DEMOBENCH

DEMISABILITY DEMONSTRATION OF CFRP OPTICAL BENCHES

BASED ON: TM-2234-OHB_01

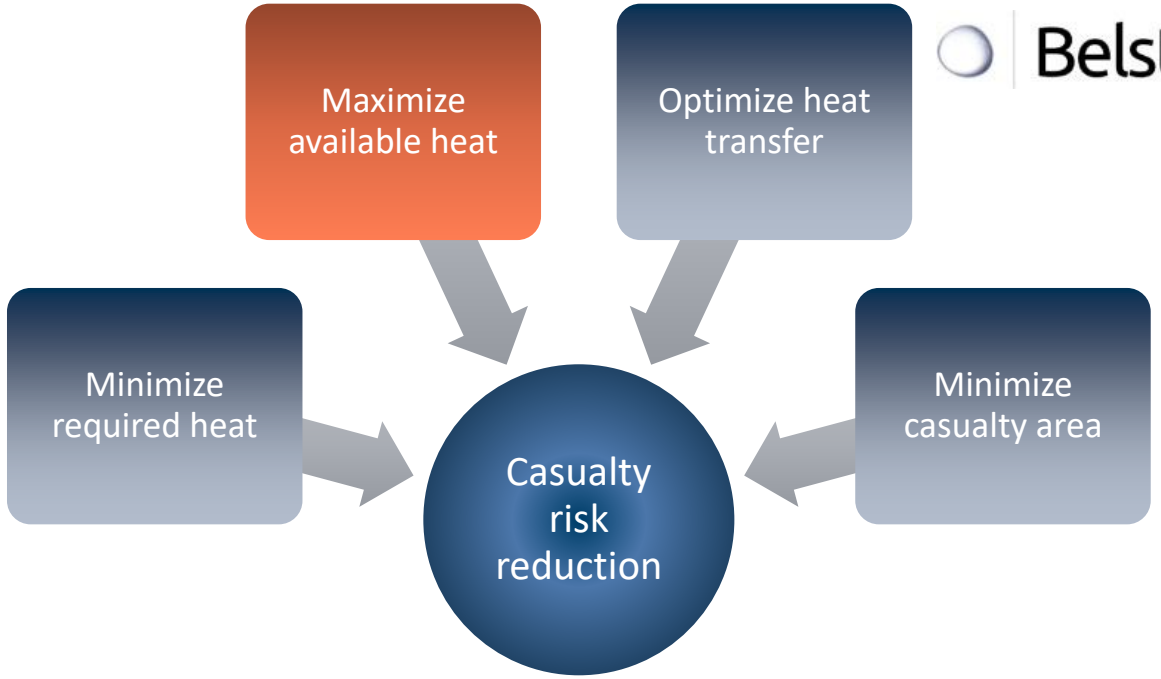
INTRODUCTION

STUDY OVERVIEW

Study Objective

Improvement of “Optical Bench design solutions for future Earth Observation optical missions to comply to demisability requirements, allowing for uncontrolled re-entry”[1]

- Assess configurations of ‘demisable’ materials, surfaces, and manufacturing technologies
- Design, analyse and test breadboard of a CFRP optical bench which fulfils predefined demise- and thermomechanical requirements



