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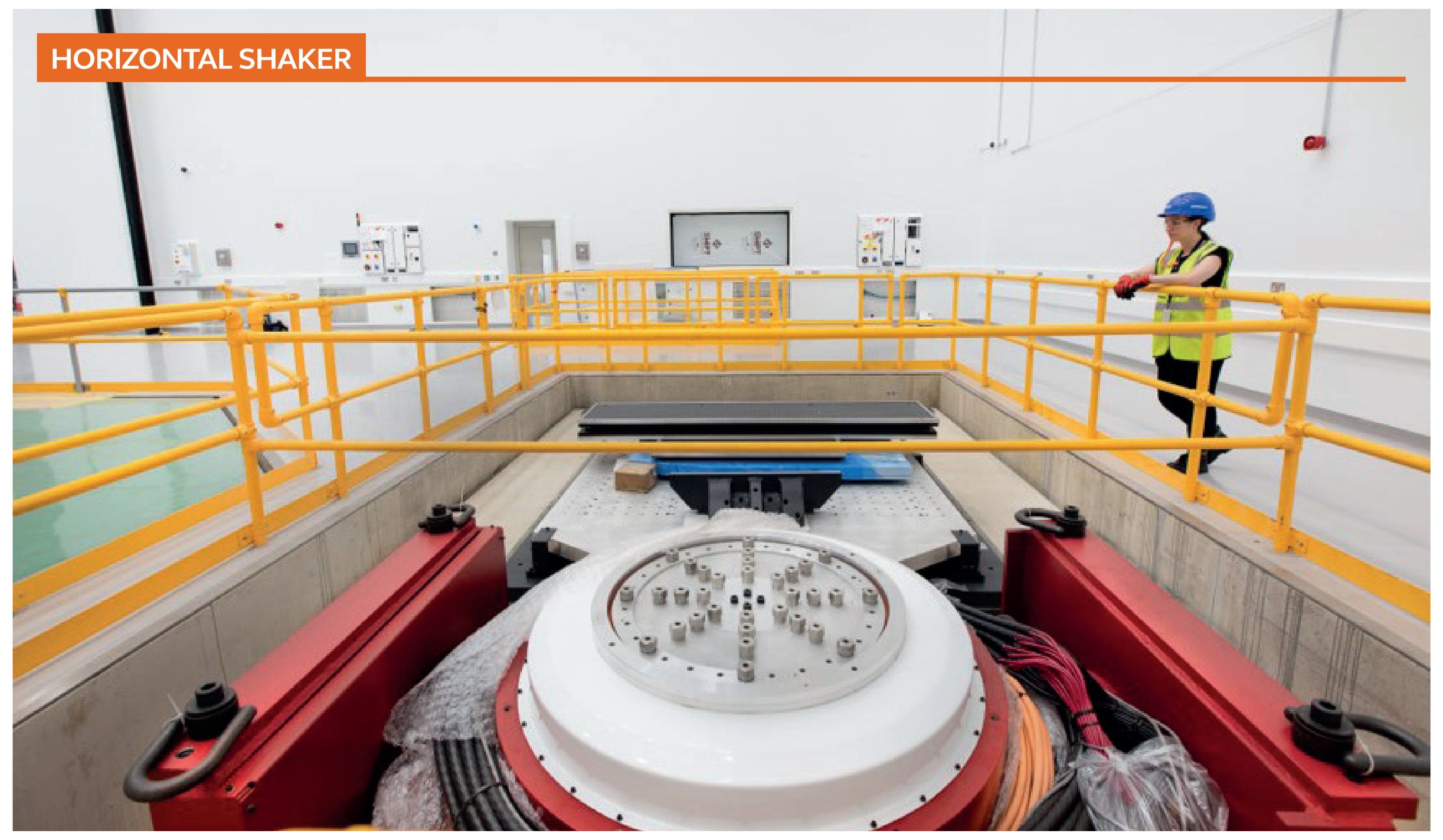
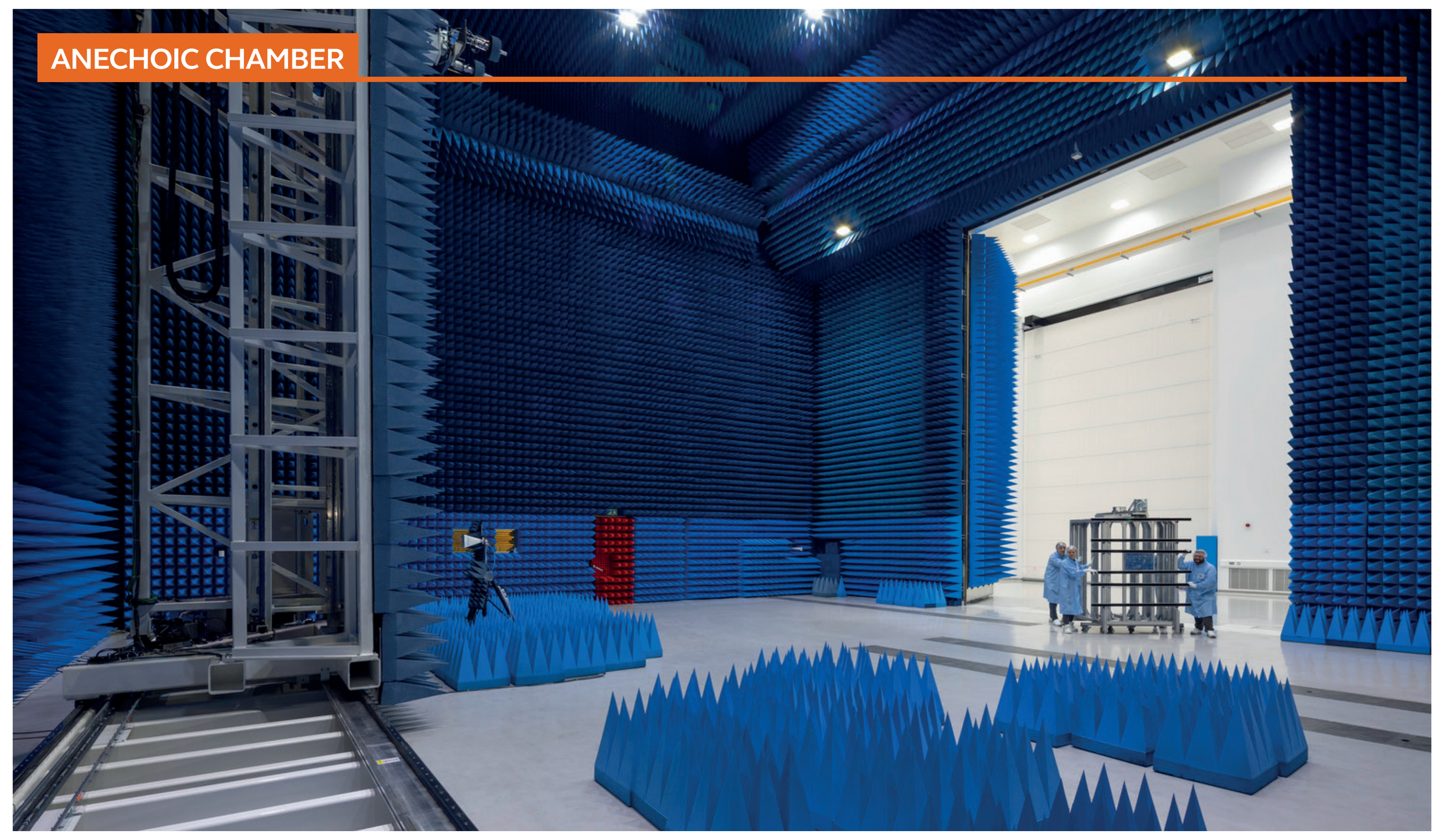
