

ProtoDUNE – Installation CPA/FC/HV Review

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CPA/FC/HV Review

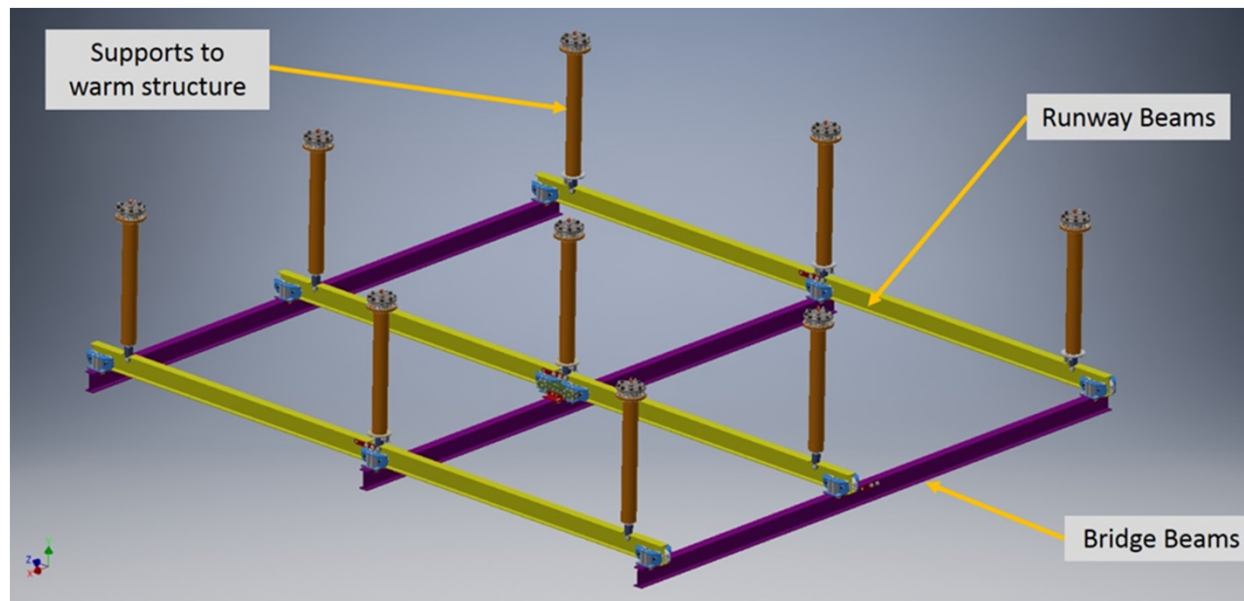
November 9, 2016

Outline

- Introduction
 - Overview of the plan
 - Trial Assembly
- Installation
 - Cleanroom set up at CERN
 - Overview
 - Installation details
 - South Drift
 - North Drift

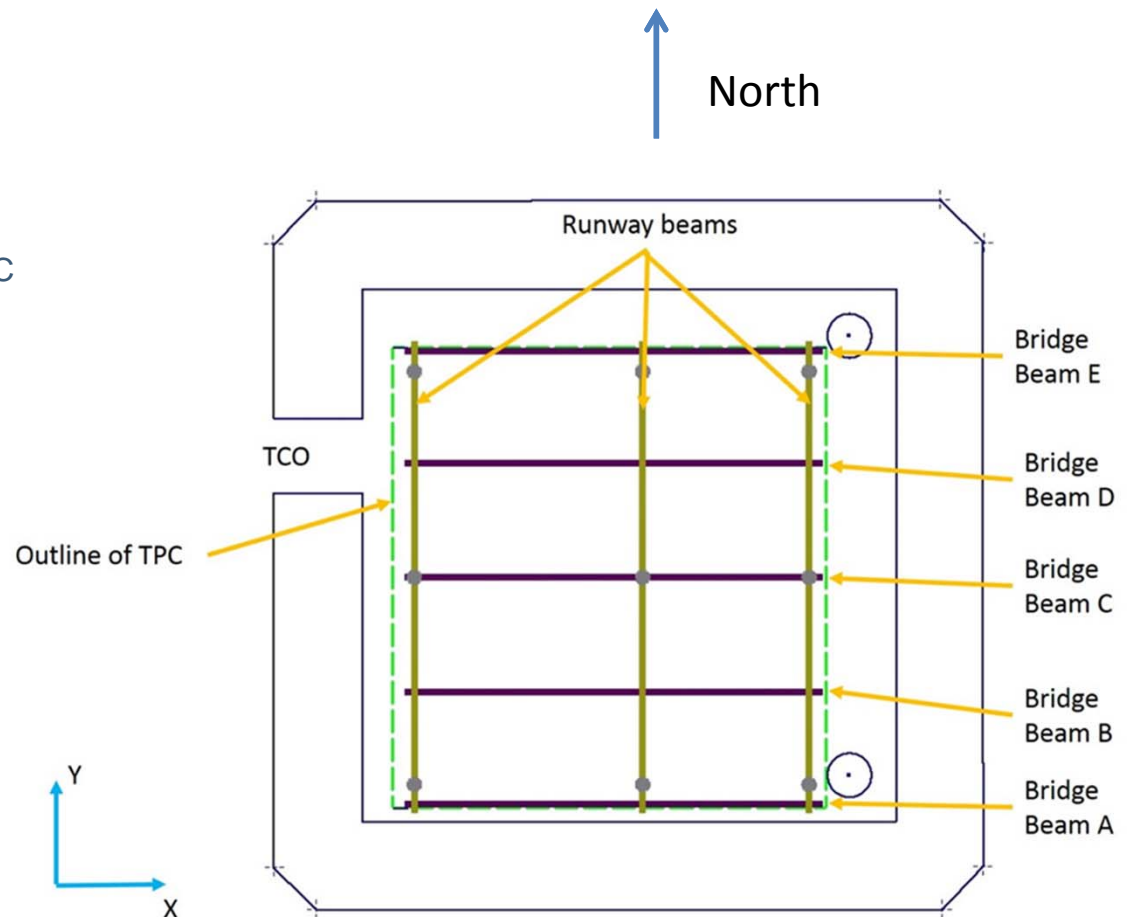
DSS delivers modular TPC subassemblies

- The DSS rail system is mounted in the ceiling of the Cryostat
- APAs, CPAs(with FCs), and EWs supported on trolleys and loaded onto bridge beams
- The bridge beam translates modules to their final position
- Allows for assembling the TPC in a tight space (and reconfiguring to 2.5m gap later)
- Minimizes lifting in the cryostat



Overview

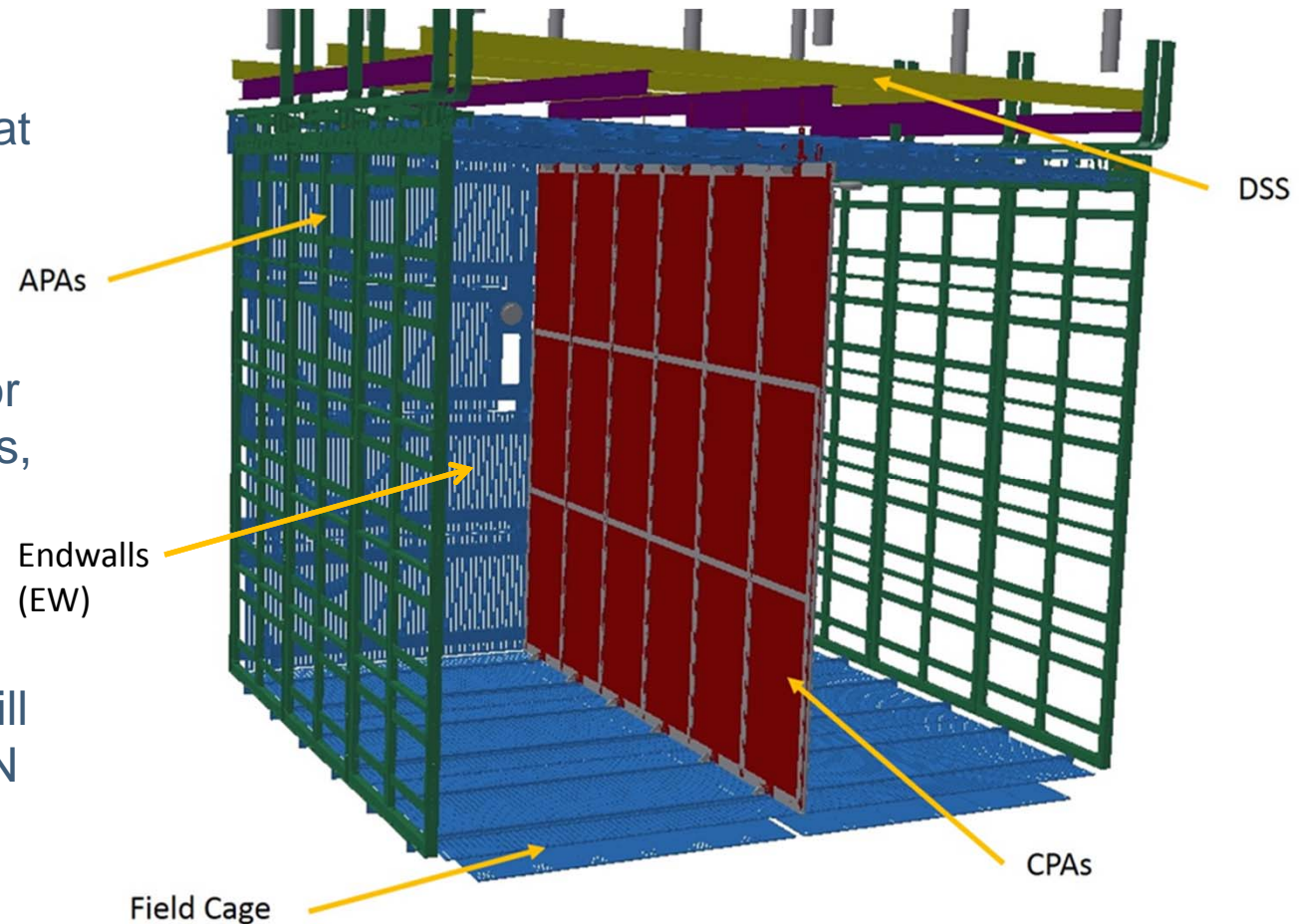
- South Drift
 - APAs delivered on Beam A
 - EWs delivered on Beam B
 - CPAs with FCs delivered on Beam C
 - EW load transfer
 - South Drift FCs are deployed
- North Drift
 - APAs stored on Beam E
 - EWs stored on Beam D
 - TCO is closed
 - EW (TCO) is delivered
 - APAs positioned
 - EW (TCO) load transfer
 - Last EW is delivered and transferred
 - North Drift FCs are deployed



