Mechanical Issues on the QBB Design (I)

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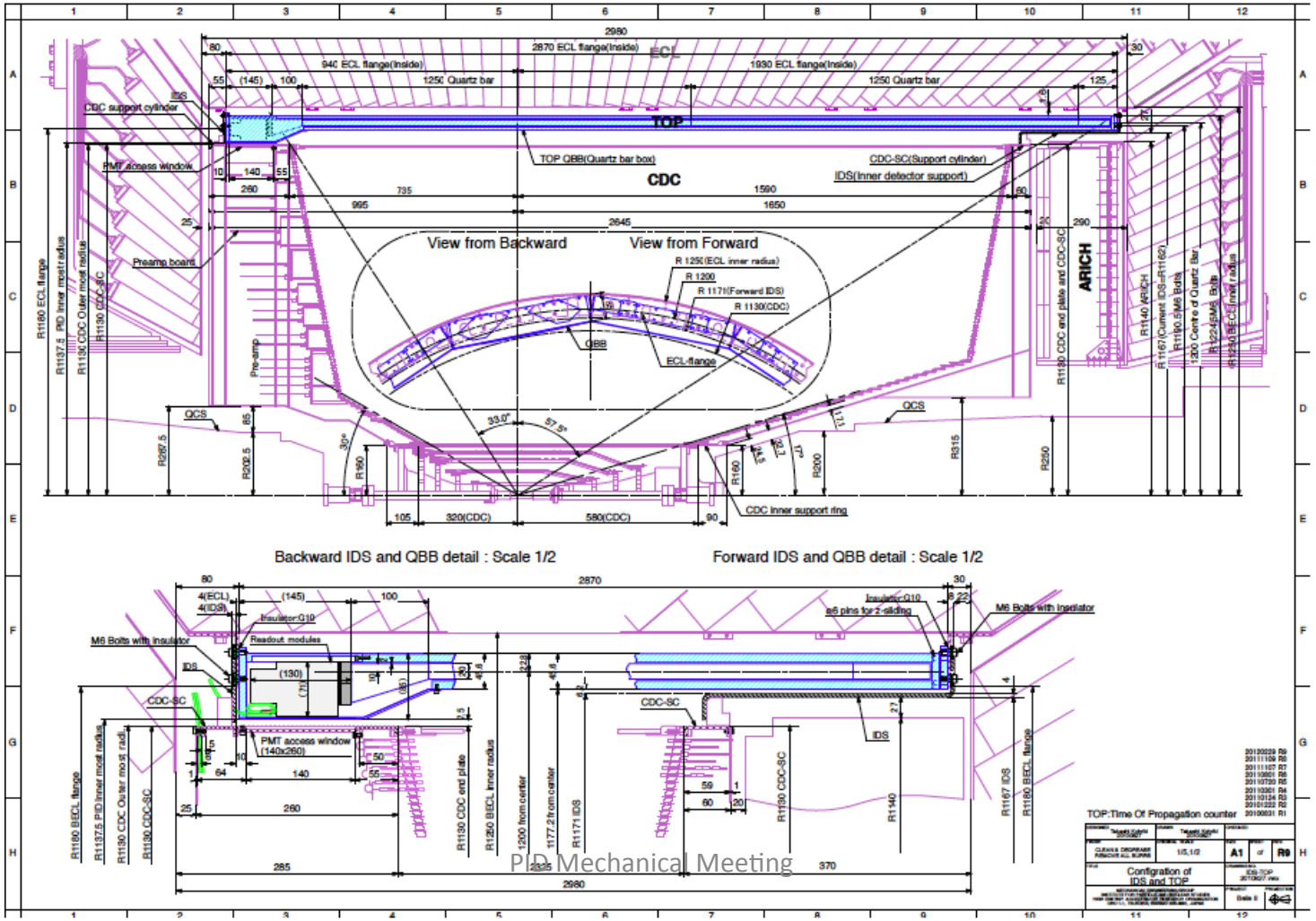
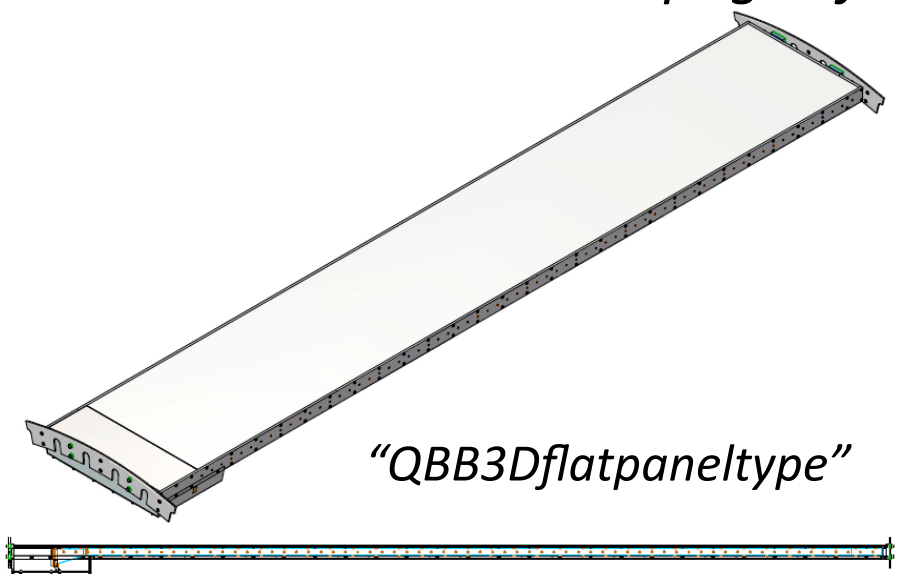
Mechanical configuration around TOP

