

DEVELOPMENT OF BALLISTIC LEVEL III ARMOR PLATES AND PLATENS

Design Objective and Applications

Objectives: A ballistic level III armor plate and platens for a hydraulic press are to be designed. Level III ballistic threats are the most common encountered threats in the field. The level III armor plates should be able to withstand six spaced rounds of 7.62x51 mm M80 NATO Ball from 51 feet at a speed of 2,780 feet per second.

The armor plate assembly is to be compact, light and should consist of materials commonly used and readily available in industry. The armor shape will replicate the curves of an existing 160 grams per square meter (GSM) ultra-high-molecular-weight polyethylene (UHMWPE) 80 ply fabric plate provided by Milburn Mountain Defense.

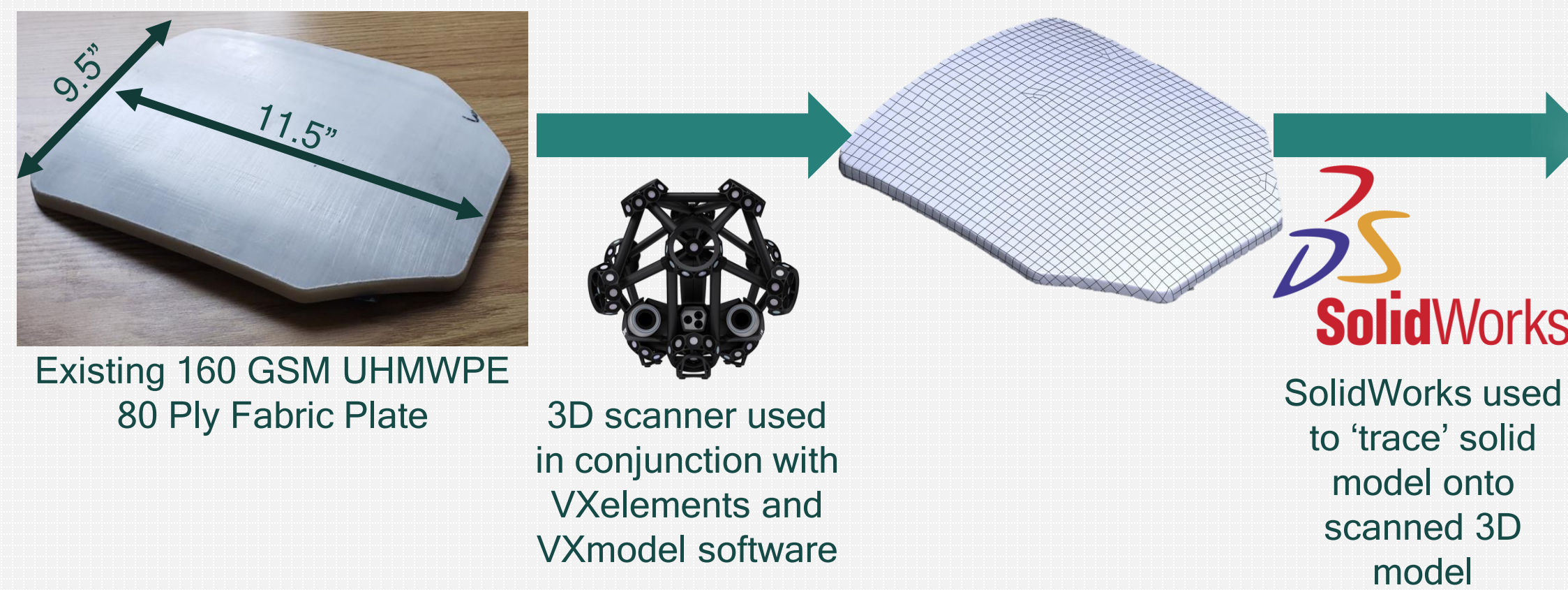
Outcome: Design and develop drawings of a fully functioning armor plate able to withstand level III ballistic threats. The aluminum platens used in the hydraulic press are also to be designed.

