Fermilab U.S. DEPARTMENT OF ENERGY Office of Science

Mu2e System Integration

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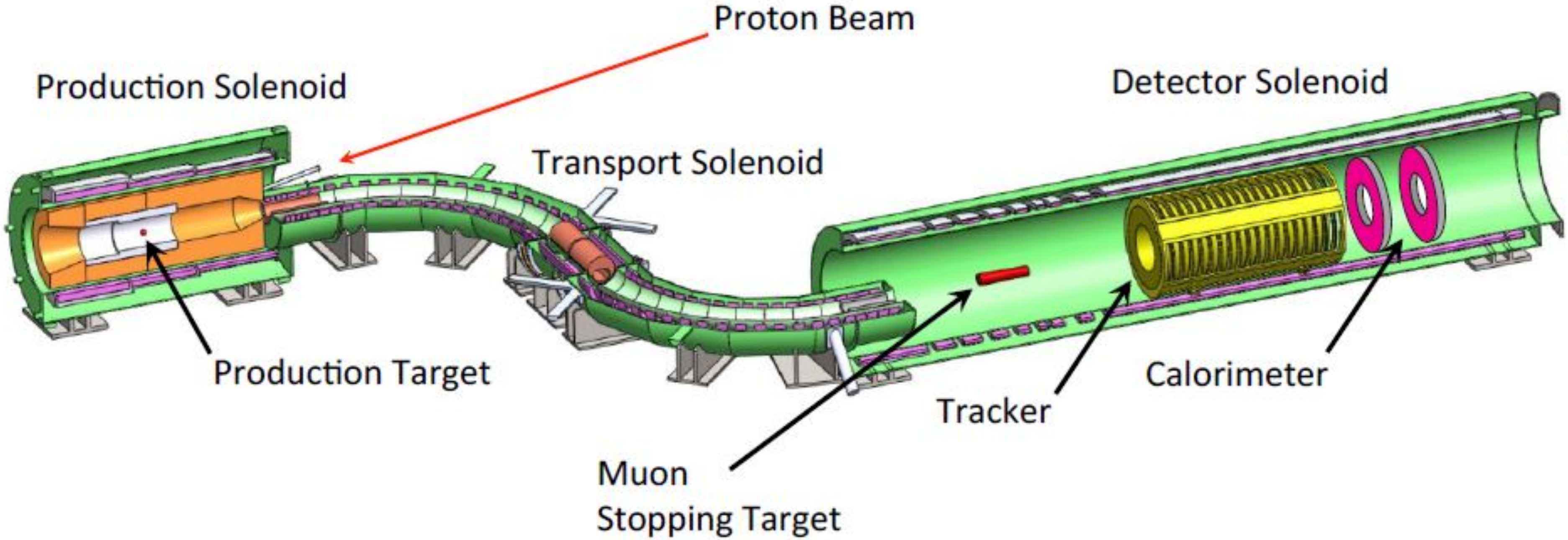
Final Presentation

Tuesday, 24th September 2019

Università di Pisa

Mu2e Project Overview



- Mu2e proposes to measure the rate of the neutrinoless conversion of a muon into an electron over the rate of ordinary muon to electron conversion
- Sensitivity of the measure is 2,87 x 10^{-17}, 4 orders of magnitude above previous experiment
- Overall cost of the project (2014) $ 271 M

Mu2e Downstream External Shielding – Future work

From Midterm Presentation 8/21/2019

Next weeks work plan:

- Design handling features for other shapes of blocks tailoring how many handling/lifting features are necessary case by case
- Modification of the orientation of some blocks in the assembly
- Verification if there are any interferences between the muon beamline shielding and:

-conventional costruction

-production solenoid

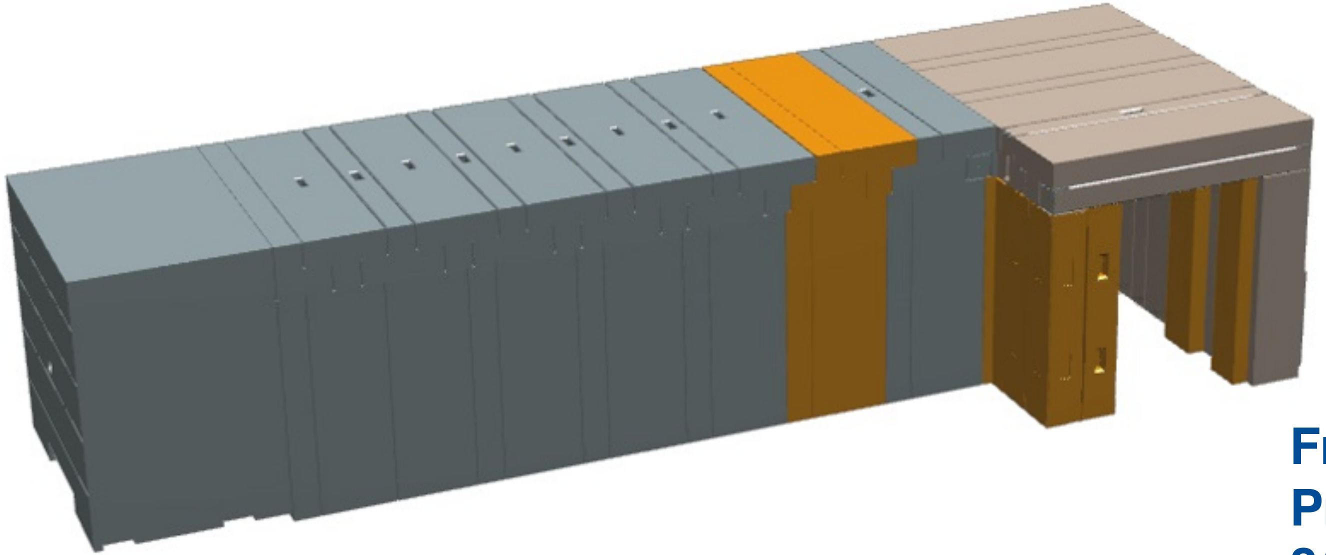
-transport solenoid

-detector solenoid

-cryogenic system

- Working on establishing access to other parts in the top level assembly F10002515 to continue studies of Mu2e System Integration

Mu2e Downstream External Shielding-Requirements



From Midterm Presentation 8/21/2019

Requirements:

- Reduce the neutron and gamma background incident upon the Cosmic Ray Veto Counter
- Allow a line of sight to the Muon stopping target monitor
- Provide a base for support of the Cosmic Ray Veto (CRV)
- Accomodate passage of power, cryo and vacuum services to the Detector Solenoid (DS) while reducing rates of particles escaping through this penetration
- Facilitate access to the Instrumentation Feedthrough Bulkhead (IFB) and the detector train inside the Detector Solenoid
- Satisfy the costraints imposed by the building geometry

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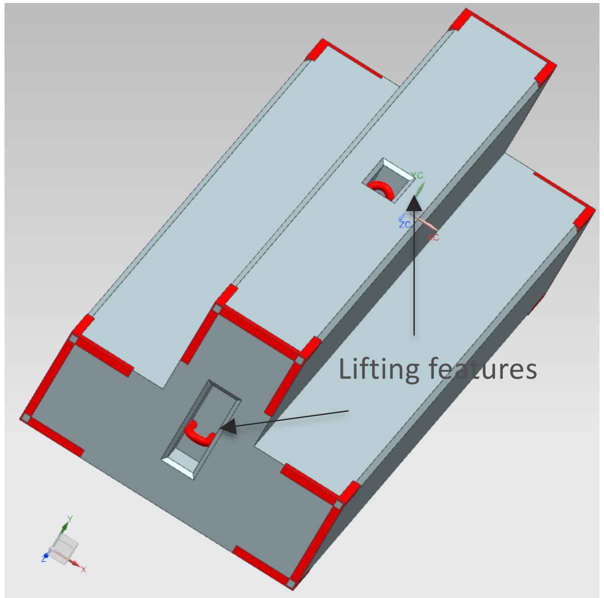
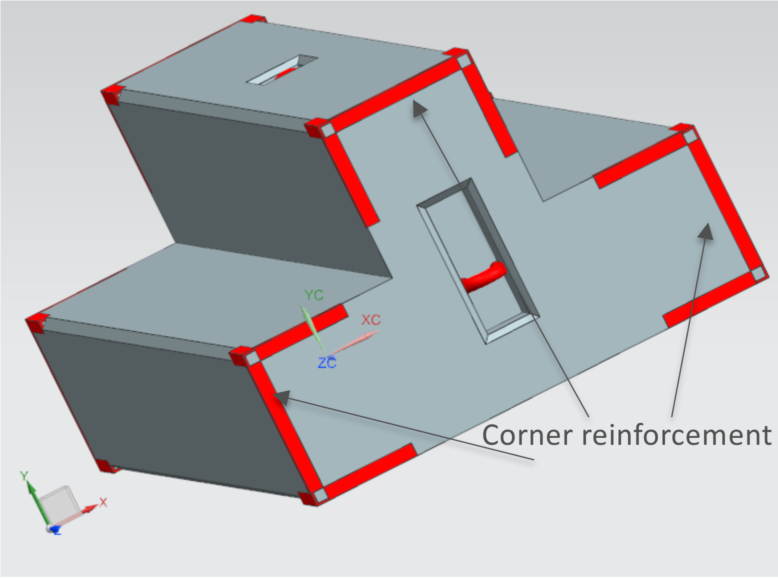
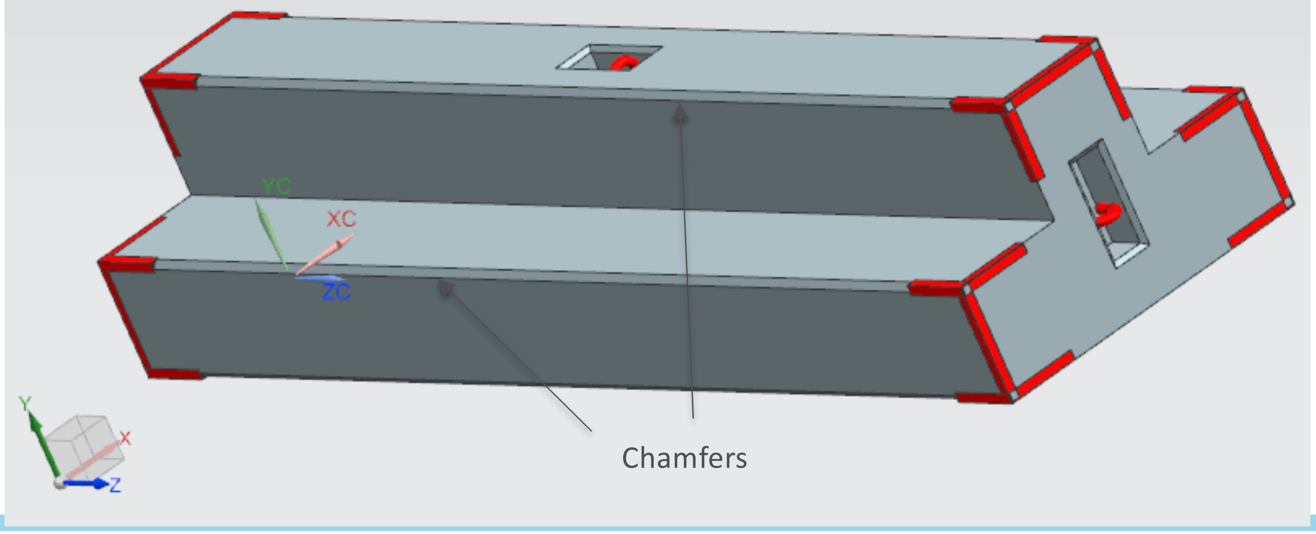
3 8/22/2019 Jacopo Aurigi | Mu2e System Itegration

Blocks detailing

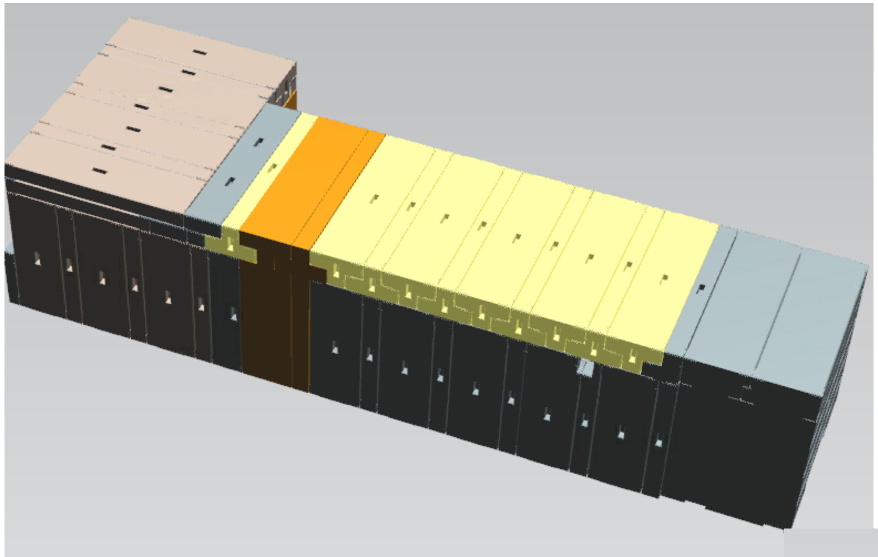
Detailing Concrete blocks of the Downstream Shielding by adding corner reinforcements, edge chamfers and lifting features.



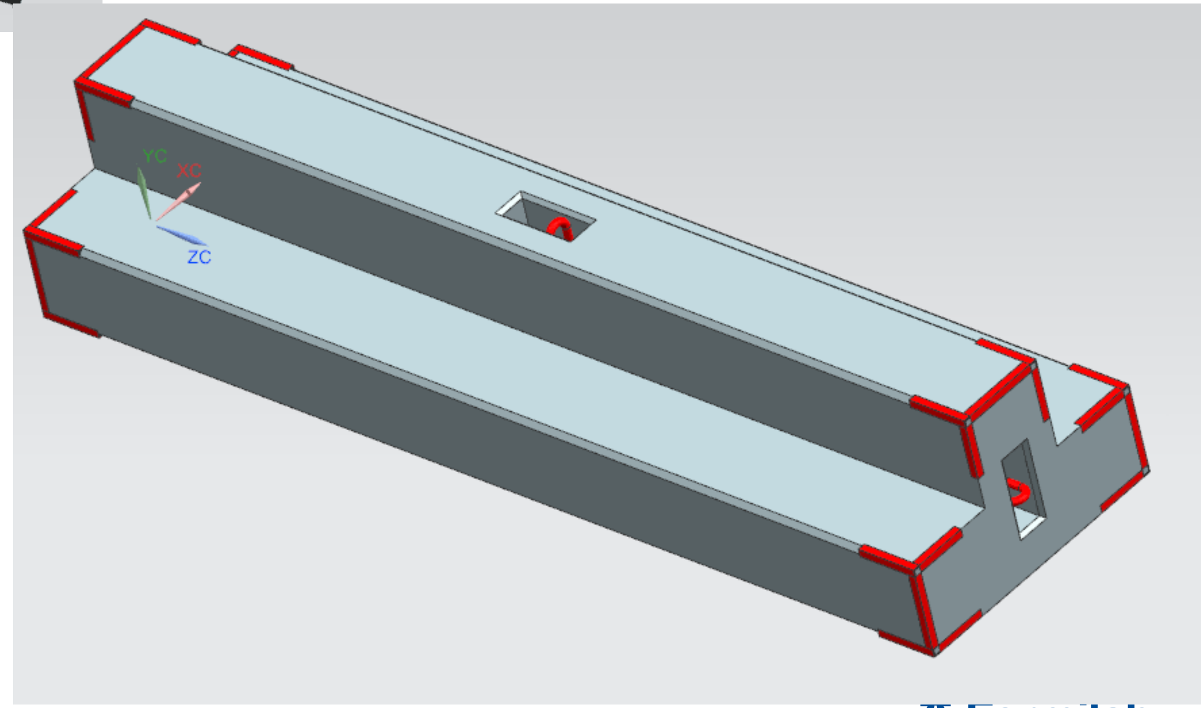




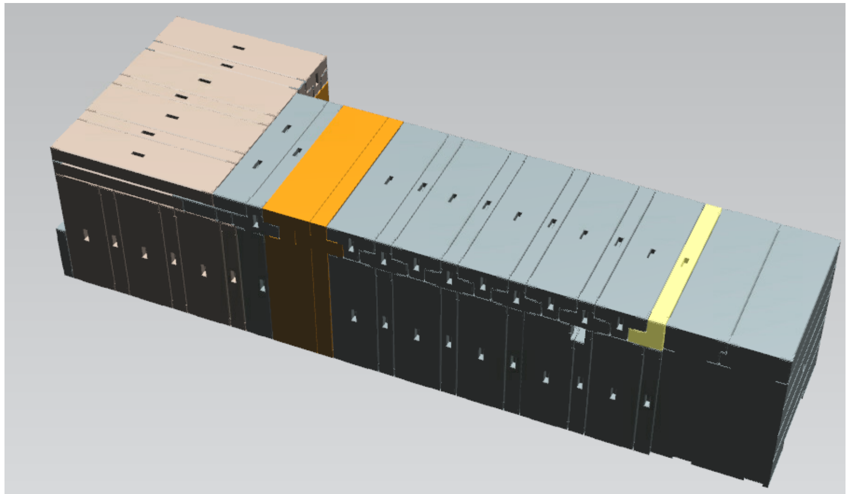
CT-194

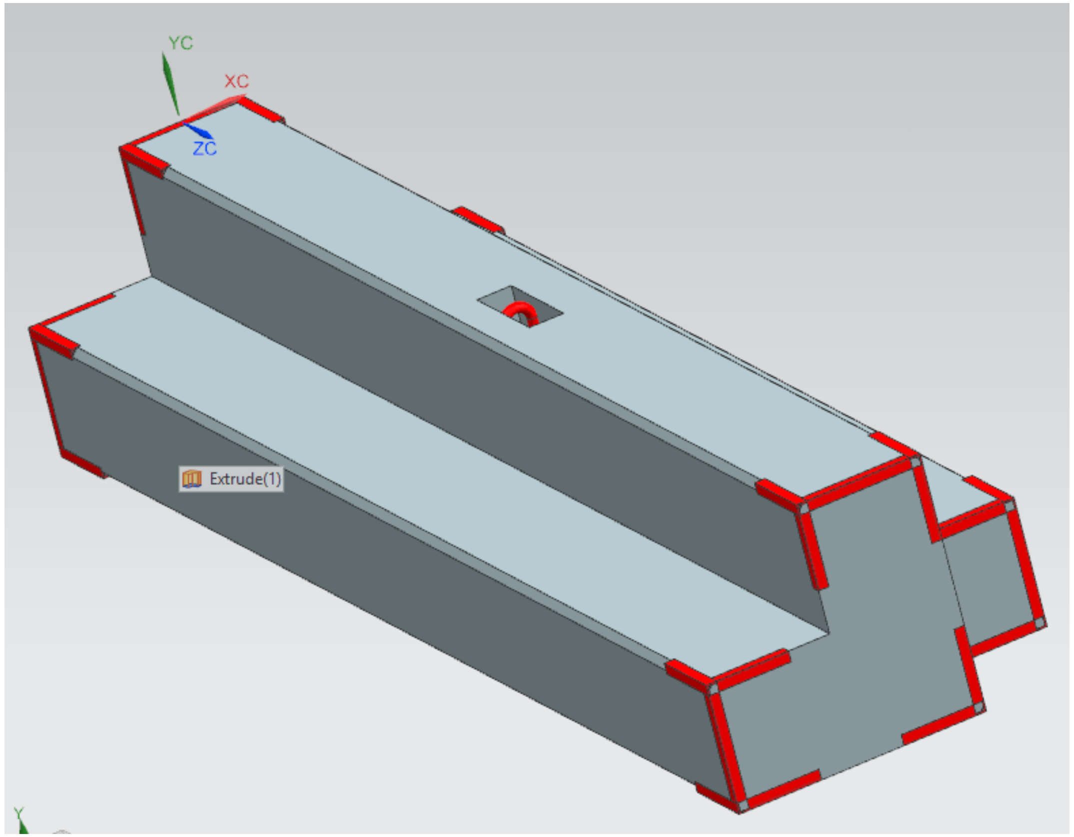


- Downstream cave roof
- Normal density Concrete block
- T section
- Length 194”