- *The latest drawing is "IDS-TOP20100827R9".*
  - *Drawn by T. Kohrki (KEK), released on 02/29/2012.*
  - *Available in the INDICO page of our mechanical meeting.*

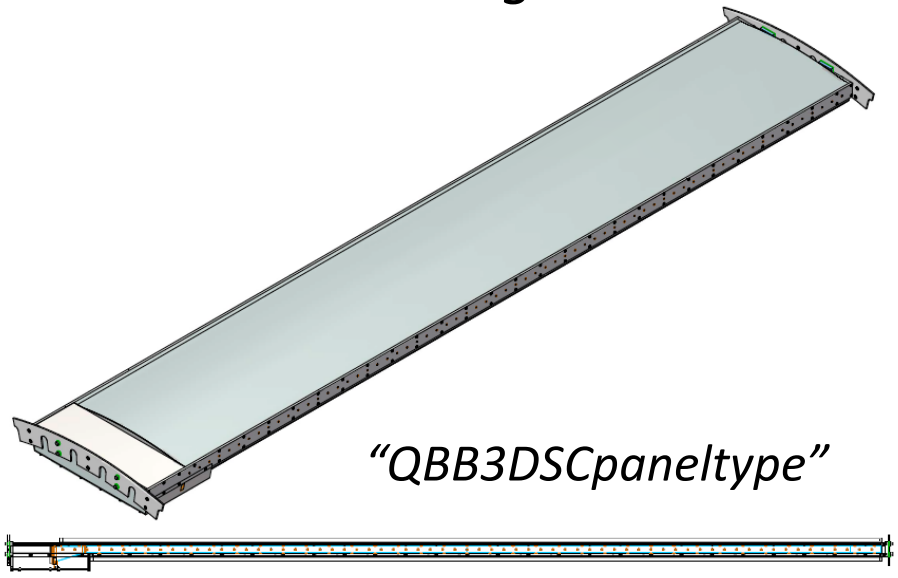


The latest QBB designs

- *The latest designs have two Honeycomb panel types.*
  - *With flat panels: "QBB3Dflatpaneltype"*
  - *With semi-cylindrical panels: "QBB3DSCpaneltype".*
  - *Some details are still missing, e.g. the fwd compression springs, dry-air inlets/outlets, laser-fiber inlets, etc.*
  - *Will choose either one or merge them for the final design after having various mechanical tests on the prototypes.*
- *Both types are available in various 3D-CAD formats.*
  - *From the INDICO page of our mechanical meeting.*



"QBB3Dflatpaneltype"