Applications: The developed design will be used to protect Canadian soldiers from level III ballistic threats.

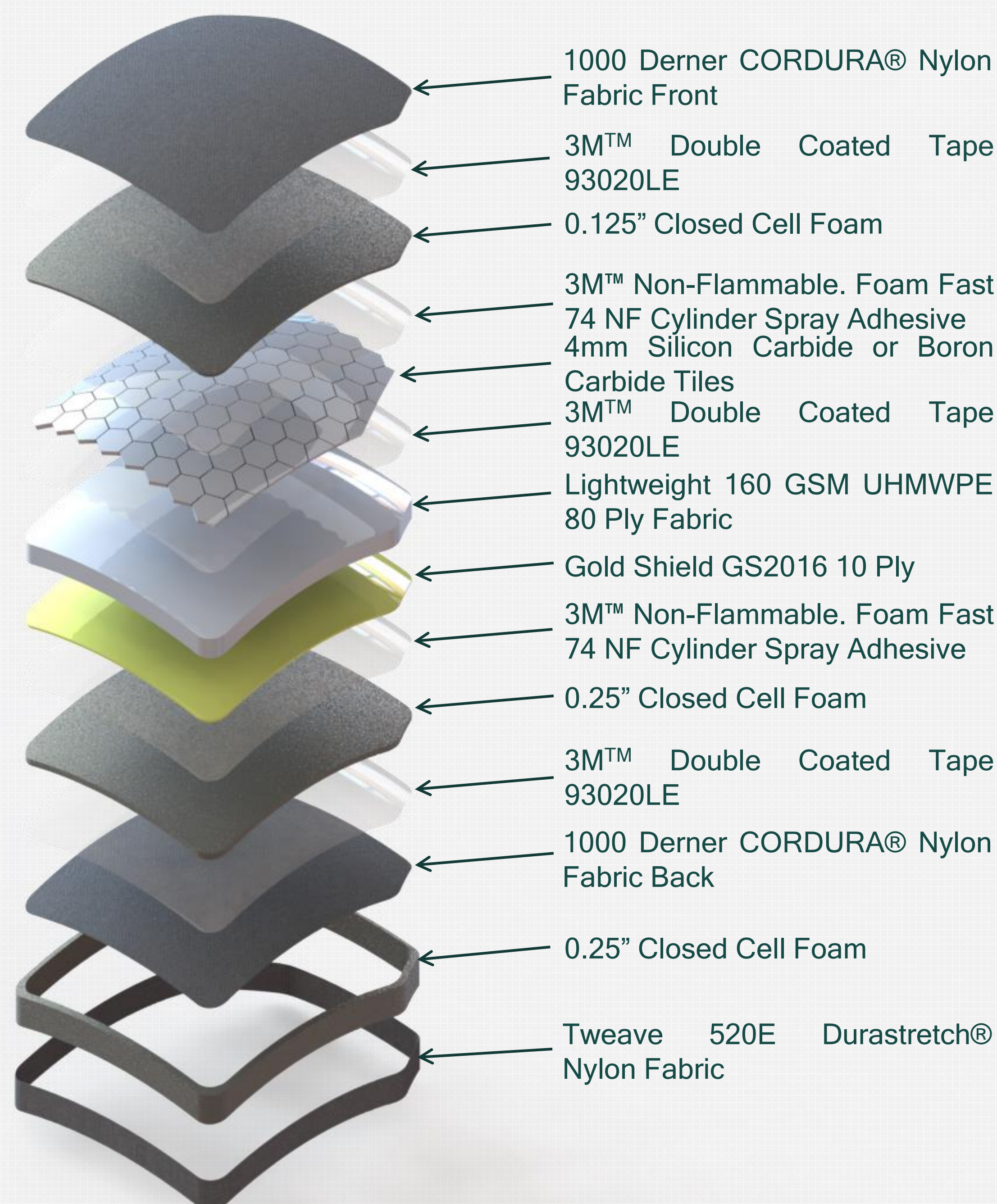
Tools Used for Design Development

- **Creaform Metrascan 750 Elite 3D Scanner:**
Used to 3D scan both sides of the existing 160 GSM UHMWPE 80 ply fabric plate to acquire curve shape.
- **VXelements and VXmodel software:**
VXelements used to acquire scanned plate curvatures. VXmodel used to stitch bottom and top plate surfaces together, to clean any unwanted noise, and export final model to SolidWorks.
- **SolidWorks 2019:**
Used to trace a newly generated solid model on the imported scanned model. The 'flex' feature was used to shape the 3D model on the existing design. These same settings were used for all parts of the assembly. Drawings were then produced for the plate assembly.
- **Coordinate measuring machine (CMM):**
In order develop the same curves on the platen, a CMM was used to collect coordinates of a grid drawn on the existing 160 GSM UHMWPE plate, which were exported to CATIA.
- **CATIA:**
Several second order curves were best-fitted to the imported coordinates of the plate's curvature. These curves were connected to form a smooth 3D surface. A 3D solid was then extruded to the curve to generate the platen design. Drawings were also produced.