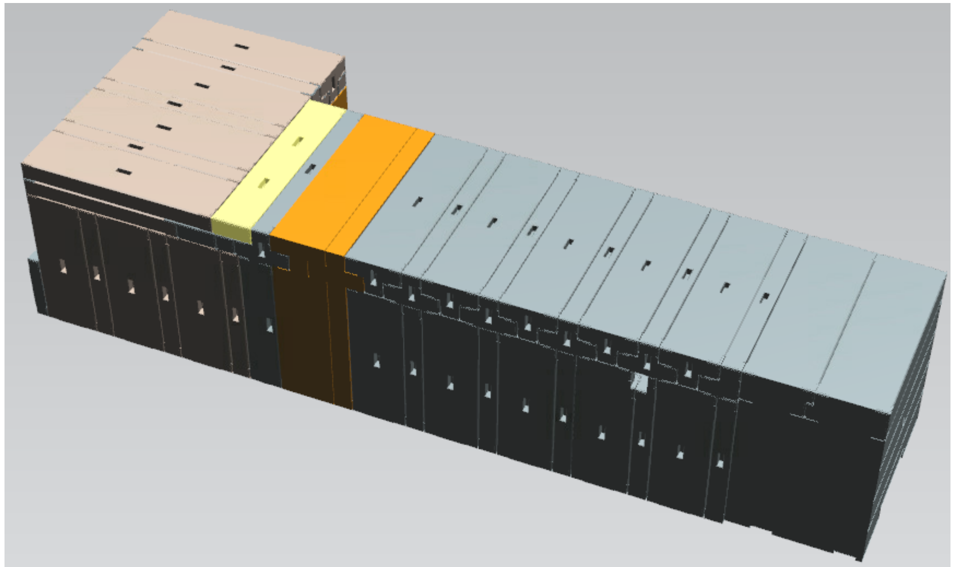
CT1-194



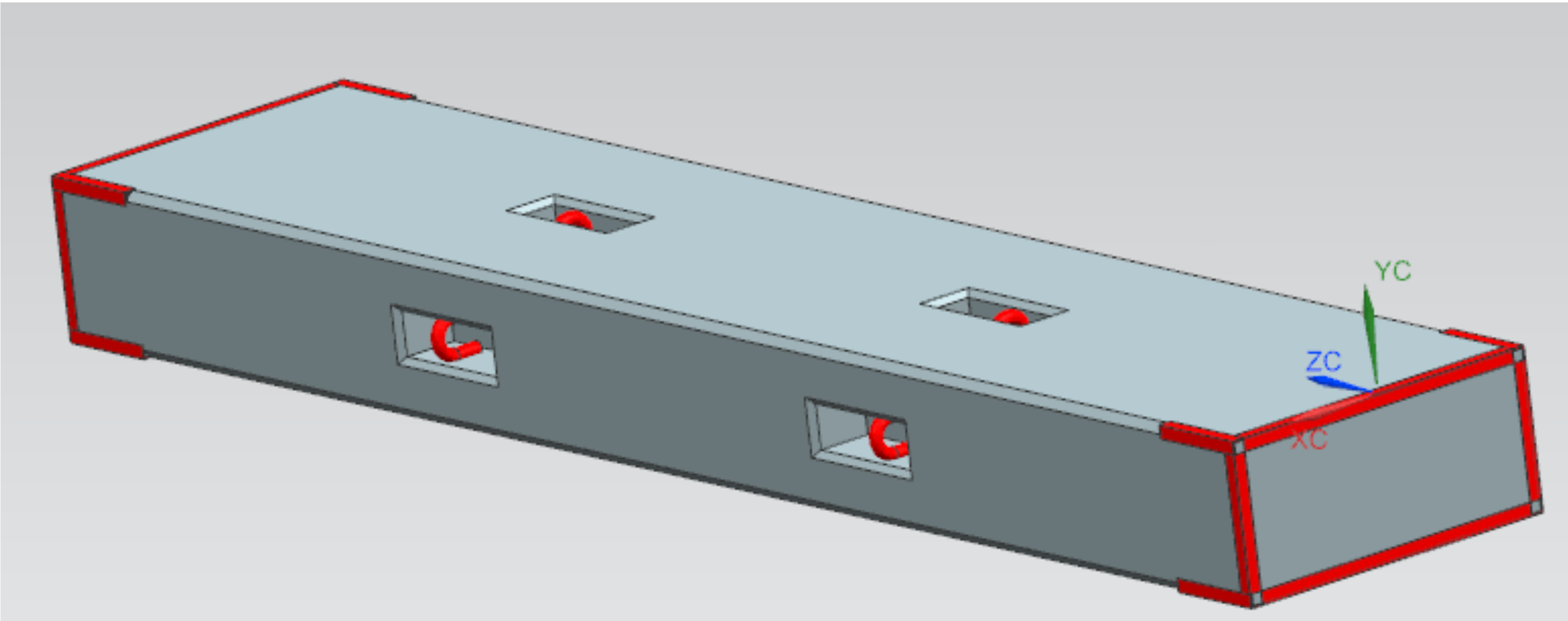


- Downstream cave roof
- Normal density Concrete block
- Intersection between the Downstream Cave and the End Cap Shielding
- Length 194”

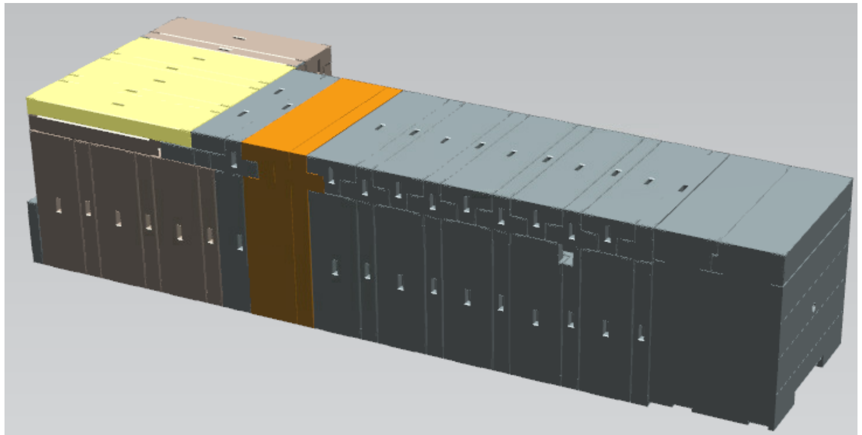
CRH-194



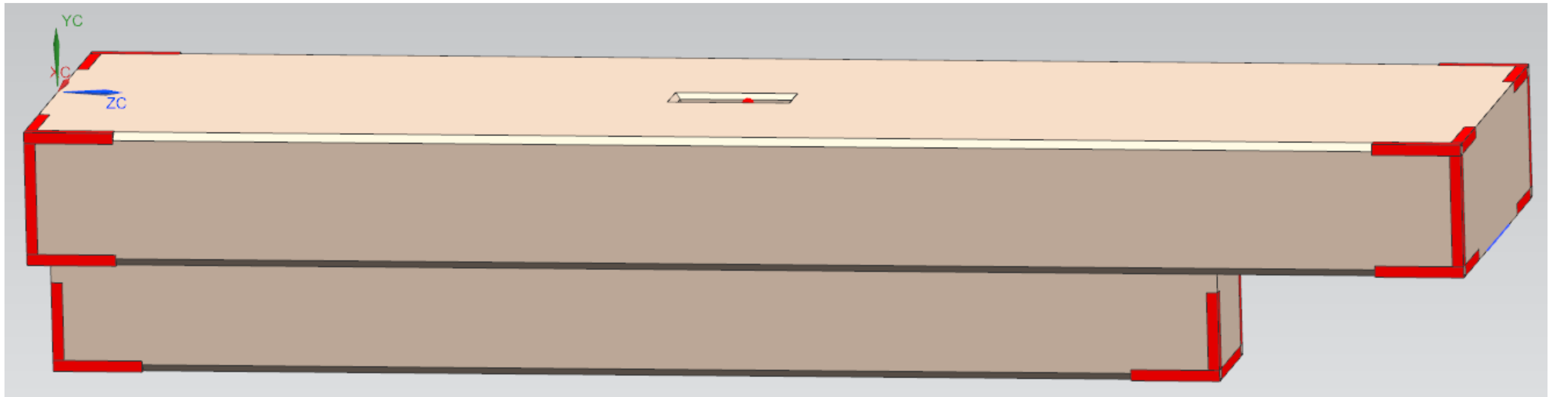
- Downstream cave roof
- Normal density Concrete block
- Rectangular cross section
- Length 194”



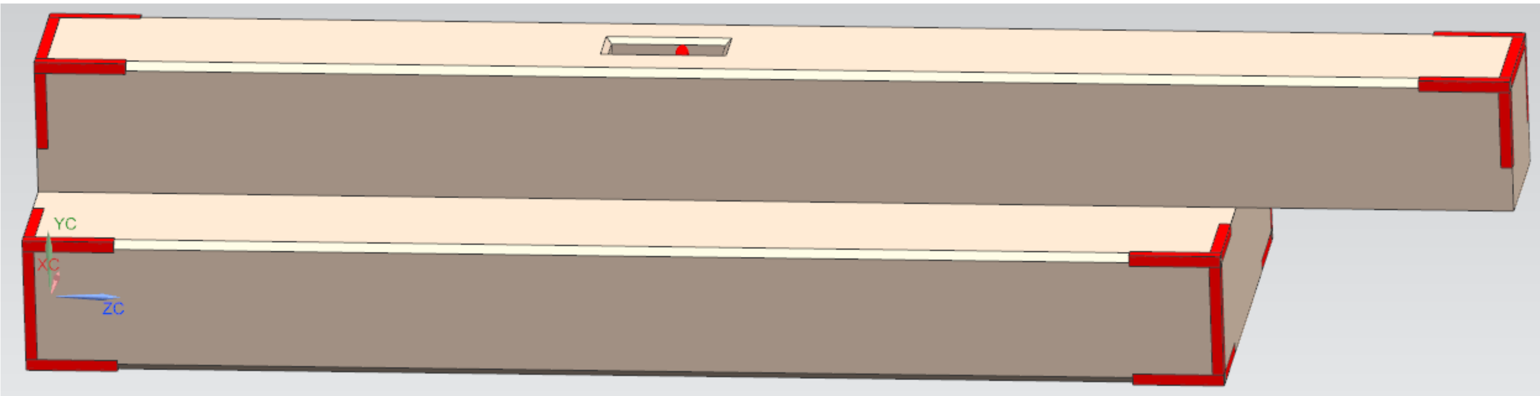
BT1 and BT2



- Downstream Cave TS roof
- Borate concrete blocks
- T Cross section with cut out
- Same height 194”

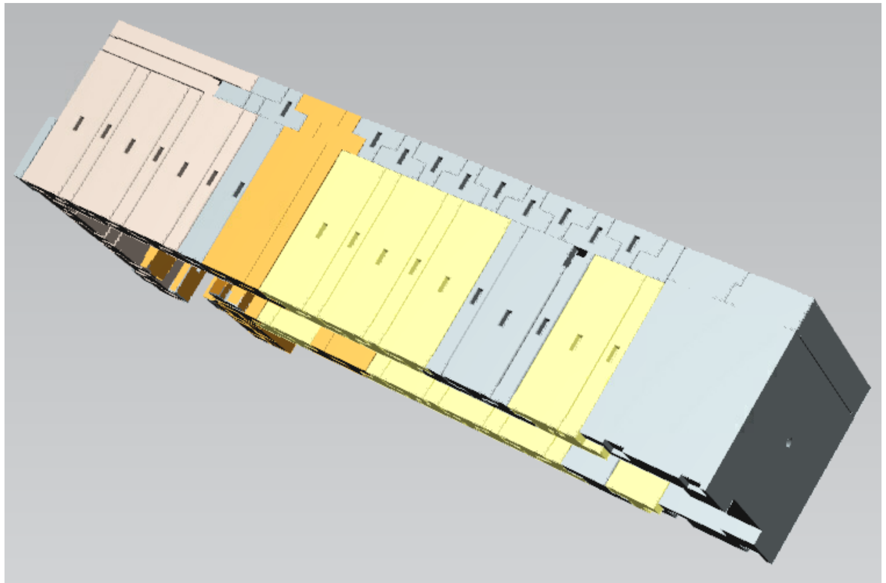


BT1

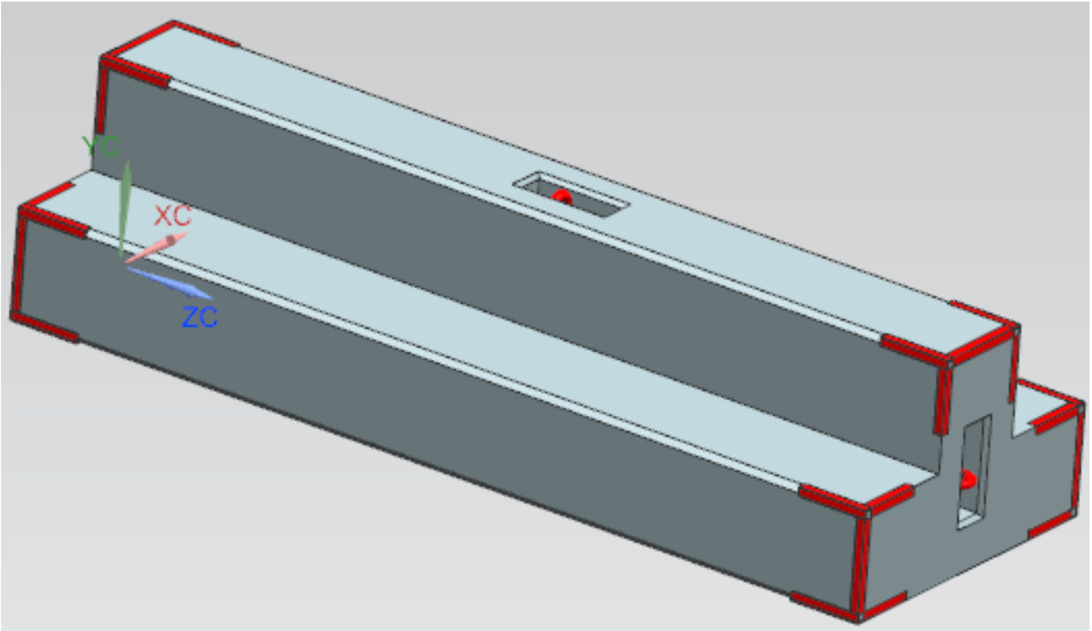


BT2

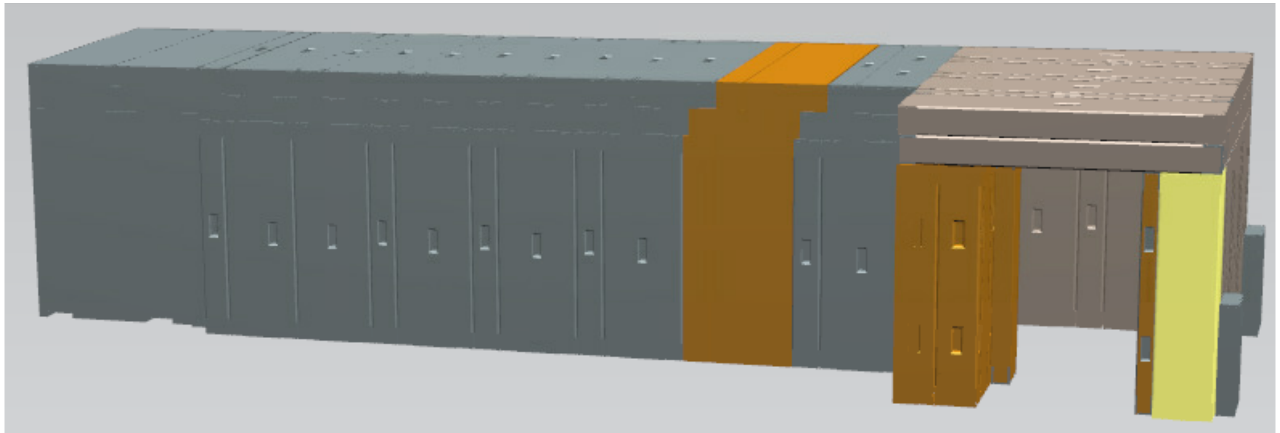
CT-152

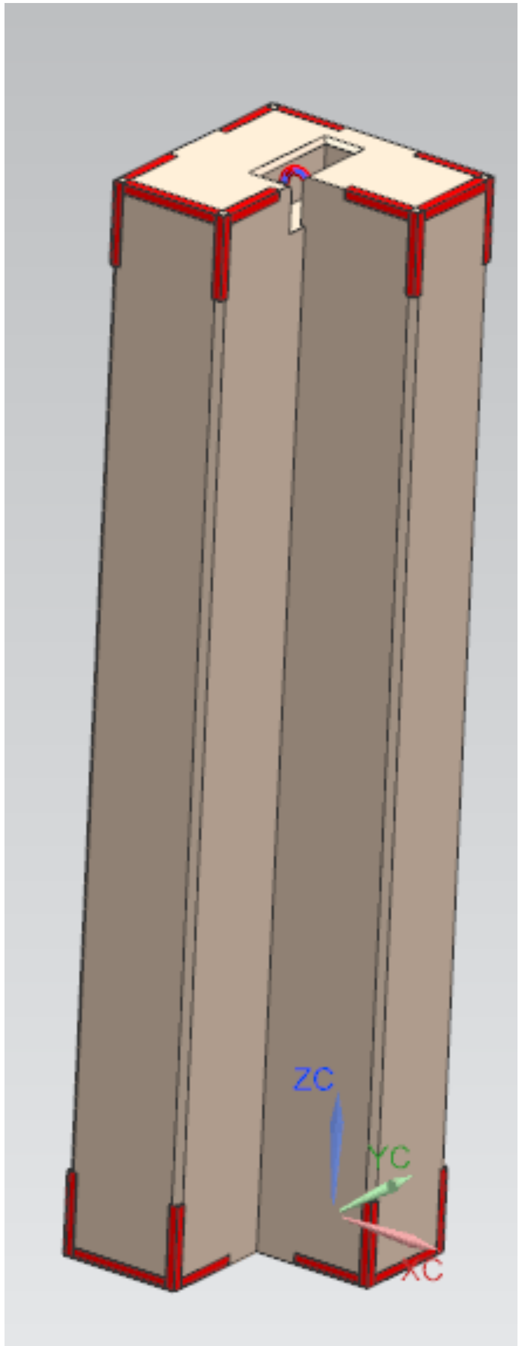


- Downstream North and South wall
- Normal density Concrete blocks
- T section
- Length 152”



