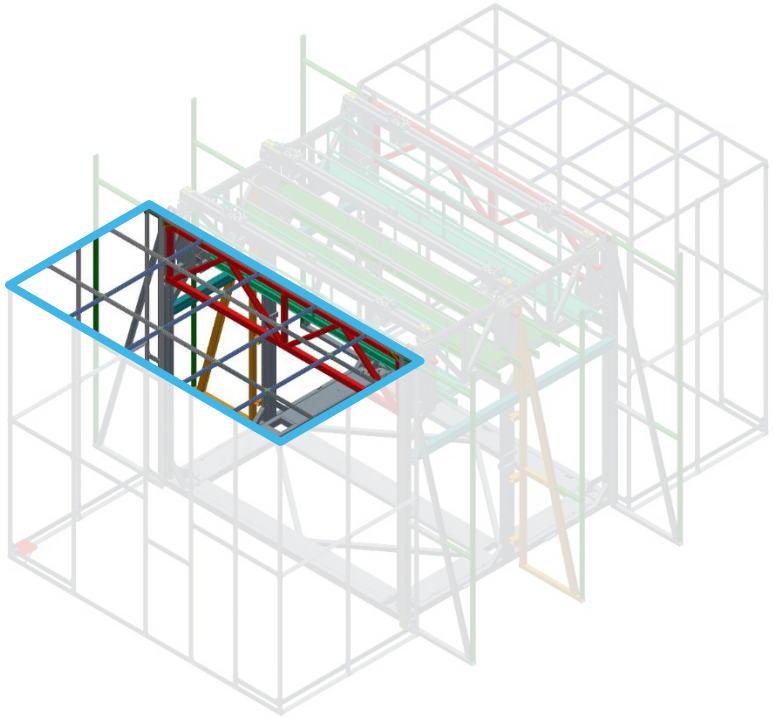
# Design – ANNIE Side

- UV plastic:  2 rolls cut to 20’, 2 cut to 20’ & trimmed for door and above
- Transfer tape:  33.7 yards
- Magnetic tape:  16.9 yards
- Grommets:  24
- Unistrut:  11.5’
- 4 sets
- Assuming a door on each of the four sides



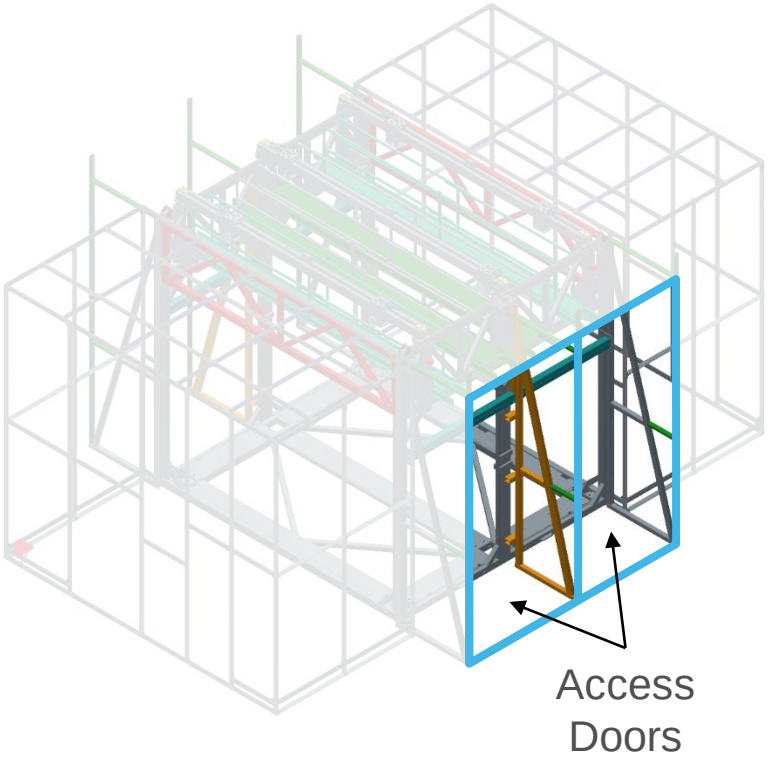
# Design – ANNIE Ceiling

- UV plastic:  3 rolls cut to 24’
- Transfer tape:  38.4 yards
- Magnetic tape:  0 yards
- Grommets:  142
- Unistrut:  0’
- 2 sets
- Transfer tape attachment with grommets at all edges
- UV plastic oriented parallel to longest edge



# Design – Outriggers Outside

- UV plastic:  6 rolls cut to 20’
- Transfer tape:  32.3 yards
- Magnetic tape:  64.5 yards
- Grommets:  37
- Unistrut:  17.8’
- 2 sets
- Each door is a set of 3 panels of plastic joined with transfer tape



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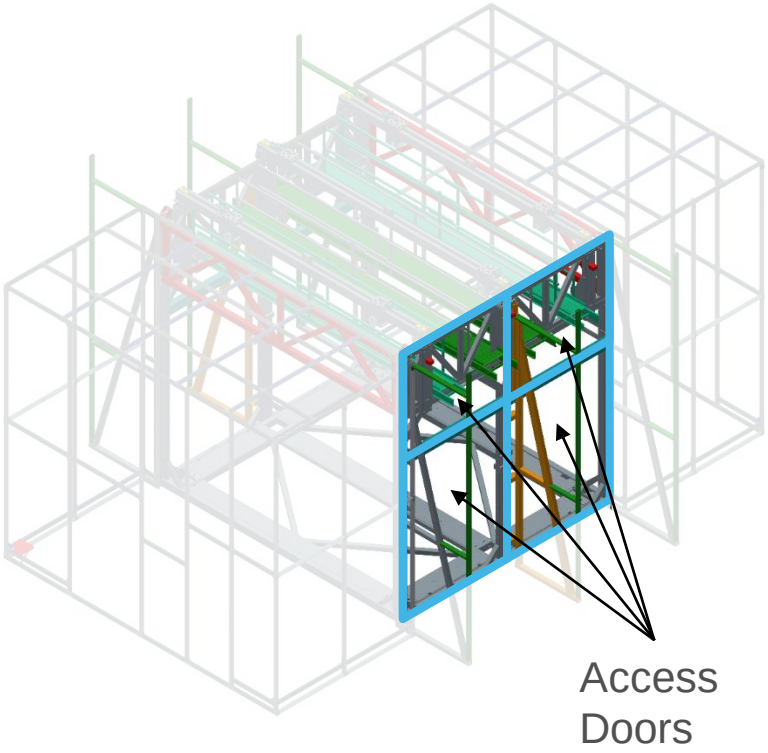
# Design – Outriggers Inside

- UV plastic:  6 cut to 15’ with the remaining trimmed to appropriate length for stage area
- Transfer tape:  38.2 yards
- Magnetic tape:  76.4 yards
- Grommets:  74
- Unistrut:  35.6’
- 2 sets
- Each door is a set of 3 panels of plastic joined with transfer tape
- UV plastic on top half has included extra to account for the stages