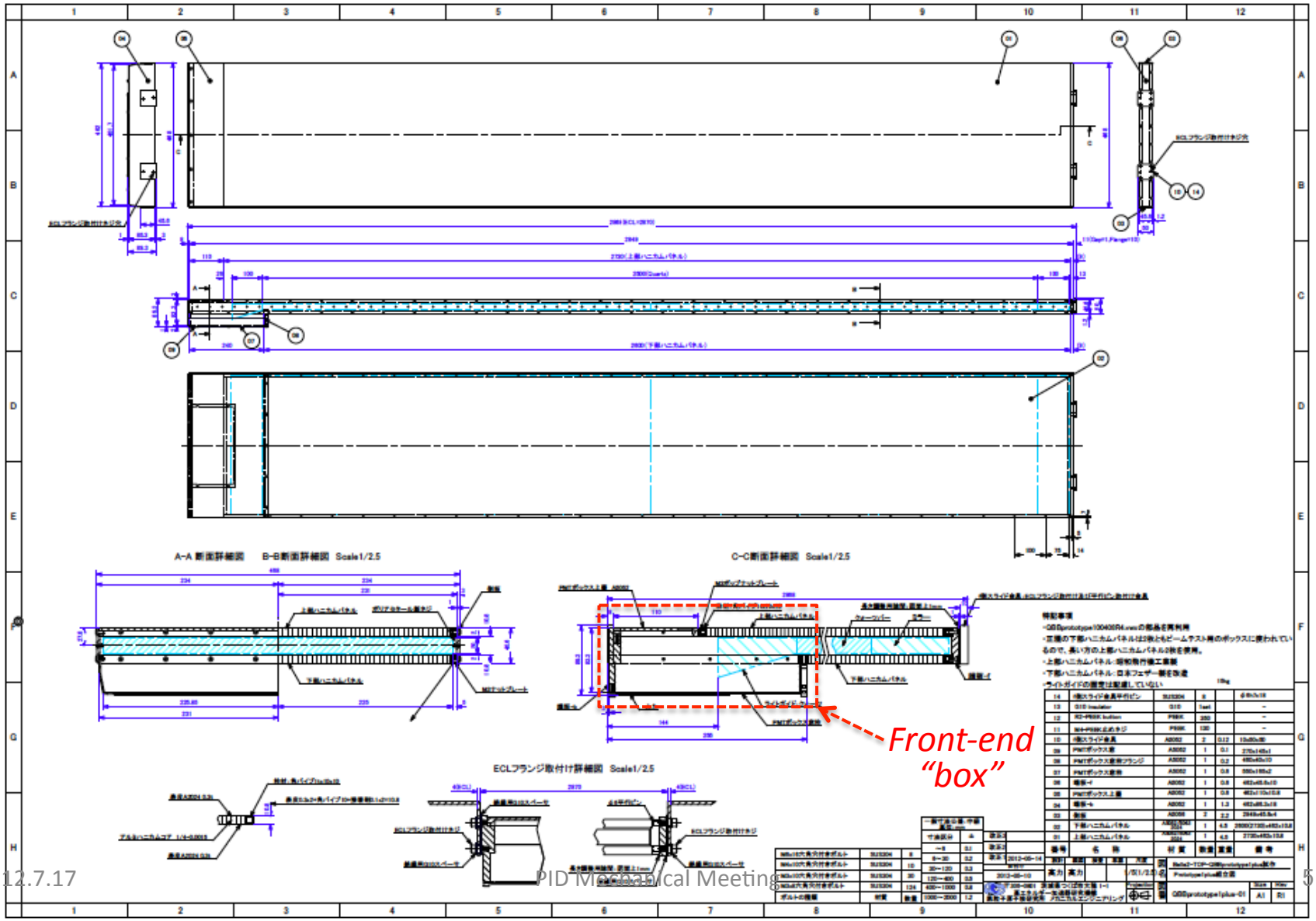
"QBB3DSCpaneltype"

The latest prototype QBBs (1)

- *Based on the latest QBB designs.*
  - *With flat panels: "QBBprototype1plus"*
    - *The inner (shorter) Honeycomb panel will be made by cutting one of the existing two outer (longer) panel.*
    - *The the side plate thickness is thinner than the latest design since the width of the existing panel is wider than the latest one.*
    - *Mounting scheme, e.g. gas-sealing materials, of the wedge is not implemented.*
    - *To be tested using an Al dummy weight only, not using a quartz bar.*
  - *With semi-cylindrical panels: "QBBprototype2".*
    - *Since the length of the produced Honeycomb panels is shorter than the latest design, 25-mm-plates are added at the forward end of the panels.*
    - *To be tested using an Al dummy weight and a quartz bar.*
  - *Both types have a front-end "box" w/o a tilted bottom.*
    - *Just for the ease of manufacturing.*
    - *After prototyping, Kohriki-san got an impression that the tilted bottom would be feasible.*
- *Both types are available in a 2D-CAD format (.dwg).*
  - *From the INDICO page of our mechanical meeting.*