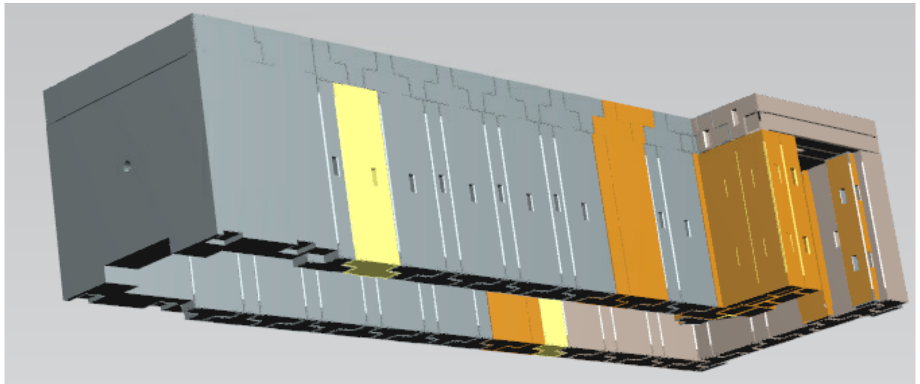
BLW-152

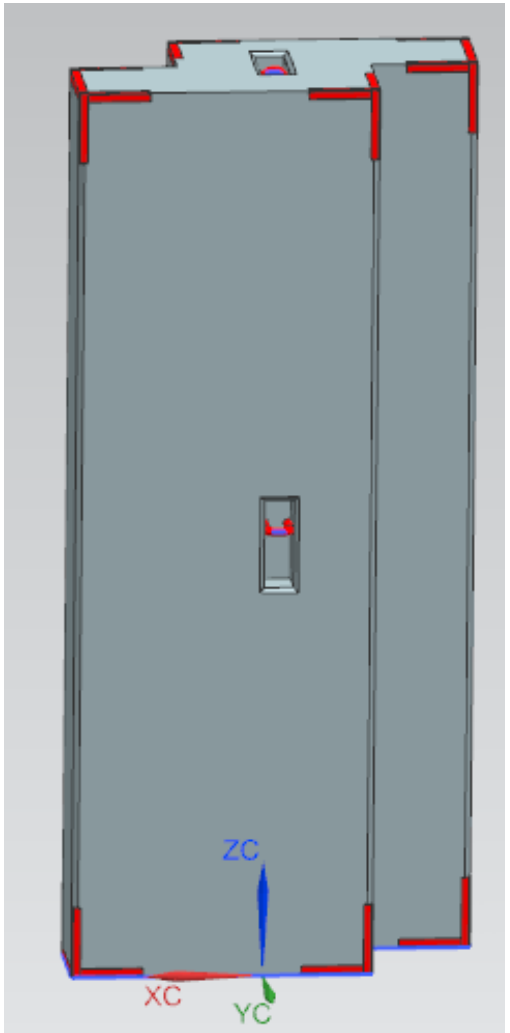




- Downstream Cave Assembly
- Close to the Upstream External Shielding
- Borate Concrete blocks
- L section
- Length 152"

CZN-152 and CZS-152



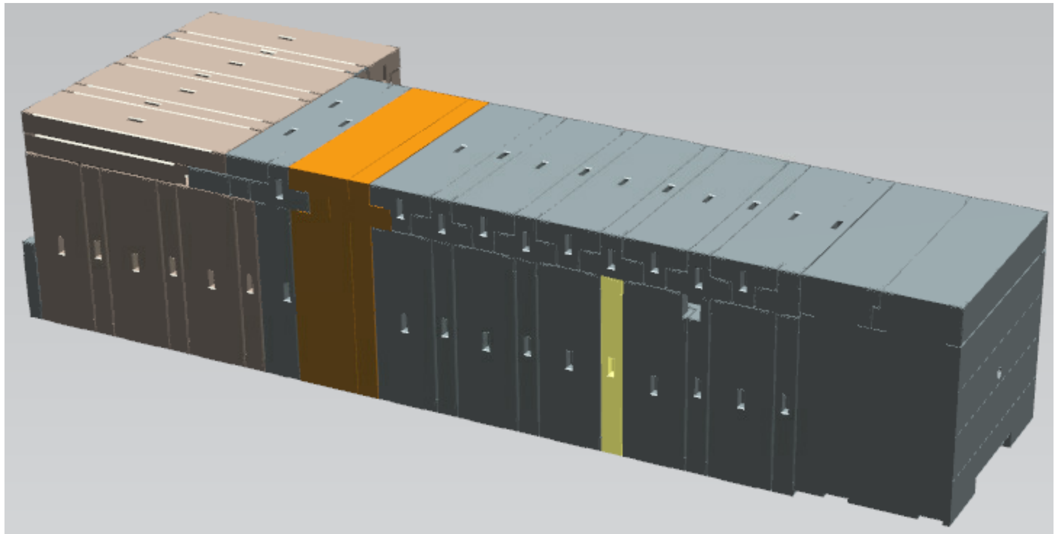


CZN-152

- Downstream Cave Assembly North and South wall
- Normal density Concrete blocks
- Z section
- Different cross section dimension
- Same length 152”

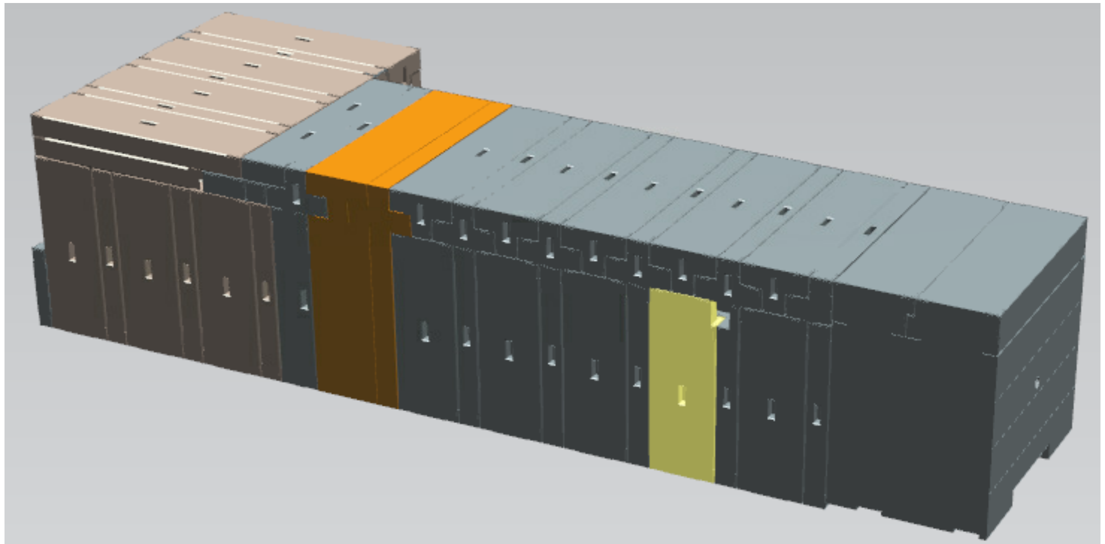
CZS-152

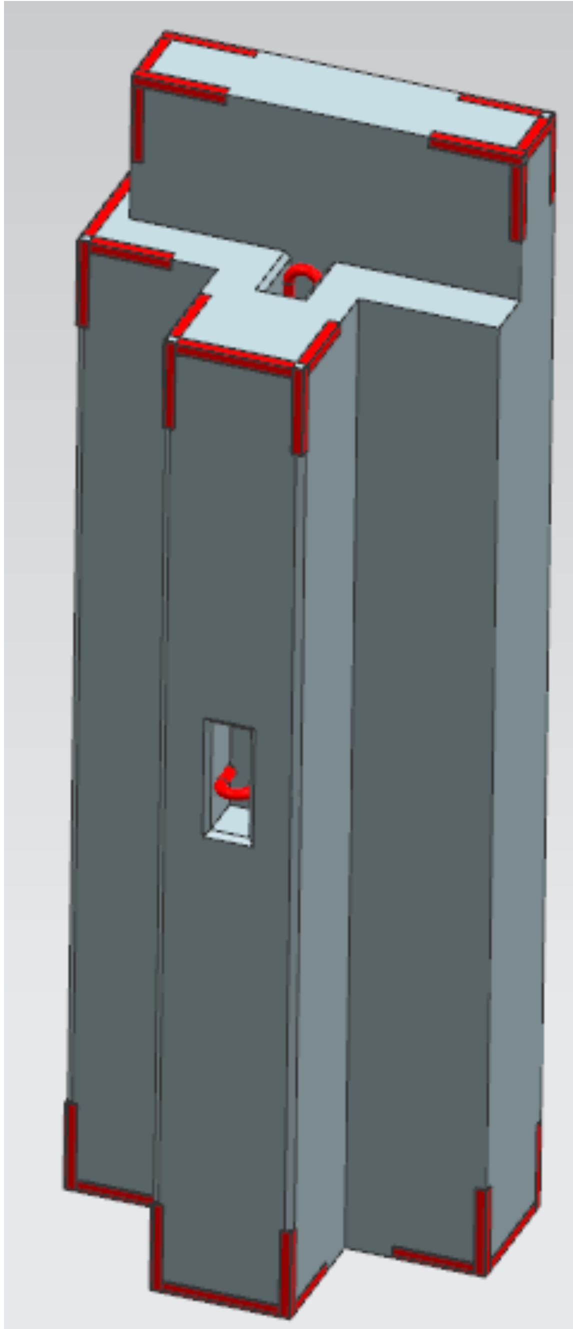
CT4-152



- Downstream Cave Assembly South wall
- Normal density Concrete block
- T cross section
- Bottom face designed to accommodate pipe for cryogenic fluid
- Problem for assembling
- Length 152”

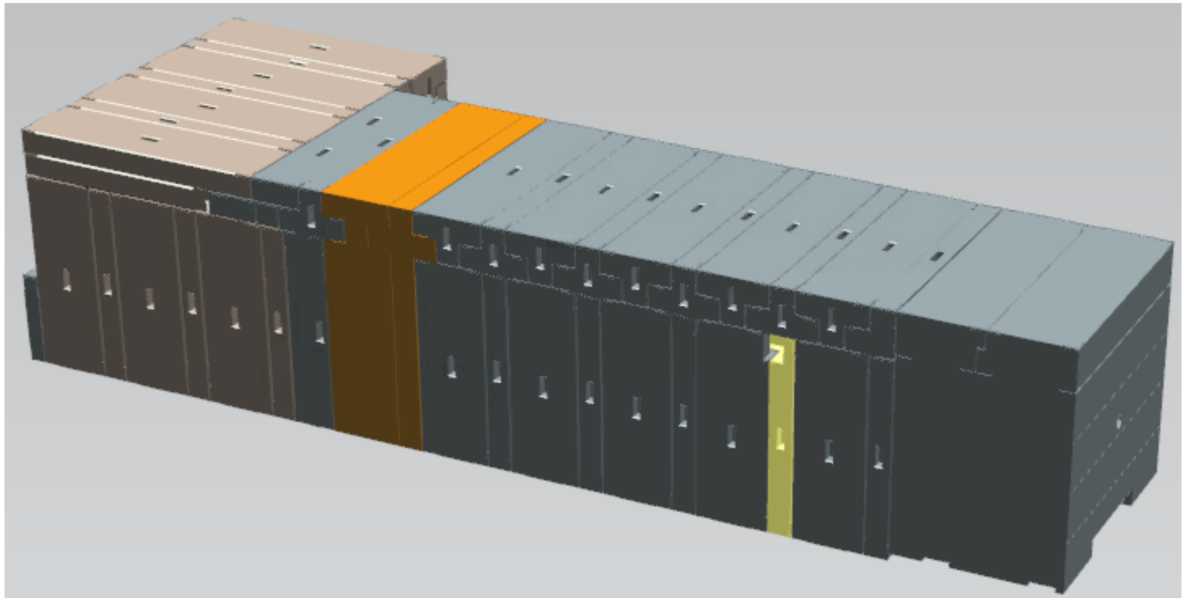
CT5-152



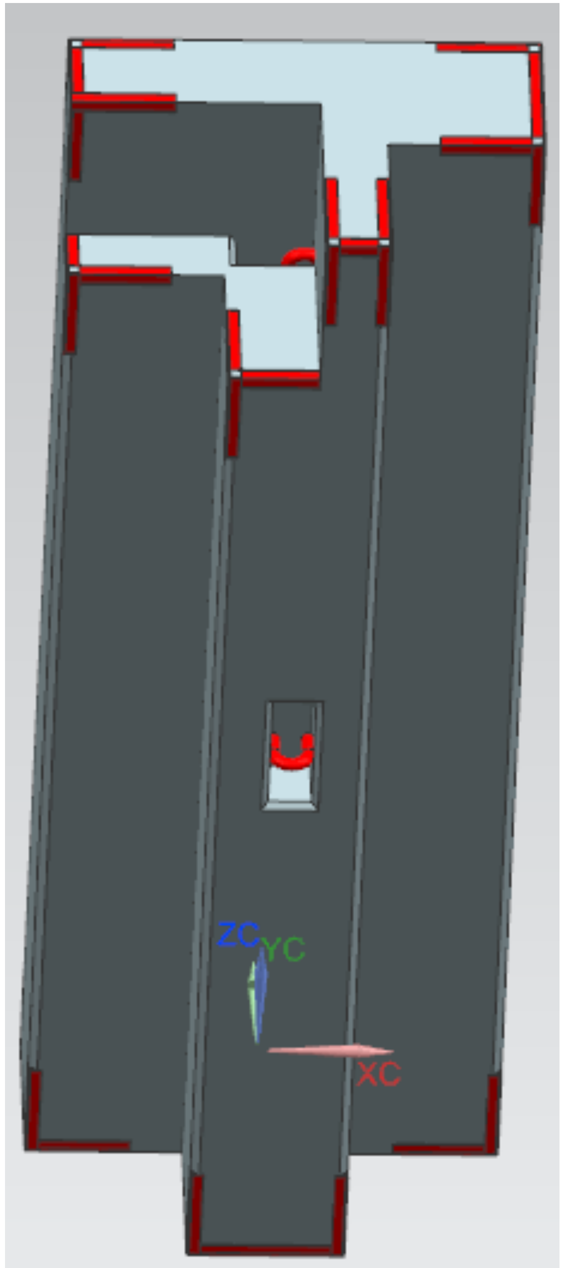


- Downstream Cave Assembly South wall
- Normal density Concrete block
- T cross section
- Bottom face properly designed to accommodate pipe for cryogenic fluid
- Problem for assembling
- Length 152”

CT6-152

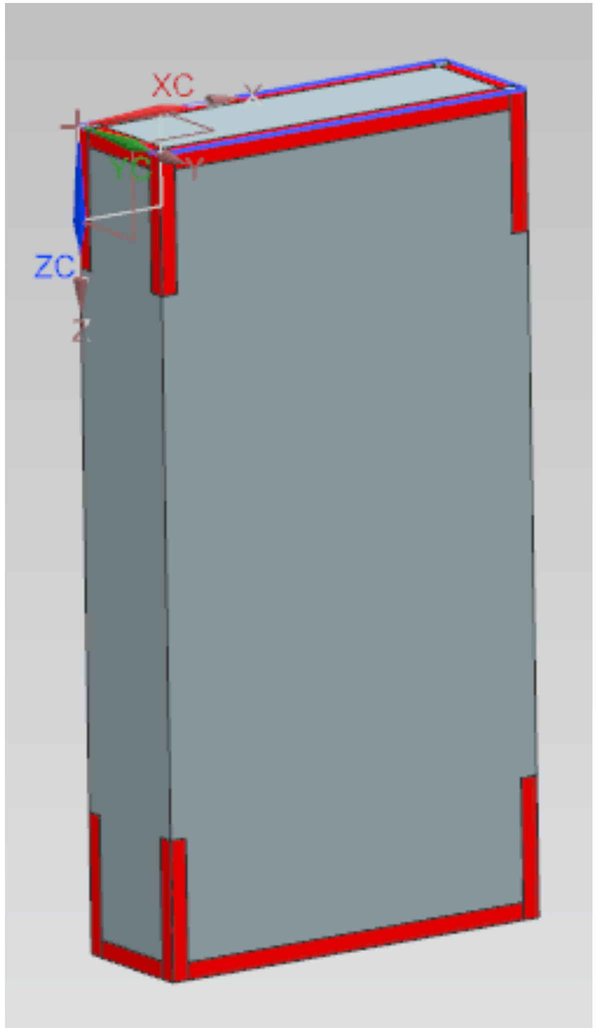


- Downstream Cave Assembly South wall
- Normal density Concrete block
- T cross section
- Bottom face properly designed to accommodate pipe for cryogenic fluid
- Problem for assembling
- Problem in positioning the lifting feature in the bottom surface
- Length 152”

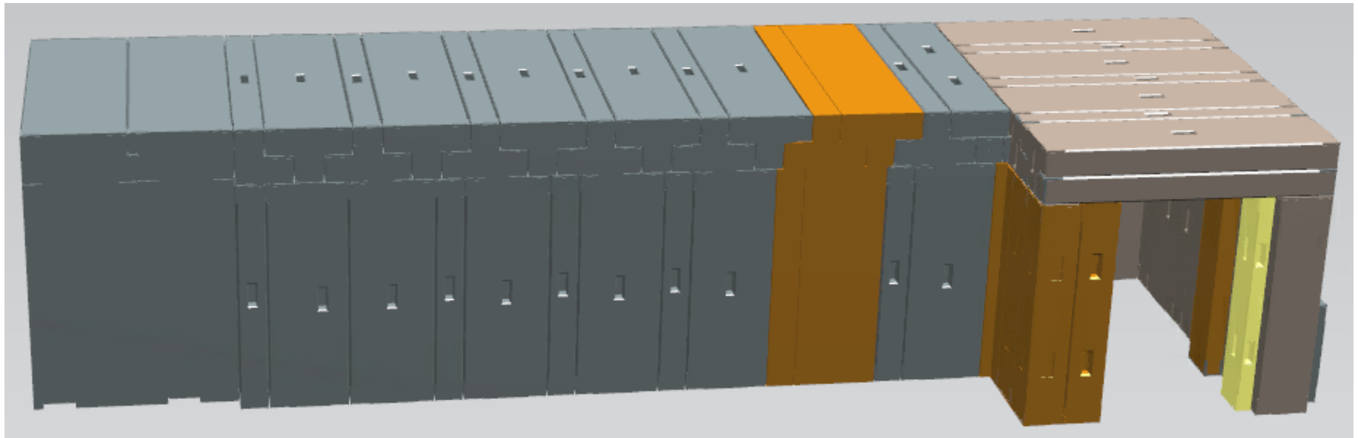


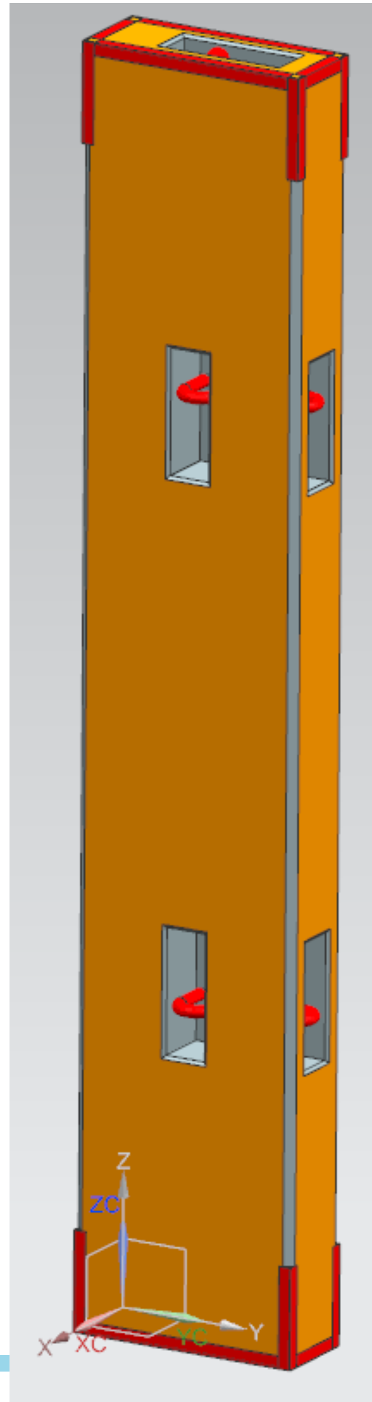
CRV-70

- Normal density Concrete block
- Two identical blocks positioned outside the west wall of the Downstream Cave surrounding Transport Solenoid
- Blocks used as a support for the Cosmic Ray Veto
- Shielding is not the primary purpose
- Rectangular cross section
- Length 70”
- Detailing to be completed during week of 09/23