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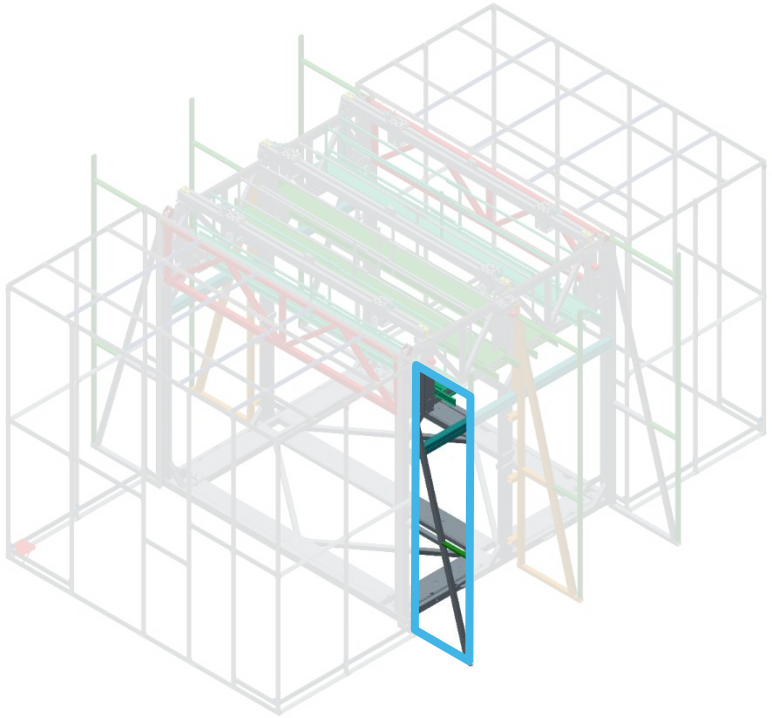
# Design – Outriggers Side

- UV plastic:  2 rolls cut to 20’
- Transfer tape:  22.8 yards
- Magnetic tape:  0’
- Grommets:  10
- Unistrut:  4.2’
- 4 sets





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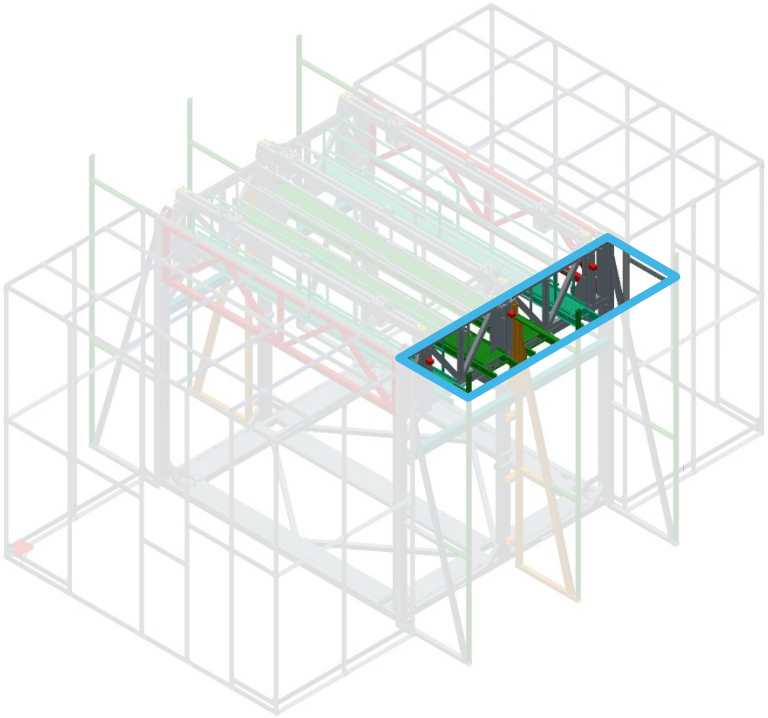
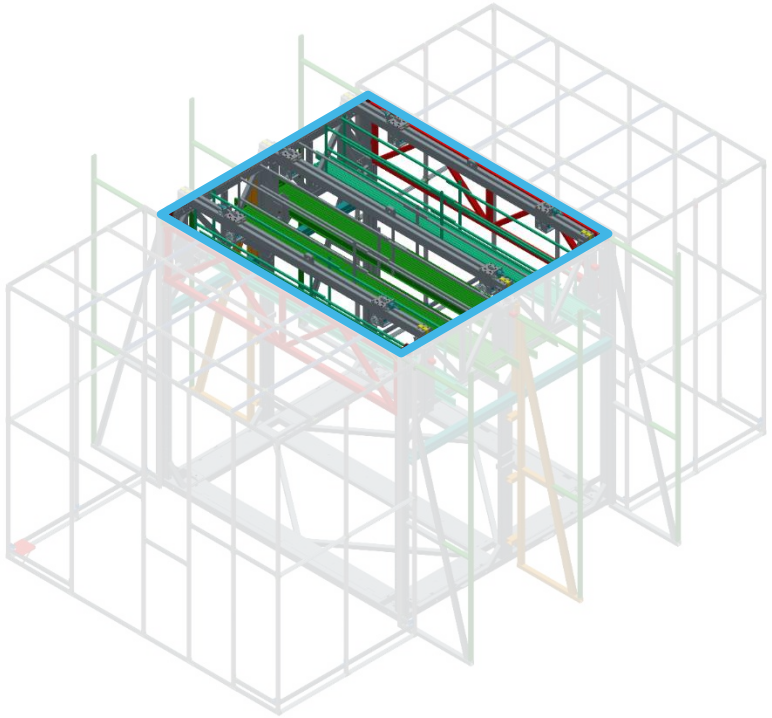
# Design – Outriggers Ceiling

- UV plastic:  2 rolls cut to 18’
- Transfer tape:  21.7 yards
- Magnetic tape:  0’
- Grommets:  100
- Unistrut:  29.4’
- 2 sets
- Transfer tape attachment with grommets at all edges
- UV plastic oriented parallel to longest edge
- Unistrut on outside of outriggers can be shared



# Design – Main Ceiling

- UV plastic:  5 rolls cut to 21’
- Transfer tape:  27.3 yards
- Magnetic tape:  51.0 yards
- Grommets:  0
- Unistrut:  0’
- 1 set
- UV plastic oriented parallel to ANNIE tent
- Ceiling joined with transfer tape between panels and magnetic tape at all four sides





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# Summary of Materials Needed

- UV plastic:  1821’
  - Currently have 65 rolls (1625’)
  - Without splicing horizontally or vertically, 87 rolls are needed
  - Need to purchase 8 rolls if vertical splicing will be done (but not horizontal)
  - Need to purchase 22 rolls if no vertical or horizontal splicing will be done
  - No floors or extra for mistakes are included in these calculations
- Transfer tape:  712.5 yards (12 rolls @ 60 yards/roll)
  - $25.66/roll -> $307.92
  - Amount did not include in any splicing of UV plastic, as noted above
- Magnetic tape:  514.6 yards (16 rolls @ 100’/roll)
  - $46.41/roll -> $742.56 (price breaks available, but not published on website)
  - Alternate suppliers may be available
- Grommets (plus associated nuts, bolts, and channel nuts):  1030
  - $20.95/1000, $1.99/24 -> $24.93 (does not include nuts, bolts, or channel nuts)
- Unistrut:  274.4’