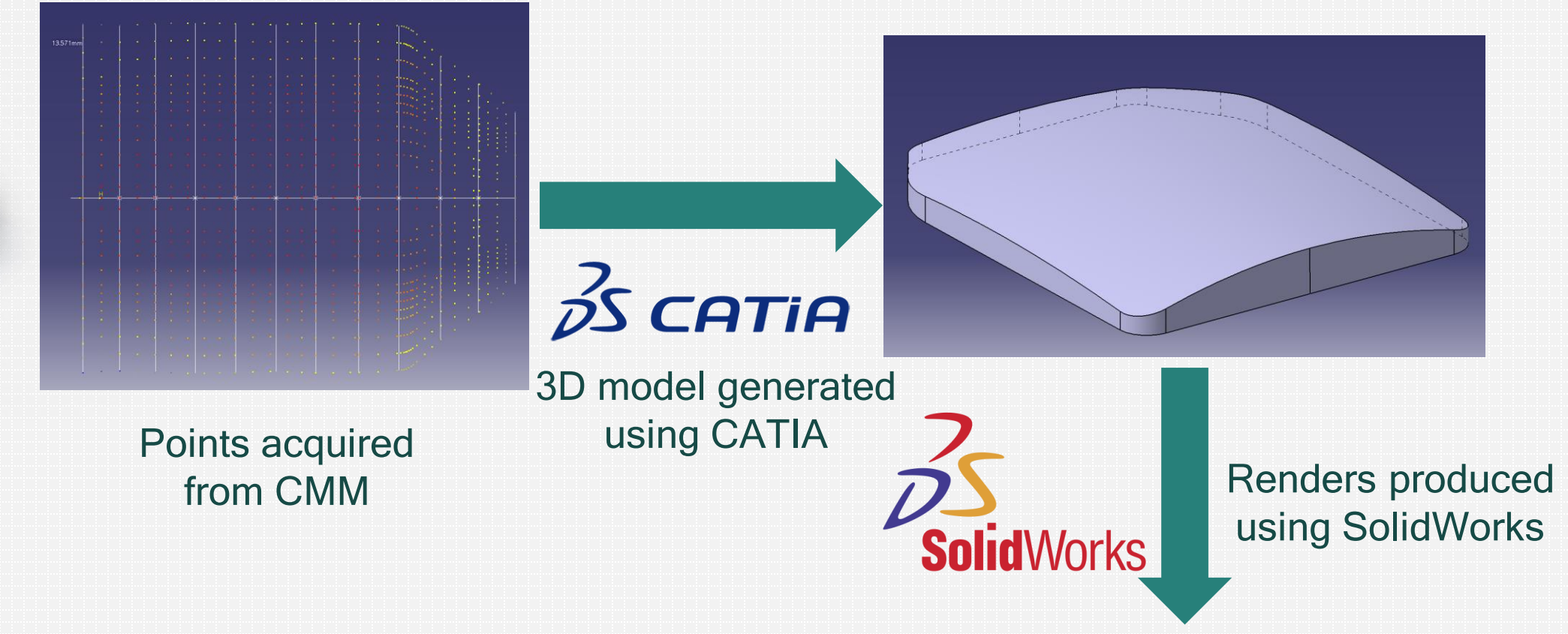
Plate Design Process



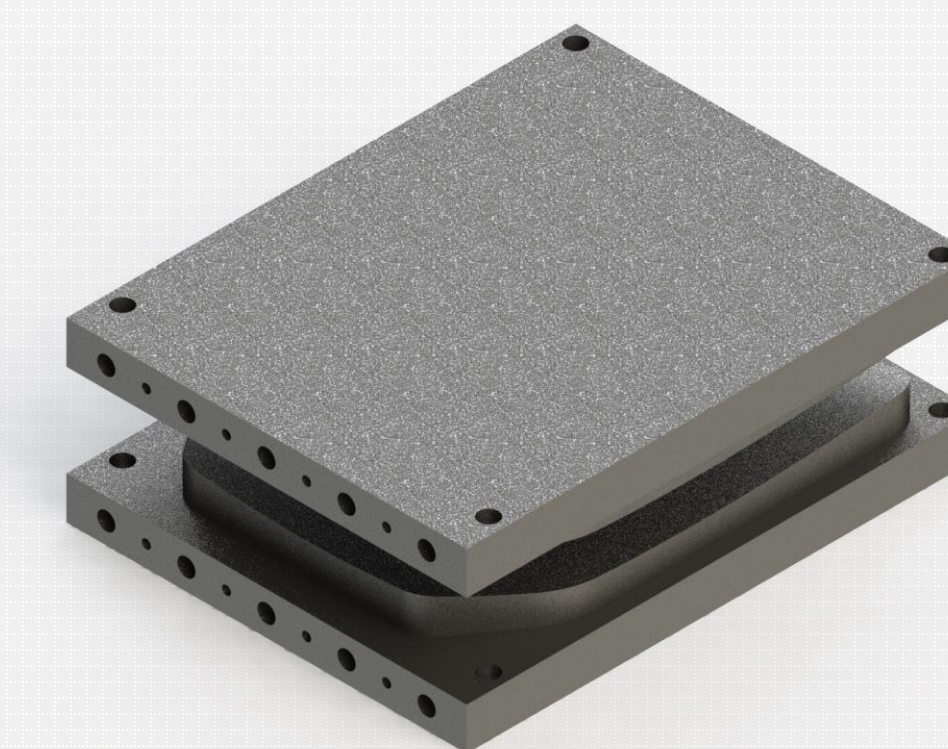