HRC-151



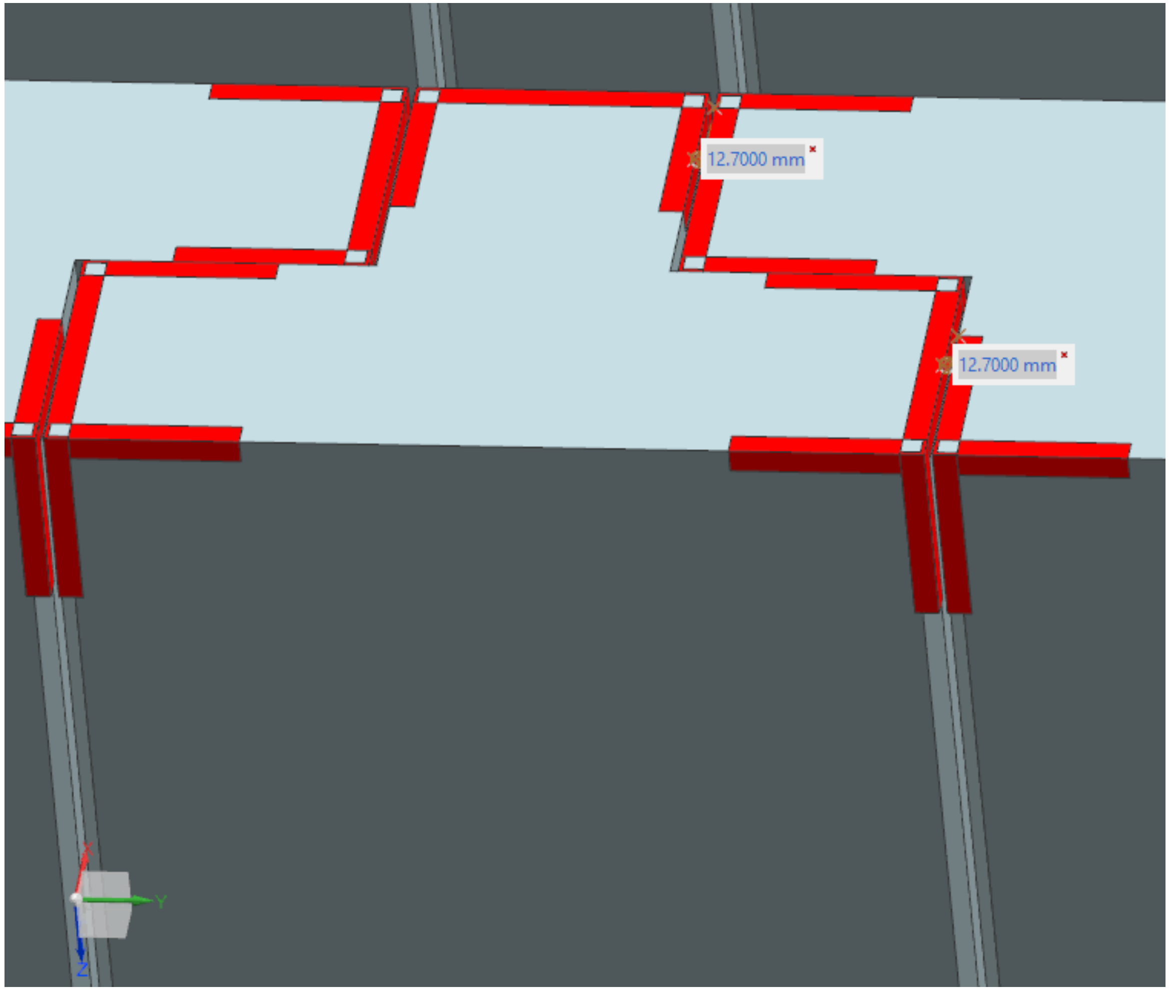


- Transport Solenoid Entrance Cosmic Suppression Shielding Assembly
- High density Concrete block
- Rectangular cross section
- Length 152"
- High price

Interferences Check

Clearance between blocks.

Needed 0,5" gap between two consecutive blocks (in the direction of the beamline) to take into account concrete tolerances and relative positioning.



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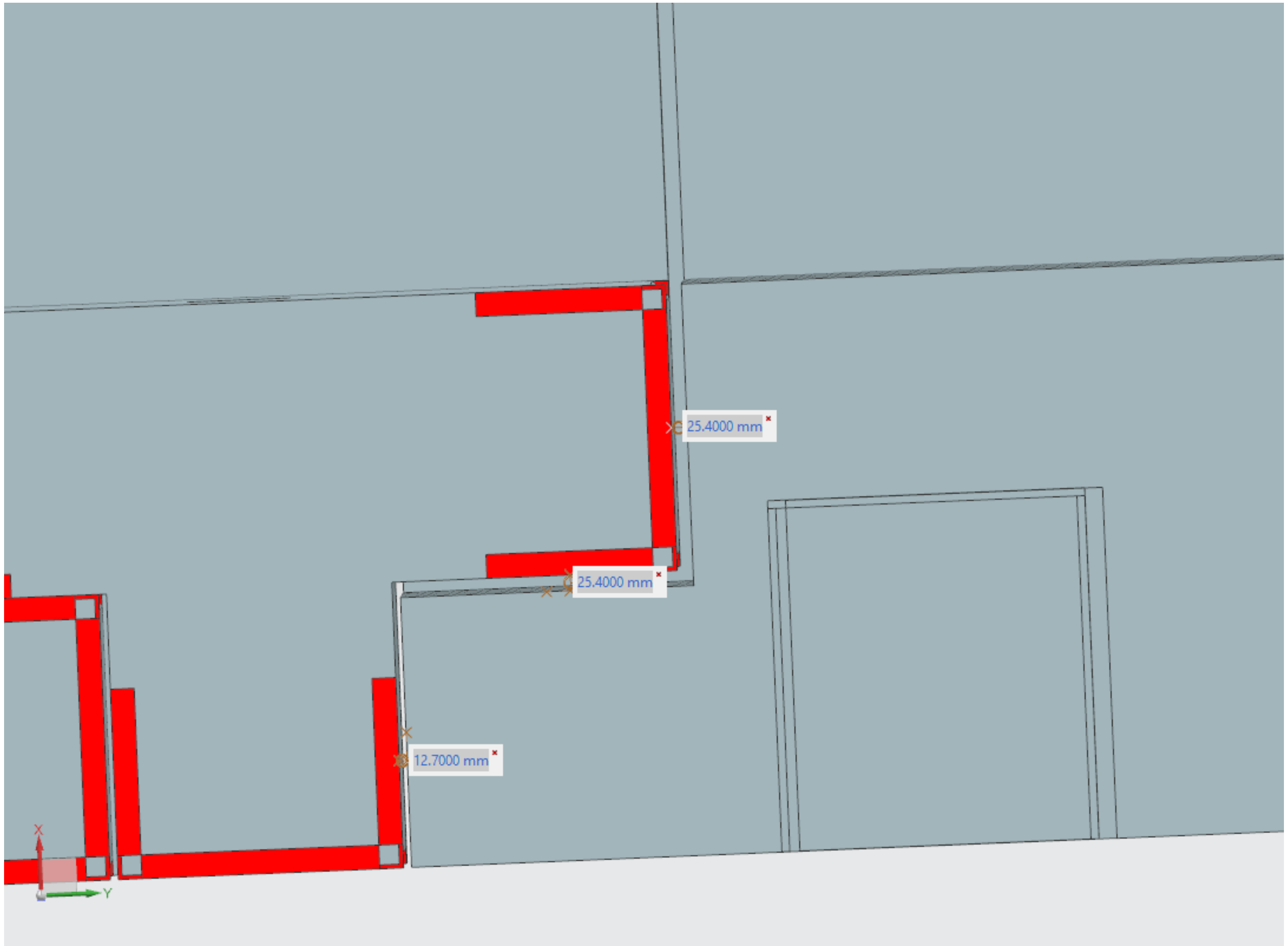
Interferences Check

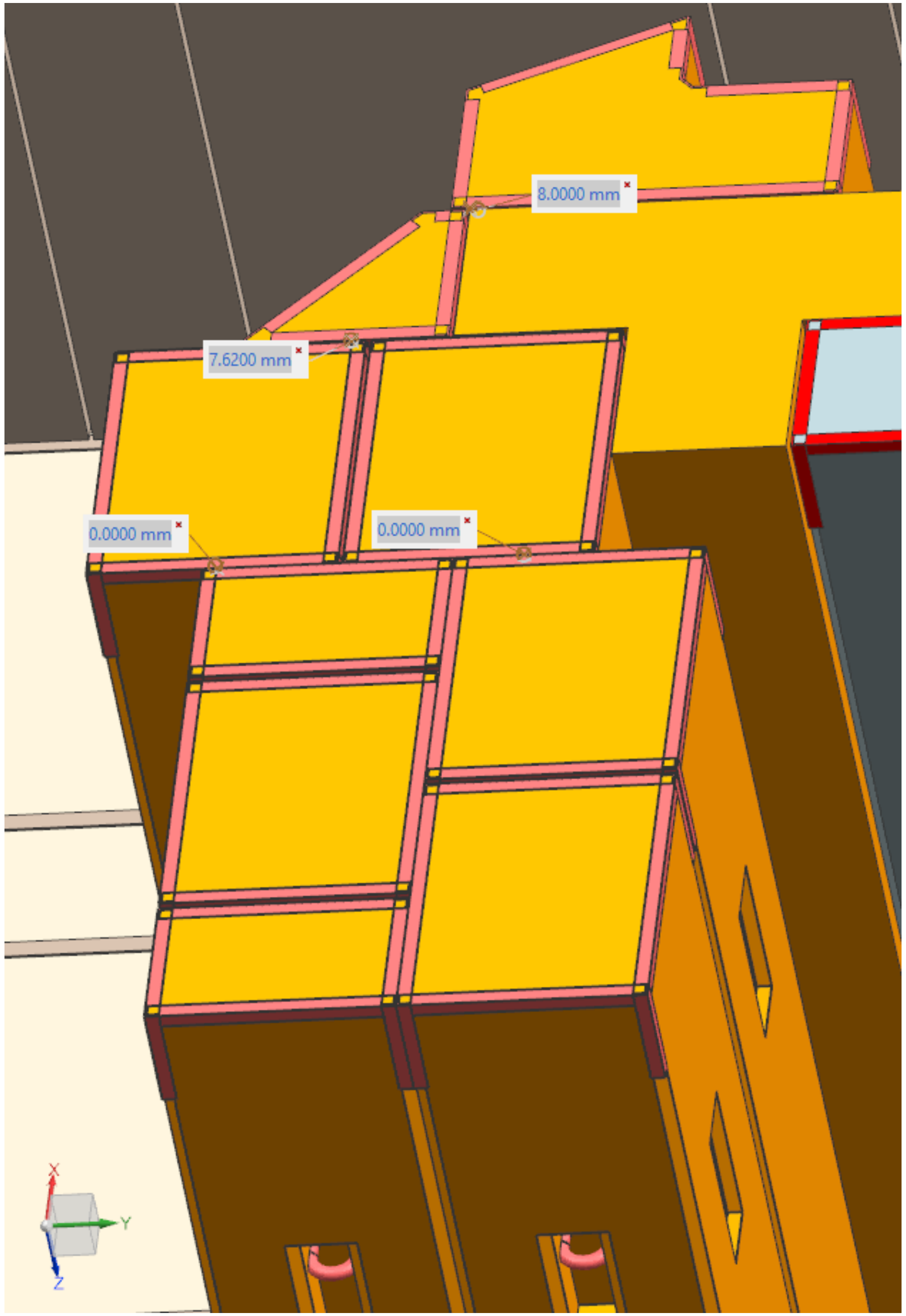
Clearance between blocks.

Gap at the intersection of the Downstream End Cap Shielding and the upstream end of the End Cap Shielding in closed position.



Interferences Check

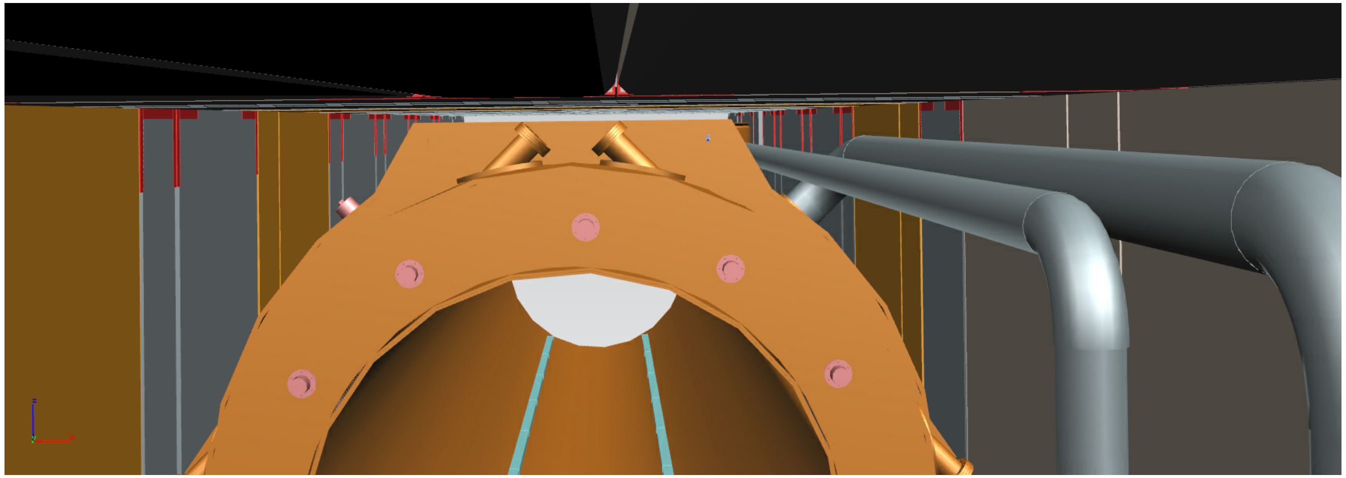
Clearance between blocks.



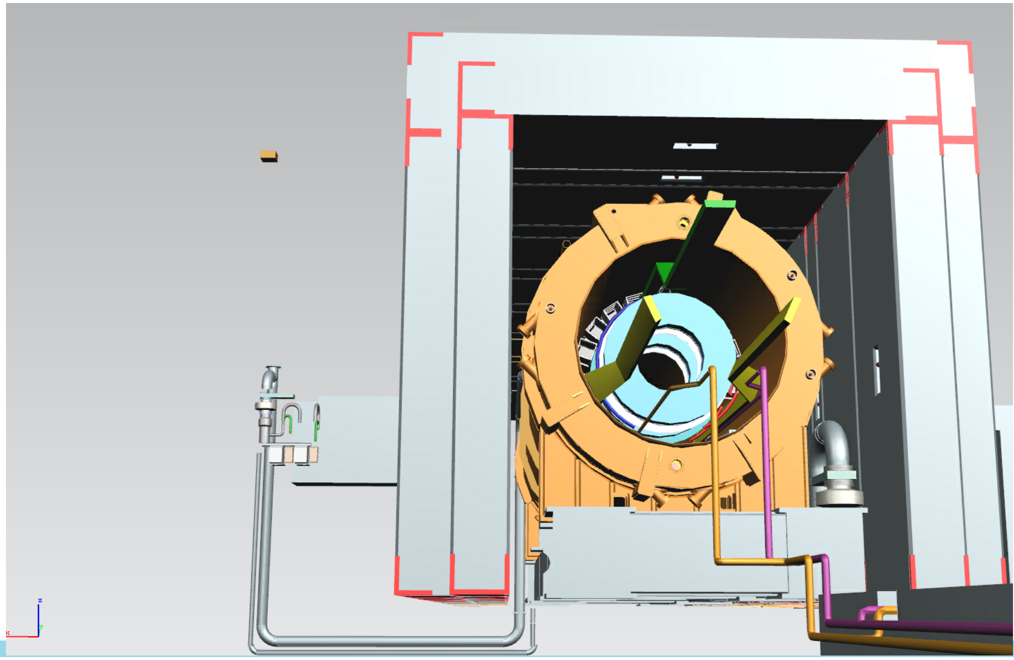
Cosmic entrance suppression.
View from bottom.
No gap in outgoing direction because of shielding reason.

Interferences Check

Clearances between Shielding blocks and Detector Solenoids (DS).