# SBN-ND

- The SBN-ND is a new construction building that will house the detector
- It contains all of the cryogenics necessary for the detector to operate (liquid nitrogen & argon)
- The detector will be housed in a pit inside the building
- The building was built such that the beam travels through the near center of the detector
- The large access door will allow entry by the ATF and the building crane will lower components into the cryostat

# SBN-ND Interior

- The pit is roughly 34’ deep from ground level
- Approximately 12’ below ground level, there is a mezzanine level, which will house some cryogenics and computer systems
- The existing 3D CAD model of the building was inaccurate and missing a number of components
- The missing components proved challenging for the addition and modification of systems
- Ductwork that leads to the bottom of the pit cannot be located in the originally designed space due to conflicts with the cryogenics



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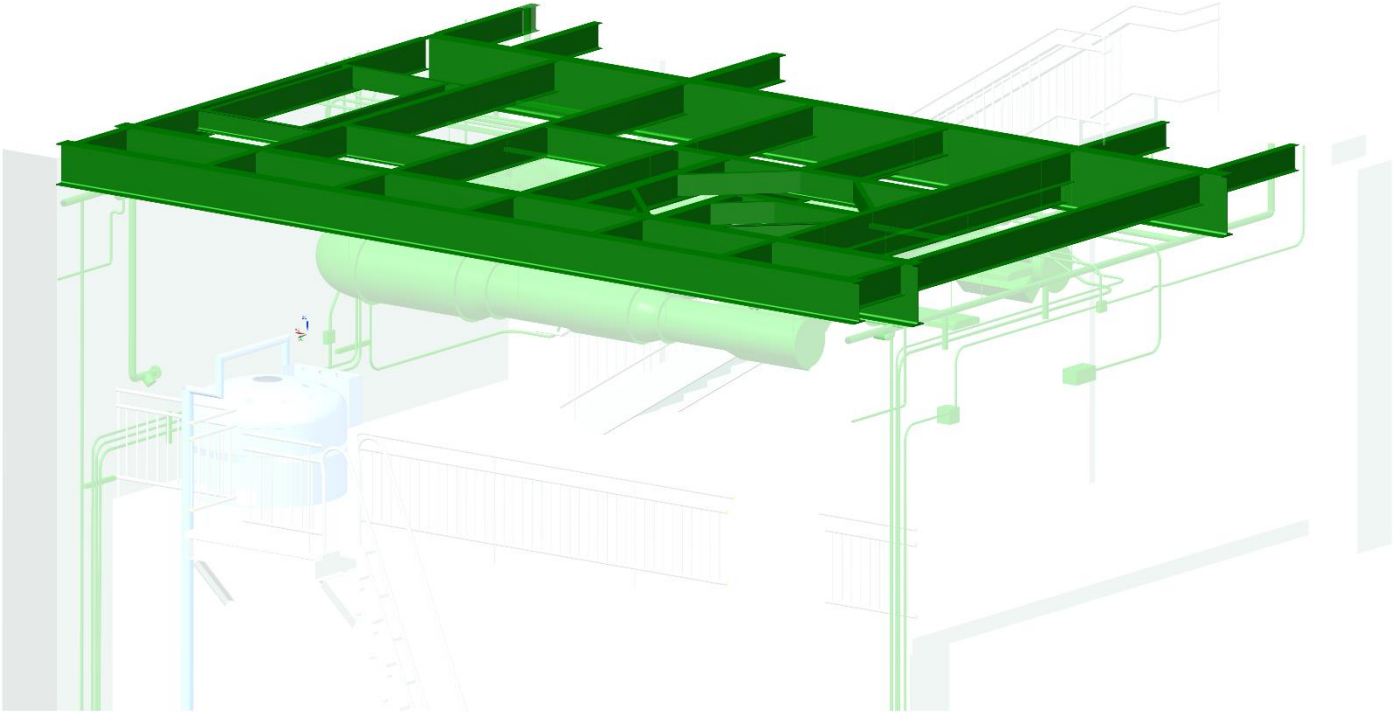
# SBN-ND Mezzanine Modeling:  Steel System





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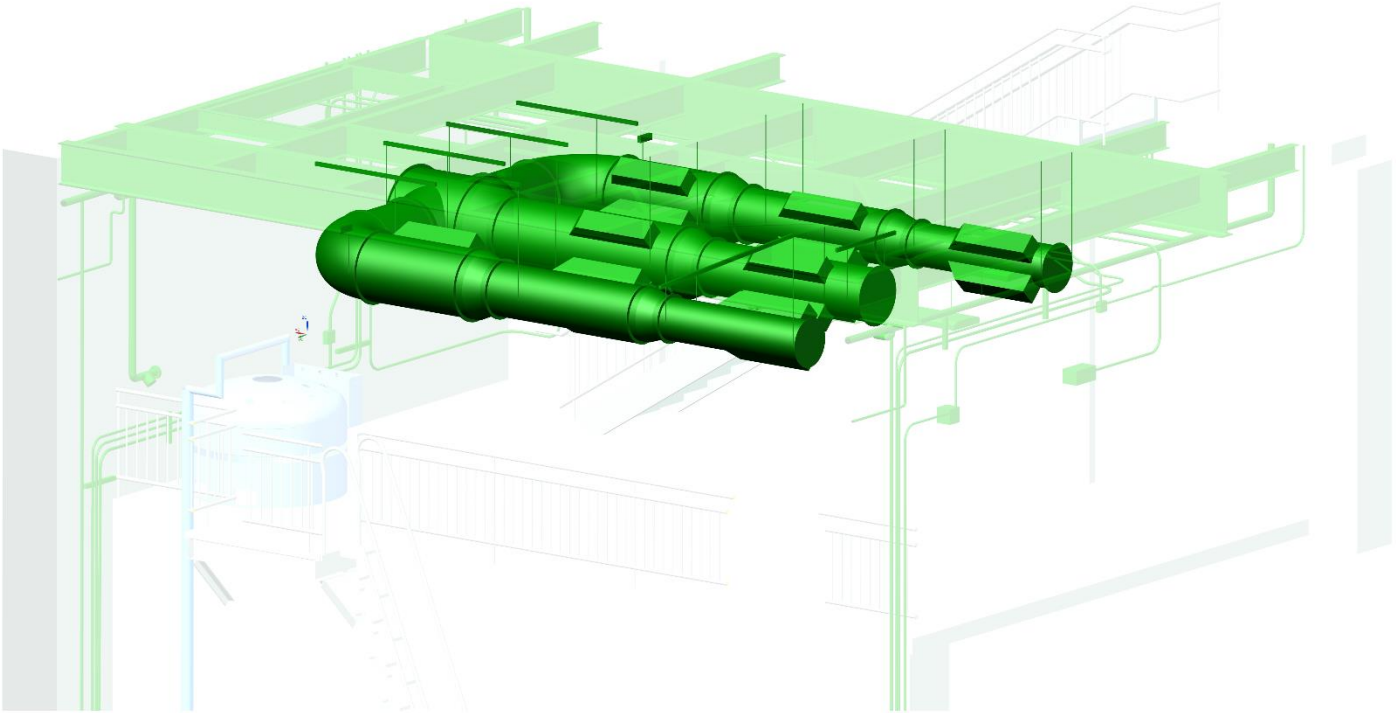
# SBN-ND Mezzanine Modeling:  Duct System