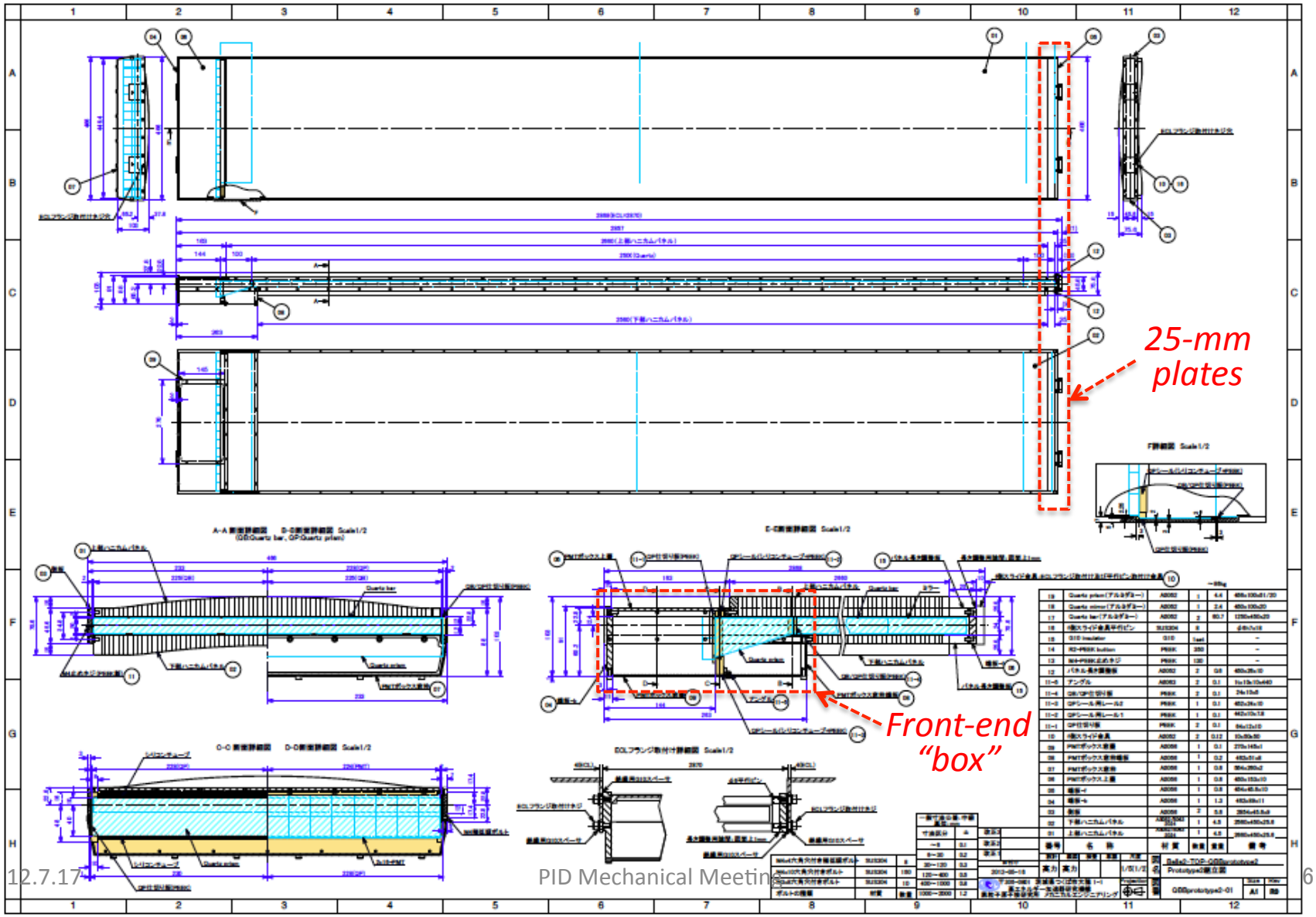
The latest prototype QBBs (2)