Top surface

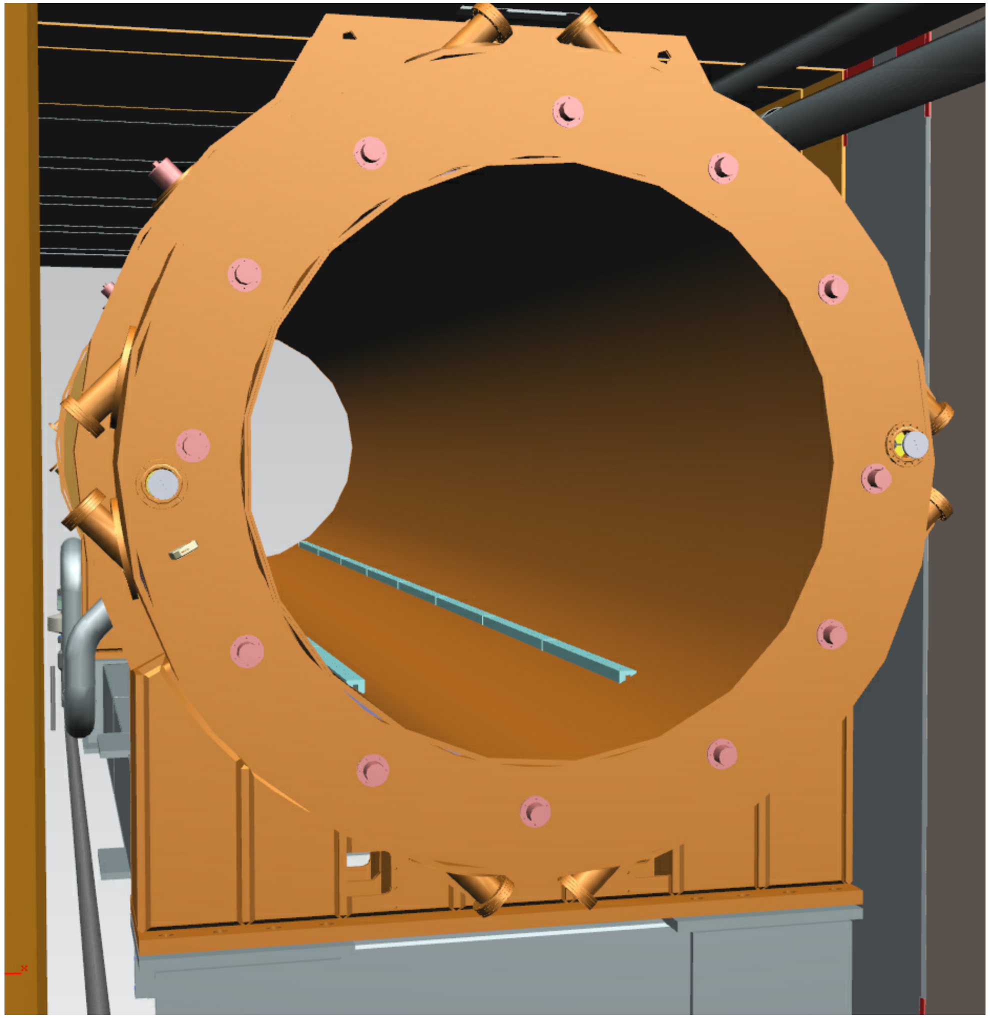


Bottom surface

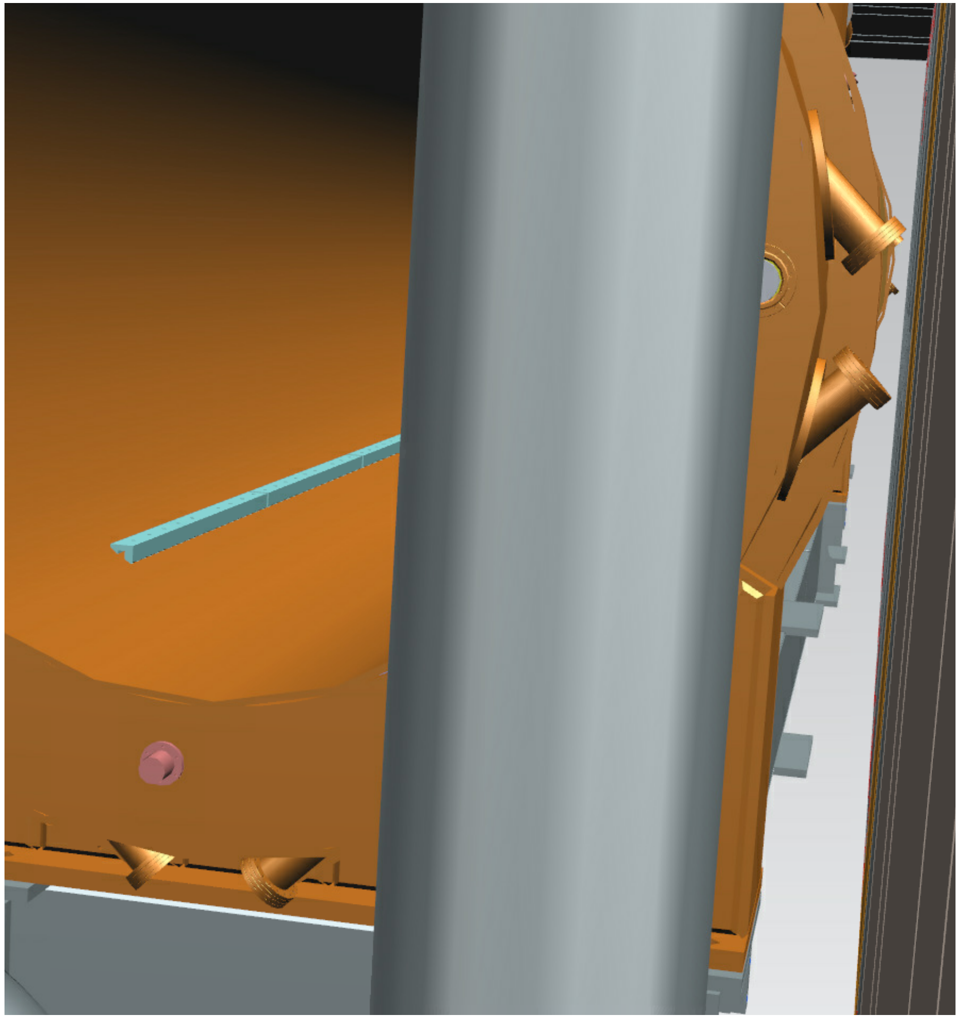
Interferences Check

Clearances between Shielding blocks and Detector Solenoids (DS).

North side

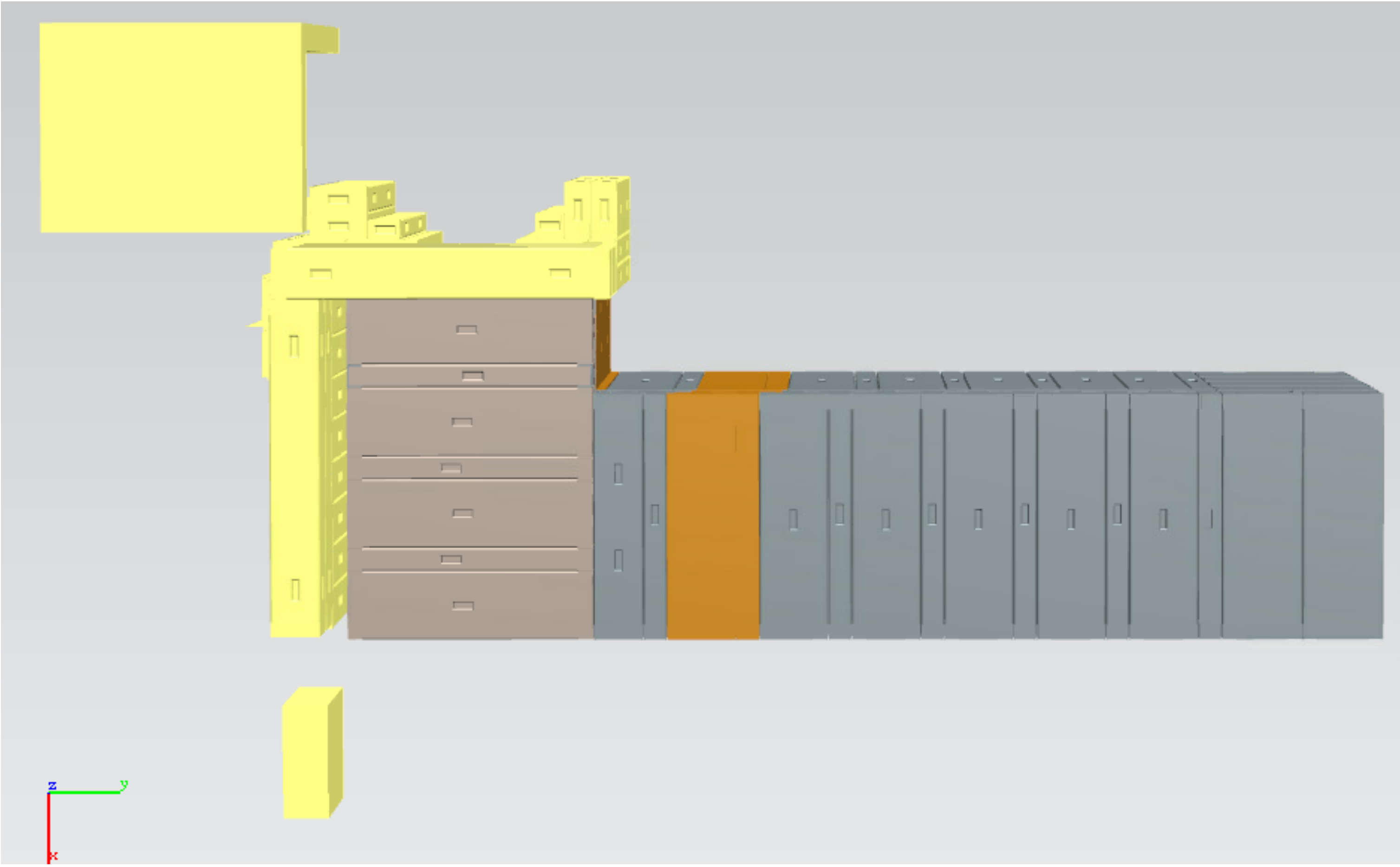


South side



Interferences Check

Investigation for possible interferences between Upstream External Shielding and Production Solenoids.

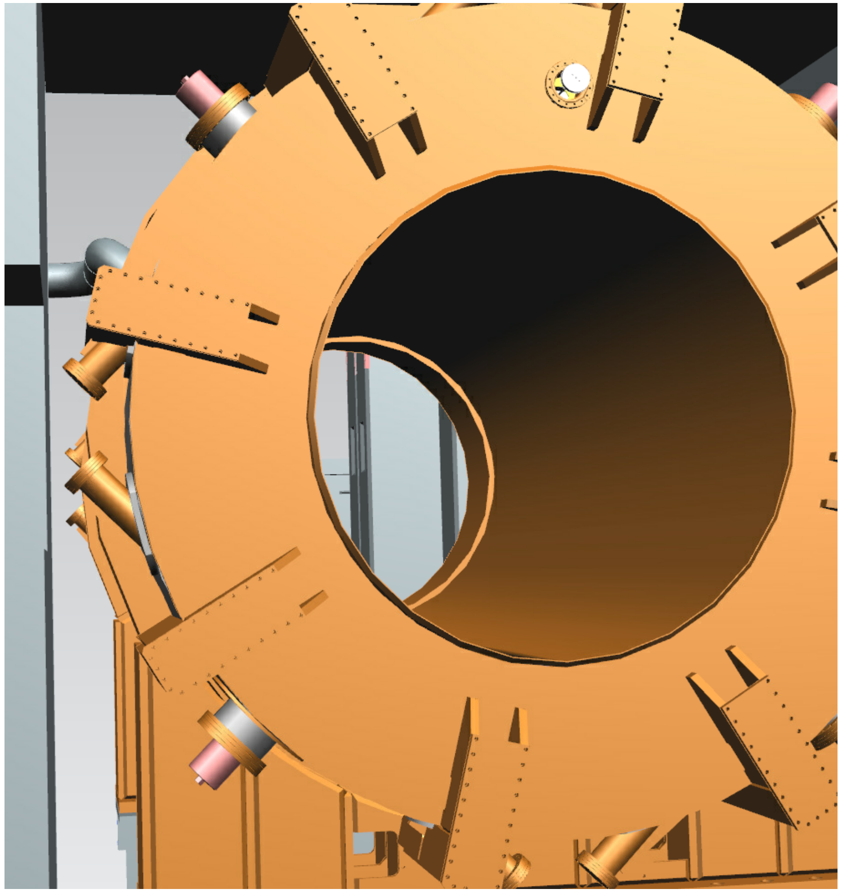


Position of the Upstream External Shielding

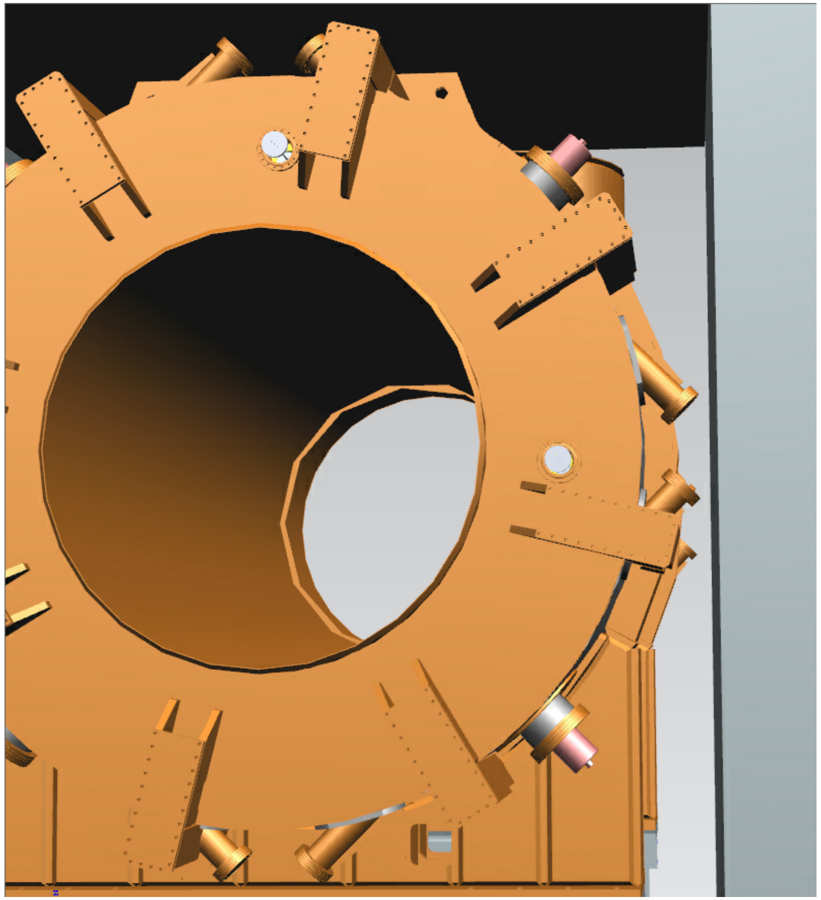
Interferences Check

Clearances between Upstream External Shielding and Production Solenoids.

North side

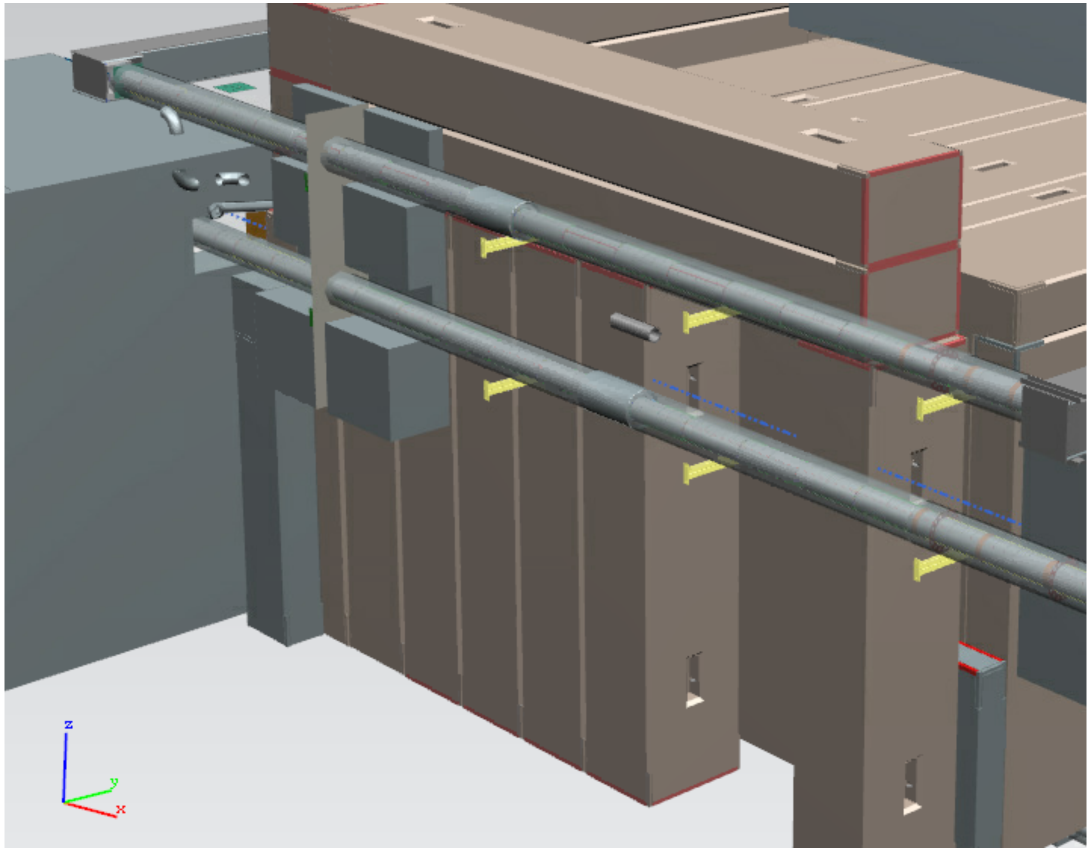


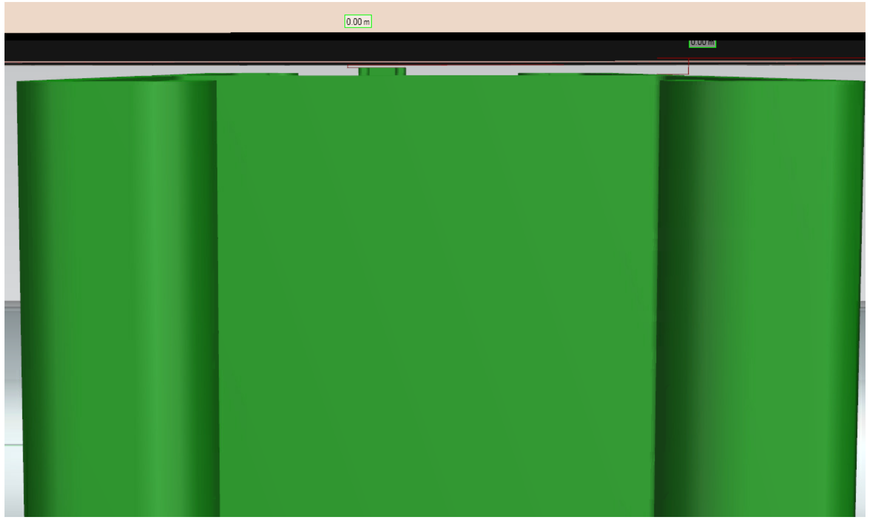
South side



Interferences Check

Clearance between Shielding blocks and Cryogenic System.