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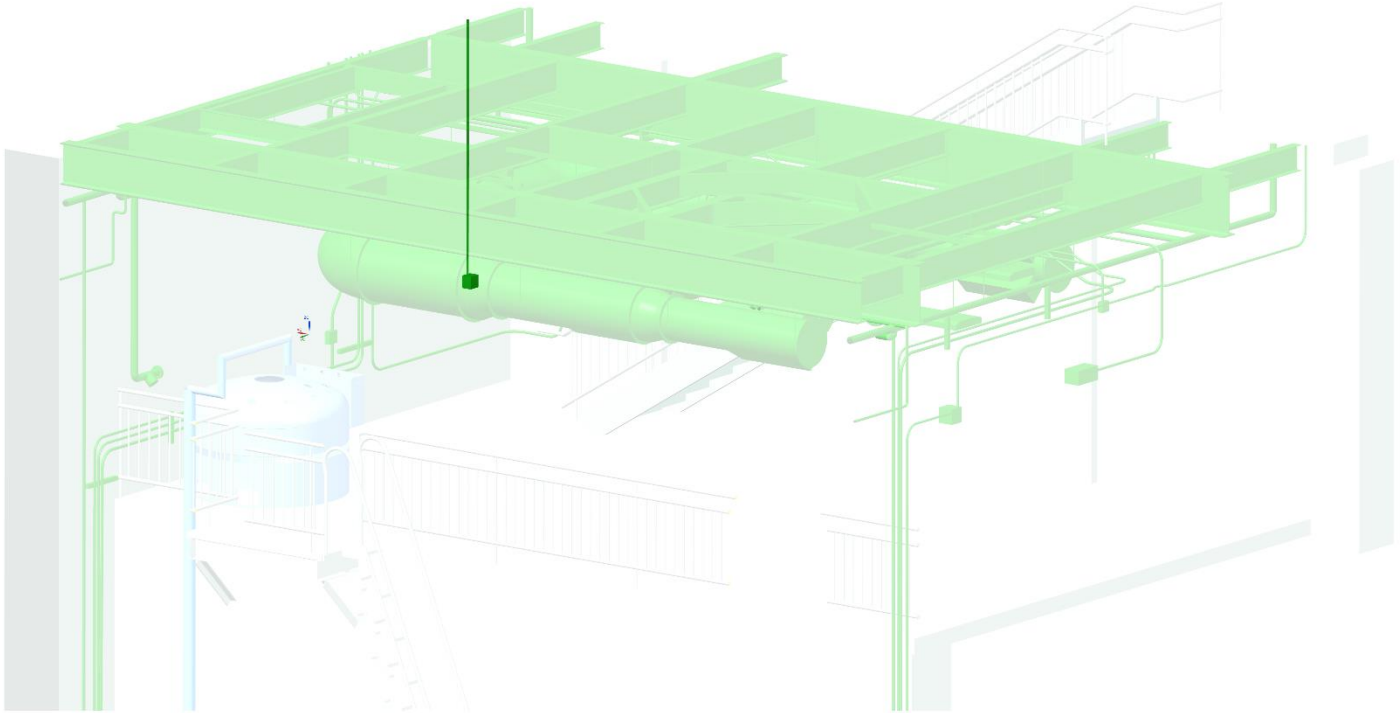
# SBN-ND Mezzanine Modeling:  Environmental Sensors System





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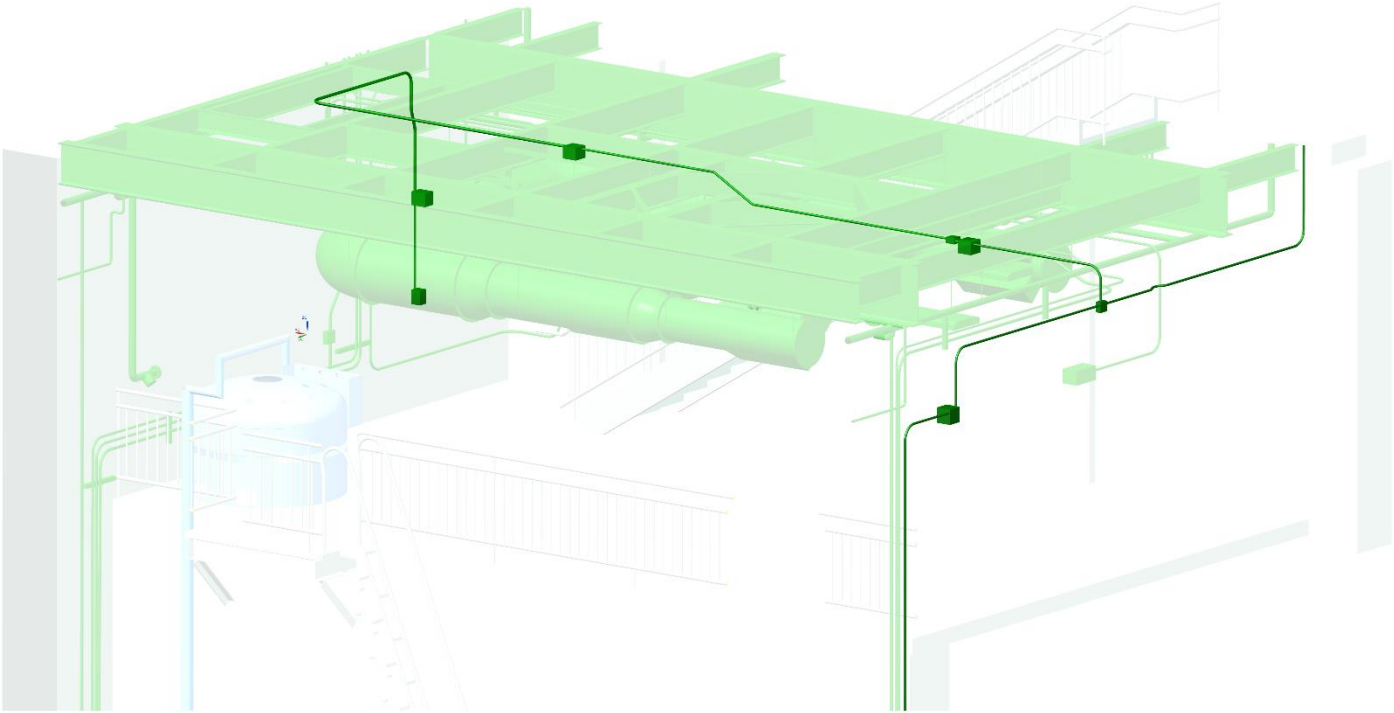
# SBN-ND Mezzanine Modeling:  Fire Alarm System





