

CFRP CONICAL GRID SHELL STRUCTURE WITH EMBEDDED FOS

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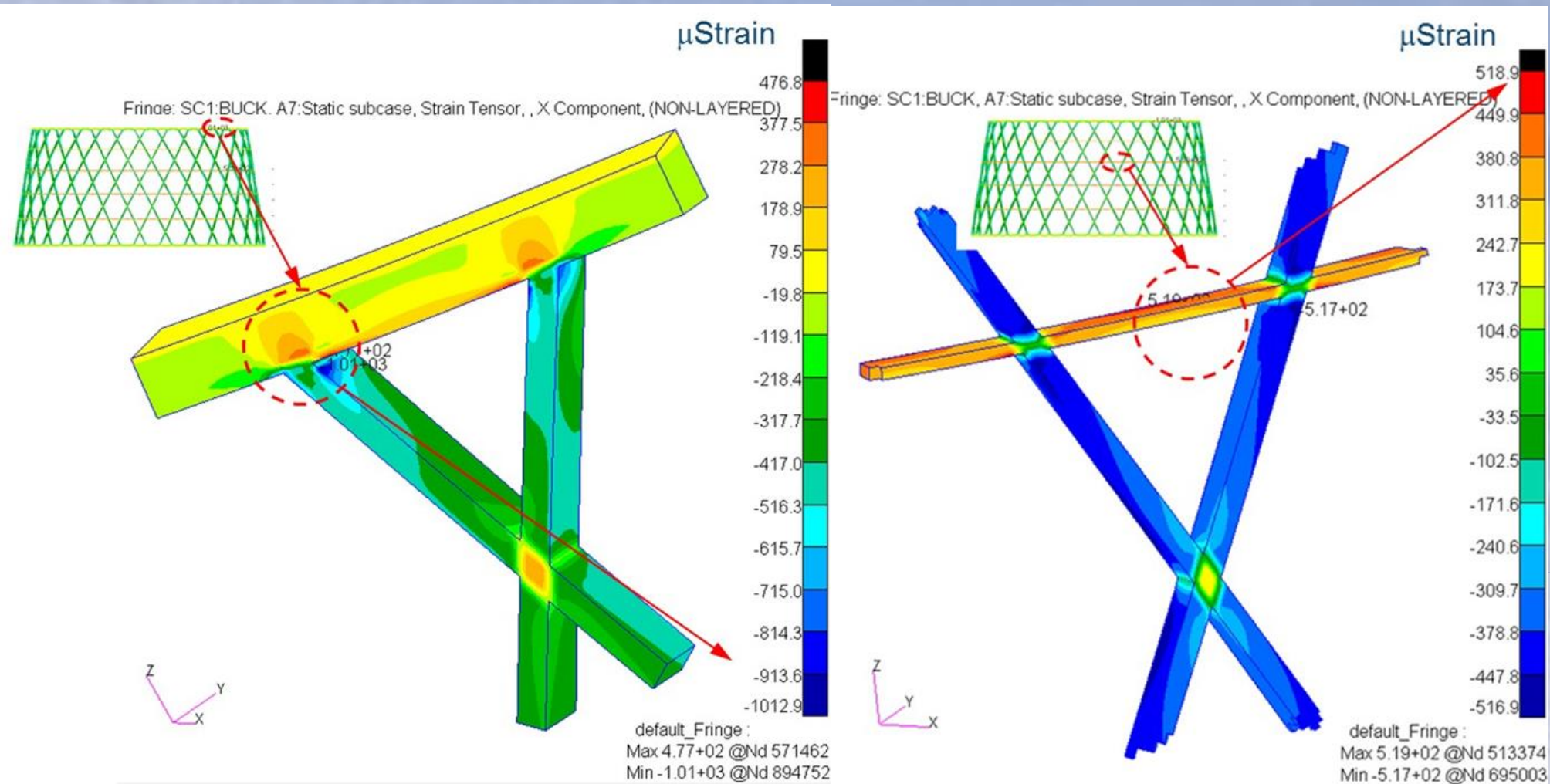
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Keywords: Grid Structure, Robotic Winding, Resin Infusion, Optical Fibers, Health Monitoring