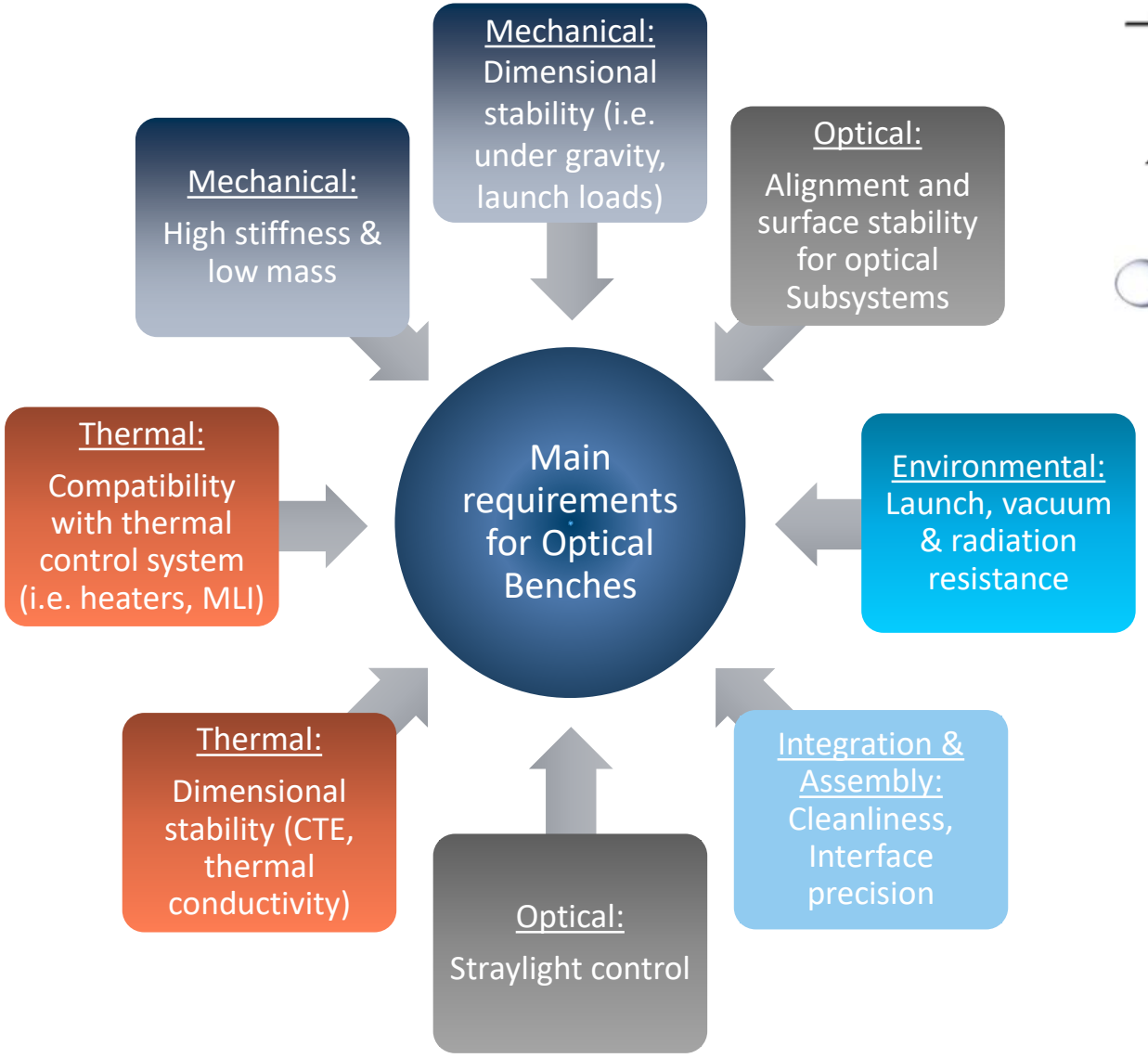
[1] *SOW Demisable optical bench in carbon fiber reinforced plastic; ESA-TECMSS-SOW-2024-002988; TEC-MSS 25/10/2024*