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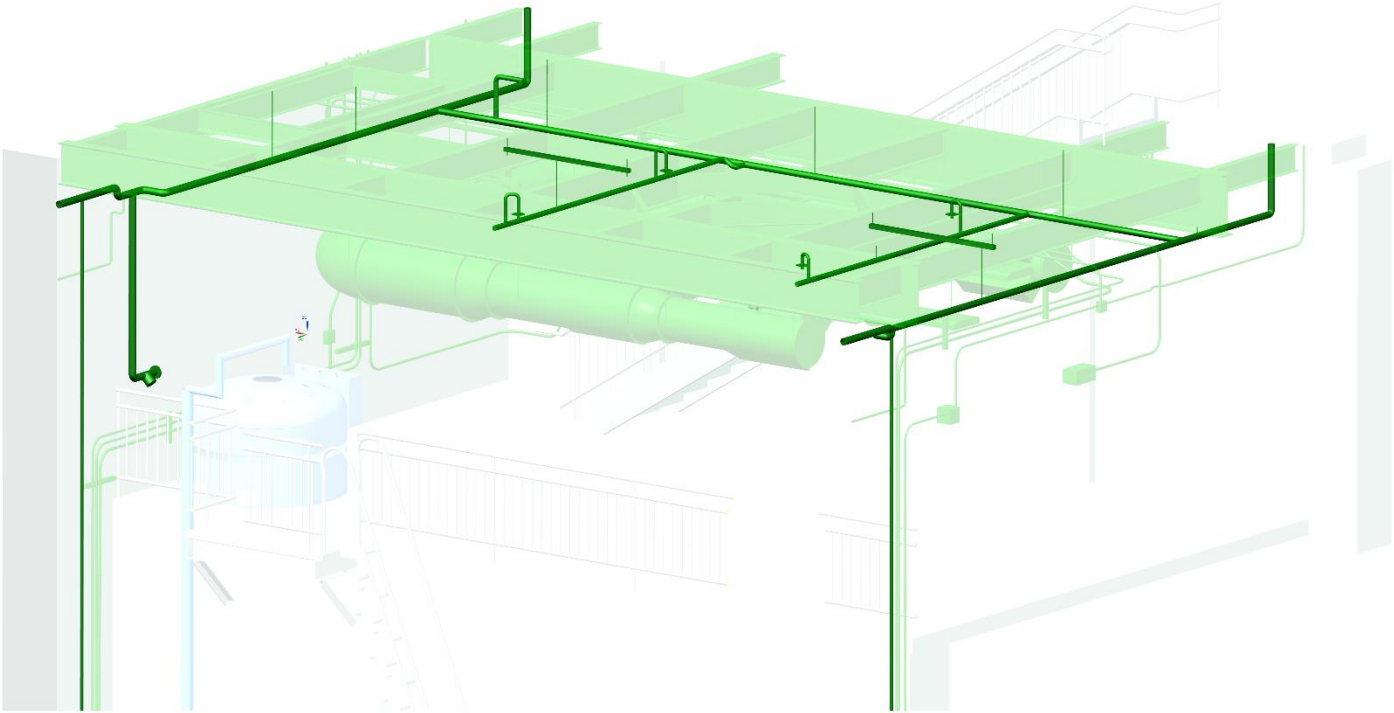
# SBN-ND Mezzanine Modeling:  Fire Protection Water System





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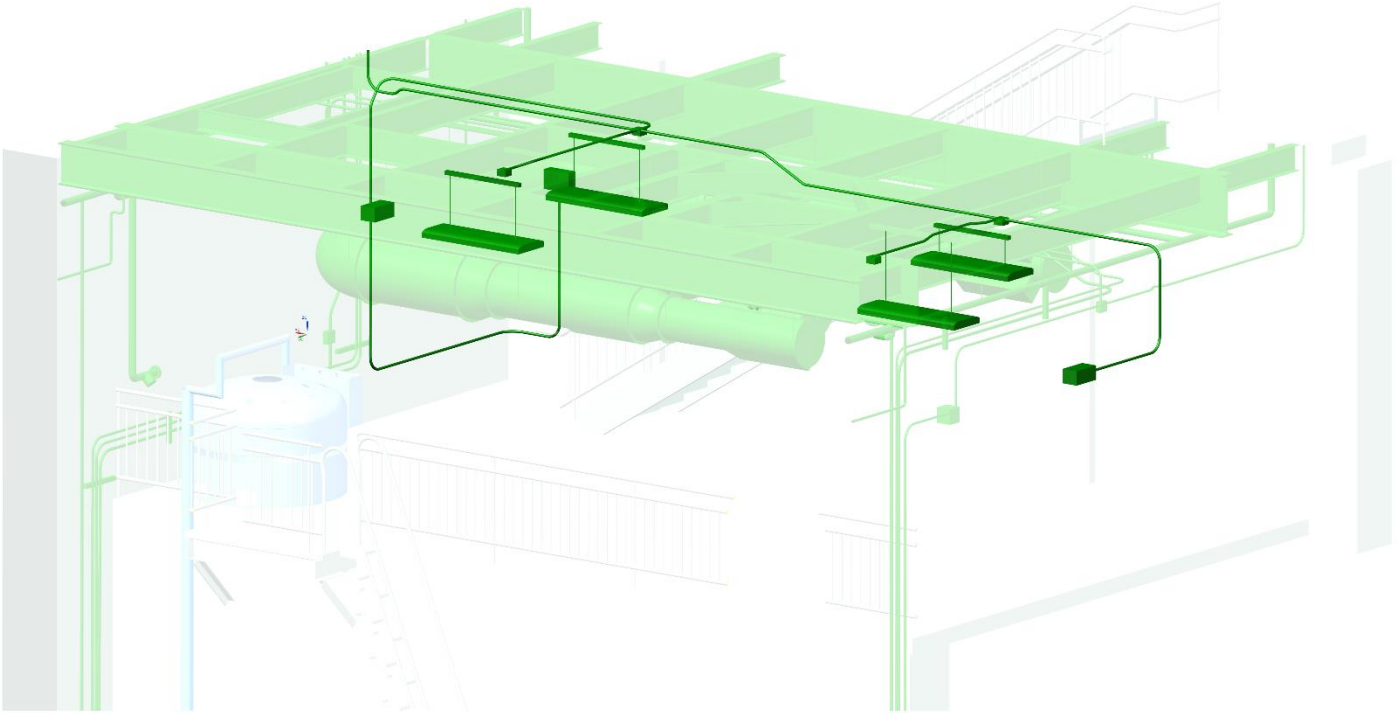
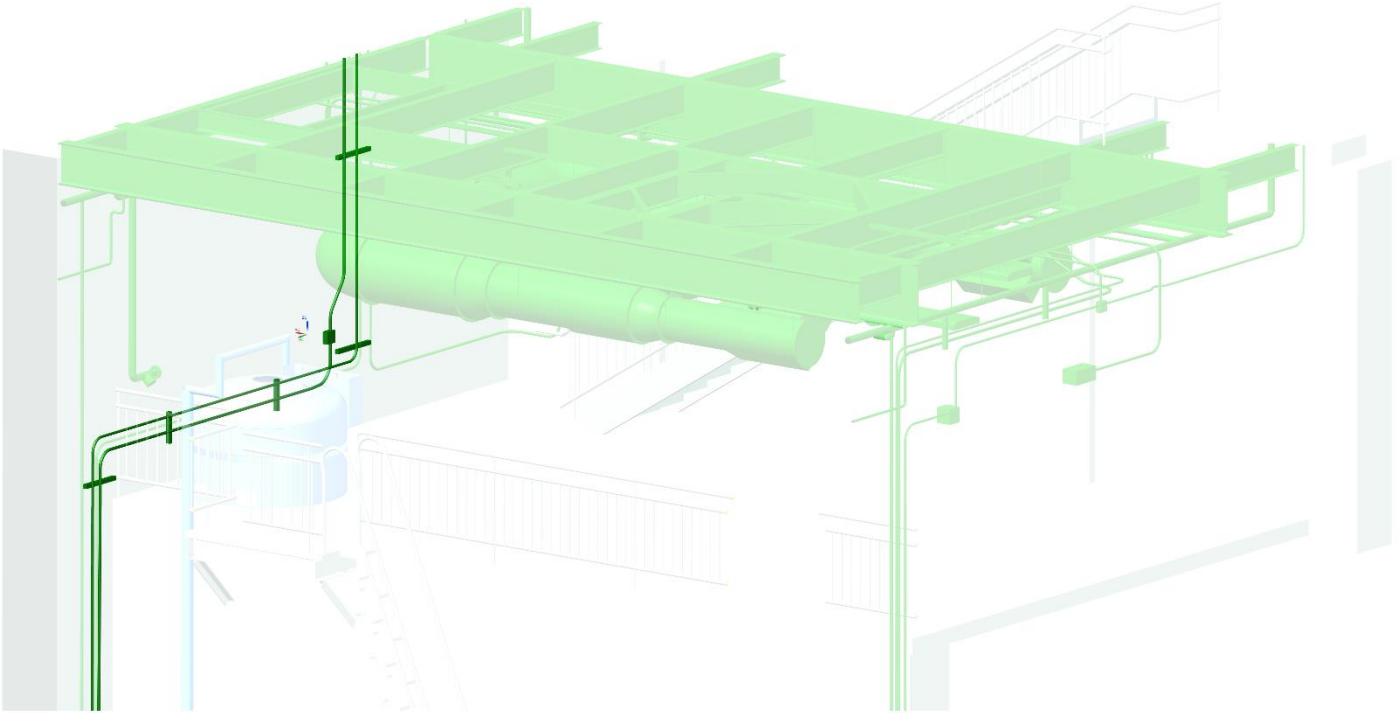
# SBN-ND Mezzanine Modeling:  Lighting System