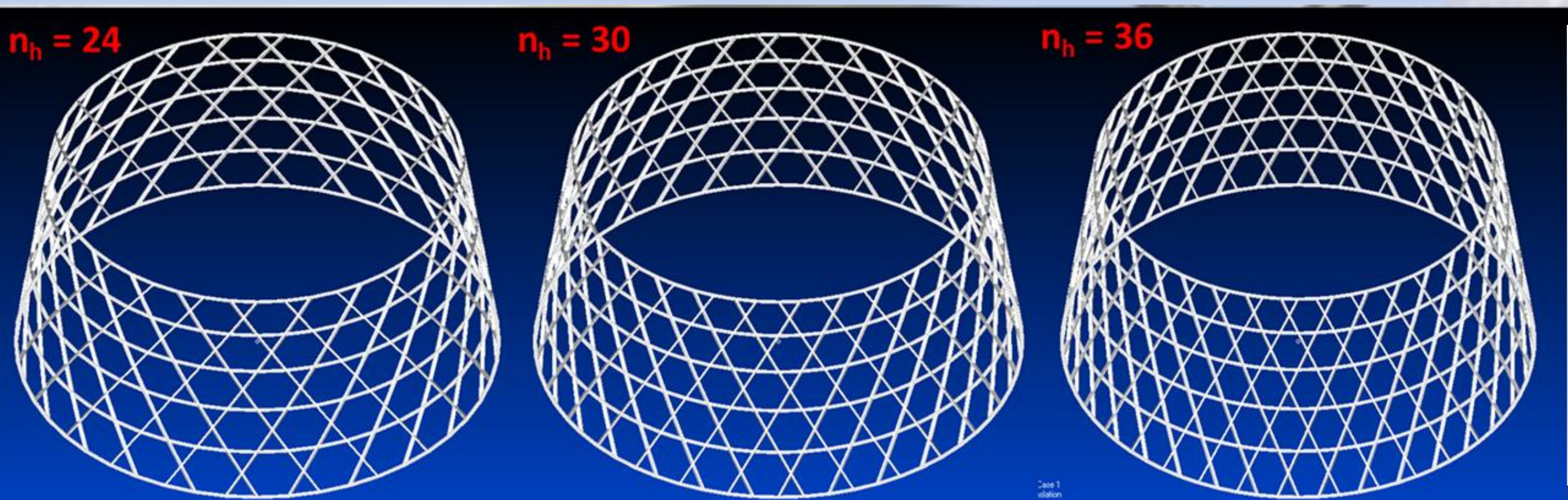
Highly efficient Conical Adapter Grid Demonstrator for medium-class satellites:
10 Optical Fibers are embedded in the middle of helical ribs during the manufacturing process
for an effective and “permanent” mechanical and thermal strain sensing system

DESIGN REQUIREMENTS

- Dimensions: height 650 mm; diameters 1400 mm, 1200 mm
- Strength: 120 kN (LL) in axial compression
- Stiffness: transverse tip displacement < 1.2 mm under 8.0 kN (tip offset 1800 mm)
- Mass target: 8.2 kg (20% weight saving over a CFRP baseline solution)