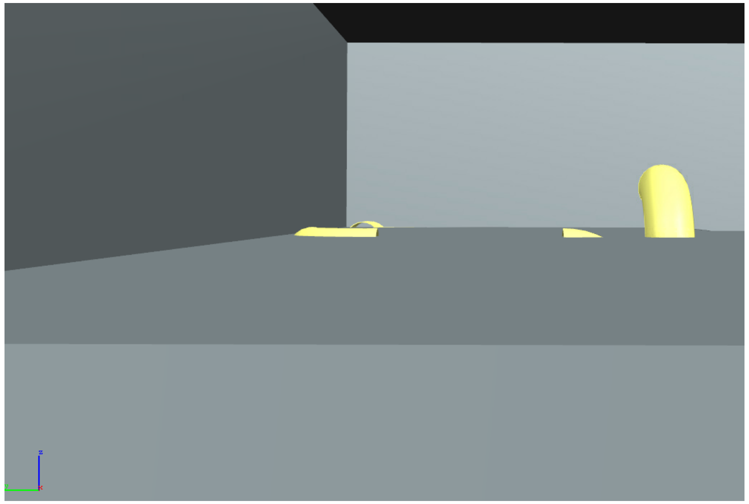


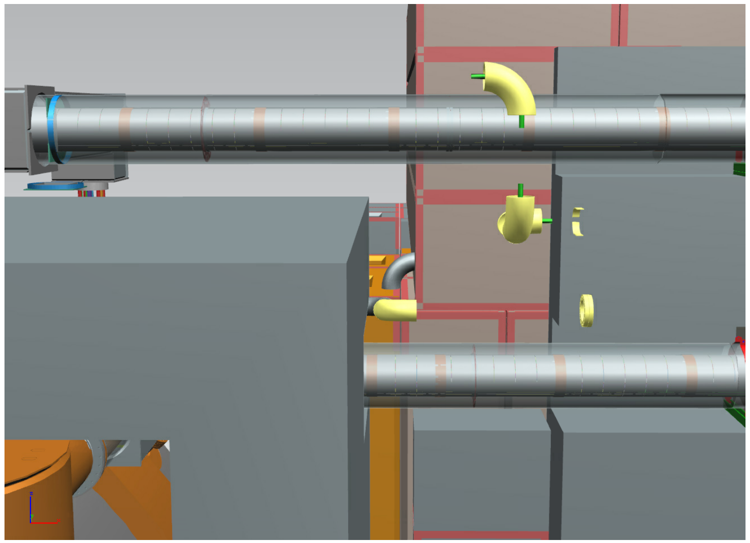


Support brackets for pipes.

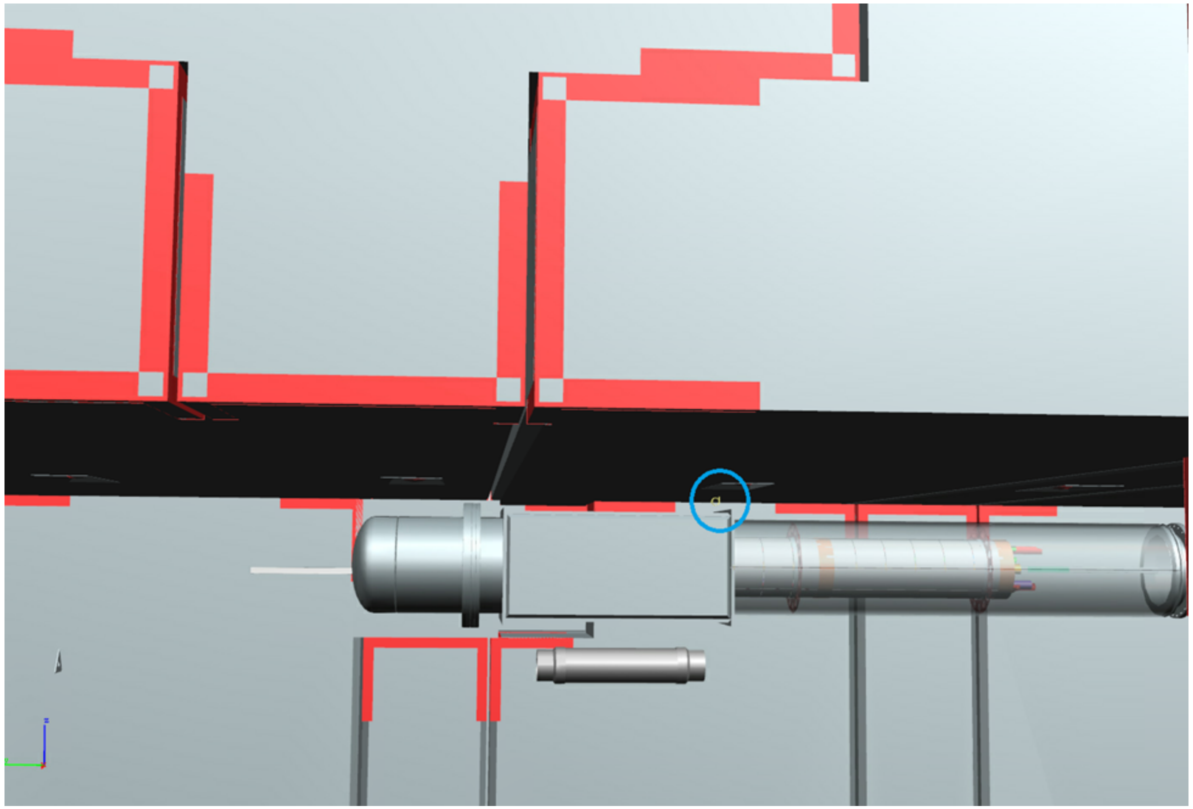
Interferences Check

Possible interference encountered between Shielding blocks and Cryogenic System.





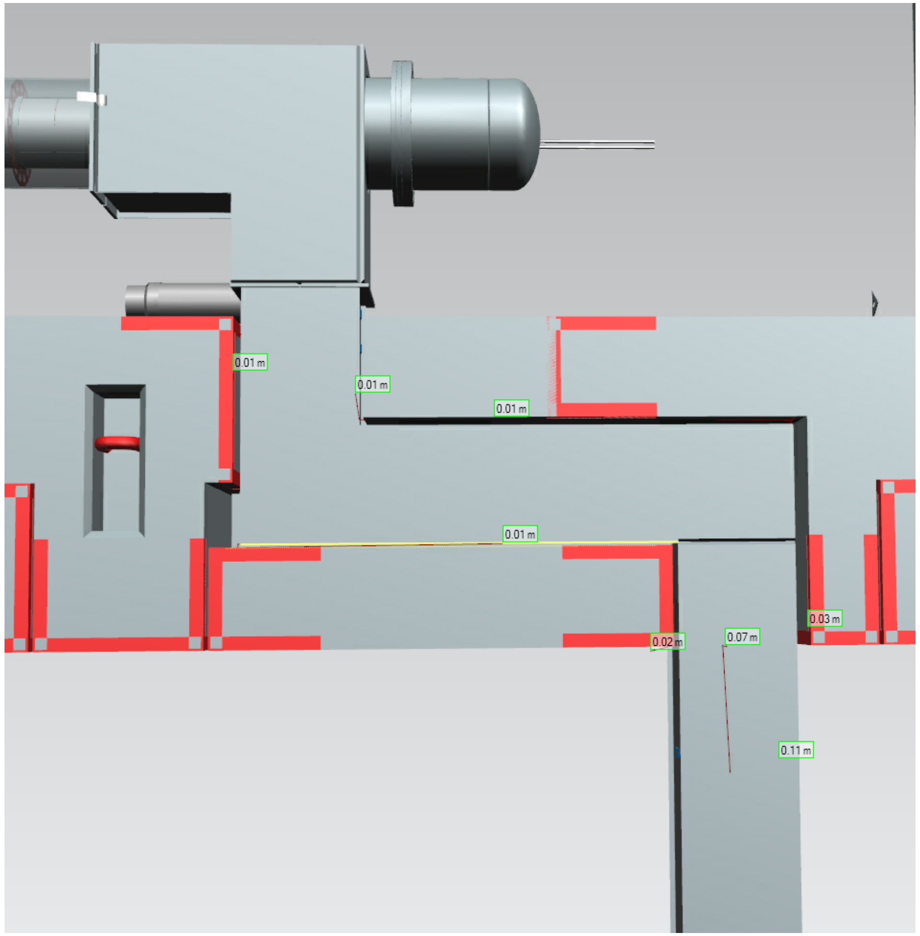
Rendering mistakes.

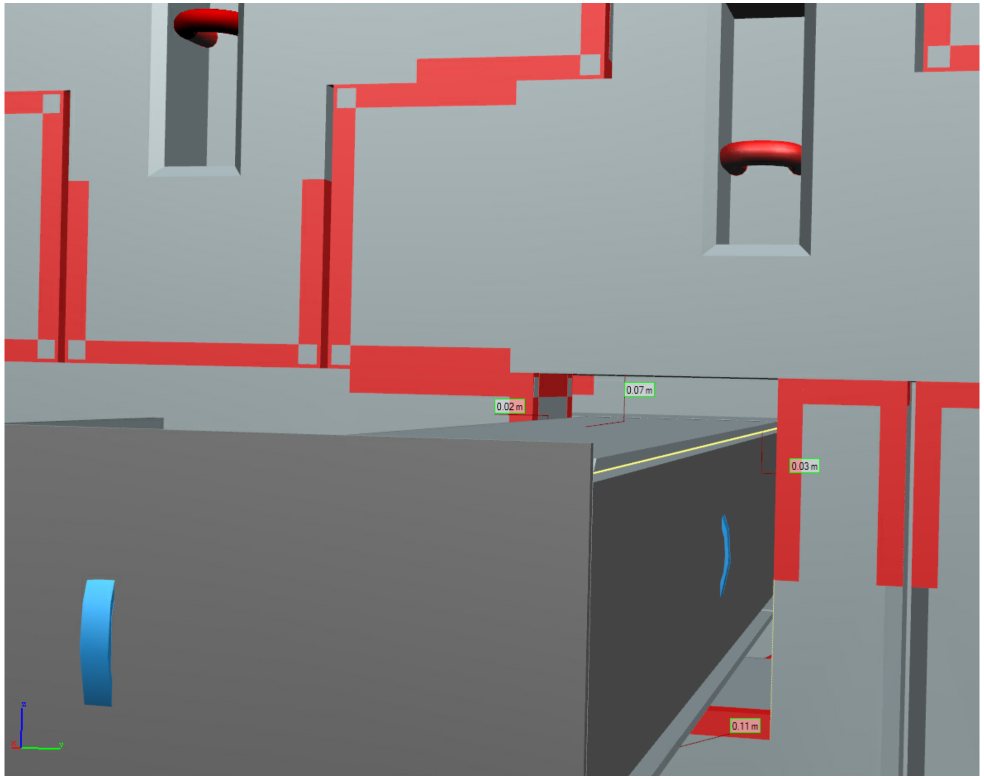


Investigation required

Interferences Check

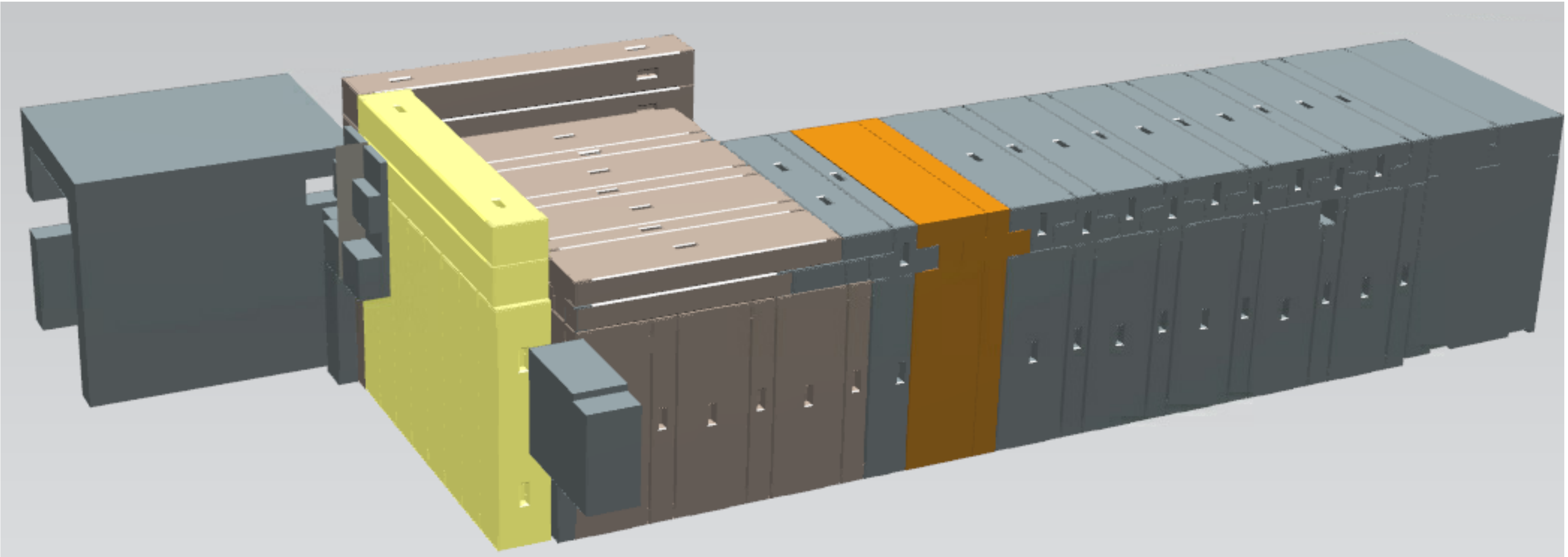
Clearances between Shielding blocks and Cryogenic System.





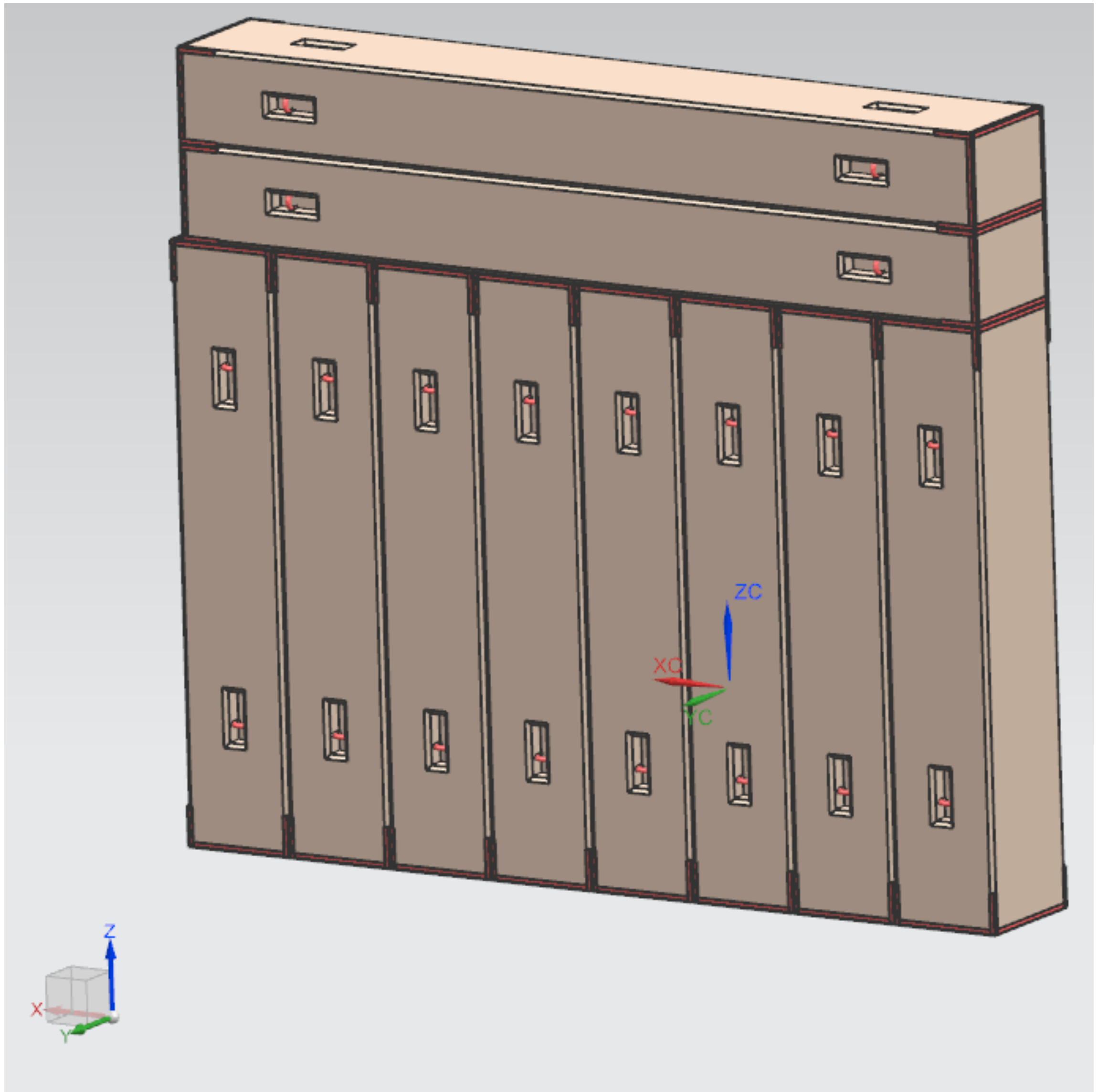
Pipe within south wall of the Downstream External Shielding .

Alternate implementation of the West Wall Shielding



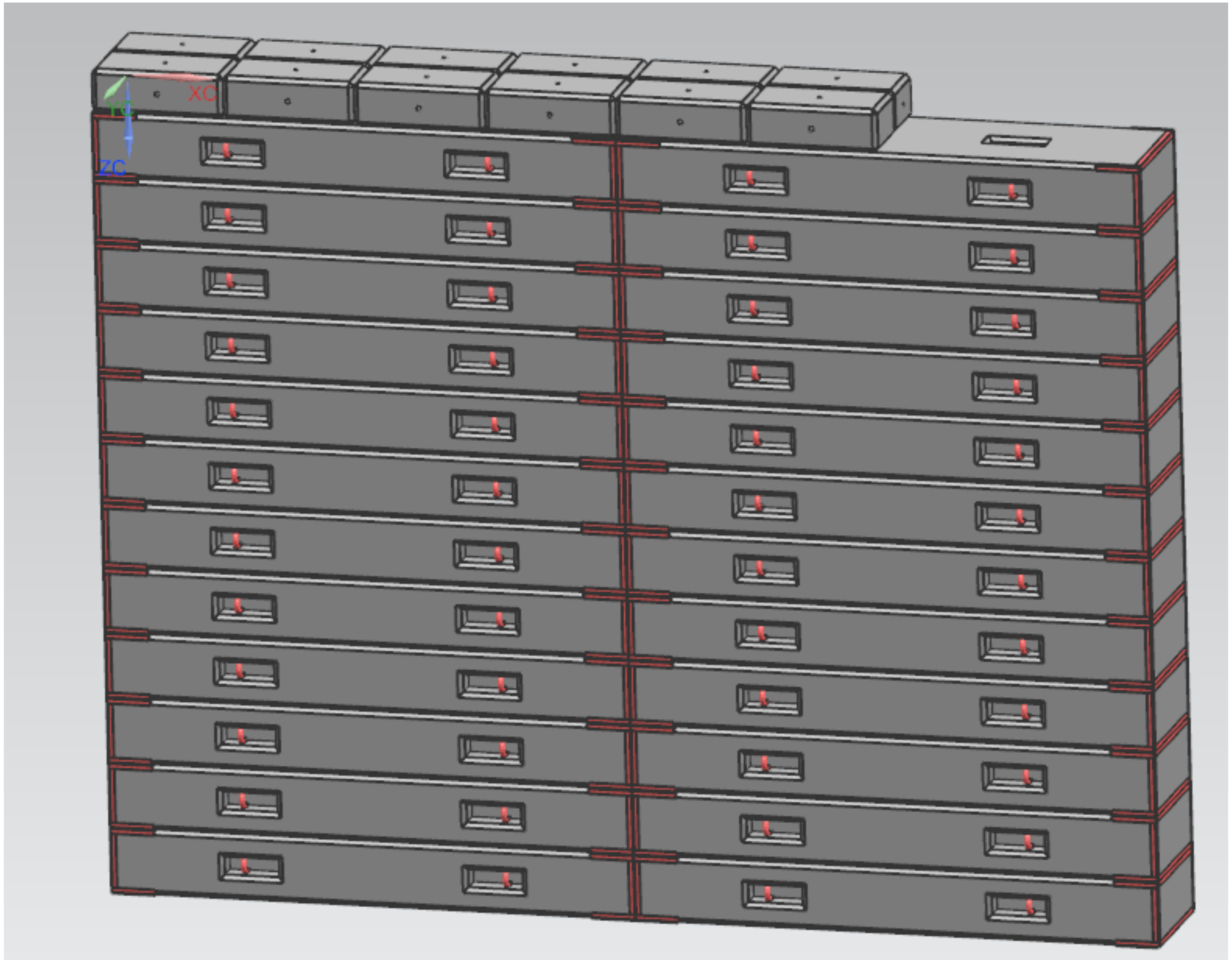
Position of the West Wall Shielding in the Upstream External Shielding subassembly.