# SBN-ND Mezzanine Modeling:  Pit Electrical System





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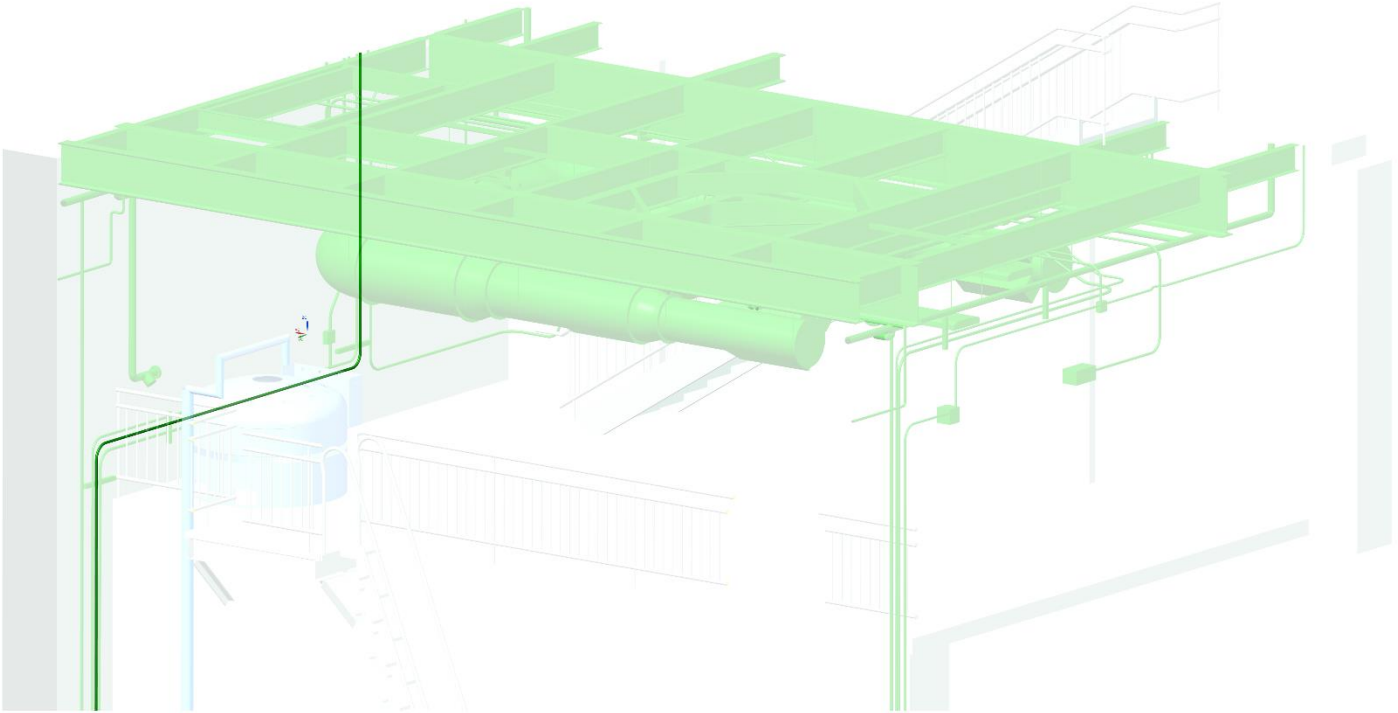
# SBN-ND Mezzanine Modeling:  Pit Lighting System





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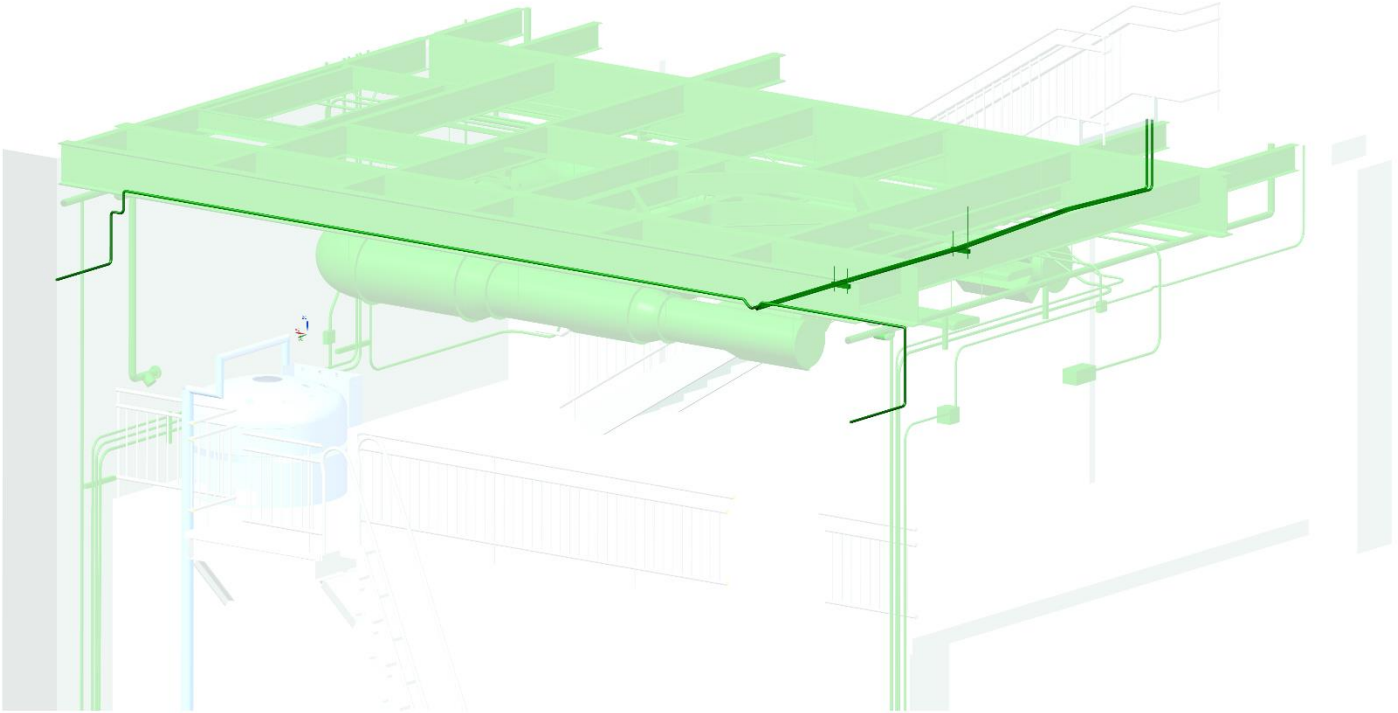
# SBN-ND Mezzanine Modeling:  Smoke Detector System