Top View of the cryostat

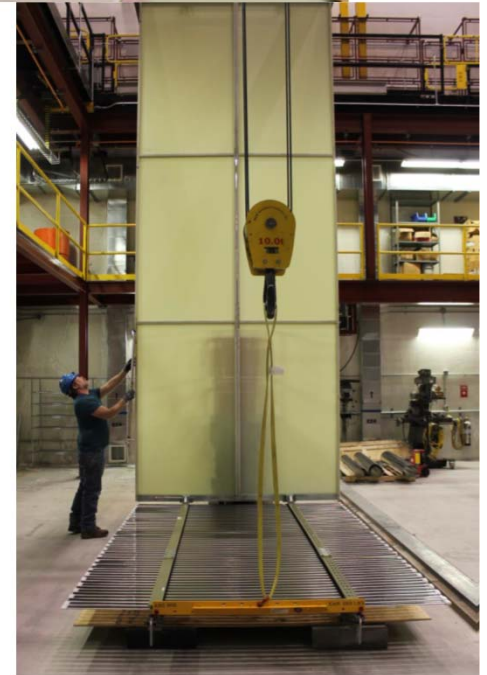
Access requirements

- Modular TPC subassemblies minimize the work that needs to be done at height in the cryostat
- Access to the top of the TPC is needed for fixing APAs and CPAs, APA cabling, FC deployment and final FC connections.
- Access equipment will be provided by CERN



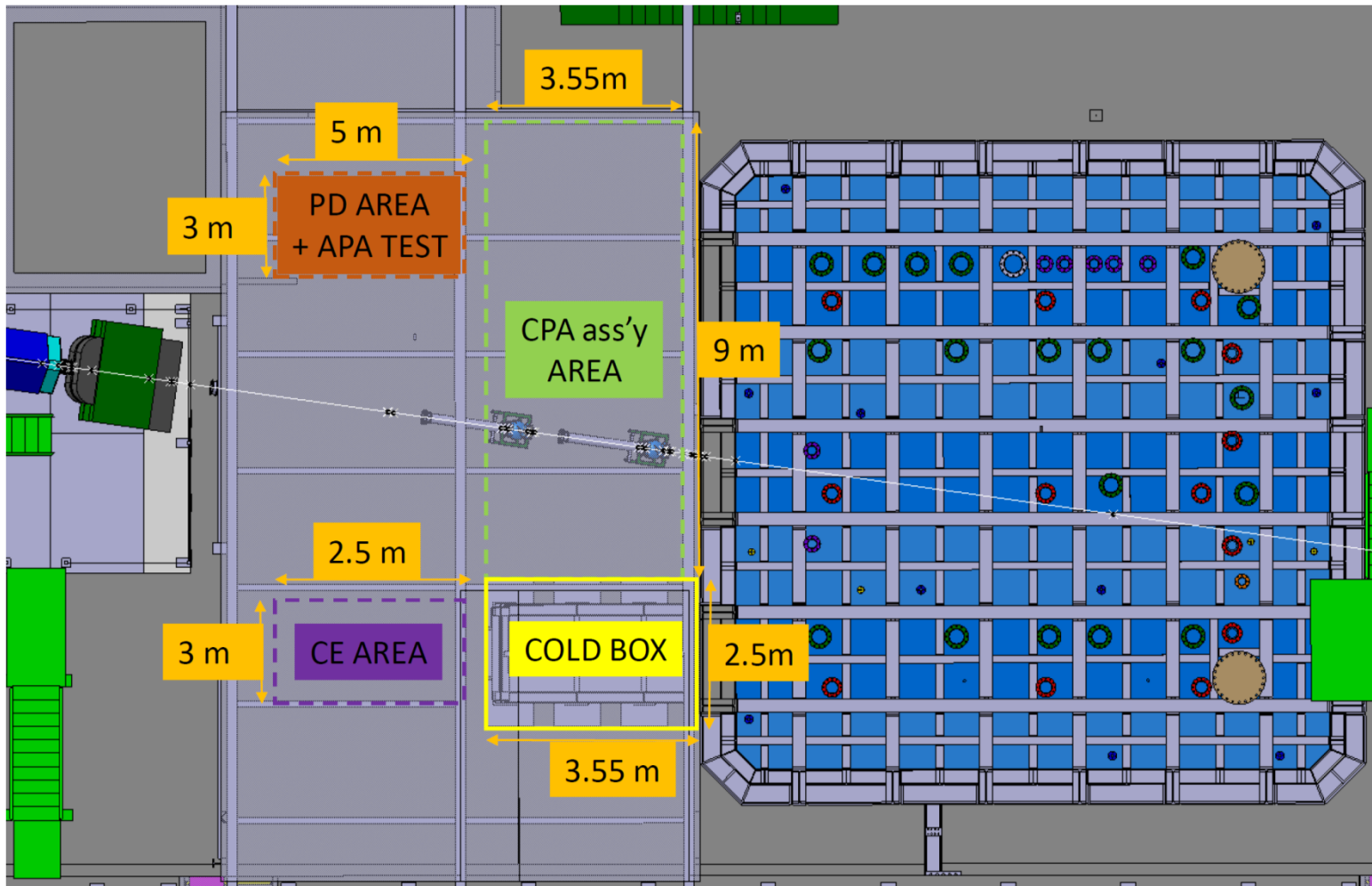
Trial Assembly at Ash River

- The mechanical trial assembly is underway at the NOvA Far Detector Lab in Ash River Minnesota
- Detailed Procedure and Hazard Analysis documents are being written as the assembly process is being fine tuned.
- Changes to installation tooling and fixtures and access required will be made during this process
- The baseline plan is to assemble the CPA plane in the cleanroom adjacent to the cryostat. A second option of assembling under the building crane and then transferring to the cleanroom is being considered.



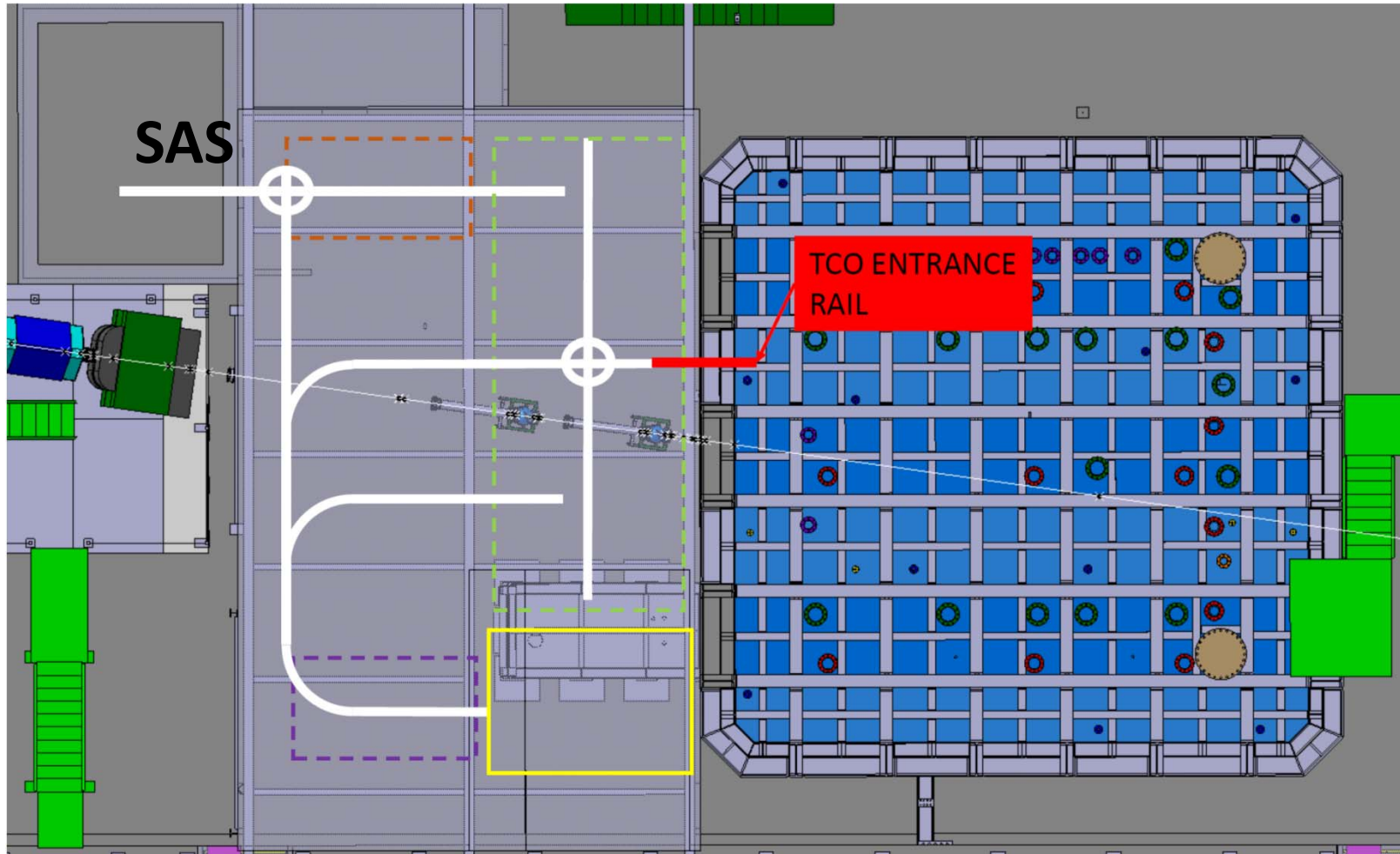
CPA and Field cage being assembled.

Clean Room



APAs, End Wall and CPA/FC assembly happens in the cleanroom where you have easy access via scissor lift

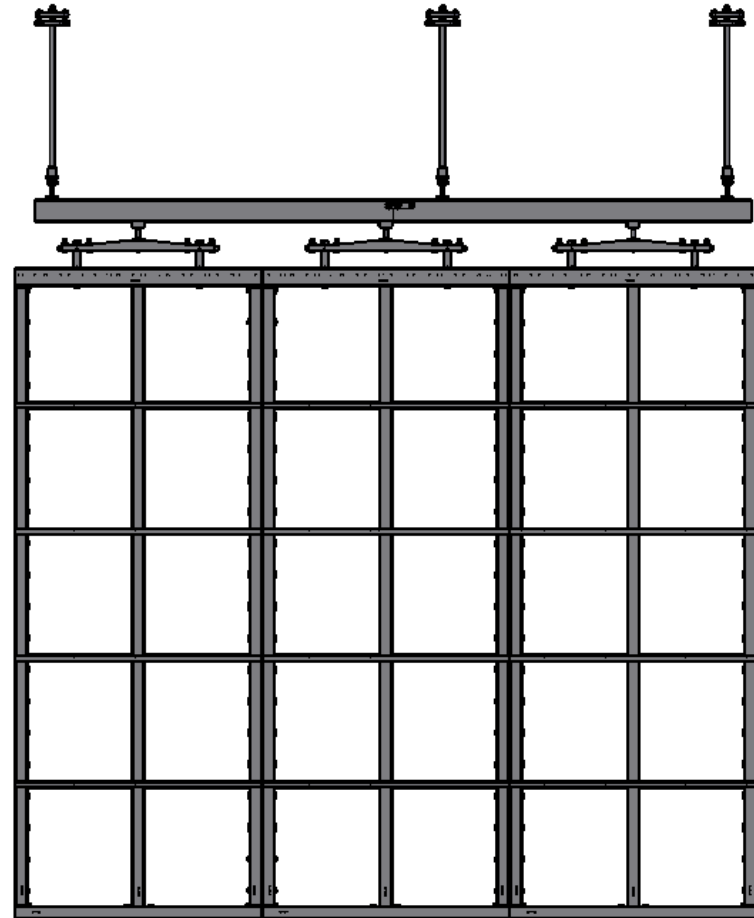
Clean Room Rail System



A rail system is used to move TPC components, delivered through the SAS (Sanitary Access) roof, through the cleanroom