- *"QBBprototype1plus"*



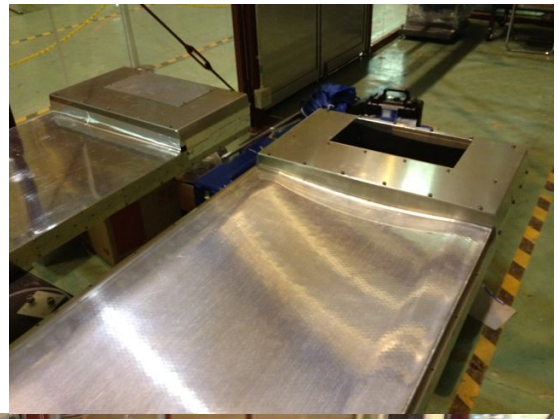
The latest prototype QBBs (3)

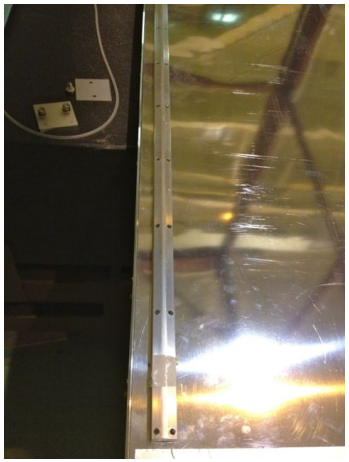
- *"QBBprototype2"*

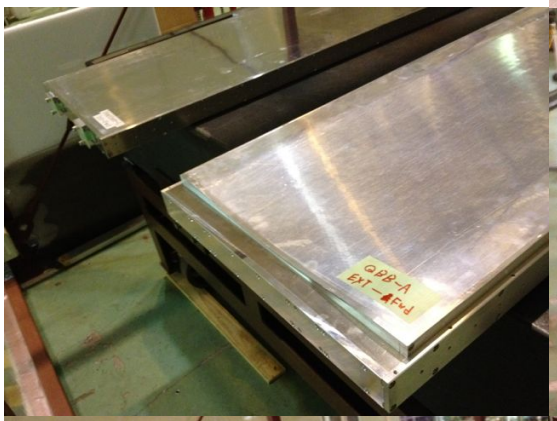


The latest prototype QBBs (4)

- *Prototyping is in progress.*
  - *All done by T. Kohriki (KEK).*
  - *Looks mostly done.*
  - *One of the flat panels has not been cut yet, though.*







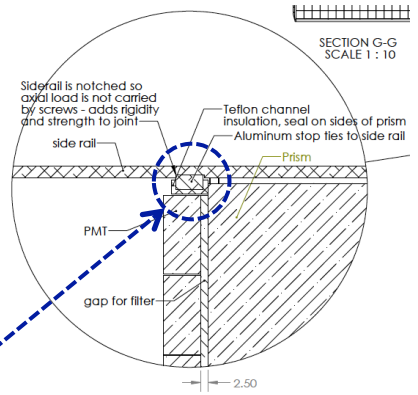
Jim Fast's suggestions (1)

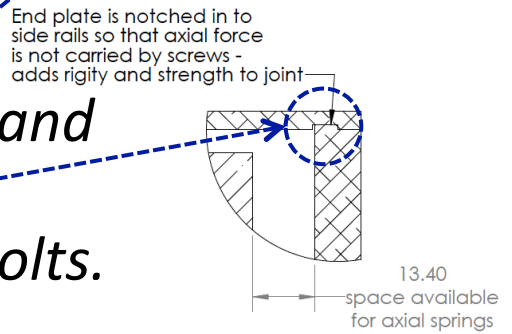
- *Continuous, uniform cross-section side rails*
  - *–Having continuous structural members end-to-end will enhance rigidity of the QBB.*
  - *–A uniform cross-section reduces complexity/cost of machining without sacrificing mechanical benefit.*

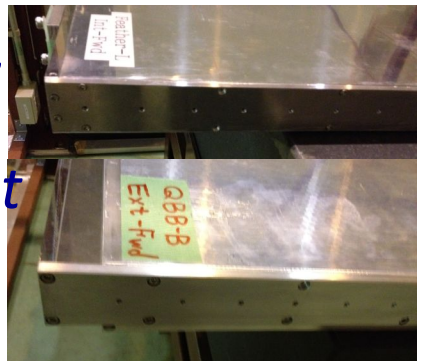
→Agreed, and has already adopted in the designs and prototypes.