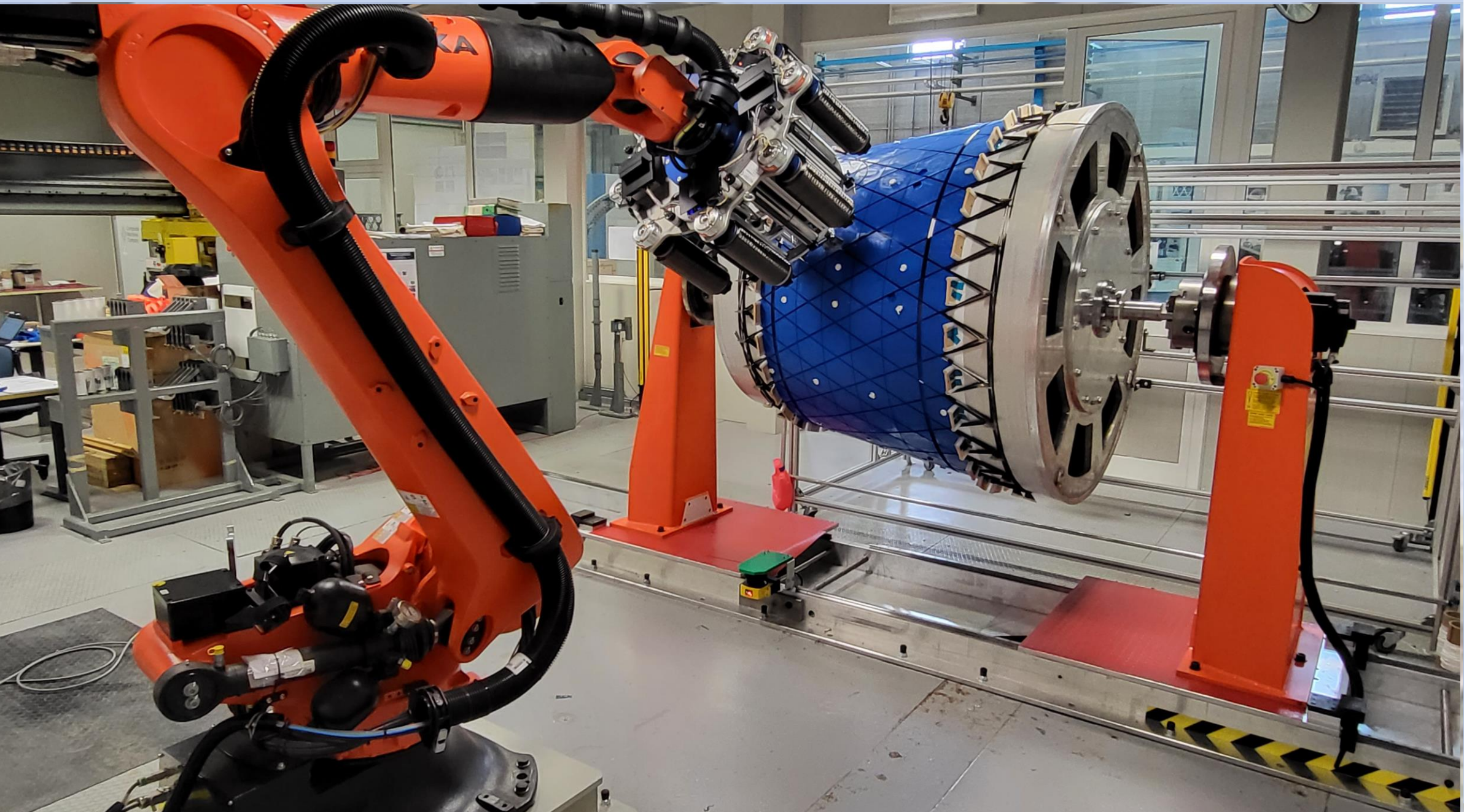


MINIMUM MASS DESIGN & DETAILED 3D FEM



- Exploration and optimization of each possible Grid configurations to identify the minimum mass solution
- In the picture on the left, 3 best candidate configurations are characterized by different numbers of helical ribs, n_h
- The final designed solution ($n_h=30$) is transformed into a 3D CAD and FE model and analysed in detail