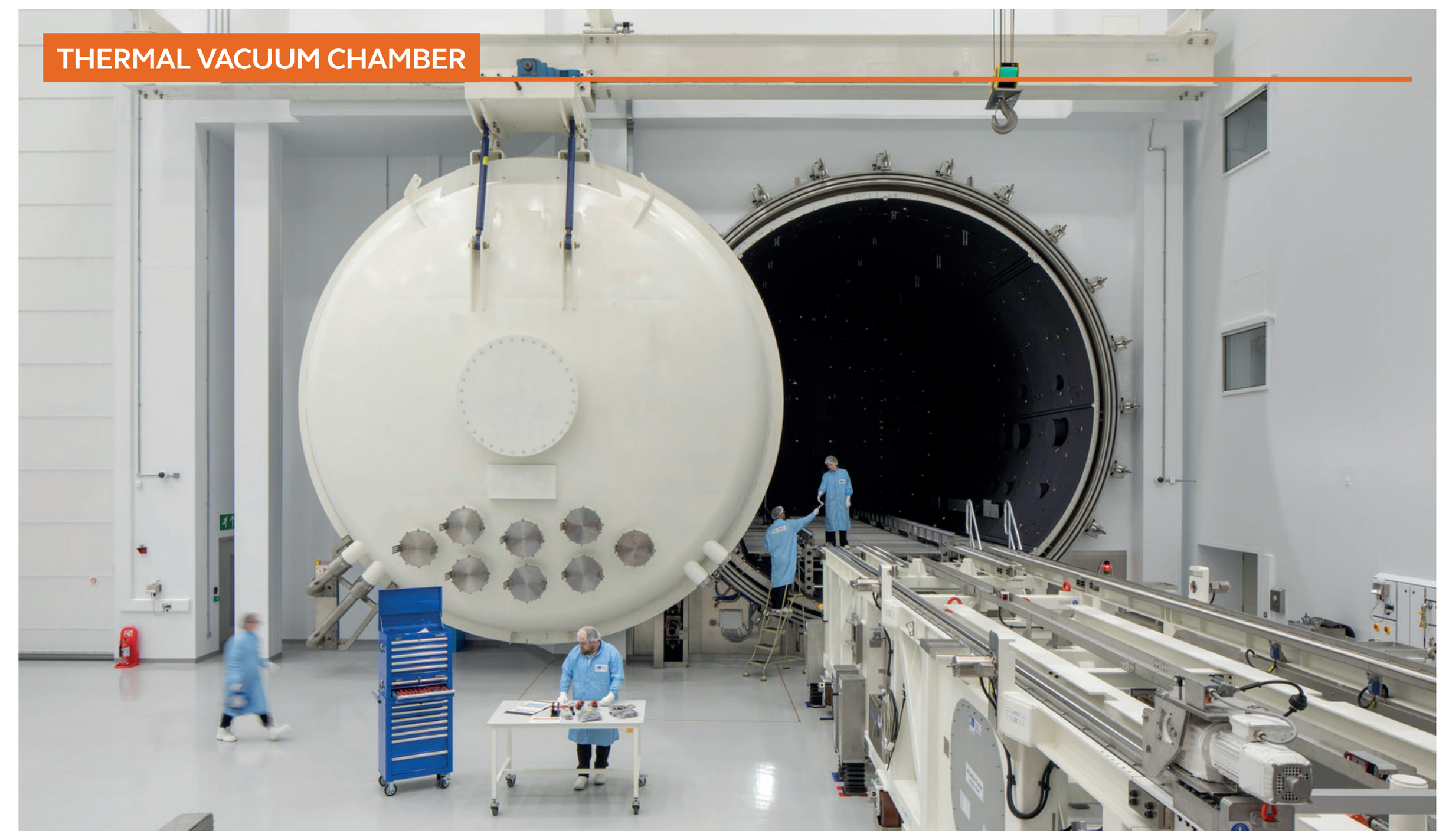