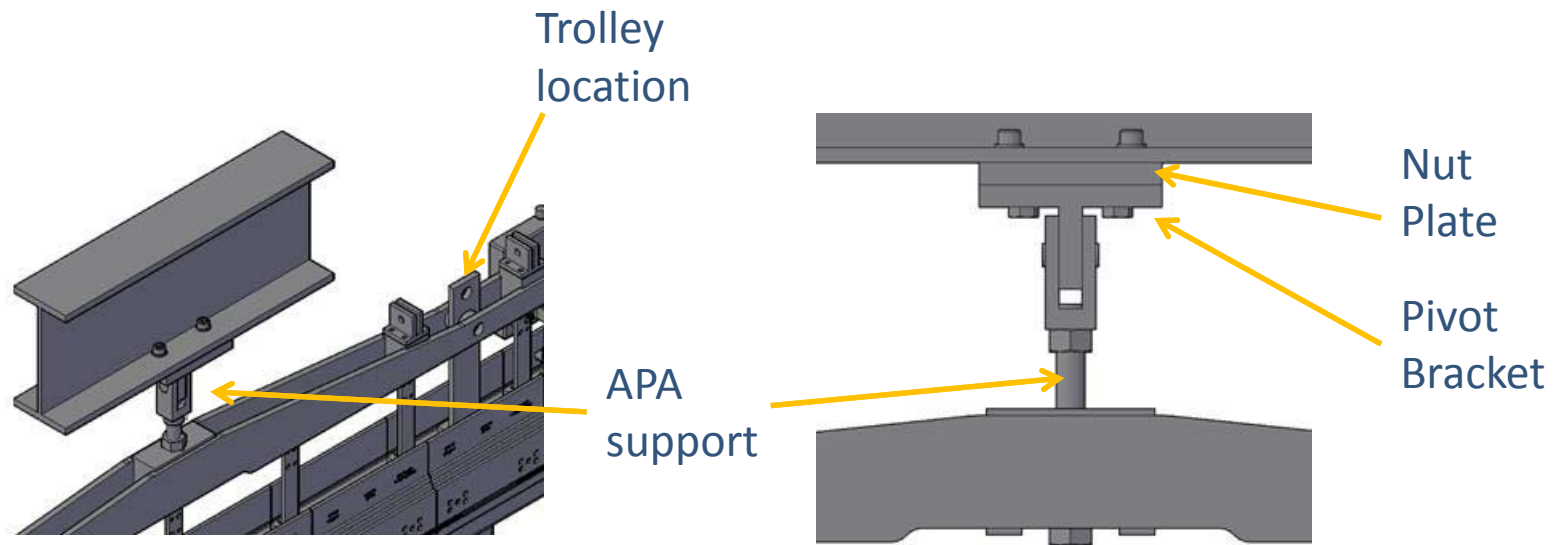
South Drift APAs

- An APA first has its Photon Detectors installed, then its cold electronics and cables are installed.
- It then spends a minimum of 1 week in the cold box where it is given a complete system test
- Cables are bundled above each APA on a temporary cable tray and it is rolled through the TCO and loaded on Beam A
- Once all 3 APAs are loaded, Beam A is translated into final position



Delivery trolleys not shown

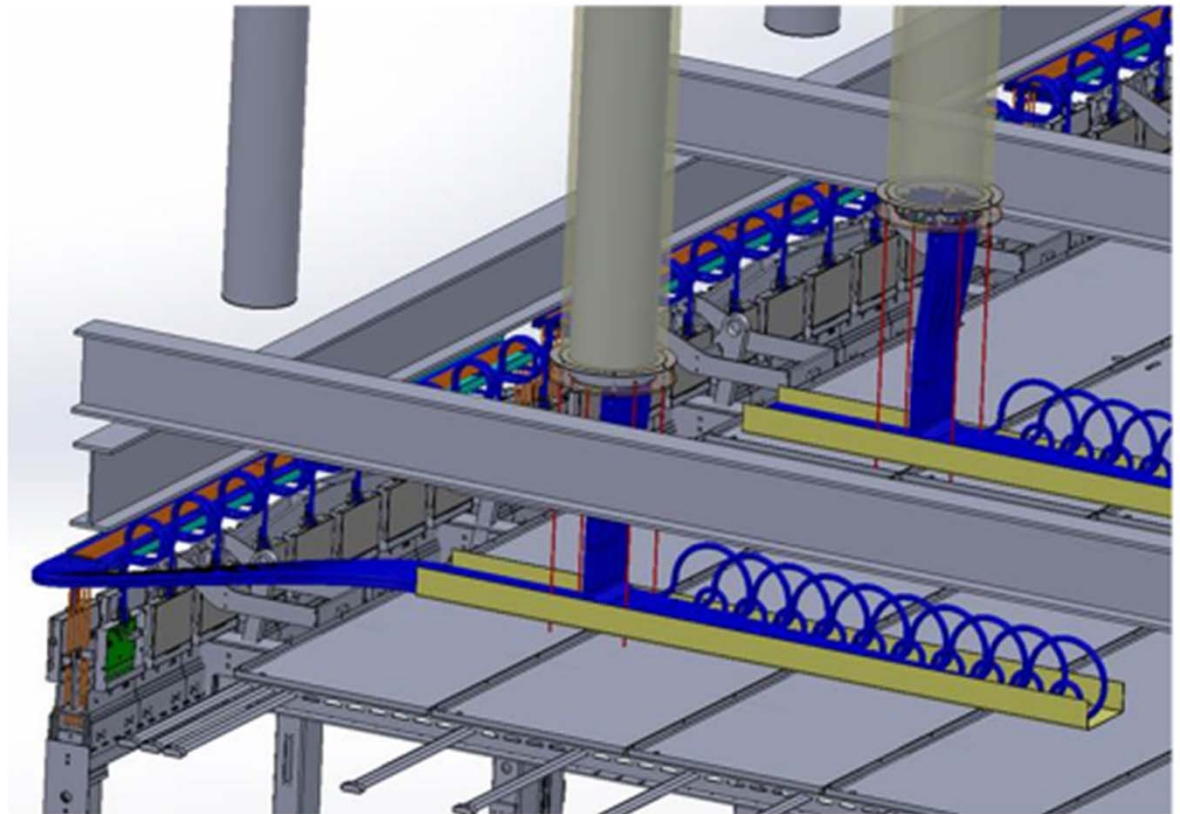
APA support



- The APA is delivered on two trolleys to its mount point
- The single permanent connection is made by connecting the mounting bracket to a nut plate
- The load is transferred by adjusting the APA support

APA cabling

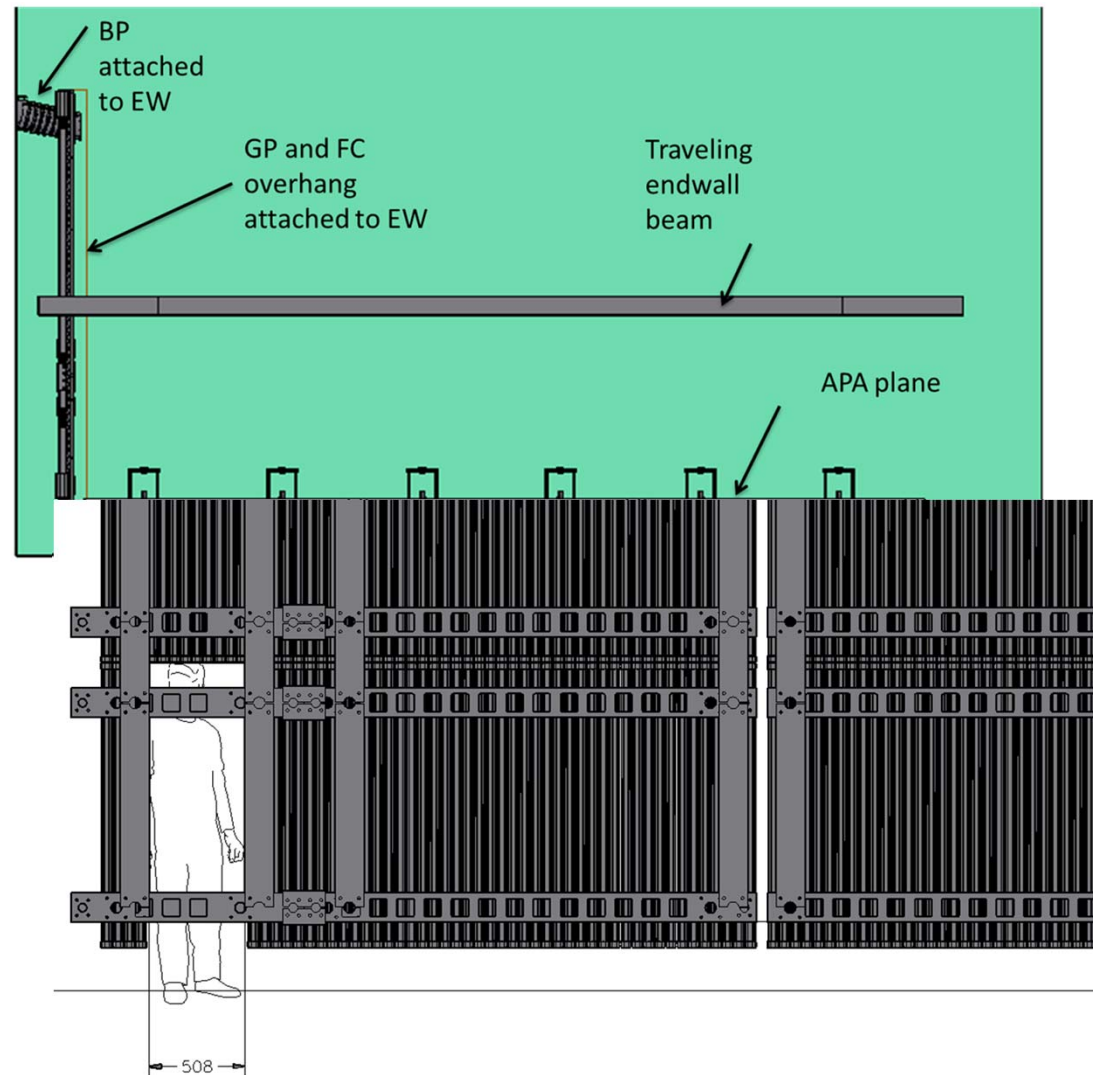
- Once the APA has been mounted to Bridge Beam A the cables are removed from the temporary APA cable tray
- The cable bundle is then routed to the strain relief and up the feed-thru