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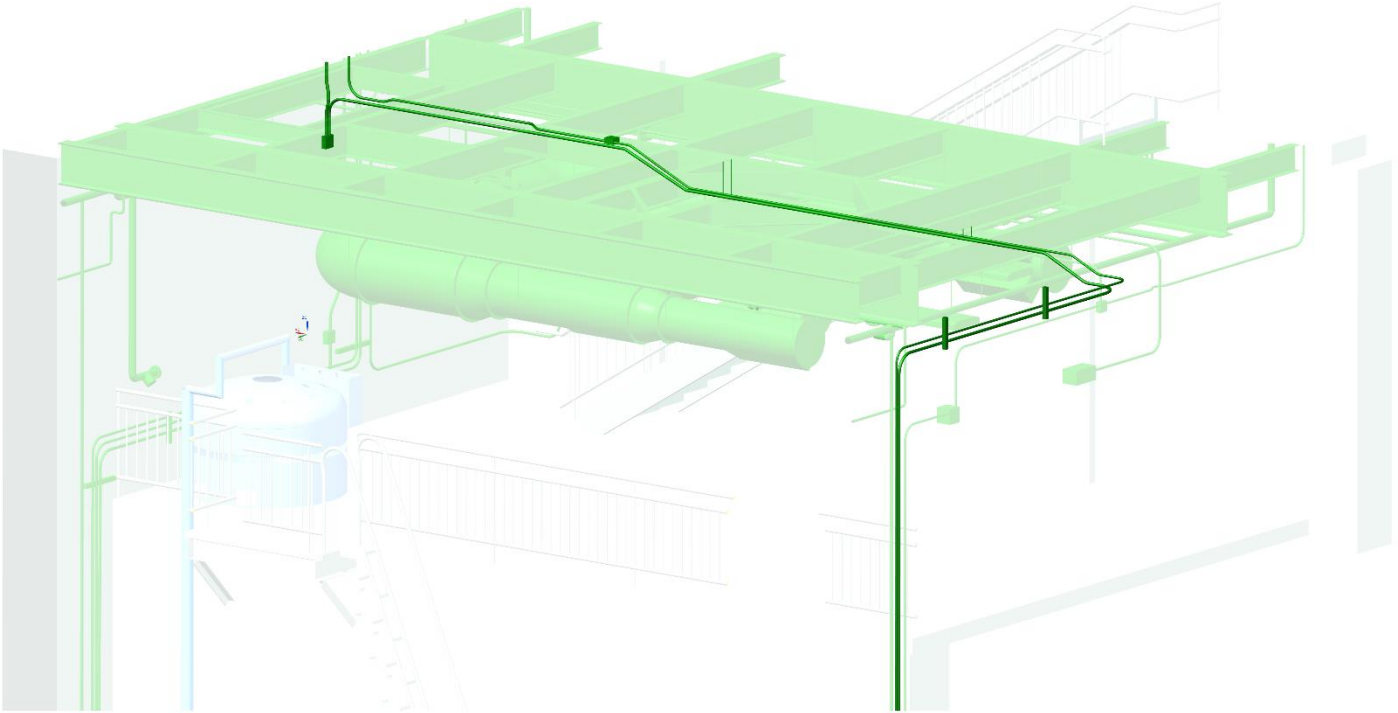
# SBN-ND Mezzanine Modeling:  Sump Pump System