▲ 20,000 movements per second - Rocket simulation test

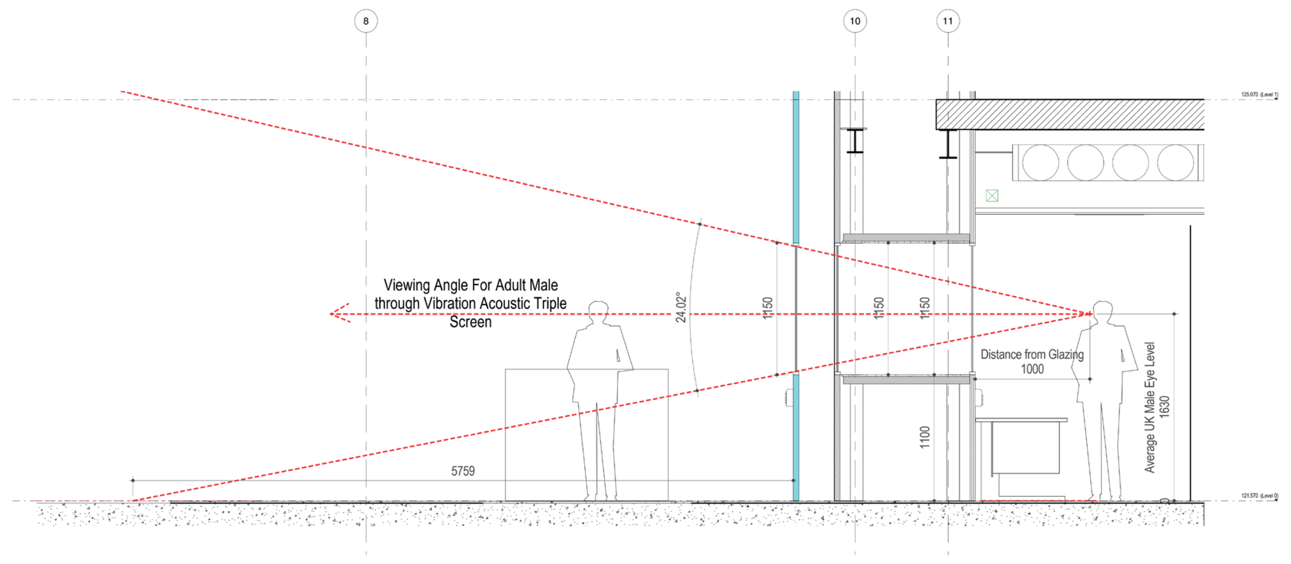


▲ Electrically isolated, signal insulated, hypoxically fire suppressed - Antenna testing

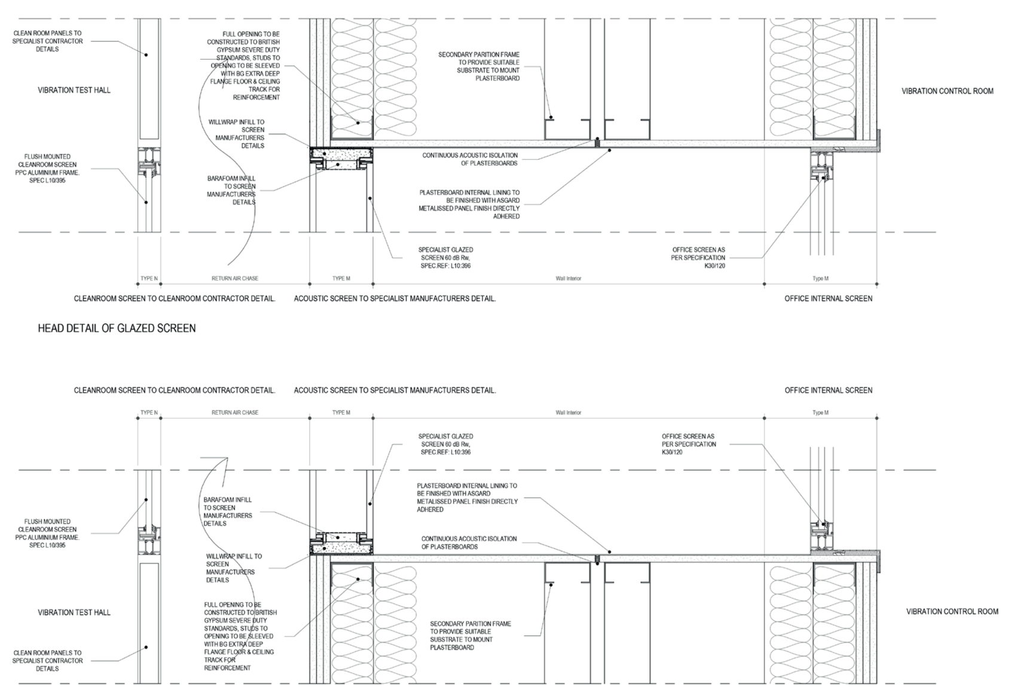
▲ ISO6 ultra clean testing space - Centre of gravity and component testing