- *Keyed joints to side rails*
  - *–Between the side rails and the prism "stoppers", and between the side rails and the fwd end-plate.*
  - *–More rigid and robust than using small screws/bolts.*
  - *–Can avoid to use screws/bolts in shear.*

→The considerations are correct in principle. However, M4 screws are not too small and, in practice, the screws used in z-direction carry the dominant load. At the moment, the current design seems fine.







Jim Fast's suggestions (2)

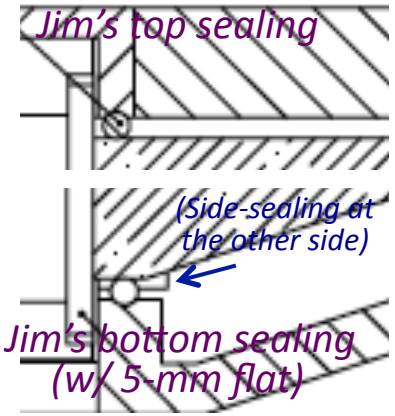
- Prism seal and prism shape
  - –Short flat (5 mm in Z) at the bwd-end of the bottom face with 2 mm chamfers along its sides.
    - ➢To put o-ring seals both on the top and bottom without producing a torque which otherwise generated from the sharp acute angle of the prism.
    - ➢Might need to suppress light reflections from the short flat face by, for instance, making the face black.

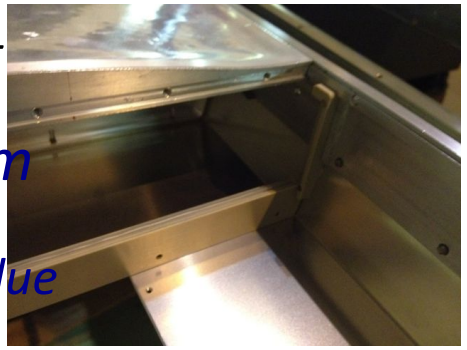
→The prototype gives us an impression that the 5-mm short flat would not be mechanically so beneficial.

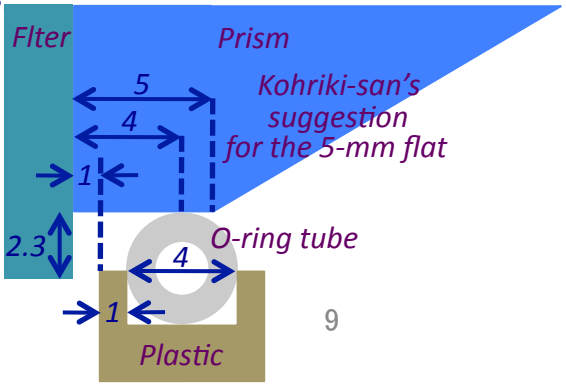
- ➢The o-ring seals should be soft enough so that no torque due to the slanted face will be generated.
- ➢It would be possible to apply the current sealing scheme to the short flat, though.

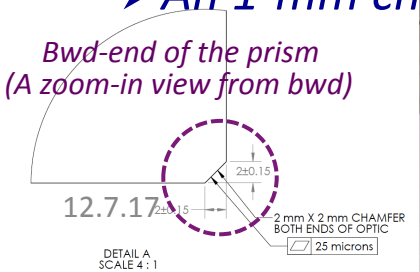
→A chamfer at the sides of the short flat does not seem to be required from a mechanical view point.

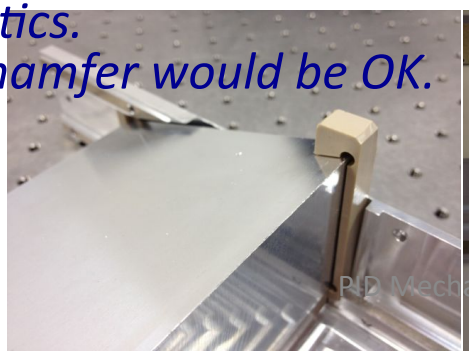
- ➢It would results in too less area to hold for the current side sealing plastics.
- ➢An 1-mm chamfer would be OK.