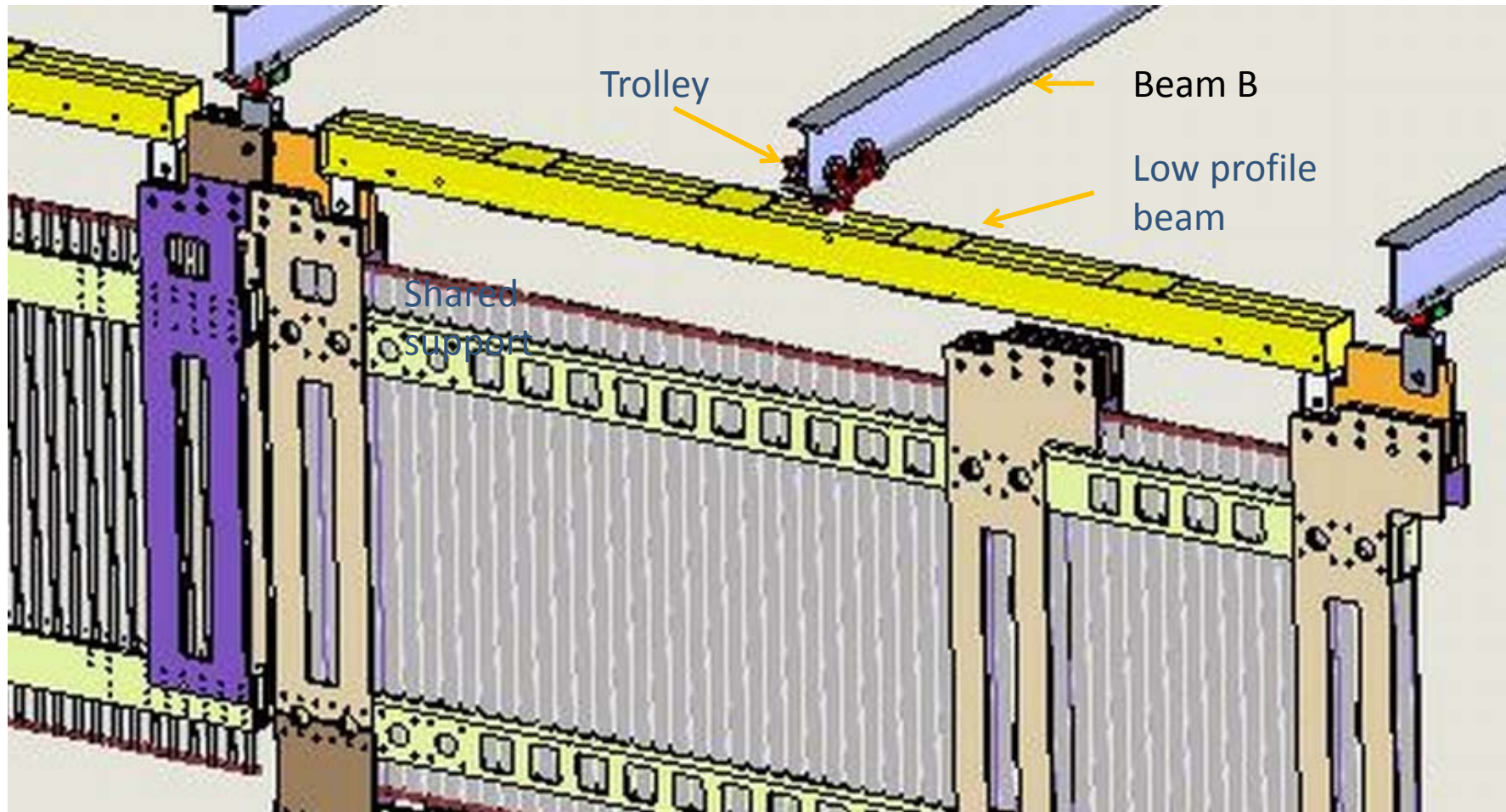
Cabling (FC and GP would not be present during cabling)

South Drift EWs

- Beam plug is pre-mounted to the “west” EW
- Some profiles are omitted in the “east” EW to provide access/doorway



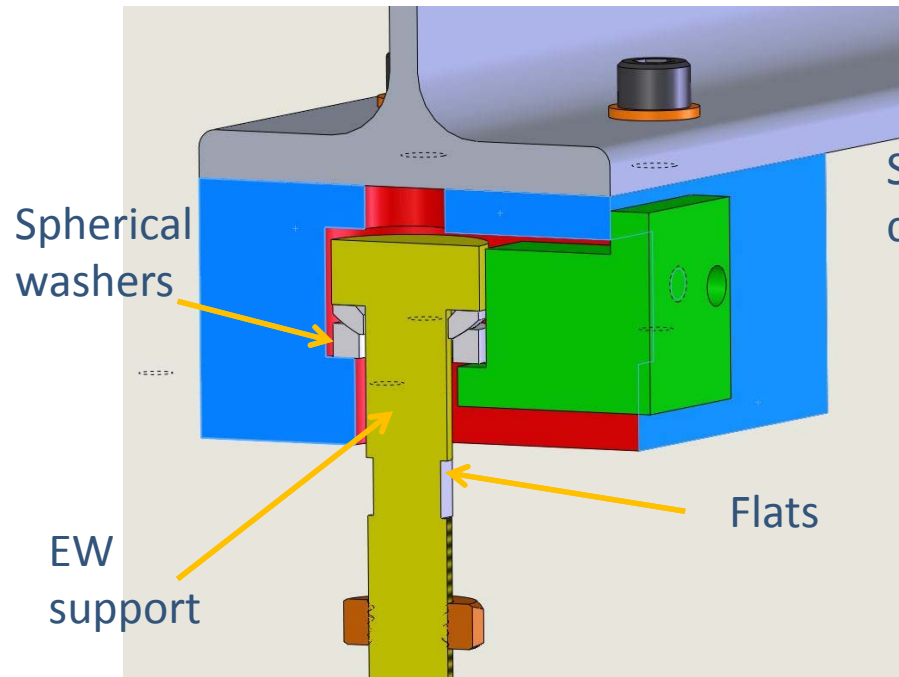
Delivering the EW's



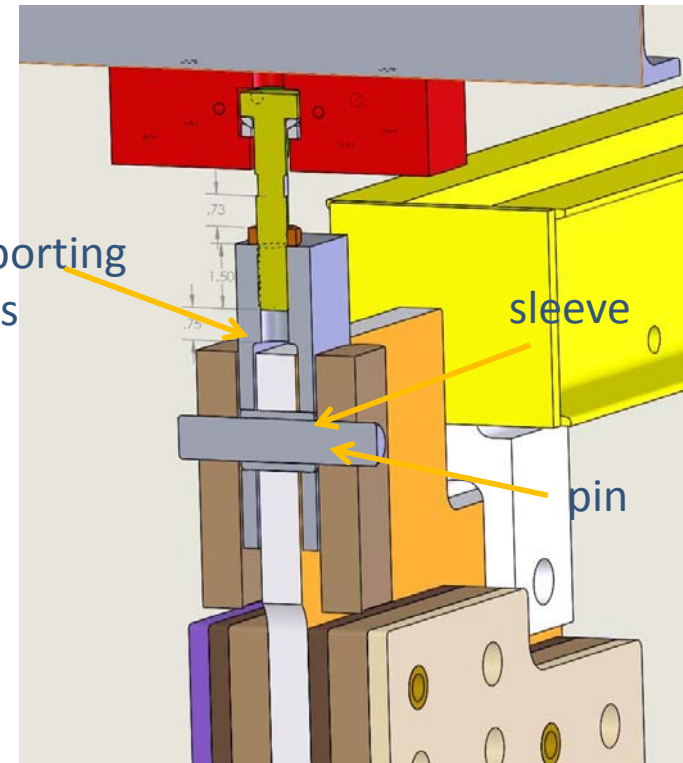
- The end wall is delivered on beam B.
- After the CPA is positioned, its load is transferred to 2 permanent support points on each end.
- The north drift EW shares the support point with the south drift.

Mounting the EW's

- EW support



EW support with spherical joint

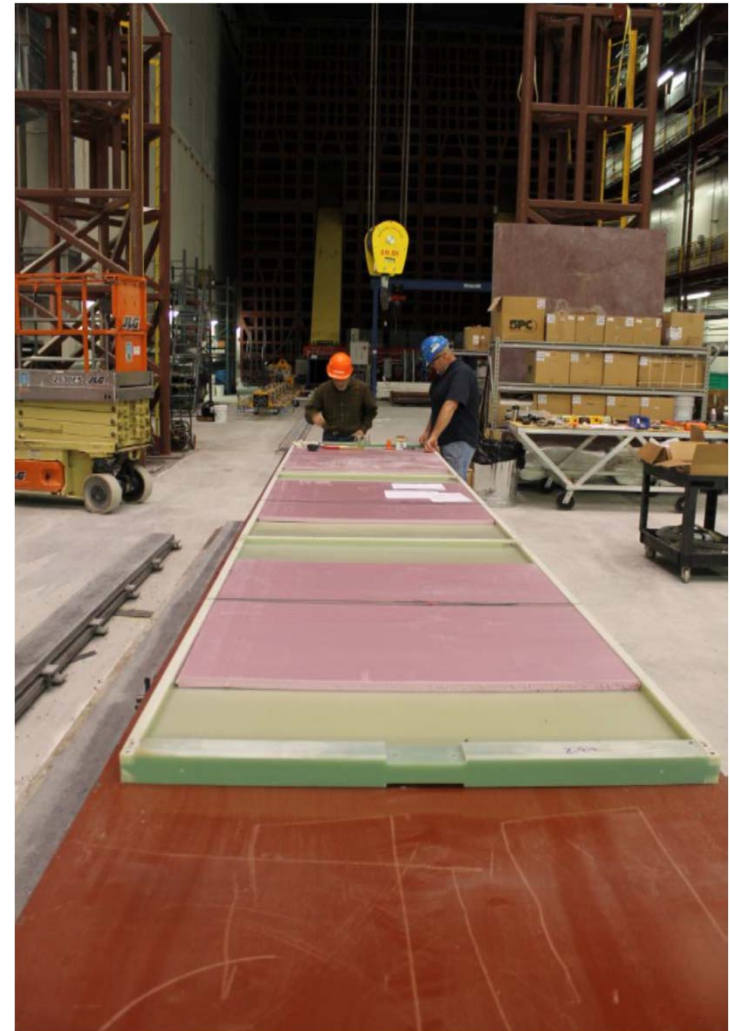


Shared EW connection

- The south drift EW is connected to the supporting clevis using a sleeve
- The EW support is then adjusted to pickup the load.
- When the north drift EW is delivered it is connected to the same clevis with a pin