▲ Simulates a satellite's travel in conditions of space



▲ Vibration screen viewing angle section


▲ Base Detail of Glazed Screen

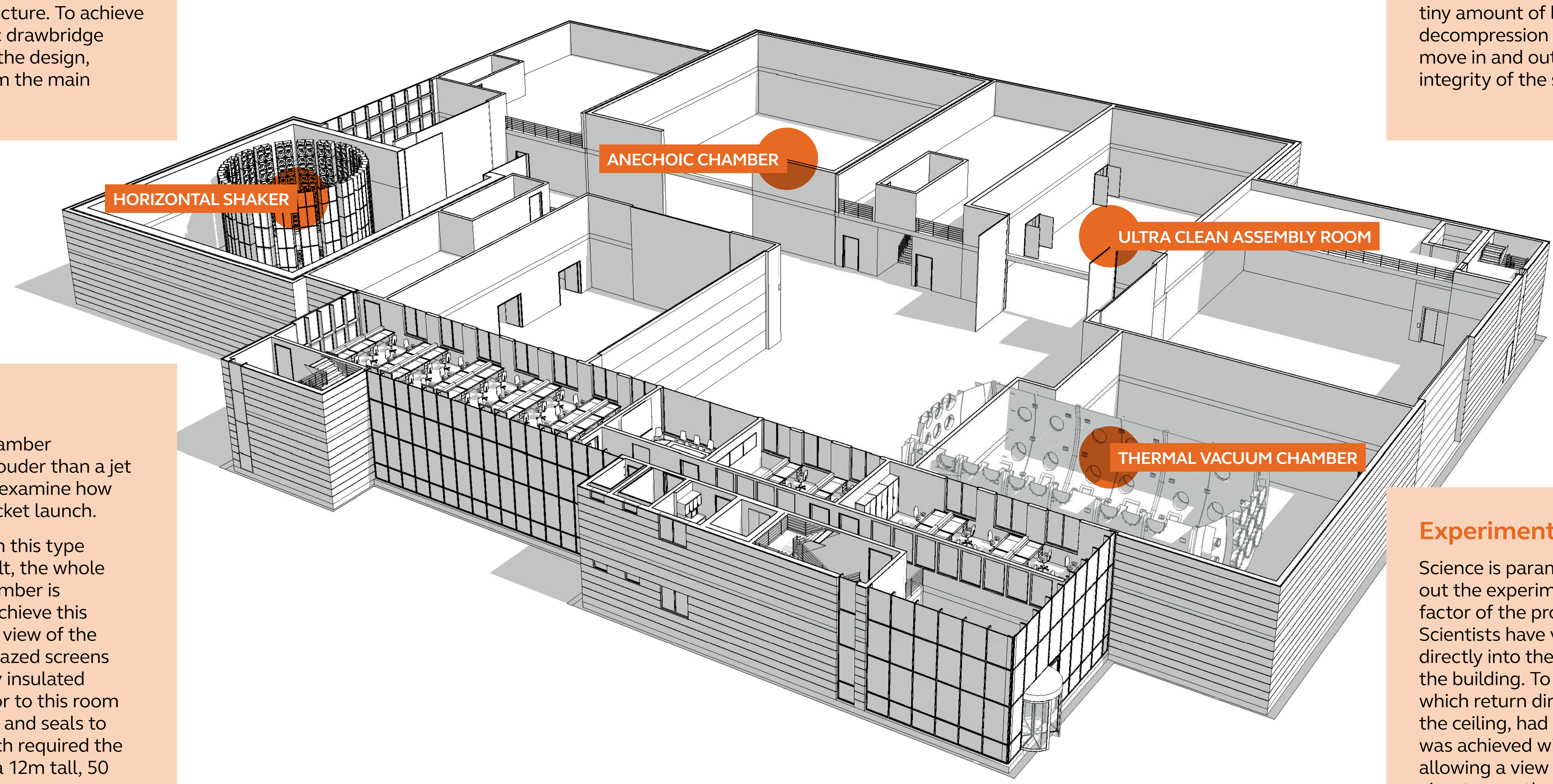
Bridging Isolation

Satellites the size of a minibus need to move into the anechoic chamber, but the chamber also needs to be completely isolated from the rest of the buildings structure. To achieve this, a complicated hydraulic drawbridge had to be incorporated into the design, separating the chamber from the main building structure.

Sounds Like

Satellites in the vibration chamber experience sound patterns louder than a jet engine at take-off. This is to examine how they will behave during a rocket launch.

People would be deafened in this type of environment, so as a result, the whole wall construction of the chamber is independently isolated. To achieve this while maintaining a physical view of the experiment, twin acoustic glazed screens were inserted into the highly insulated wall build ups. The main door to this room automatically rolls to closed and seals to prevent noise escaping, which required the independent suspension of a 12m tall, 50 tonne steel door.