EFFICIENT “PARALLEL WINDING” OF DRY PREFORM & LIQUID RESIN INFUSION



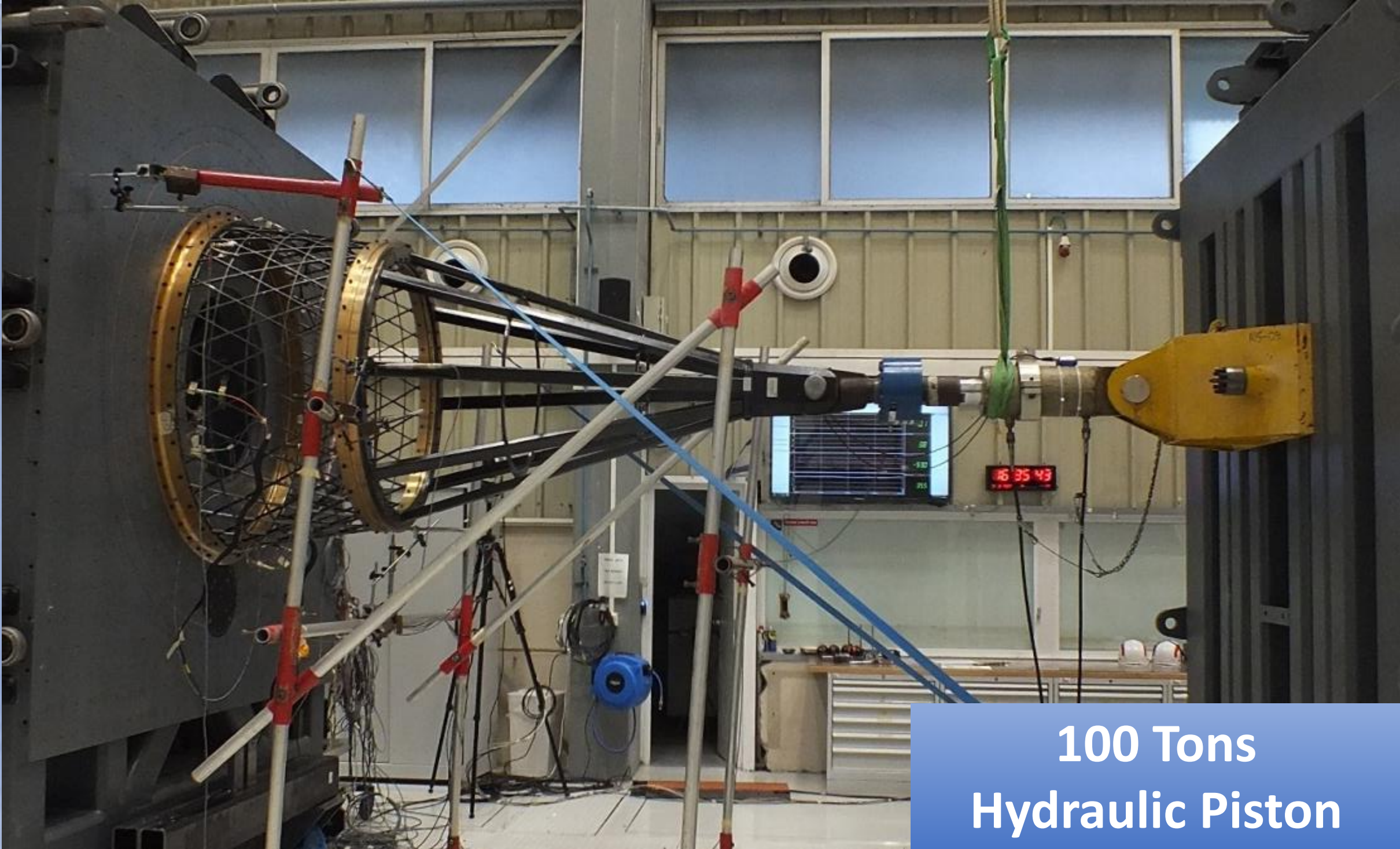
- The Robotic cell is capable of winding a single layer in only 20 minutes
- Helical and hoop ribs are continuously interlaced (Parallel Winding)
- Manual insertion of 10 Optical Fibers at half the rib thickness
- Vacuum bag, resin infusion, oven cure