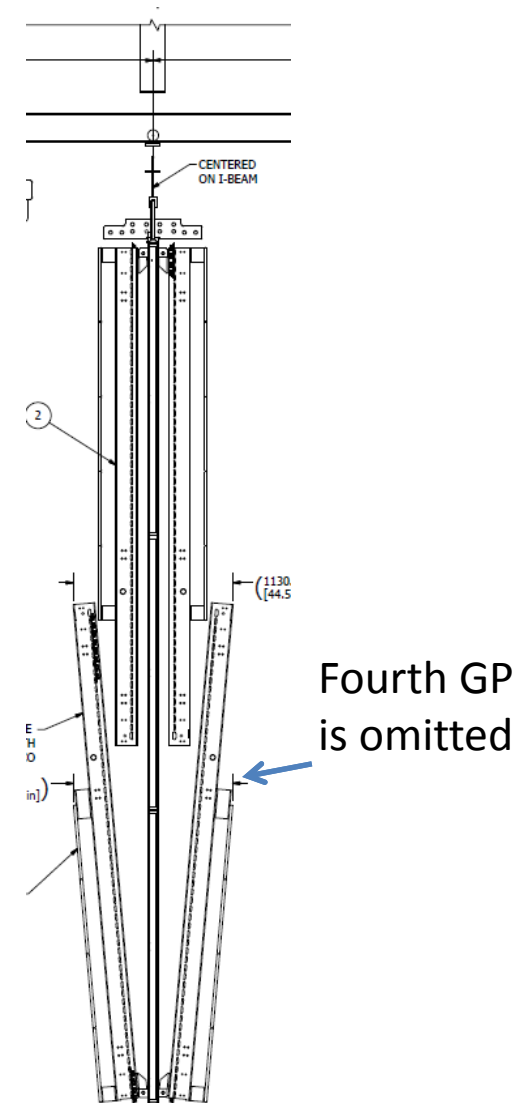
CPA Assembly

- A CPA plane arrives at CERN in 3 modules that must be bolted and pinned together on a flat table.
- As many module-to-module electrical connections, HV cables and field shaping strips are installed as possible
- A pair of CPA planes are hung on the rail system and joined together
- Four FC units are mounted to the CPA assembly



CPA and FC

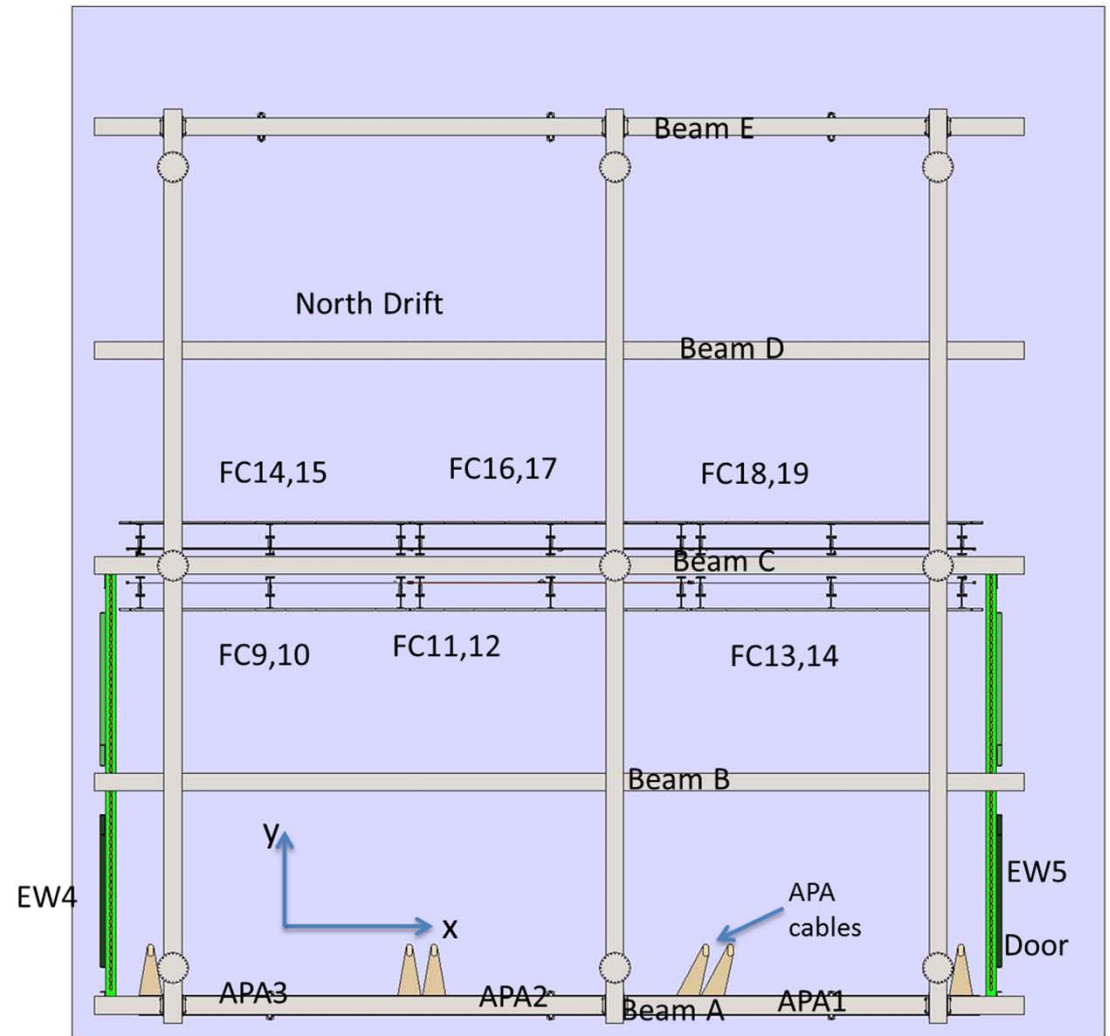
- Once the CPA with FC assembly is completed it is rolled thru the TCO and loaded in its final position on Beam C
- Three pairs may be rolled into final position as unit to allow for electrical connections to be made and tested via scissor lift
- Some profiles on the APA end are omitted to allow for lowering of the FC.
- Some ground plane and latch hardware will have to be installed after passing through the TCO



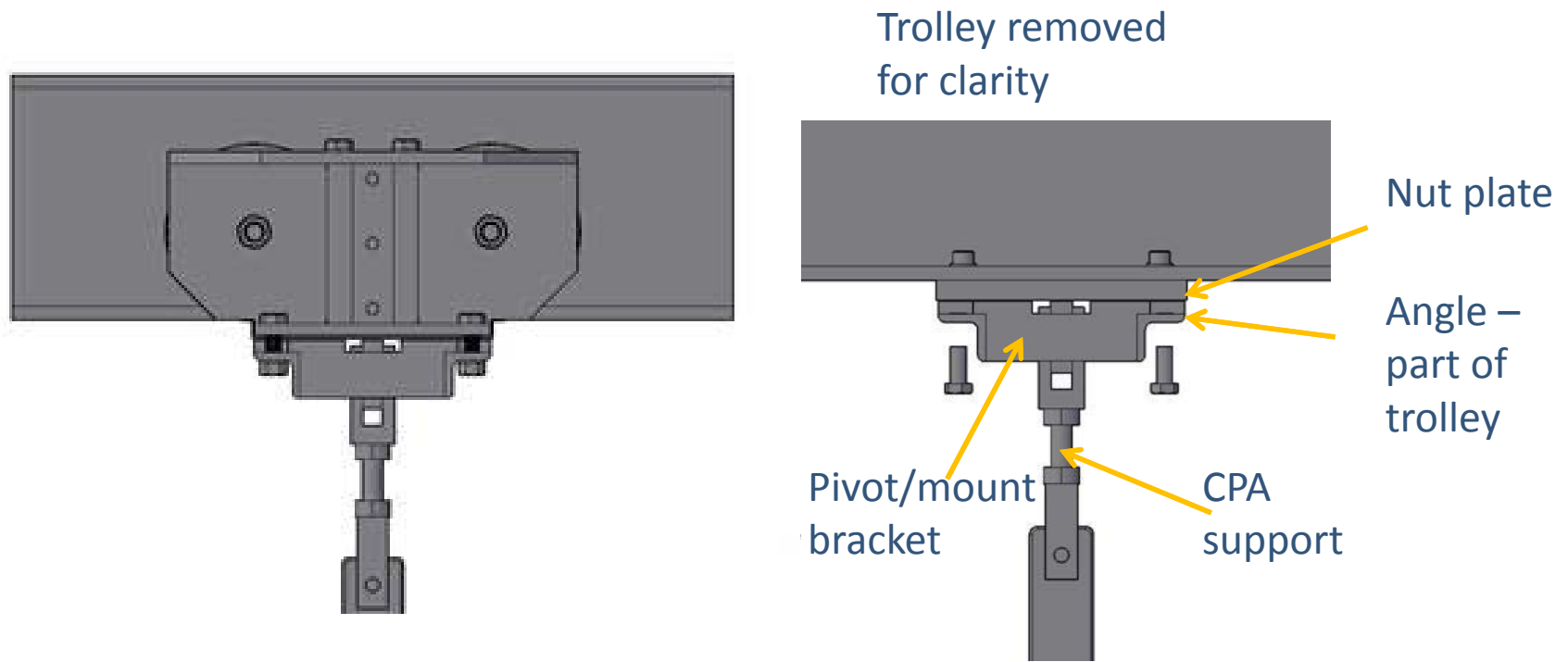
Edge view of CPA
with FC's

CPA and FC

- Beam C is translated into final position



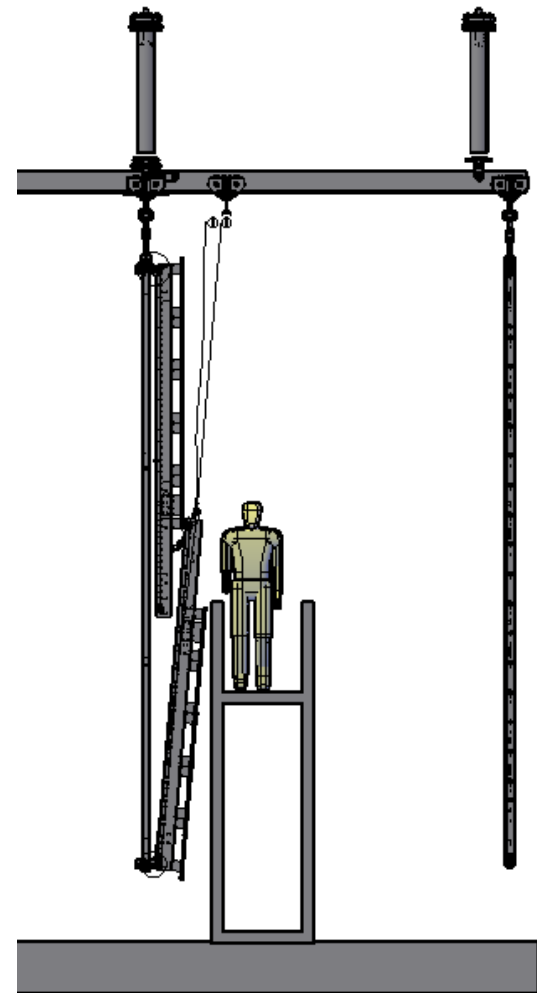
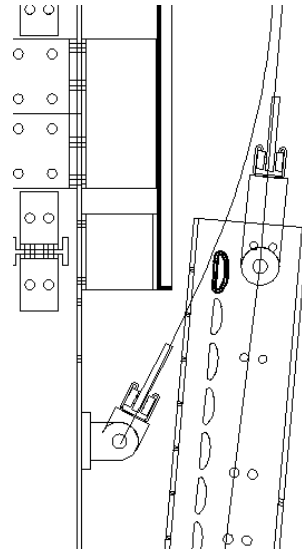
CPA load is transferred to Beam C



- The CPA is delivered on one trolley that is connected to its single support point
- The pivot mount bracket is in the load path between the trolley and the CPA support.
- There is clearance between the nut plate and the pivot mount
- Bolting the pivot mount to the nut plate lifts the CPA and takes the load off the trolley.
- The trolley halves could be removed at this time if desired.