Baseline Configuration of the West Wall Shielding



Baseline Configuration of the West Wall Shielding

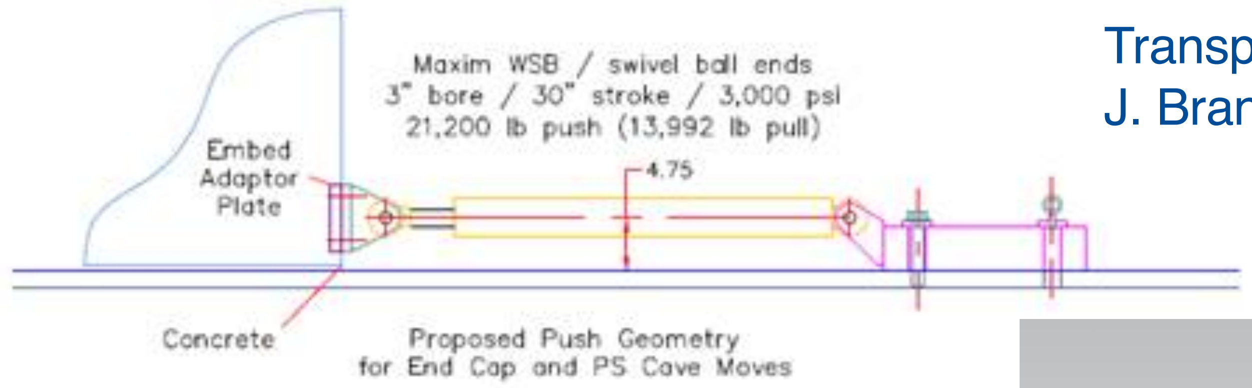
Alternate implementation of the West Wall Shielding using already available blocks



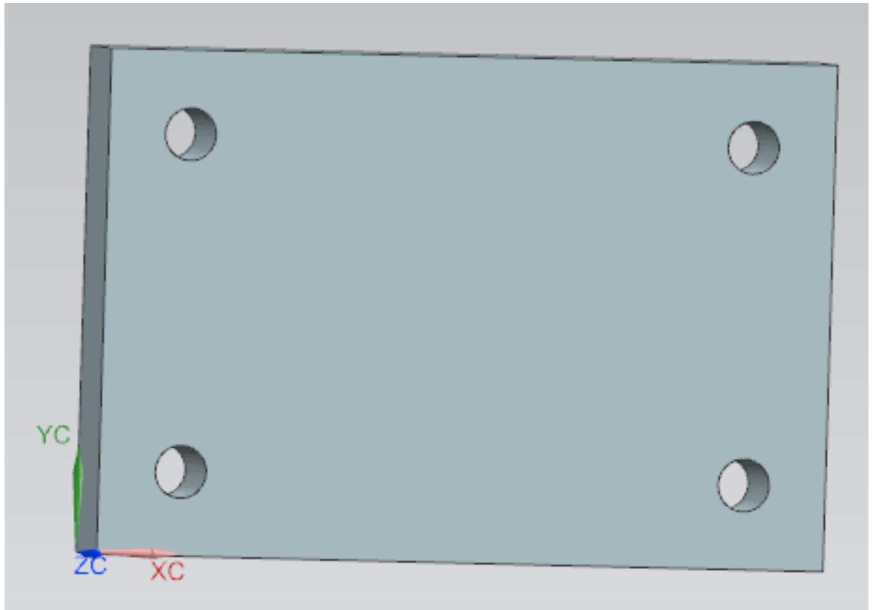
West Wall Shielding
New configuration
Concrete blocks using old Fermilab standard blocks

- J blocks
- L blocks

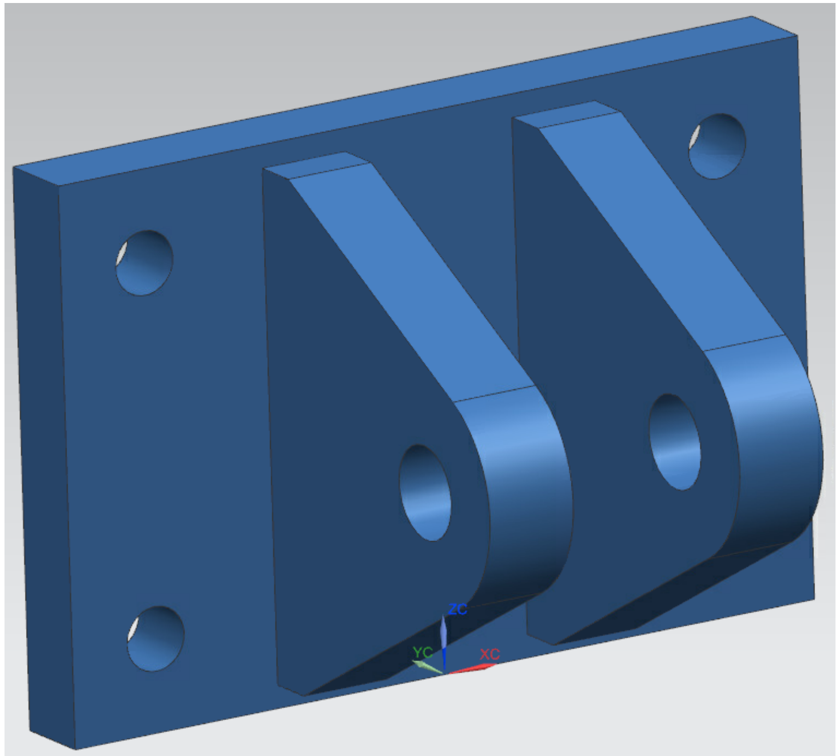
Pulling-Pushing Mechanism for the End Cup Shielding



Transport Geometry mechanism
J. Brand 04-Sept-2018



Adaptor plate



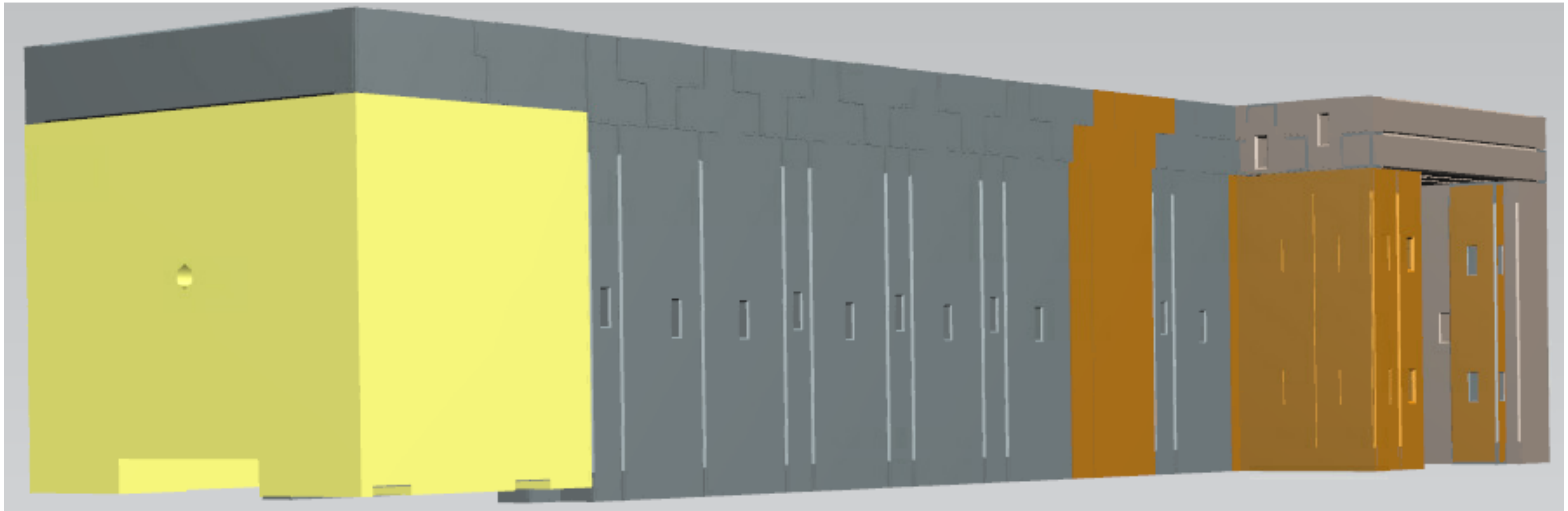
In-line Clevis Bracket

Pulling-Pushing Mechanism for the End Cap Shielding

Gap Between the bottom face of the lower block of the End Cap Shielding, CU2-194, and the floor is (6”) bigger than the elevation of the line of force of the pulling mechanism (4,75”)

No matching between the adaptor plate and the CU2-194. NOT SURPRISING RESULT

Pulling-Pushing Mechanism for the End Cap Shielding

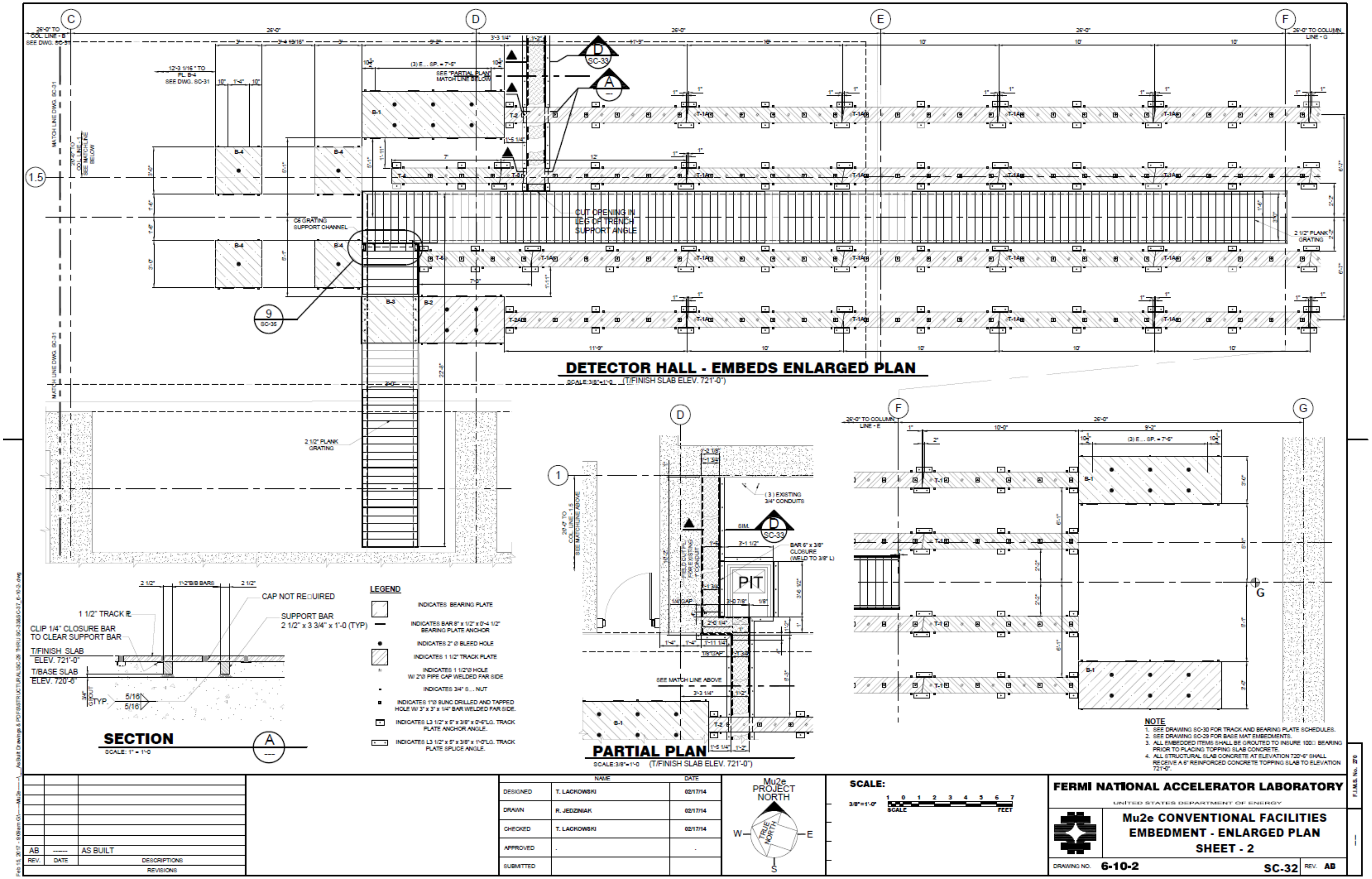


Next step:

- **Change the height of the blocks in the wall of the End Cap Shielding so as to have 2,5" gap (chosen taking into account tolerances due to concrete stiffening) between the blocks and the floor**
- **Ensuring that the hole will remain at the proper elevation wrt the coordinate system and aligned with the Muon Beamline**

DS Trench Grating Corner Plate

Docdb 11669 SC-32



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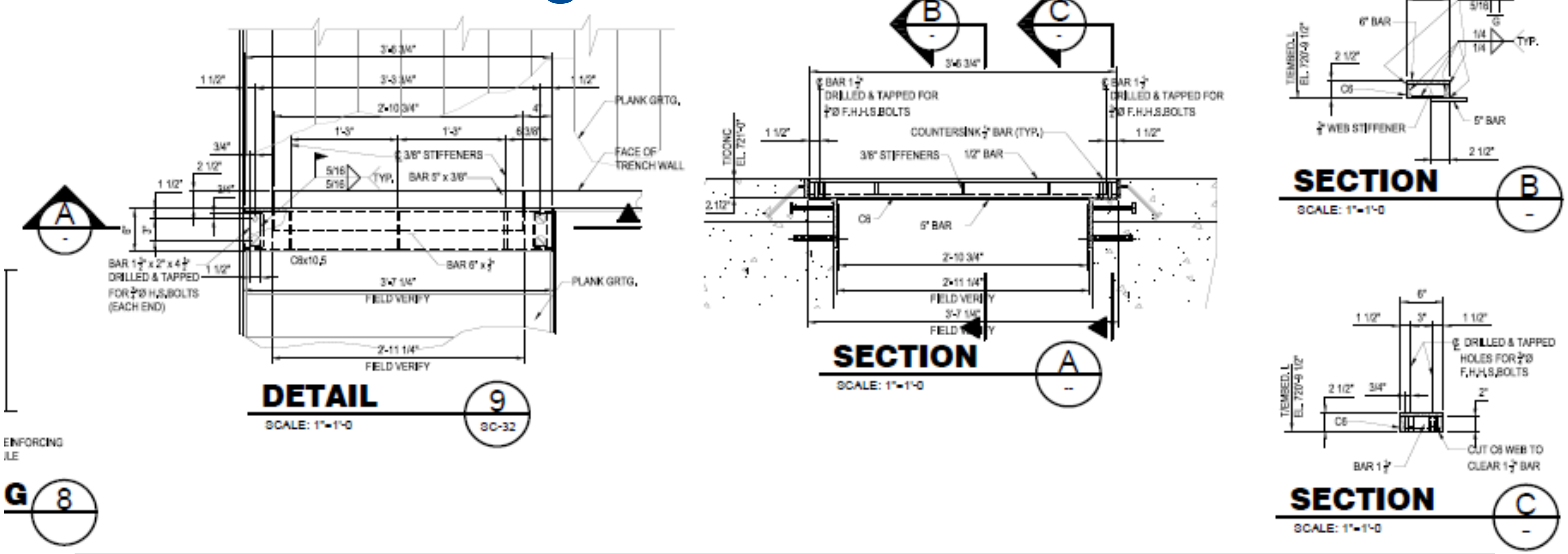
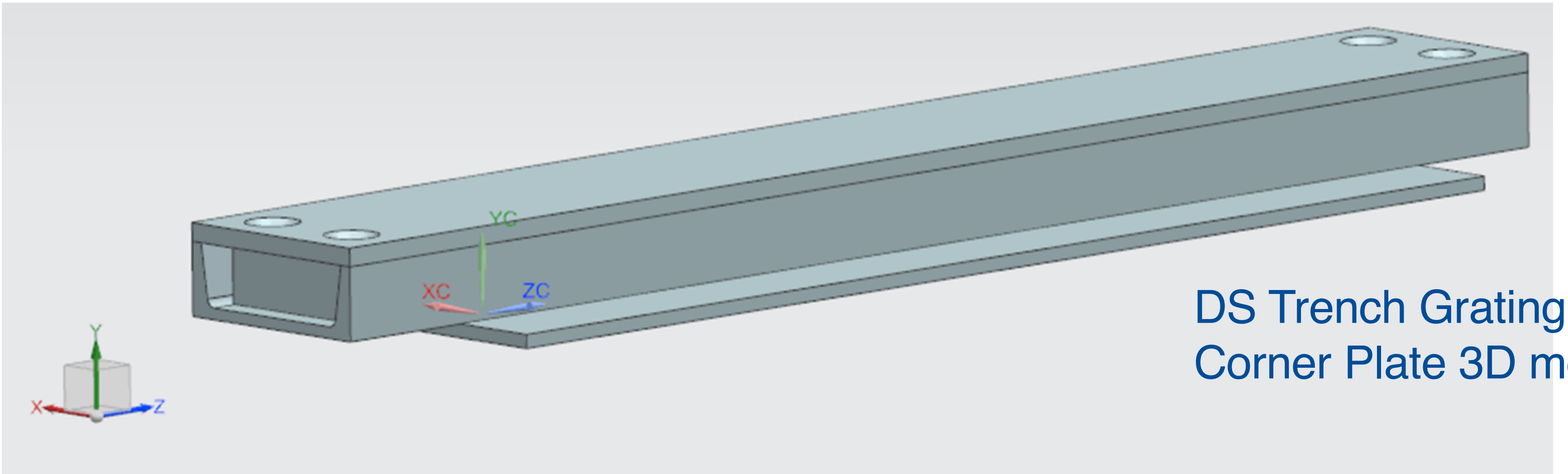
DS Trench Grating Corner Plate