MECHANICAL TESTING CAMPAIGN WITH EMBEDDED FOS SYSTEM PERFECTLY WORKING

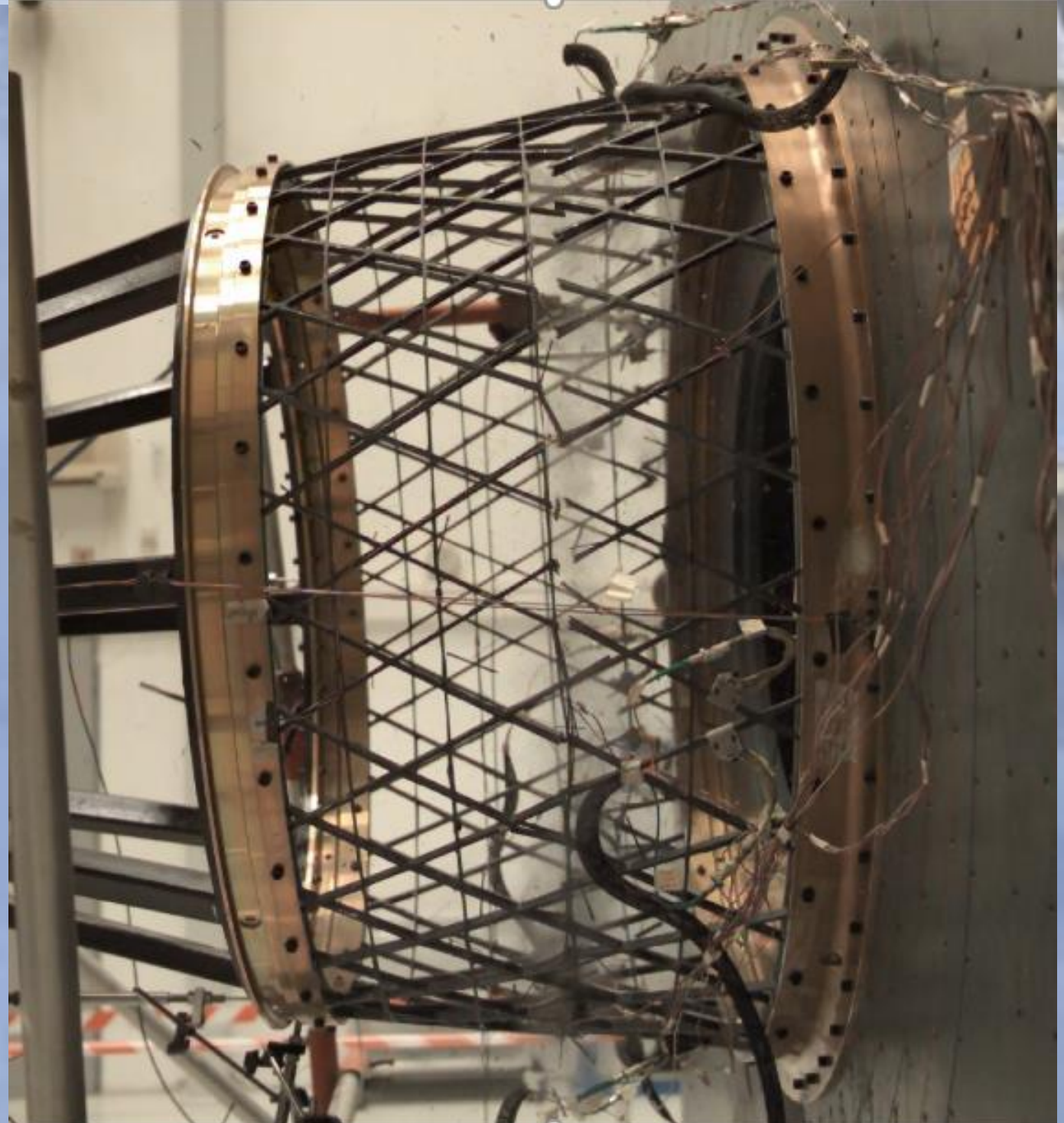


Mass = 7.2 kg (30% weight saving)