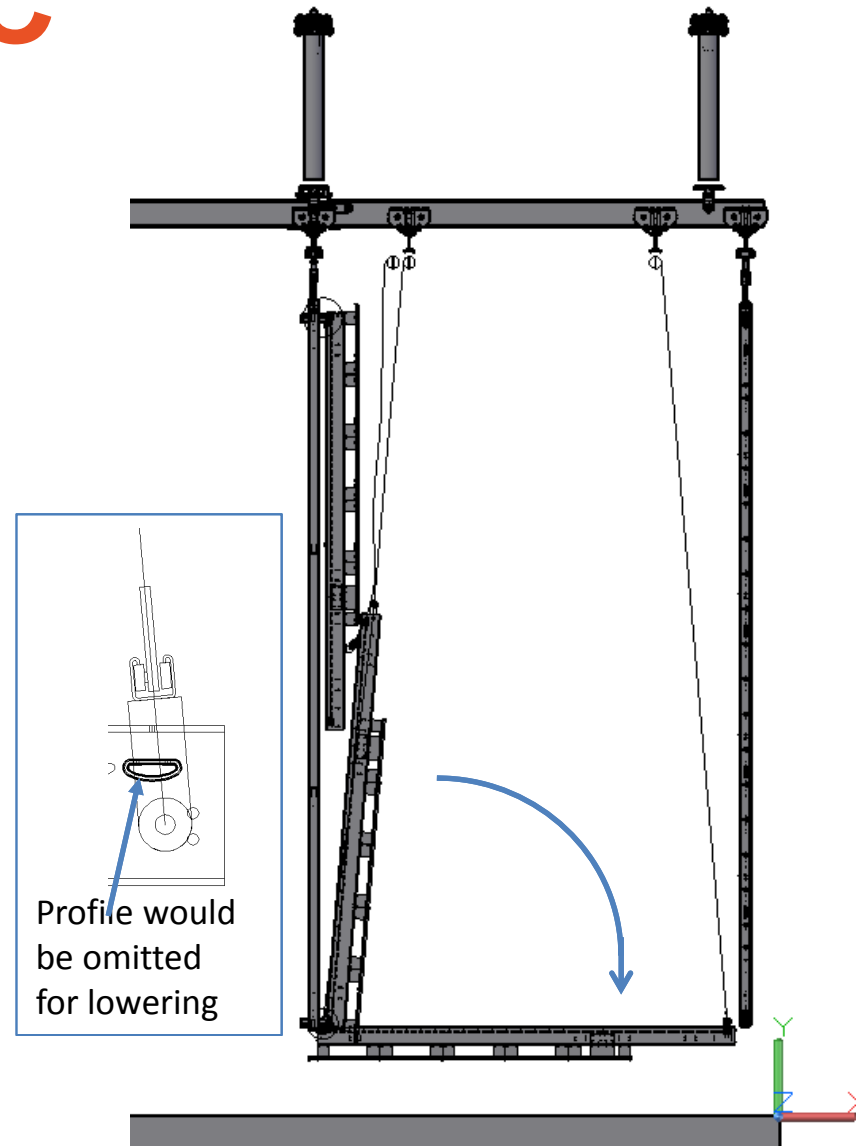
Preparing to lower FC

- FCs are deployed starting on the beam plug side, alternating bottom then top.
- Two sets of lifting hardware is used. One is connected to the bottom FC and one to the top.



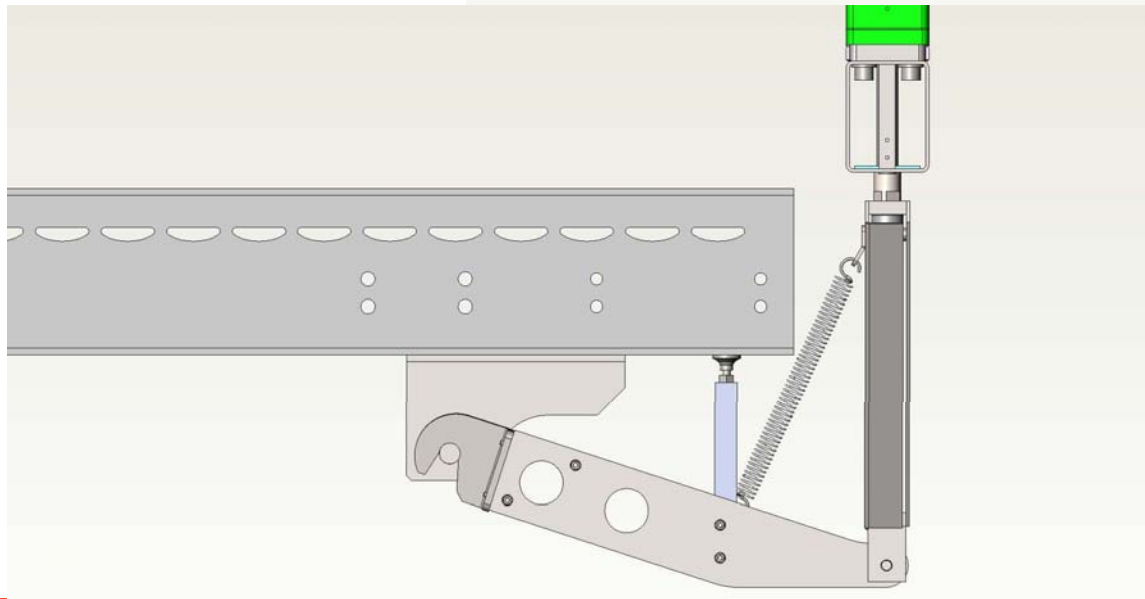
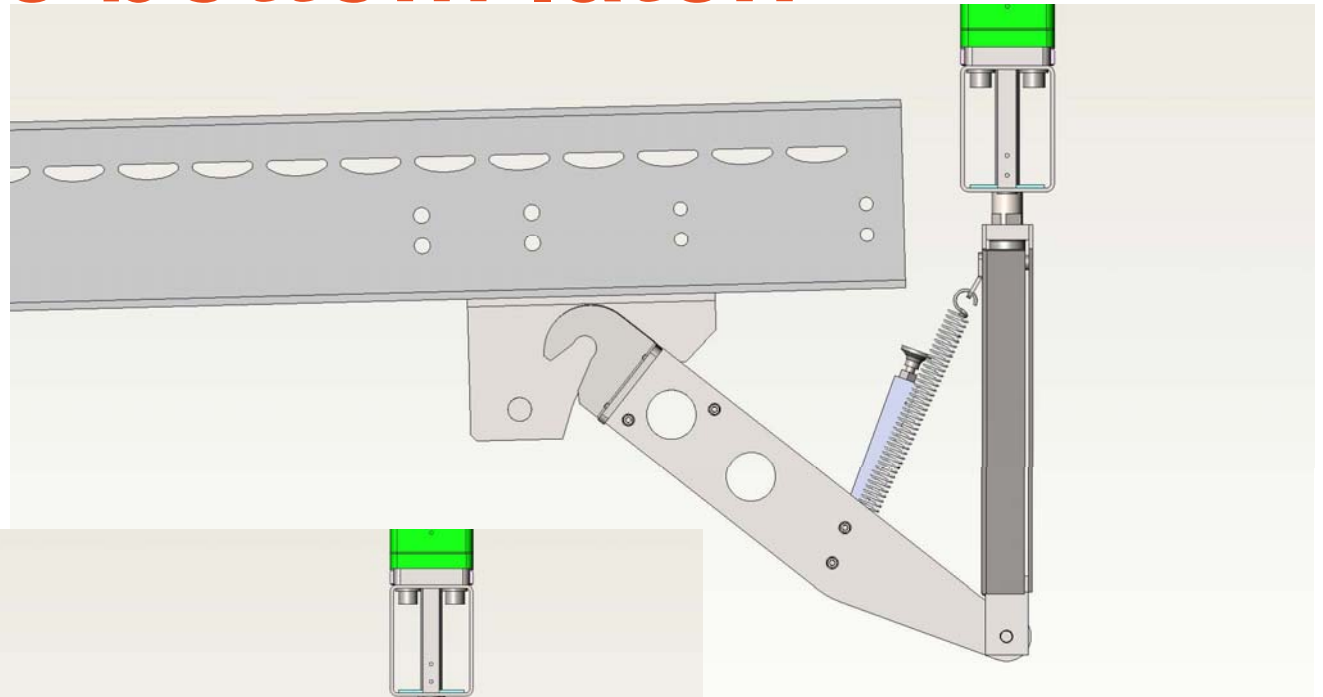
Lowering the FC

- The bottom FC is lowered and automatically latched.
- Lifting gear is removed from the bottom FC with access from the top of the FC



Automatic bottom latch

Initial
engagement

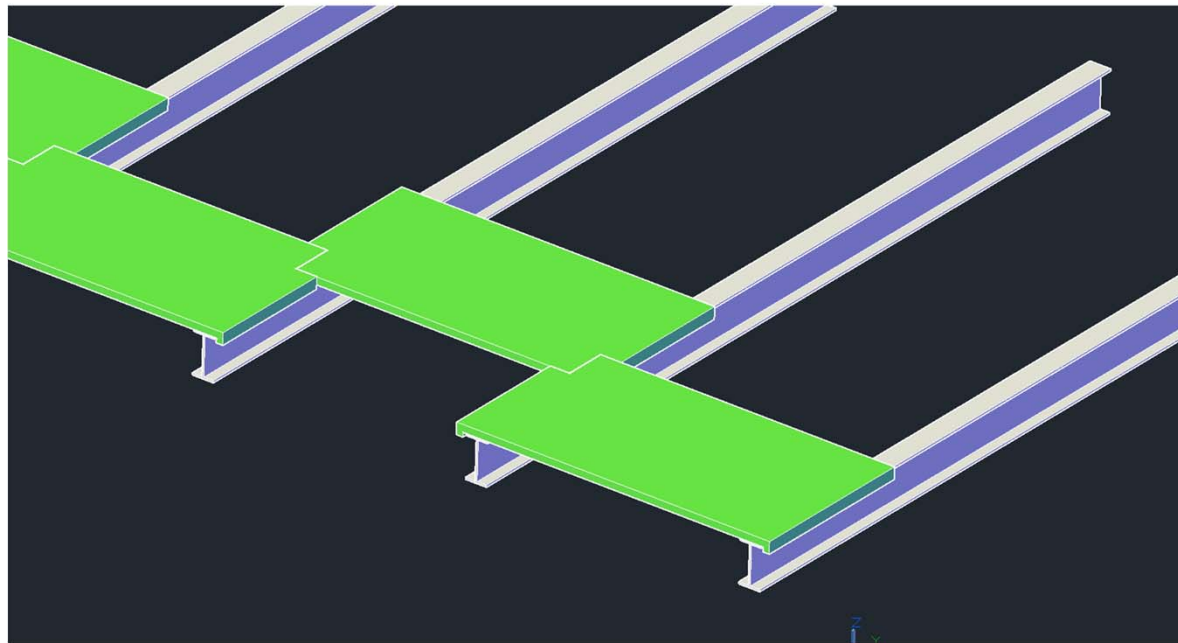


Fully engaged

Planks for access to the field cage

- Planks provide temporary surface for access
- FC beams are supported from below on feet