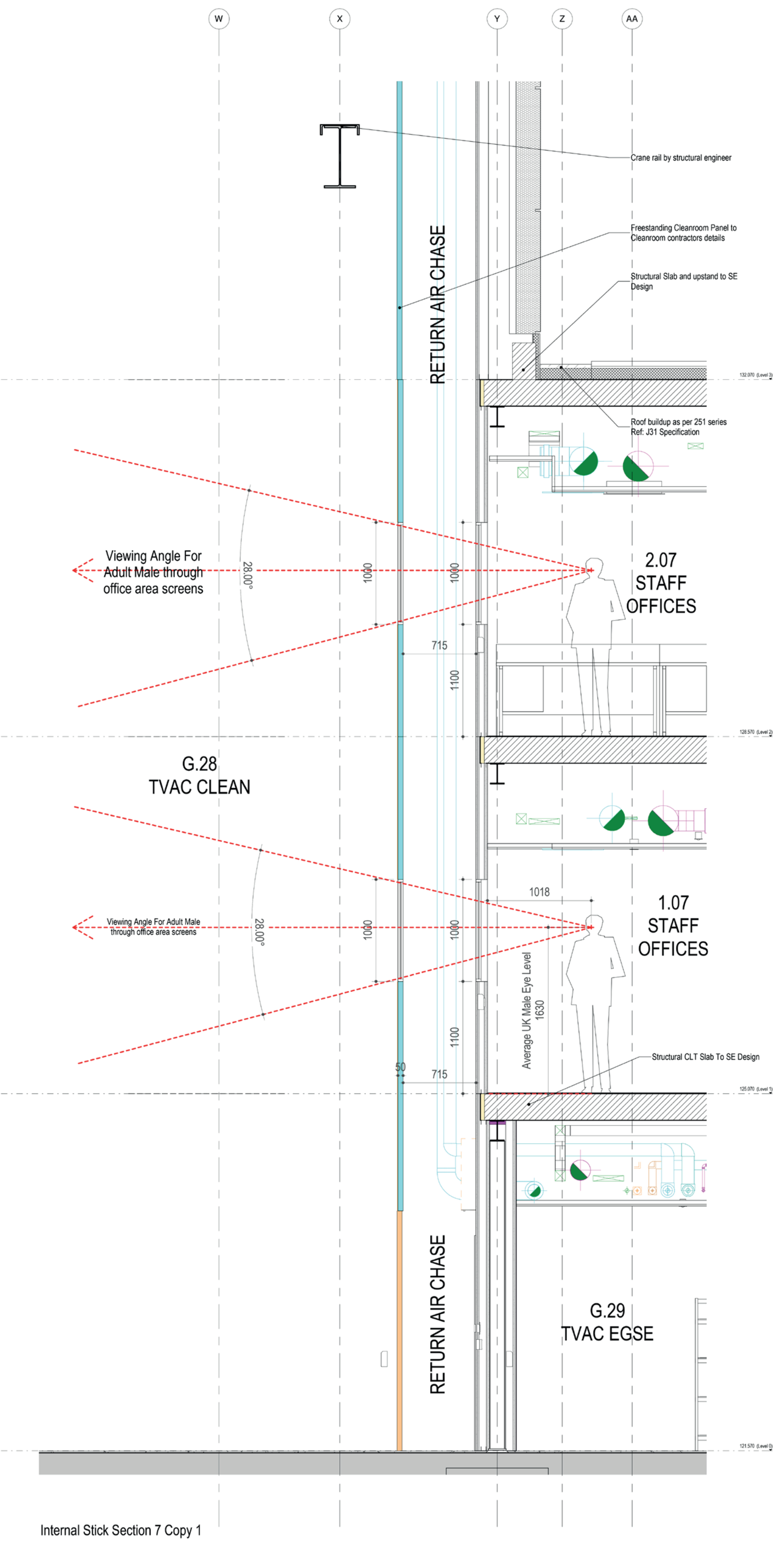


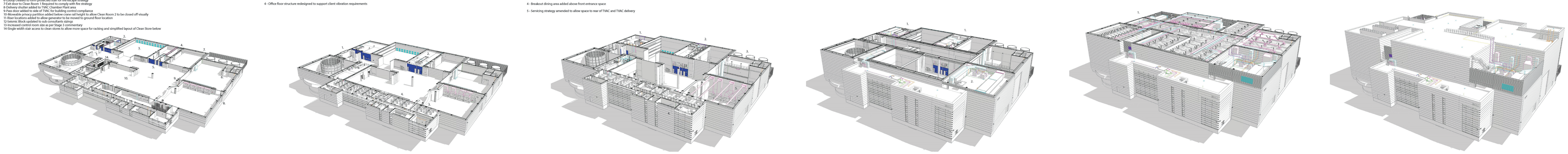
Airtight

The ISO6 cleanroom affords scientists an ultra-clean workspace to examine the most intricate satellite parts. The room has a tiny amount of leakage and interlocked decompression lobbies to allow staff to move in and out without compromising the integrity of the space.

Experimental Overview

Science is paramount, but people carry out the experiments, therefore the human factor of the project was never overlooked. Scientists have views from office spaces directly into the central clean areas of the building. To facilitate this, air chases, which return dirty air to the filter banks in the ceiling, had to be made invisible. This was achieved with a twin screen system allowing a view directly through a sealed air return path.