INTRODUCTION

STUDY OVERVIEW

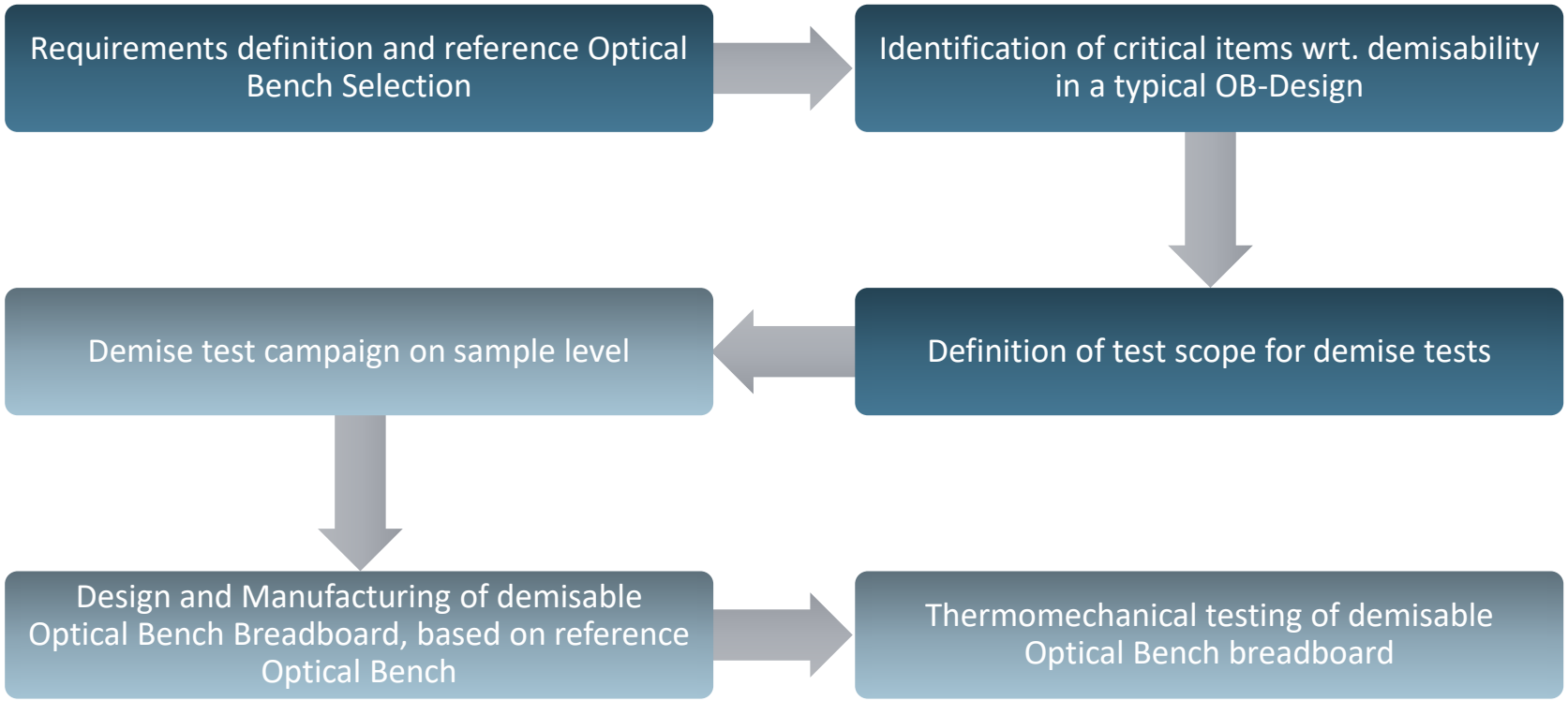
Typical design solution for optical benches

- Monolithic: machined (or 3D-printed) from Aluminium, Silicon Carbide, Zerodur
- Sandwich Panel: Aluminium honeycomb with CFRP facesheets
- Frame/Truss Structure: Sheets, Beams and Rods (mostly CFRP) and Fittings (often metallic)
- Hybrid designs
- Isostatic mounting required