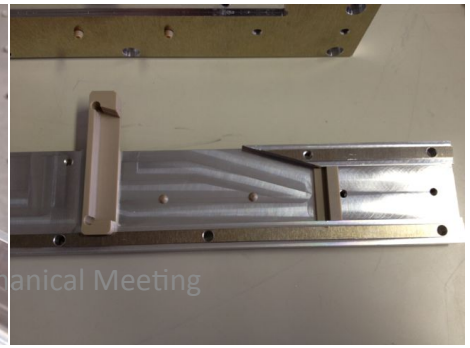










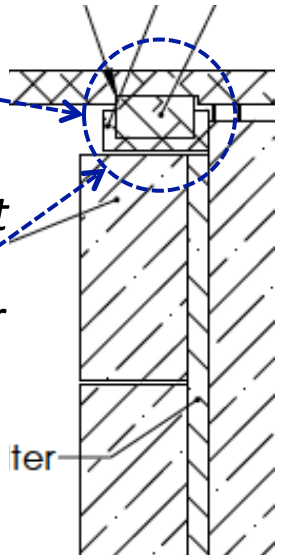


Jim Fast's suggestions (3)

- *Prism seal and prism shape (cont'd)*
  - *–Plastic channels over the metal keys, for side-sealing.*
    - *PEEK, POM, etc., but not Teflon due to the radiation weakness.*
    - *The thickness of the plastic channel (or metal key) can be different between the upper 20 mm (a bit thicker) and the lower 31 mm (a bit thinner) so that the channels only react to the –z-load of the fwd spring without generating a torque from +z-load of the bwd plunger to be used to push PMTs.*

→It is applicable for Jim's "keyed joint" scheme.

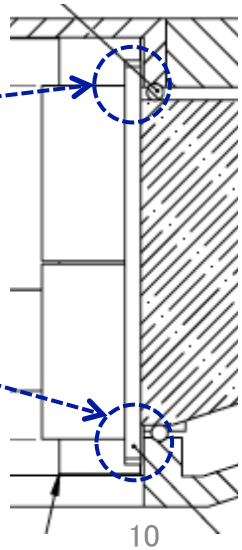
- *The current design has already used PEEK for side-sealing.*
- *The "different thickness" scheme does not seem to solve the torque issue since the prism still gets both the –z and +z loads; Jim agreed.*



- *HV insulation for the PMTs*
  - *–Above-mentioned plastic channels for electrical insulation along the sides of the PMTs.*
  - *–Extension of the filter past the PMTs would provide the HV insulation along the top and bottom.*

→The current design requires to have Kapton sheet at the inner faces of the front-end box at around the PMTs.

- *Kapton sheet should be enough, but need to consider how to set.*
- *For the side-insulation, the current scheme works in the same way.*
- *The filter extension can be another way for the top/bottom.*



Jim Fast's suggestions (4)

- Honeycomb panels
  - –Extend the lower panel to enclose the prism.
    - ➢Have a single stiff element running the length of the optics volume and reduce the number of seals.
    - ➢Will improve QBB stiffness overall compared to the design with the sheet metal cover over the prism.

  →Less joints would result in a stiffer structure, but the complex design around the front-end modules leads to the current design.

  - –How to fabricate?.
    - ➢Simple method: Machine the prism enclosure section as a single part. Then have this bonded in to the end of the lower panel as done for the Al bars of the panel enclosure.

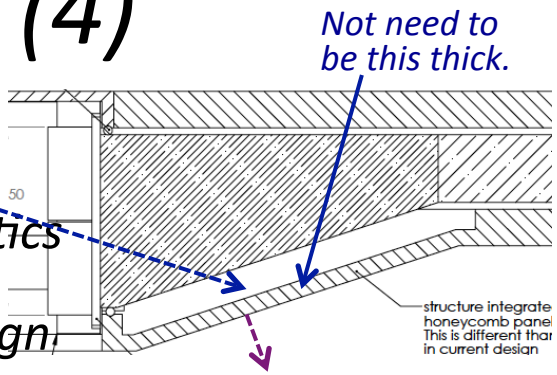
    →Although the Al enclosures are glued to the Al skins, such a massive section should be screwed to the Al enclosure.

    - ➢Aggressive method: Manufacture the lower panel, i.e. the core and the skins, as a monolithic panel with this shape.