Multi-Curve Armor Plate Assembly



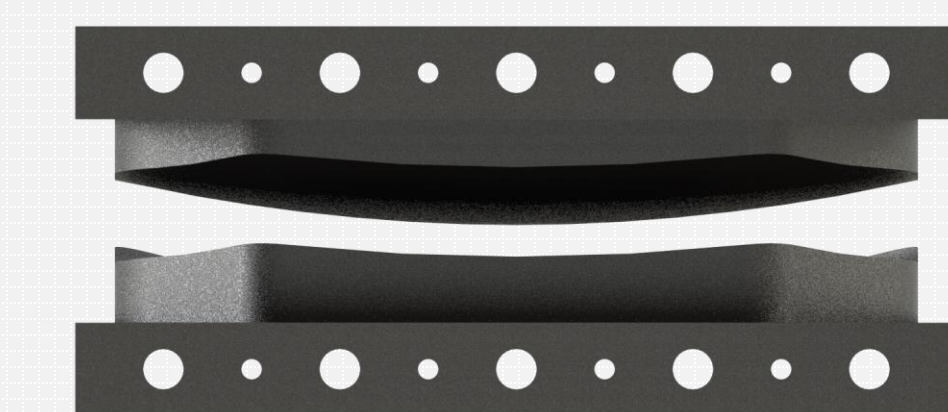
Platen Design Process