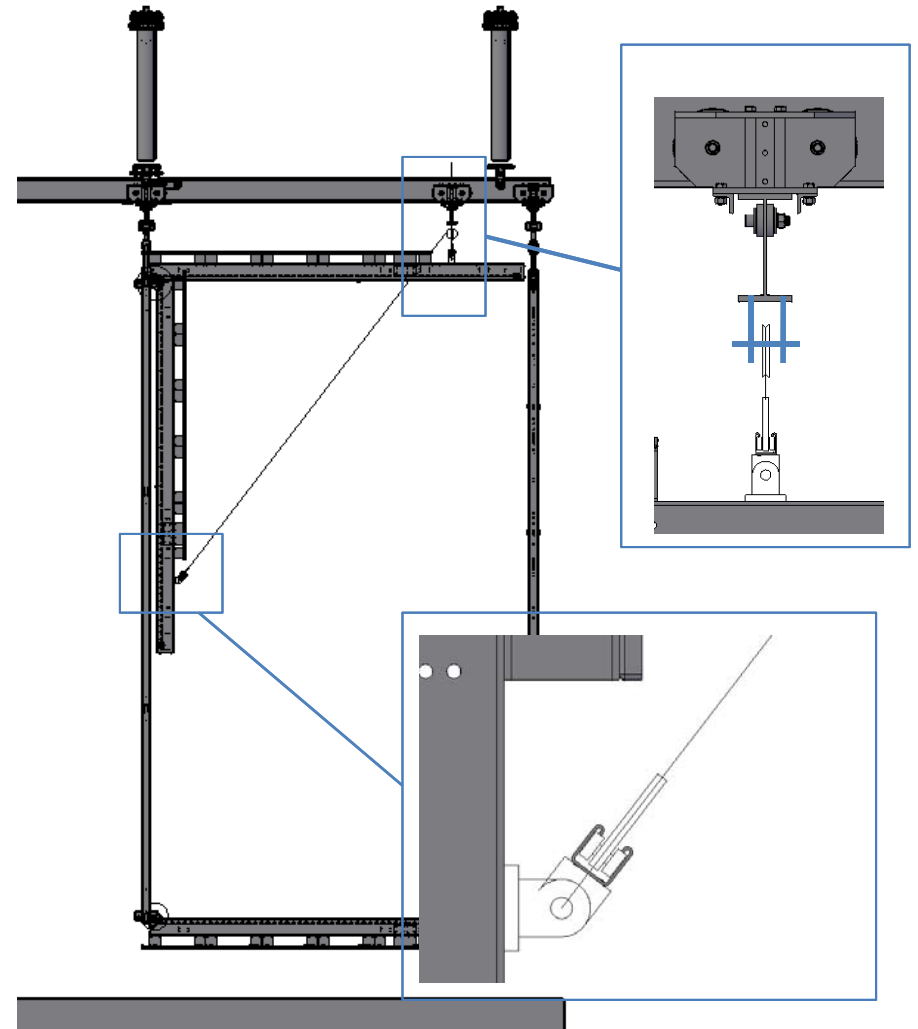
Plank concept from Bo



Planks for access

Lifting the top FC

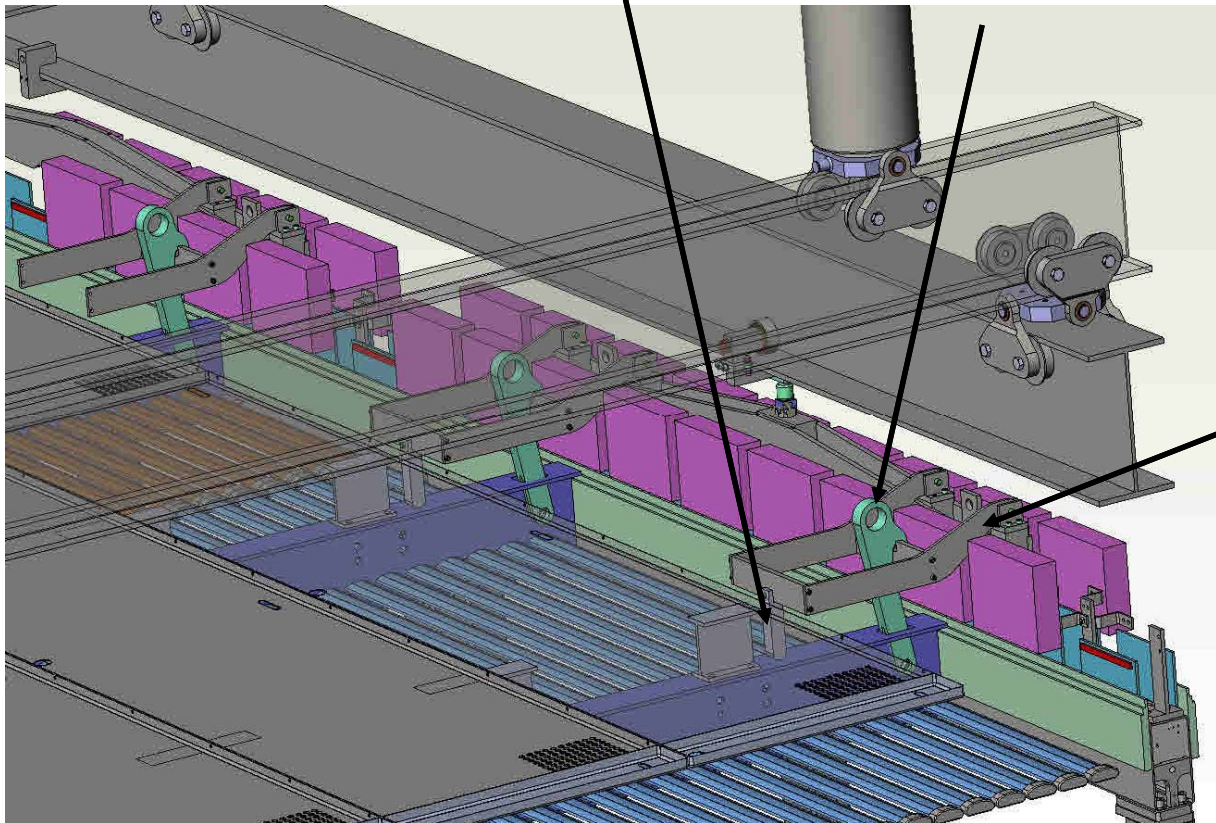
- The top FC is lifted into position, manually latched
- Repeat for the 2nd pair and 3rd pair of FC
- Note: After the lifting gear is connected on the third pair of FCs, the access equipment is disassembled and removed through the access door and from above the EW
- Half length profiles are installed and spliced to fill in the EW doorway.



Top Latch

Latch brace reacts latching forces

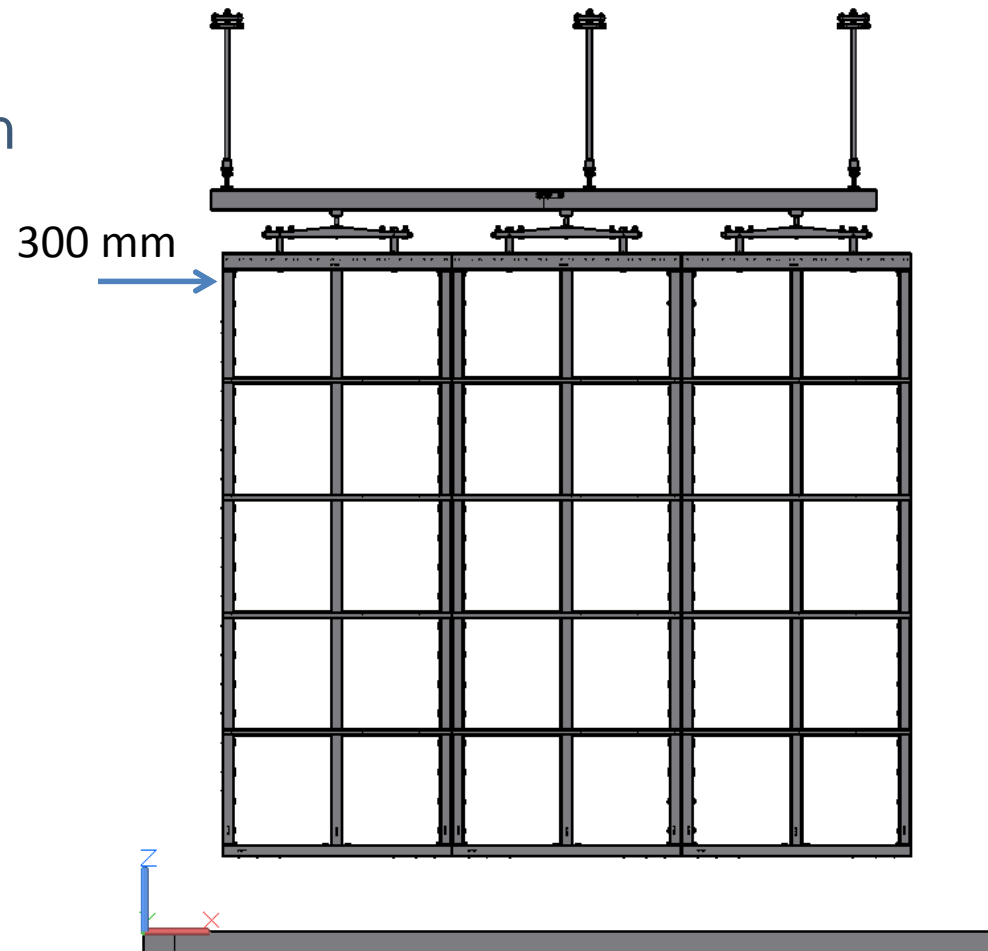
After FC is lifted slightly higher than final position and the latch is manually engaged.