PROJECT STEPS

WORKFLOW DIAGRAM



REFERENCE MISSION SELECTION

REFERENCE OPTICAL BENCH SELECTION

Identified reference missions to derive generic mission requirements

- LEO (approx. 650 – 1000 km)
- S/C Mass: 500 – 1200 kg

Relevant Optical Bench aspects for this S/C mass-class

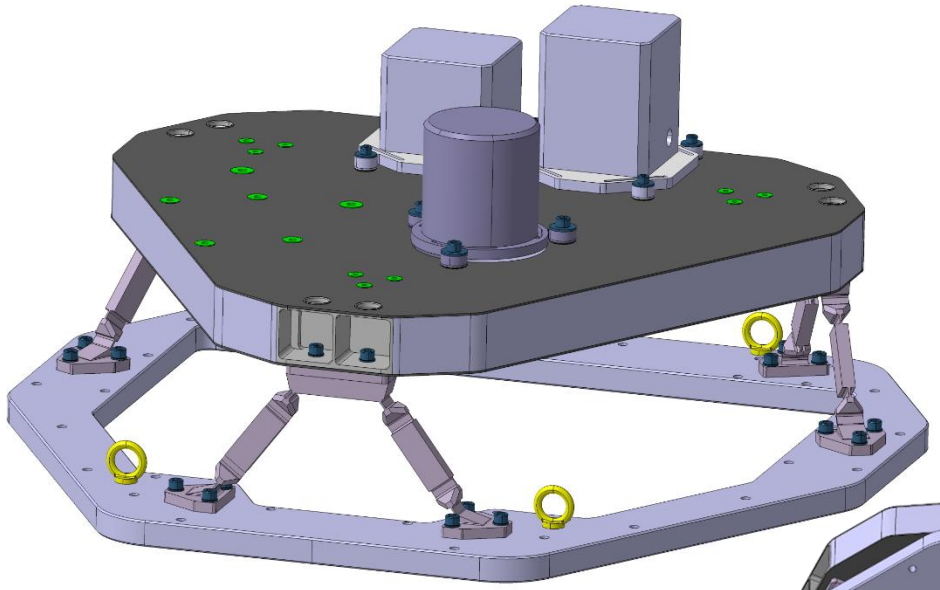
- Weight of Optical Bench (w/o mounts, instrumentation, thermal HW, optics): 30-80kg
- Dimensions of Optical Bench (area): 0,4 -1,0m²
- Sandwich panel design as the most used design solution

REFERENCE OPTICAL BENCH SELECTION

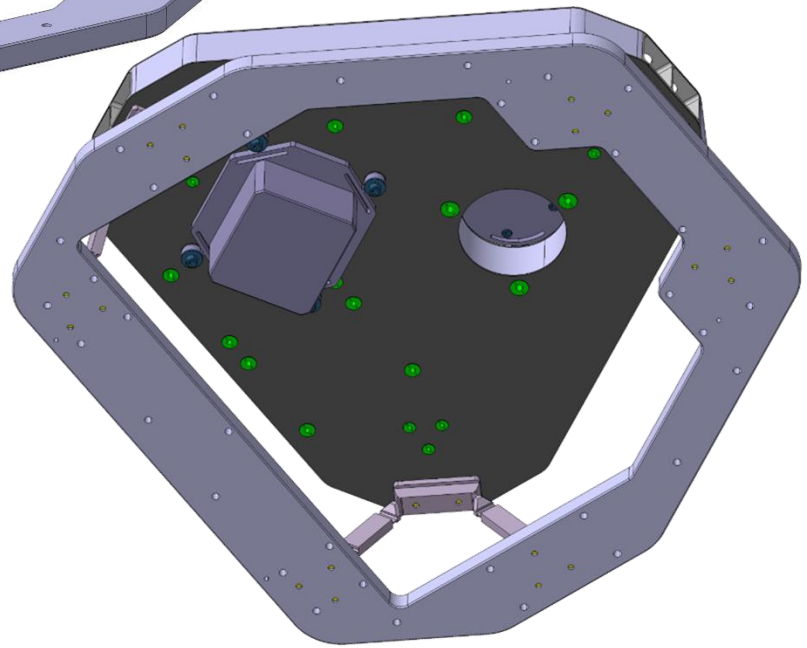
DESIGN ASPECTS AND DECISIONS

Design and materials

- CFRP-Al Honeycomb panel with 70mm overall-thickness, high-modulus fibres and cyanate ester resin
- Face-to-Face inserts: interfaces for mass dummies and measurement equipment
- Block inserts: interfaces for kinematic mounts
    - Potting adhesives for various insert types under consideration
    - 4 mass dummies masses totalling approx. 50kg +/- (tbd)