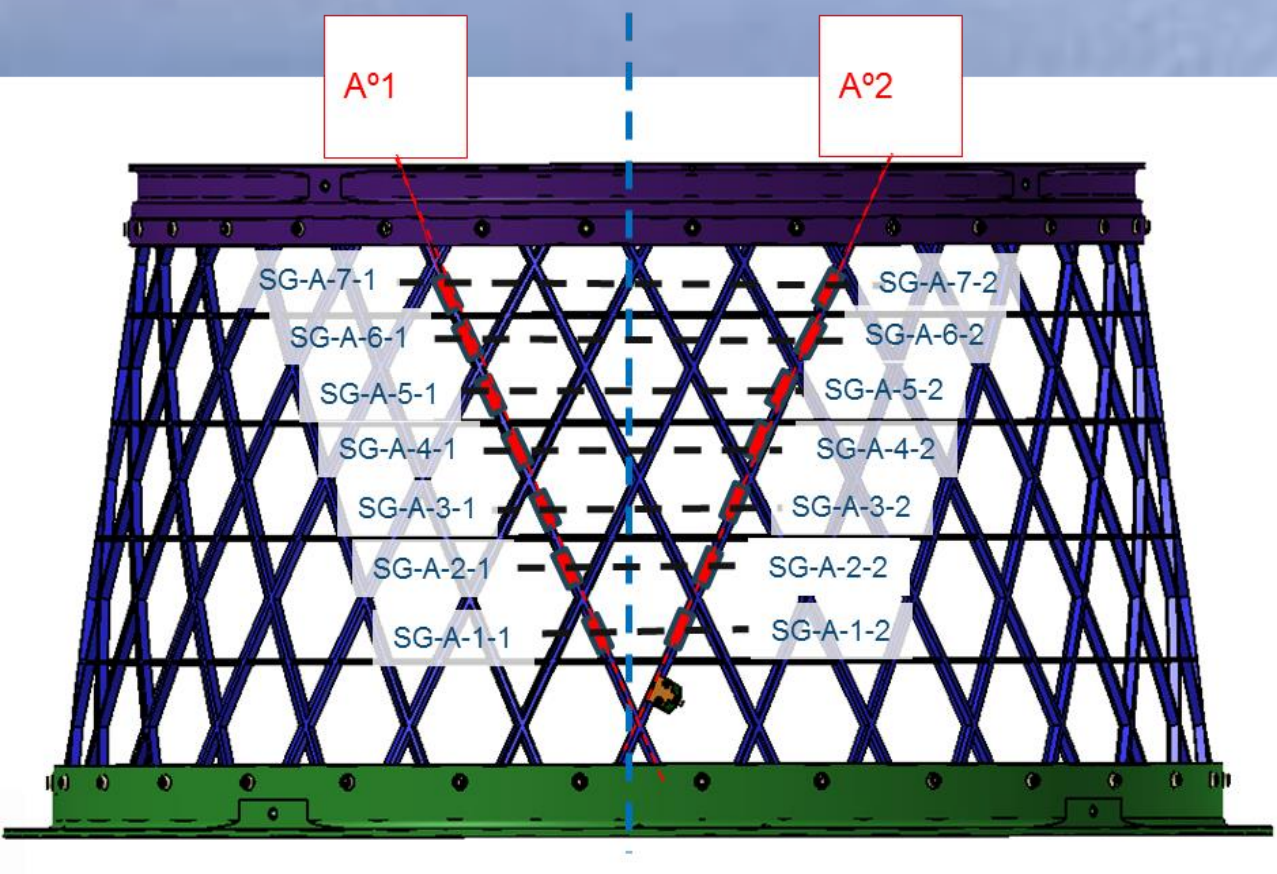


100 Tons
Hydraulic Piston

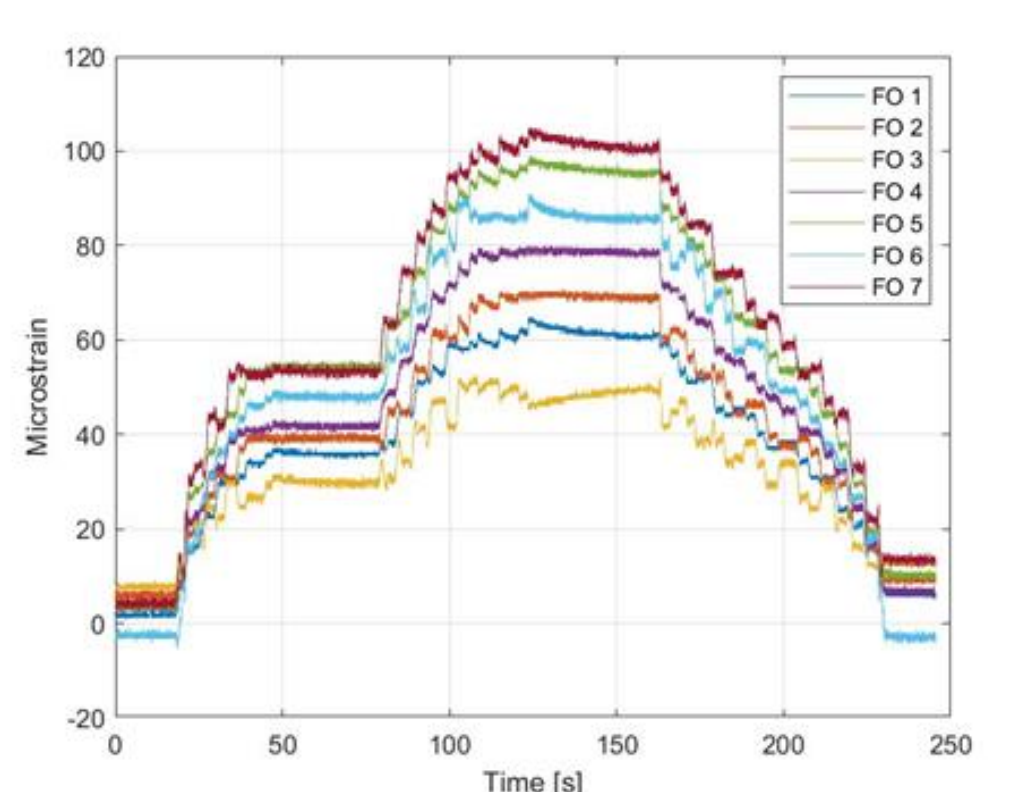
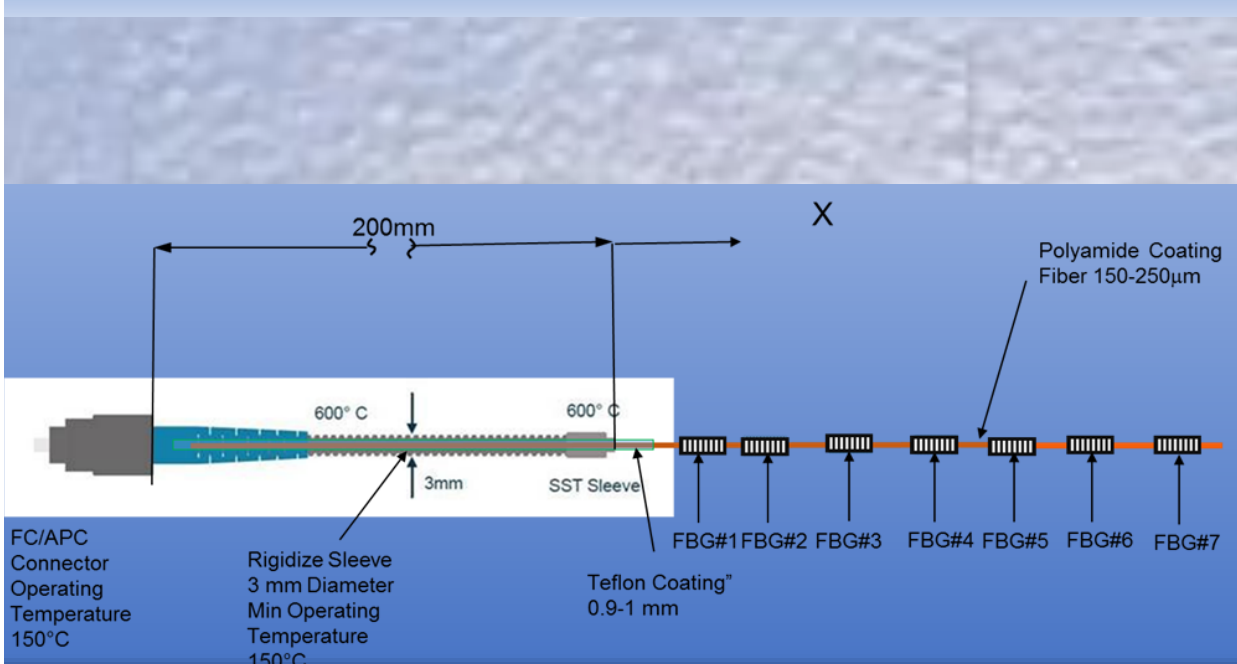
Test Assembly at IAI premises (Tel Aviv)



Failure Load = 80 Tons !



70 FBG sensors embedded



Design, Analysis, Manufacturing and
Test of the Grid Demonstrator
will be fully detailed in specific papers