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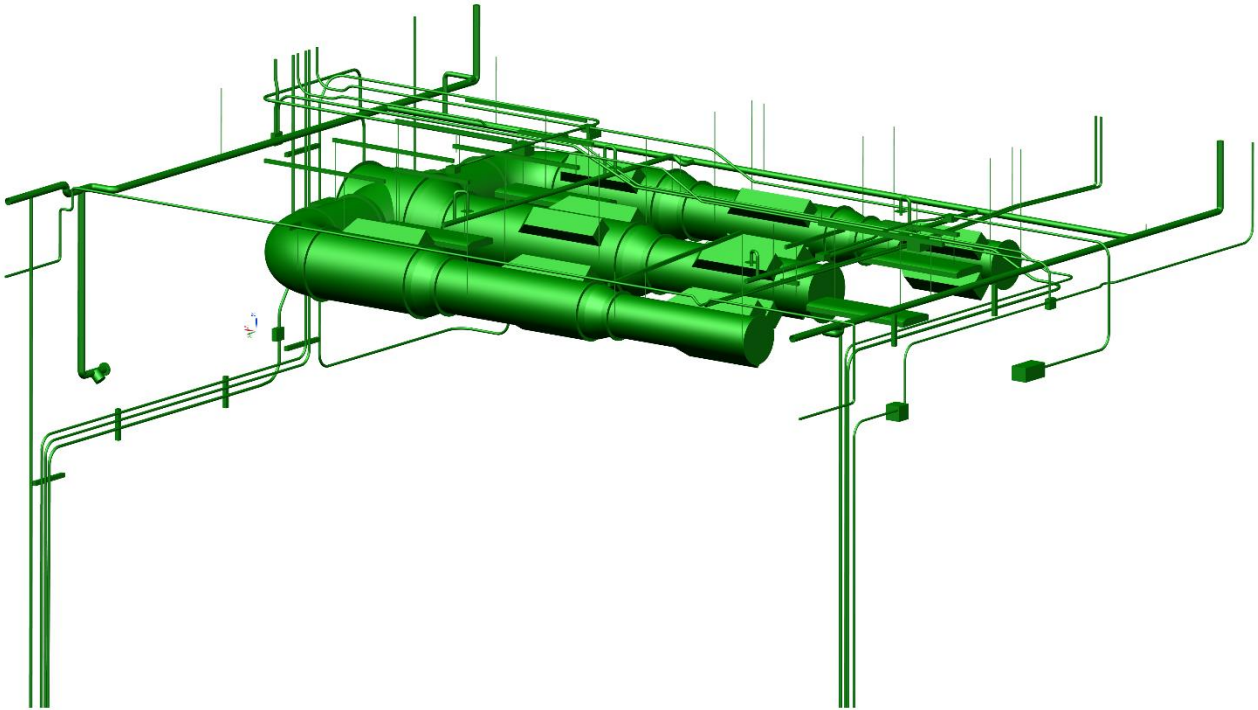
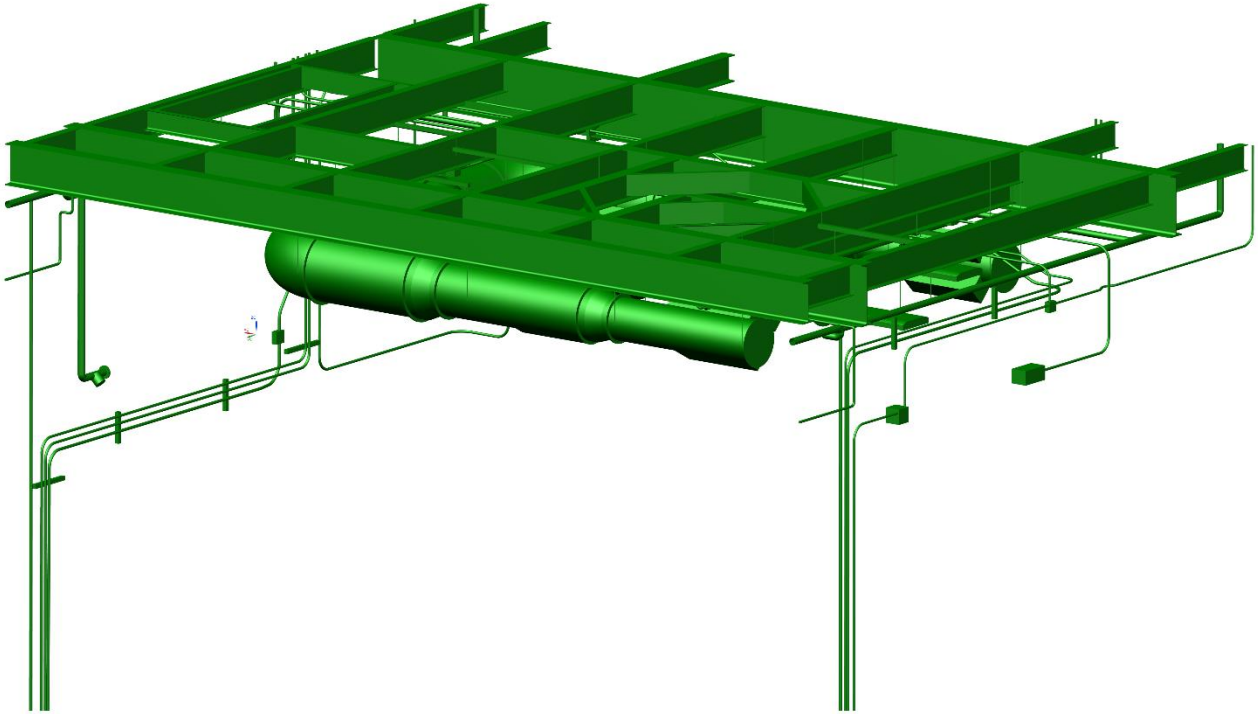
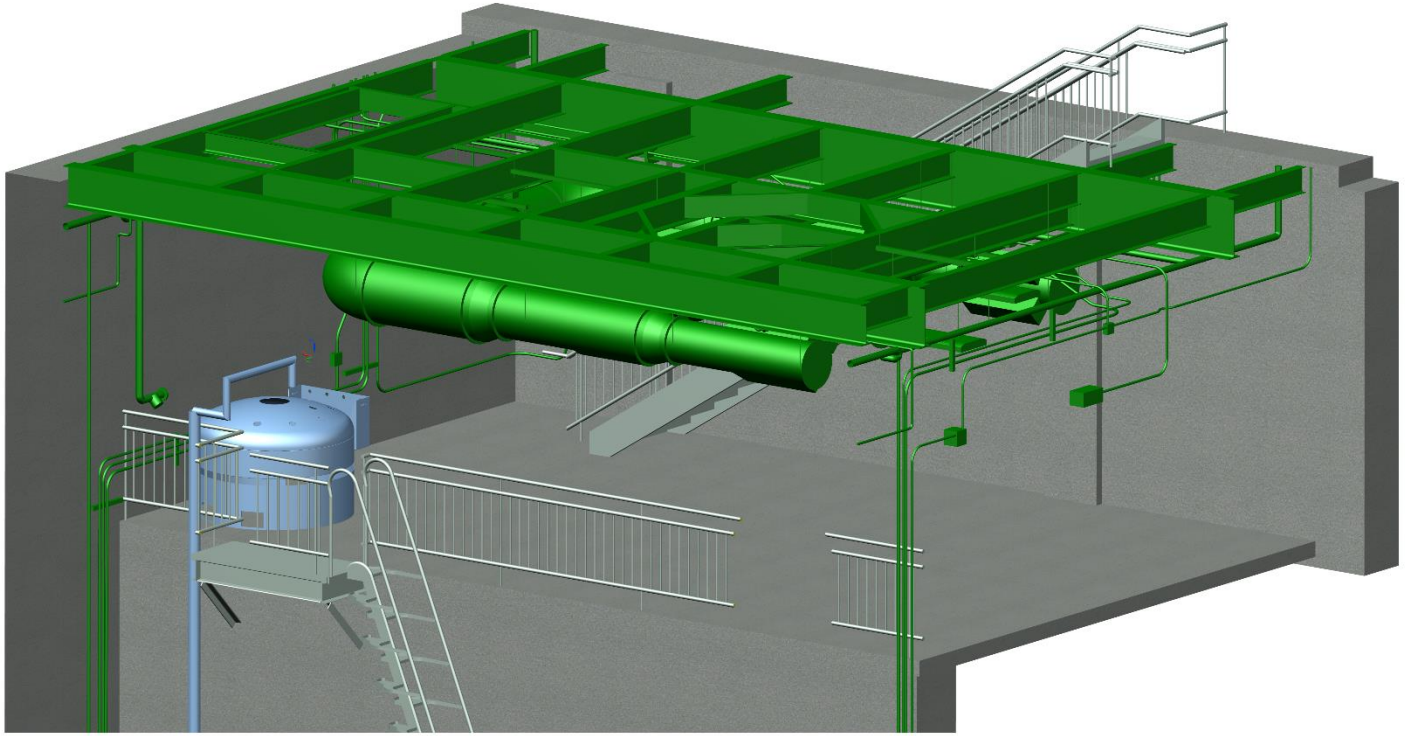
# SBN-ND Mezzanine Modeling:  Full Model, My Parts, No Steel



# SBN-ND Mezzanine Modeling:  Full Model, My Parts



# SBN-ND Mezzanine Modeling:  Full Model



# Thank You!

- Thank you to Fermilab for providing this opportunity
- Thanks to all that helped this summer on these projects!
  - Harry Cheung
  - Angela Fava
  - Don Friend
  - Cristobal Garces
  - Steve Hentschel
  - Lucas Kilmer
  - Nicola McConkey
  - John Najdzion
  - Anne Schukraft
  - Shishir Shetty
  - Joseph Zennamo