Optical Bench reference top view



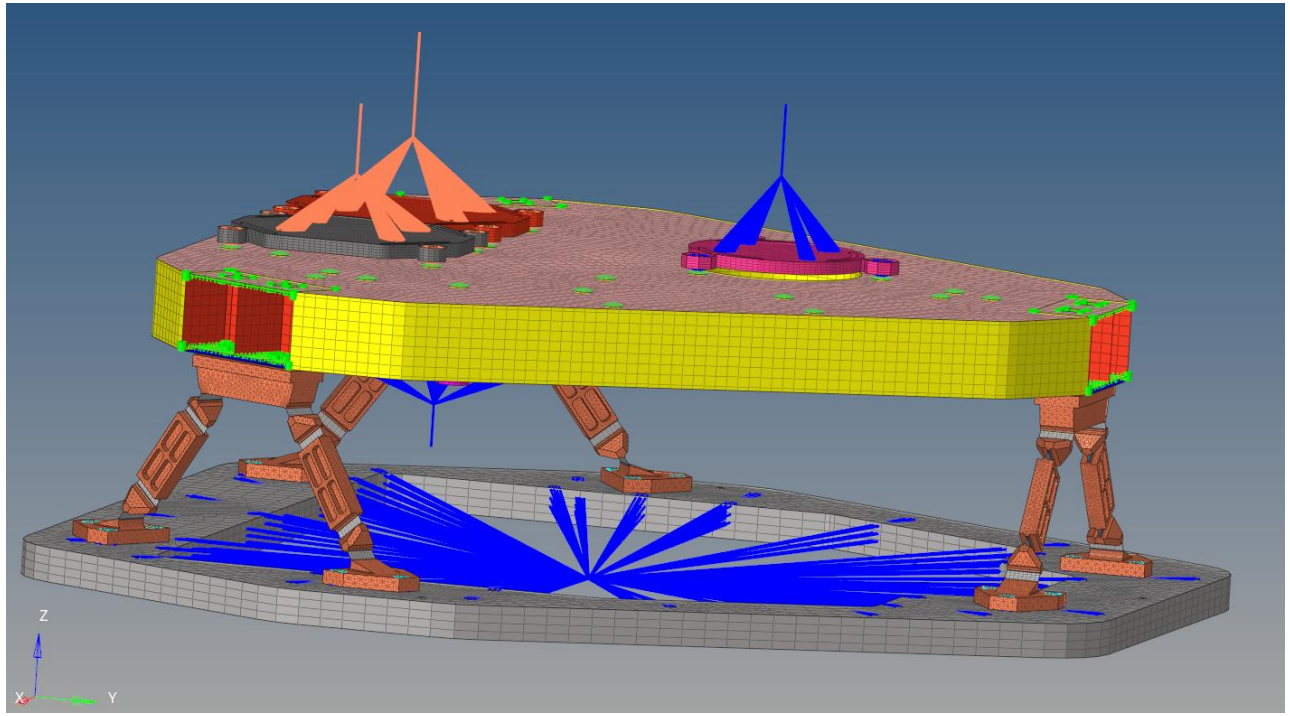
Optical Bench reference bottom view

REFERENCE OPTICAL BENCH SELECTION

STRUCTURAL ANALYSIS

Structural (Performance) analysis

- FE-model of reference OBA established
- Analyses were performed with MSC-NASTRAN
- Performed analyses and results:
  - Modal analysis – 1st Eigenfrequency sufficient
  - Quasi-static-loads (QSL) – positive MoS
  - Performance analysis – evaluation of relative motion (6DOF):
    - ➢ Gravity release: 1g in each direction
    - ➢ Delta-temperature=1K