304 SS latch striker assembly. Mounts to the top of the APA support hanger. Mechanical stop constrains rotation

North Drift APAs

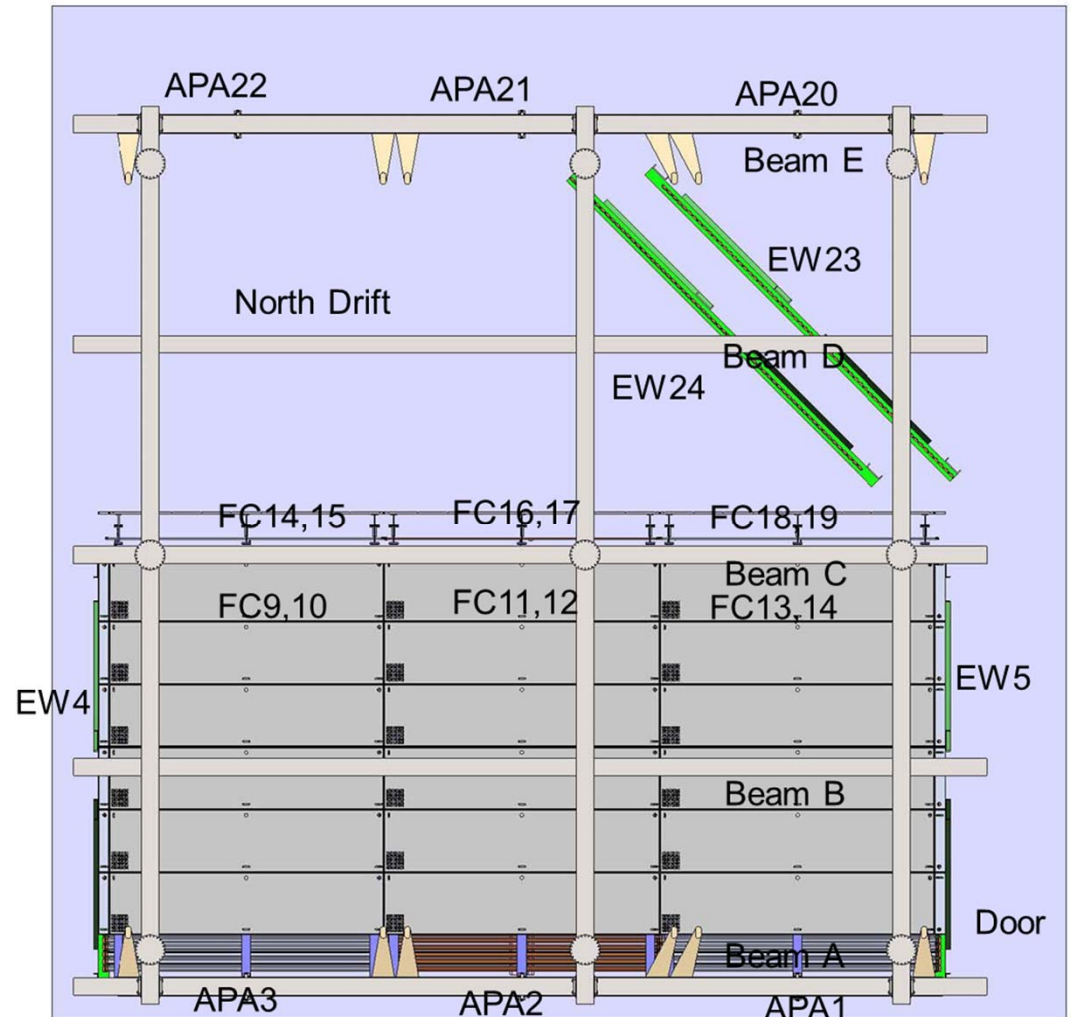
- APAs are loaded on to Beam E in storage position (300mm further “east” on beam)
- Beam E is translated into final position
- APA cables are routed



APA storage location

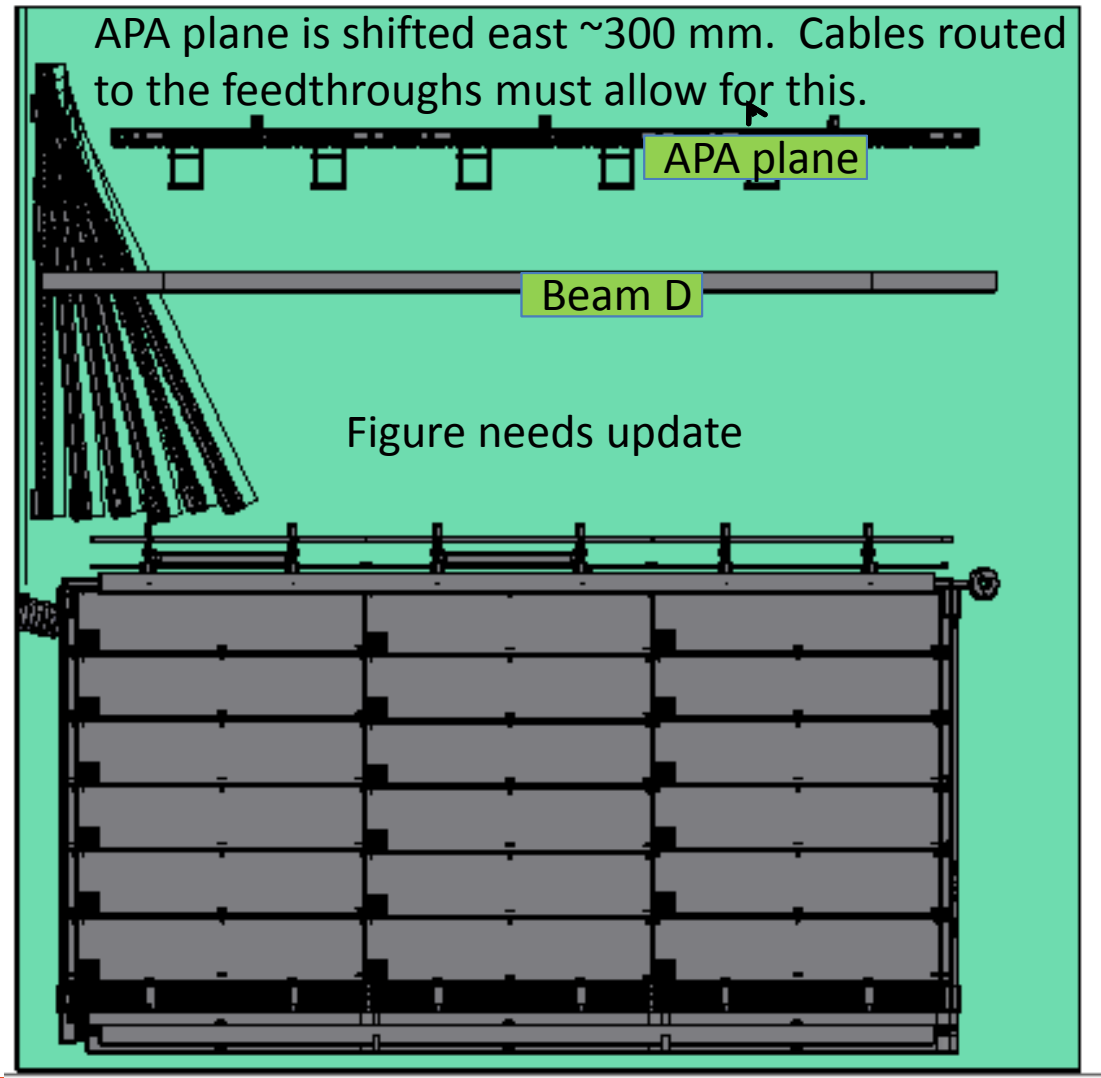
North Drift EWs – Step1

- North Drift EWs are loaded onto Beam B
- Some profiles are missing in the “east” EW to provide access/doorway
- EWs are delivered to the storage position
- EW maybe positioned to protect the APA plane
- TCO is closed



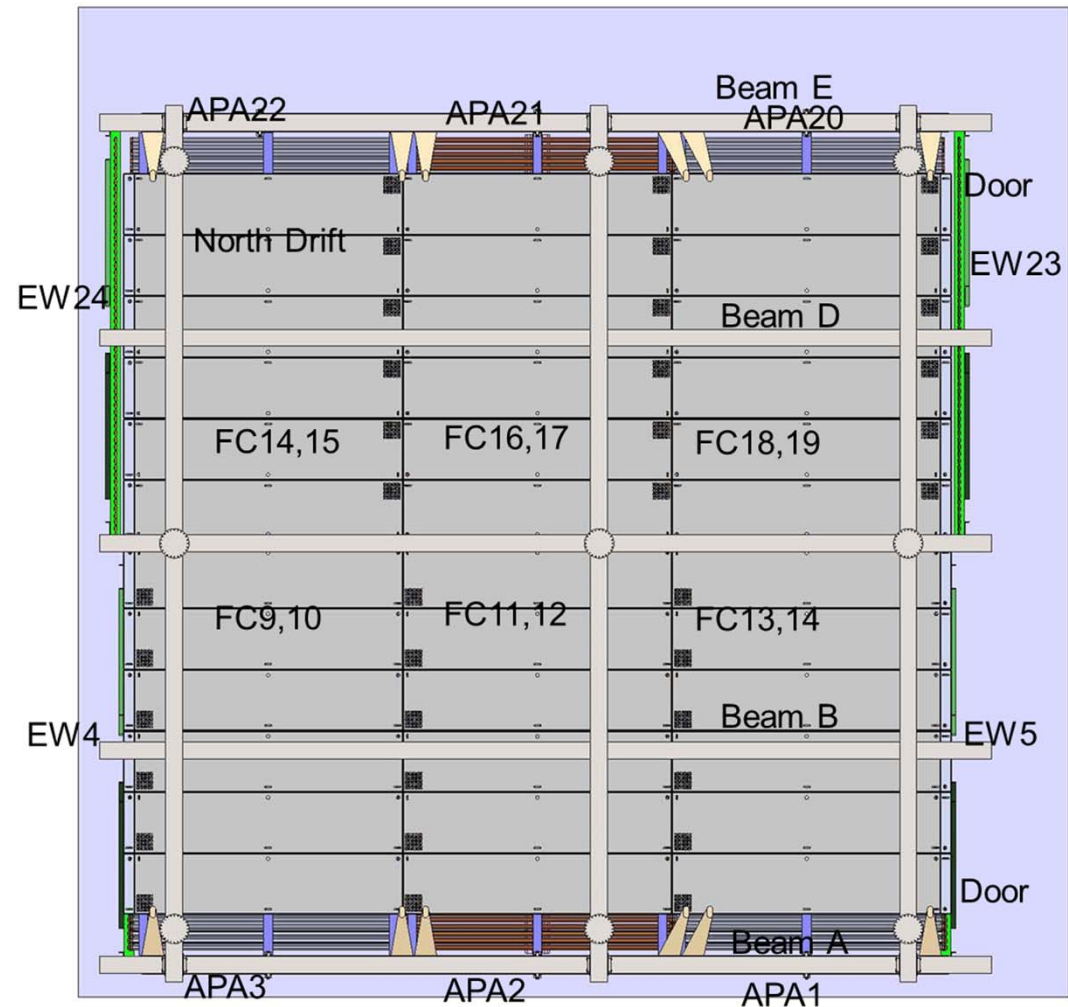
North Drift APAs & EWs – Step 2

- EW on the TCO side is moved into final position
- North Drift APAs are moved into final position
- APAs load is transferred to the single support.
- EW load is transferred to Beams C and E
- The second EW is delivered and connected



North Drift FC deployment

- Steps are the same as the North drift



Back up slides