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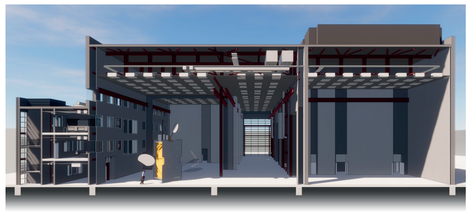


▲ *Building Section - Left to Right - Main Office Blocks - Cleanroom Space to TVAC - Main Spine Corridor - ISO6 Cleanroom*

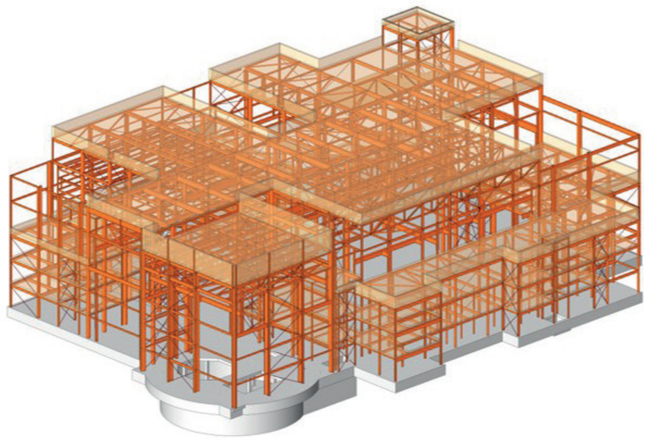
▲ *NSTF Building Exterior*

▲ *Engagement via Virtual Reality Headset*

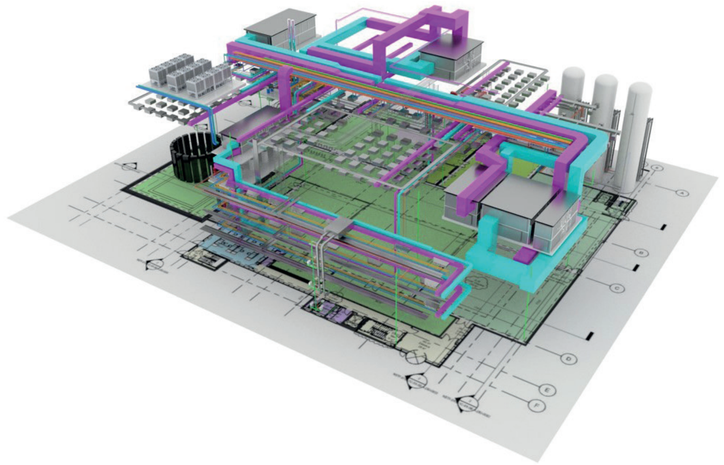
Building Fabric

The building is designed to respond to the science that it contains. The ground floor has a solid concrete slab which facilitates glass smooth transfer floors within the cleanrooms and resistance to vibration. The superstructure is formed of steelwork which creates an exoskeleton around each chamber. Individual chamber walls are formed of differing materials dependent on their unique needs, ranging from copper cassettes, to bunker like concrete panels or lightweight aluminium honeycomb panels.