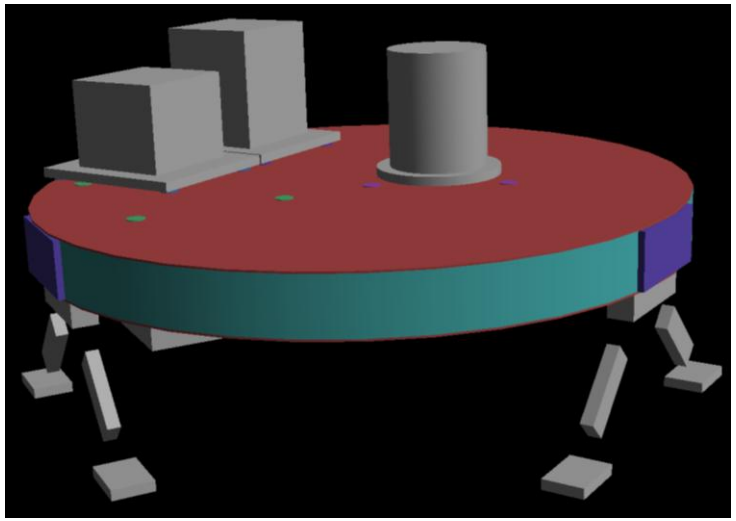


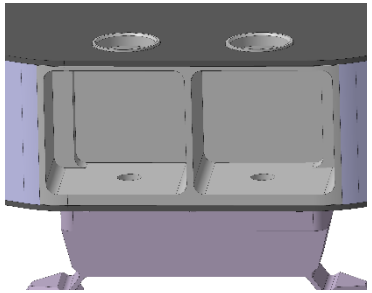
Optical Bench reference structural analysis

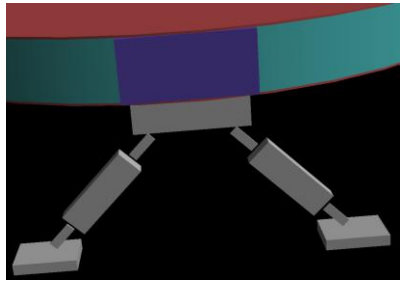
REFERENCE OPTICAL BENCH SELECTION

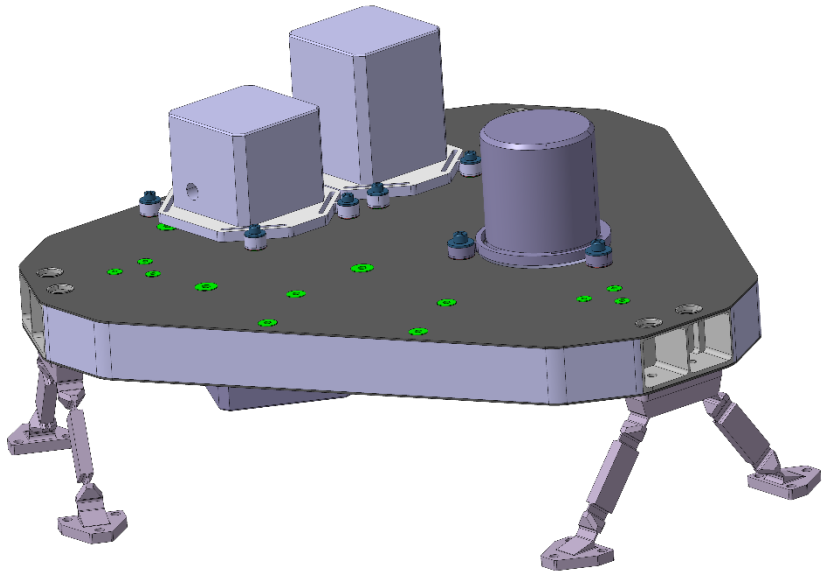
RE-ENTRY SIMULATION – DEMISE ANALYSIS

- SAMj Model of Reference Optical Bench
  - All key parts modelled
  - Facesheets, honeycomb, block inserts, standard inserts
  - Basic model of instruments, simplified bipods
  - Minor shifting of instruments so not to overlap edge
- Adaptations
  - Major approximation is shape of bench
  - Matched projected area of facesheet
- Hard Point / Bipods
  - Thin sections included for fragmentation
  - Titanium and steel bipods modelled
  - Block insert modelled as cuboid
    - Heating factor for shape









THANK YOU!

OHB System AG
Universitätsallee 27-29
28359 Bremen
Germany

Phone: +49 421 2020 9362
Email: bradley.lockett@ohb.de
Web: www.ohb.de

OHB System AG
Manfred-Fuchs-Straße 1
82234 Weßling
Germany

Phone: +49 8153 4002 645
Email: ludwig.eberl@ohb.de
Web: www.ohb.de