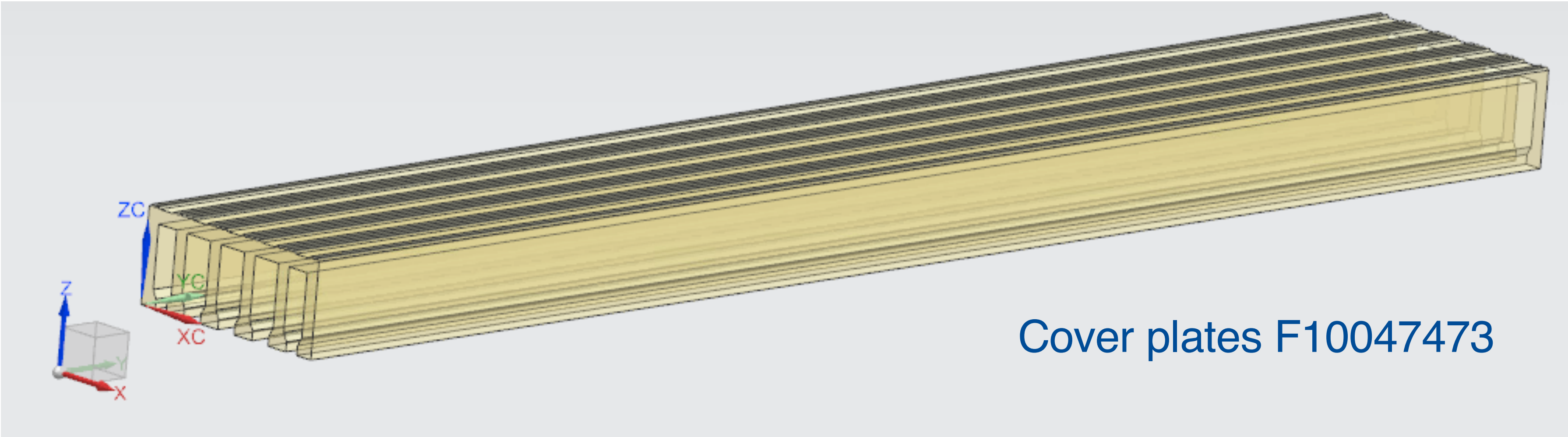
Docdb 11669 SC-35

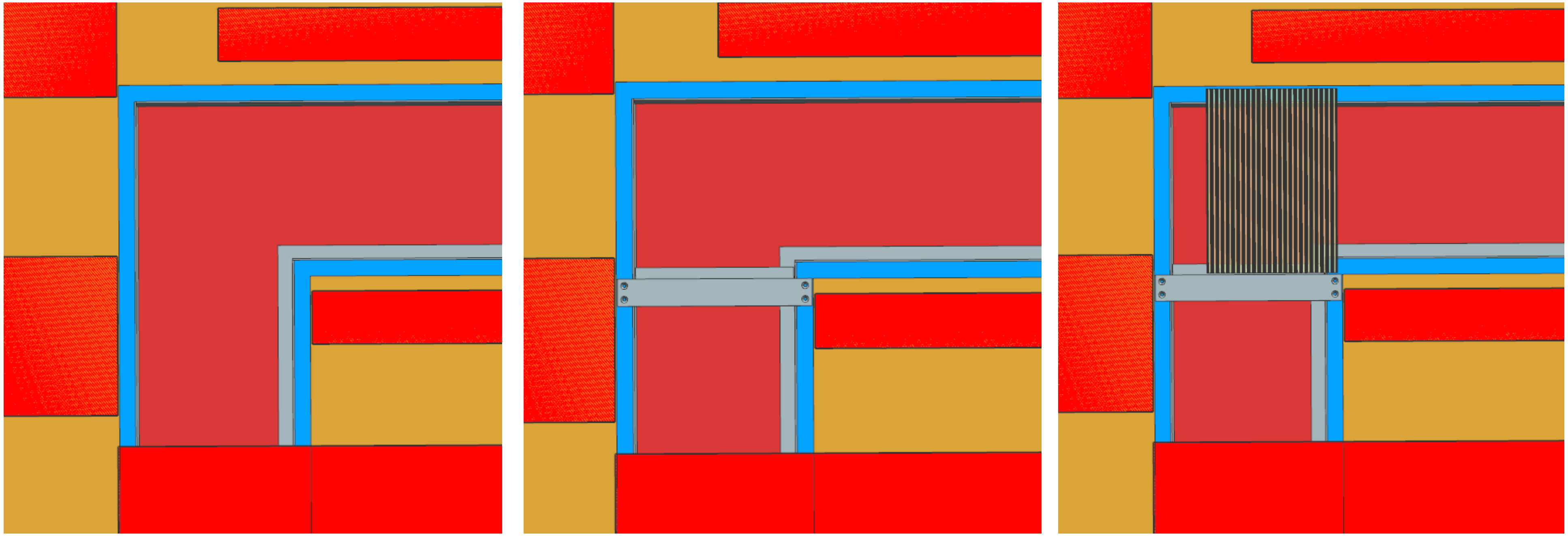




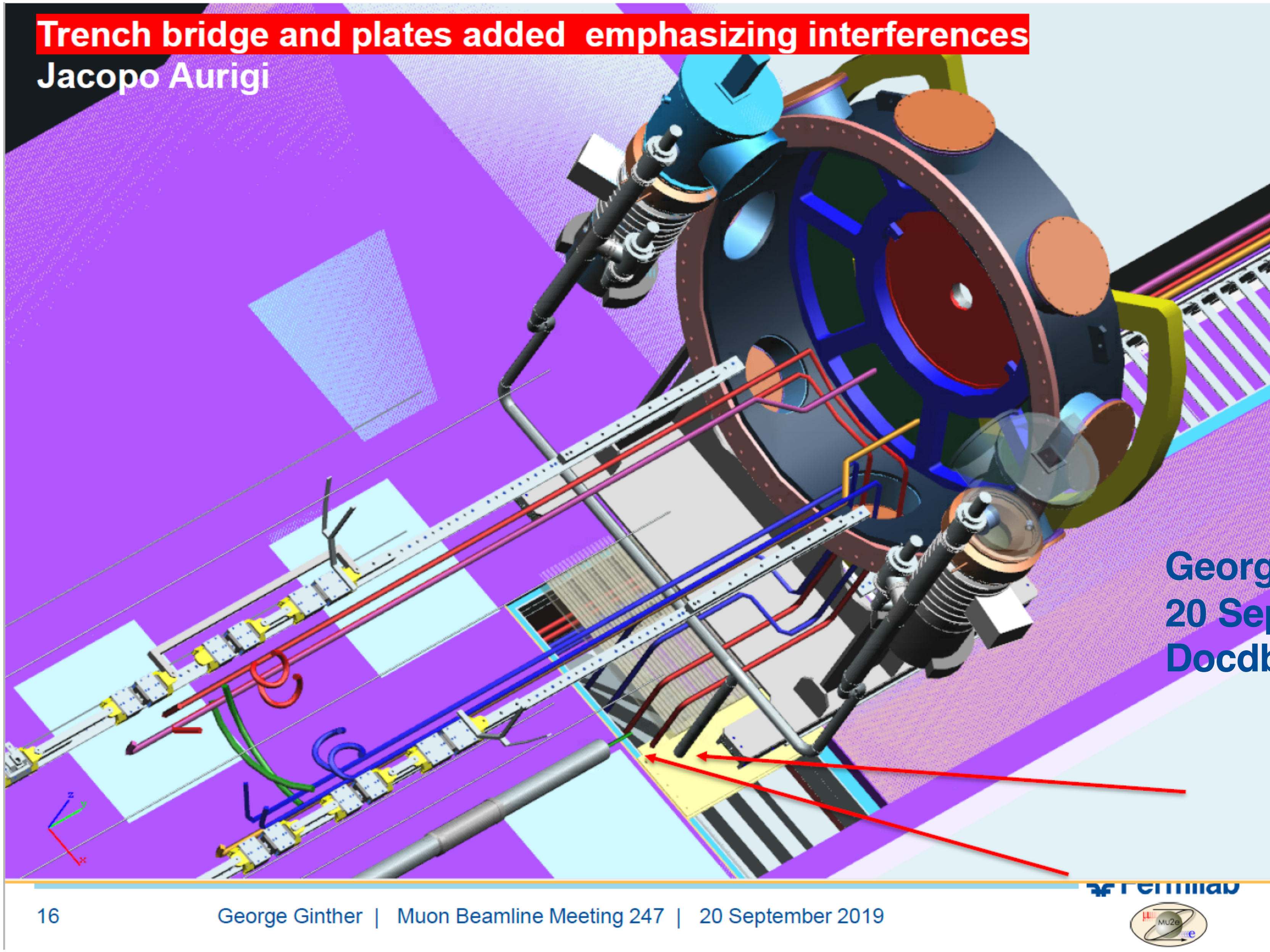
DS Trench Grating Corner Plate 3D model

DS Trench Grating Corner Plate- Cover plates in the DS Trench



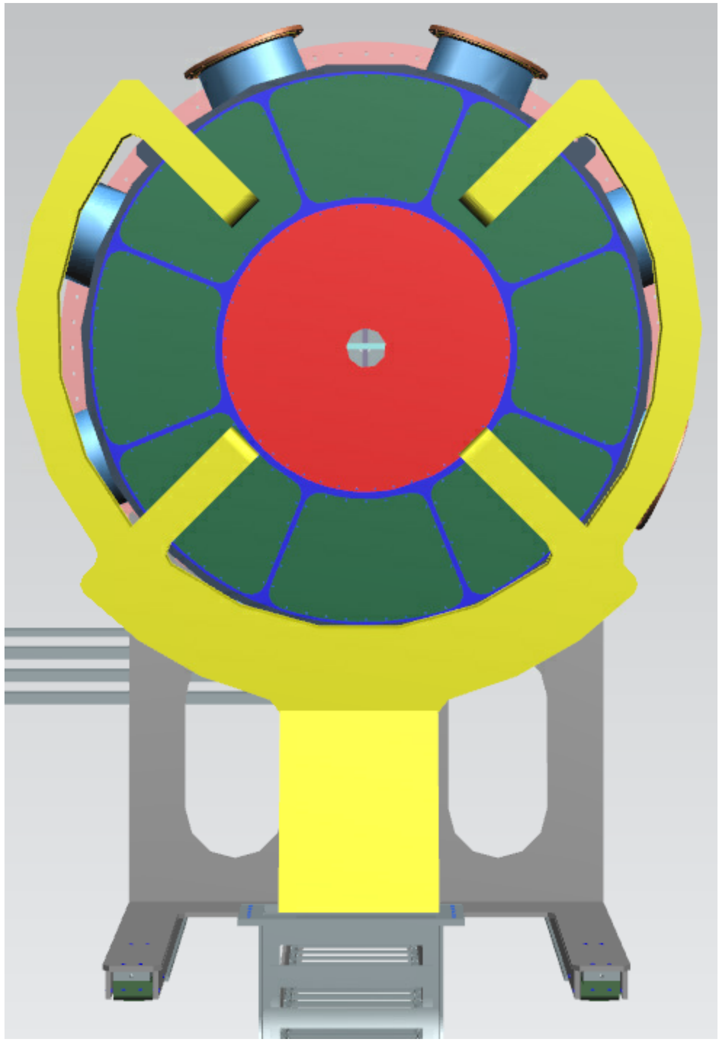


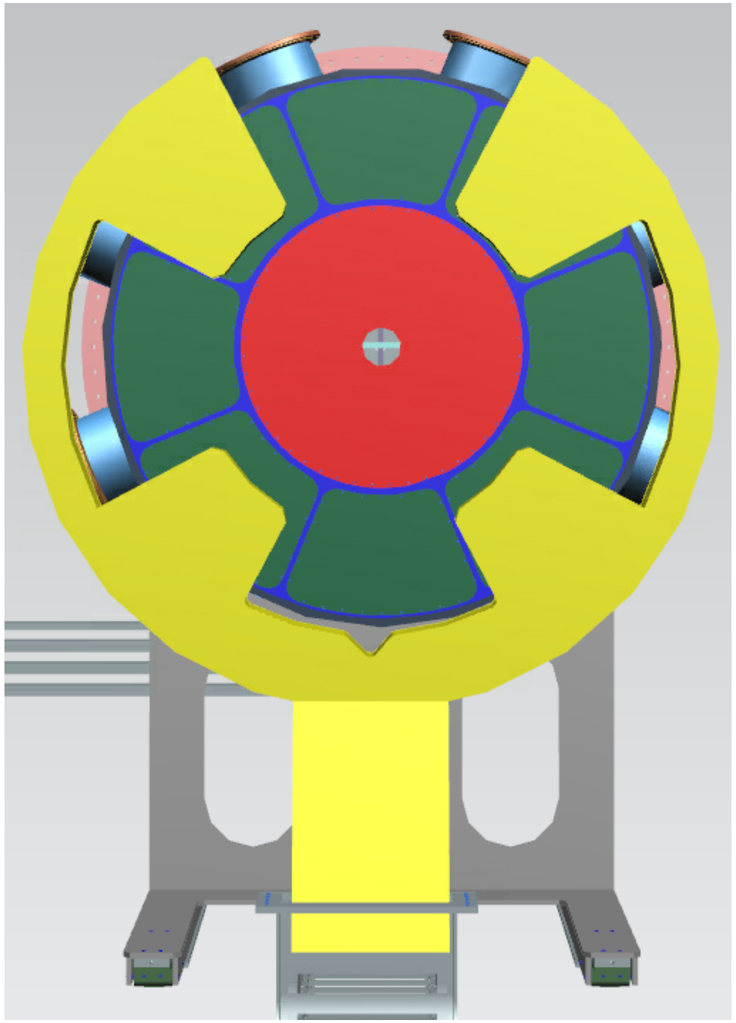
Trench Corner Plate – Clearences and Interferences



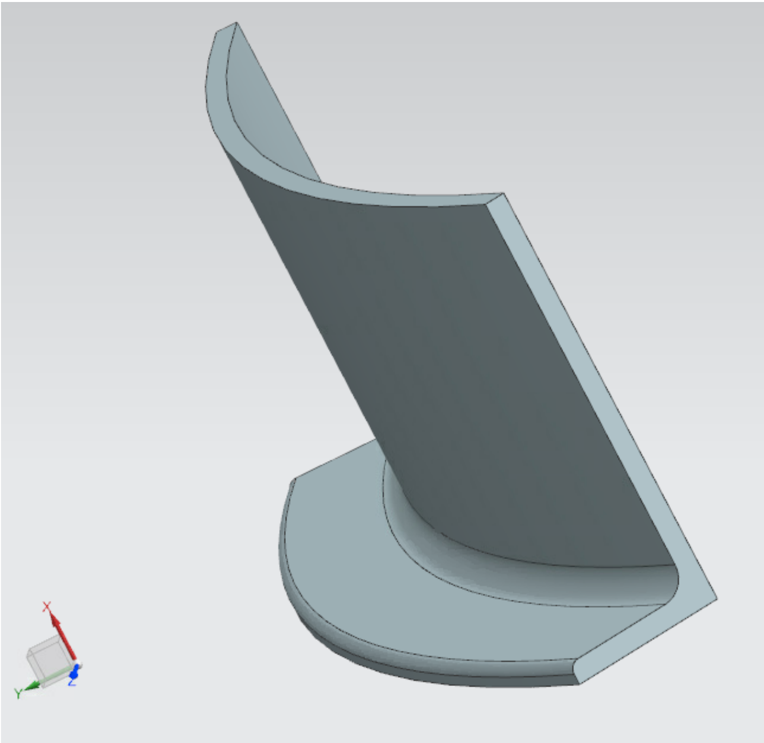
IFB Cable Placeholder

Modification of the old version of the IFB Cable Placeholder into a more realistic one

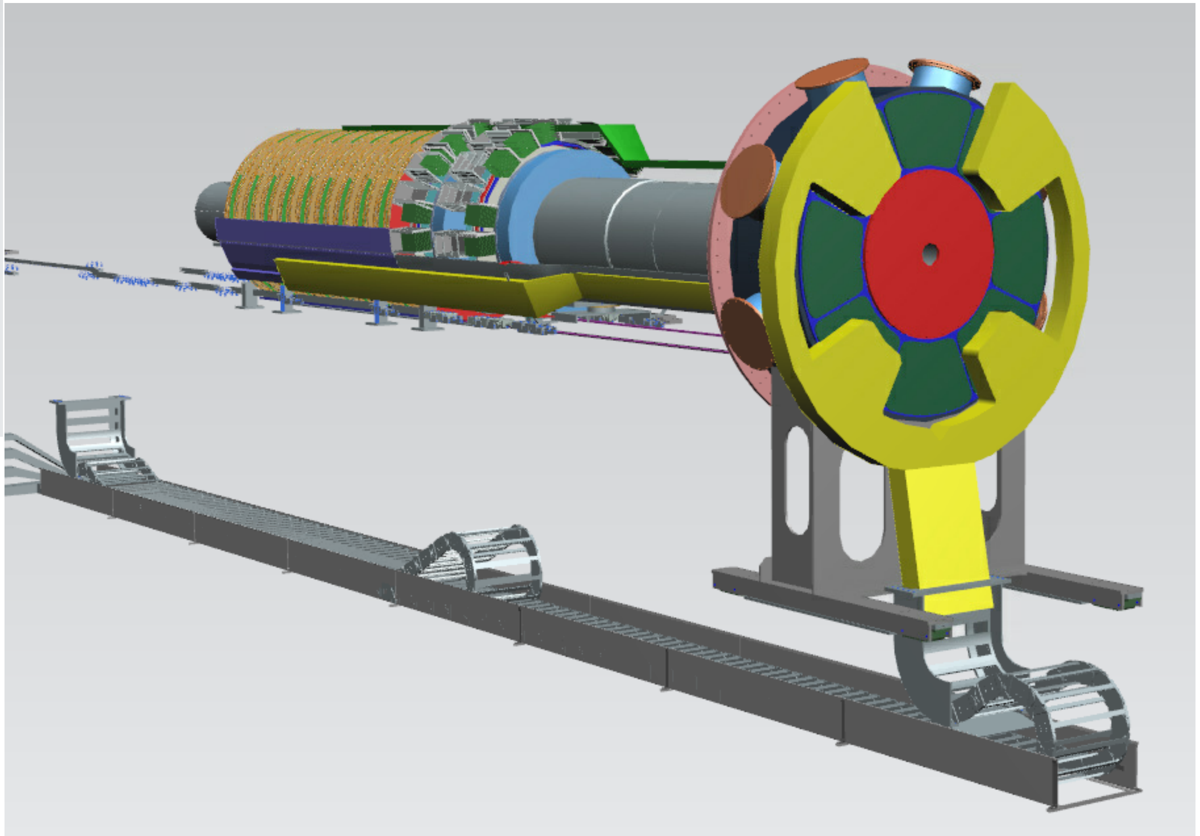




IFB Cable Placeholder



Cable Protection Brackets. Inserted into the model to be sure that the cables don't unplug while pushing out the four inspection panels.
Task to be accomplished in the week of 09/23



Conclusion

The work has been accomplished using both:

- Teamcenter for getting access to all the parts, assembly and subassembly of the experiment
- NX for the 3D integration model

At the same time, confidence with the Mu2e assembly and experiment has been acquired attending:

- Muon Beamline Meeting, on Friday every other week
- Mechanical Integration Meeting, on Monday every other week
- Mu2e Tool Box Meeting, on Thursday every week