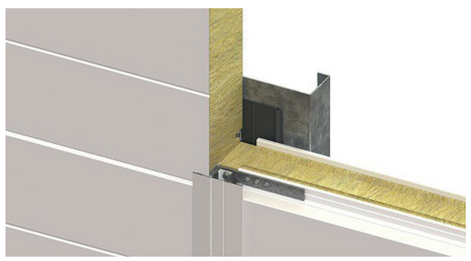
The outer skin of the building is formed from panellised panels packed with stone wool insulation with sealing gaskets. This approach allows modification and removal to change equipment configurations or later add to the buildings fabric. A GRP floorslab creates a deck for the plant space above ceiling and offsite manufactured CLT slabs complete the upper floors. Extensive coordination via Revit with both equipment and building fabric subcontractors allowed the building to be built at speed, even during a global pandemic.



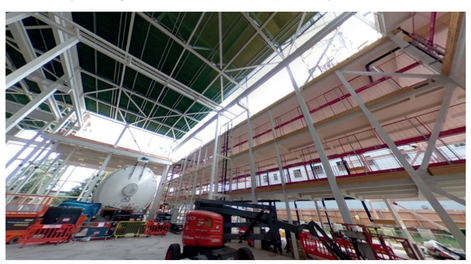
▲ *Structural frame - Revit model*



▲ *Architectural/MEP/Structural coordination model*



▲ *Reusable - Recyclable - Airtight. Well-insulated aluminium composite panels carefully details to minimise structure*

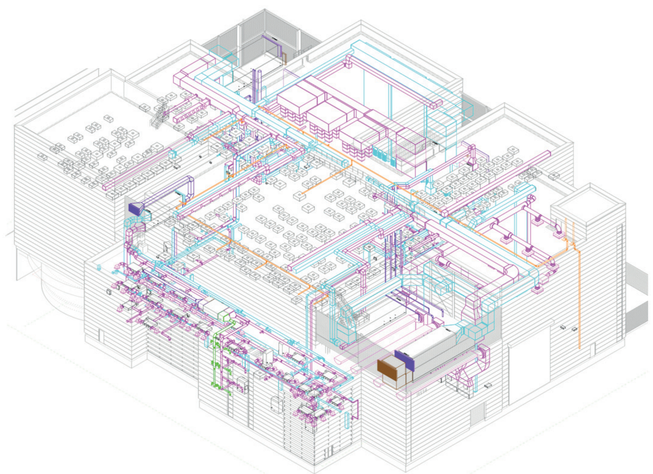


▲ *Onsite 3D photography during construction*

Working through Covid-19 Virtually

The Covid-19 pandemic occurred during the construction period of the building, however coordination and site works were able to continue using digital measures. BIM models from all consultants and equipment manufacturers were federated weekly and linked to onsite 3D photography on a daily basis. This allowed the team to the track progress during the build remotely without attending site.

Virtual reality was used to walk through various spaces, detect clashes and find solutions without putting site staff at risk with additional design team presence. Extensive use of BIM with subcontractors also allowed the elimination of superfluous structural support and optimisation of the materials used on site to minimise waste.



▲ *MEP strategy - Revit model*

Doors For Godzilla

The scale of the NSTF was hard to convey in drawings, so in both user and sub-contractor consultation, virtual reality was used to demonstrate how large the building would actually be. Using a VR headset, we were able to show how the spaces would work together, what the views and vistas for scientists inside would be and also show the scale of the challenge to those bidding to work on the project.

One sub-contractor commented that the 10 x 12m chamber doors must be for Godzilla rather than a satellite showing the massive scale of the design.

The use of the VR headset continued during construction to explore the daily site photography and to help to close out challenging design issues where physical access was limited.

▲ *A34 shut down to transport the TVAC Chamber from Portsmouth Docks*

▲ *TVAC Chamber Size Comparison Courtesy of RAL Space*

Assembly

The building was conceived as a flexible shell around which scientific research could evolve. RAL Space has, over a number of years, increased their capacity to have larger, more sophisticated equipment, however to stay ahead the building would need to be flexible enough for the latest innovations to be integrated.

More than 40 individual suppliers models linked together to form the final NSTF BIM model with each piece being designed to fit together but be flexible to be retrofitted in future. Even the large TVAC chamber was detailed in modular sections which were shipped by boat and then via the A34, closing the motorway temporarily to allow them to be delivered. Once onsite they were bolted back together.

Floors, MEP modules and facade panels all followed this ethos, limiting the need for construction on site.