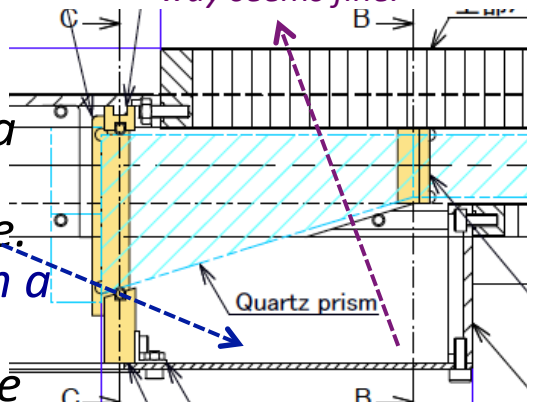
    →Sounds too challenging.

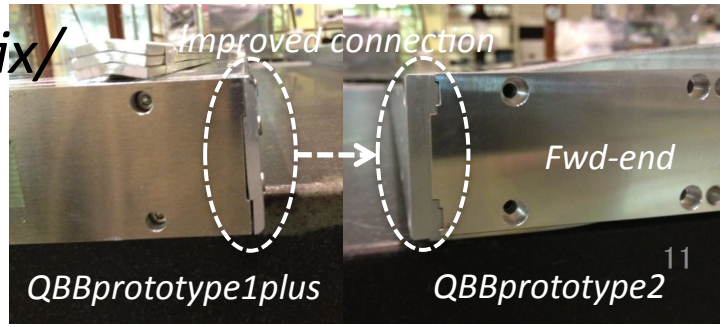
  - –Side rails should have small steps to self-fix/ position the Honeycomb panels.

  →Already done in the earliest design.



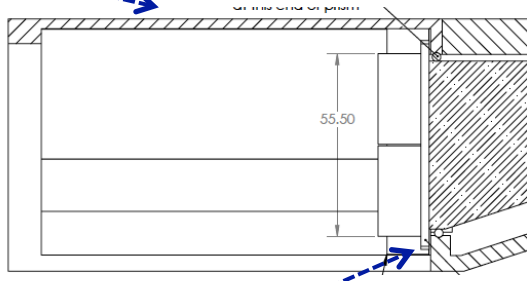
Does the bottom shape need to be slanted? Can it be a box shape? Mechanically either way seems fine.



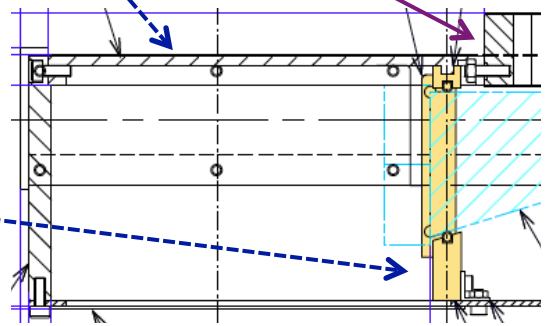


Jim Fast's suggestions (5)

- *Electronics enclosure*
  - *Make the top part of the front-end box be very securely attached to the side rails.*
    - *To help carry the TOP module load from the stiff area (prism to mirror end) to the bwd ECL flange.*
    - *This section must be stiff on its own so that it is not impacted during servicing of the front-end modules.*
  - *→Agreed and has been designed to accomplish the consideration.*
  - *Provide a design that would allow the PMTs to be slid straight down off the prism because of the greased contact.*
    - *The design would need to be completely open at the bottom up to the prism.*
  - *→Yes for the greased contact and the bottom of the PMTs/prism interface is completely open in the current design.*
  - *→Use of an optical cookie, instead of the optical grease, should be considered as well,*
    - *where the PMTs will be removed/contacted by pulling/pushing straight in z-direction.*



This step is due to the round-shape upper panel in a cross-sectional view.



Jim Fast's suggestions (6)

- *Electronics enclosure (cont'd)*
  - *The rear and bottom parts of the front-end box can either be independent parts or integrated as part of the front-end assemblies.*
    - *If they become a part of the assemblies they can be better coupled to the front-end boards so that they are part of the thermal path to get the heat out.*
  - *→They are independent parts in the current design.*
    - *The thermal path as well as the cable path and light shielding are the design items to be realized.*
  - *Essentially the rear, bottom and sides, up to the bottom of the side rails, of the front-end box are a to-be-determined design.*
    - *Requiring integrated design along with the electronics and CDC access constraints.*
  - *→It has been designed considering various constraints, especially the ones given by CDC.*
    - *We need more realistic details for the front-end modules and their (dis)mounting scheme.*
    - *We are planning to examine some conceptual schemes using a mock-up of the front-end box.*