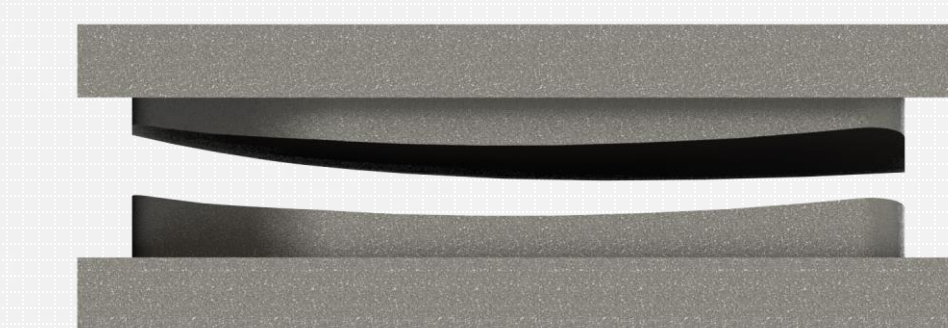
Platen Assembly



Isometric View

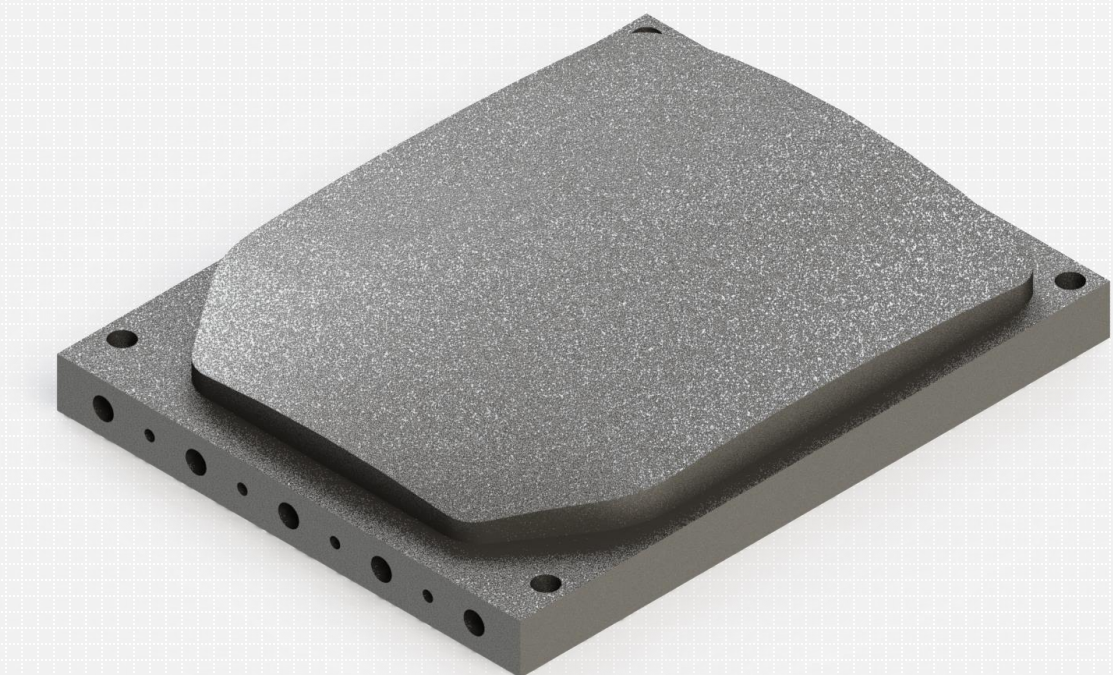


Front View

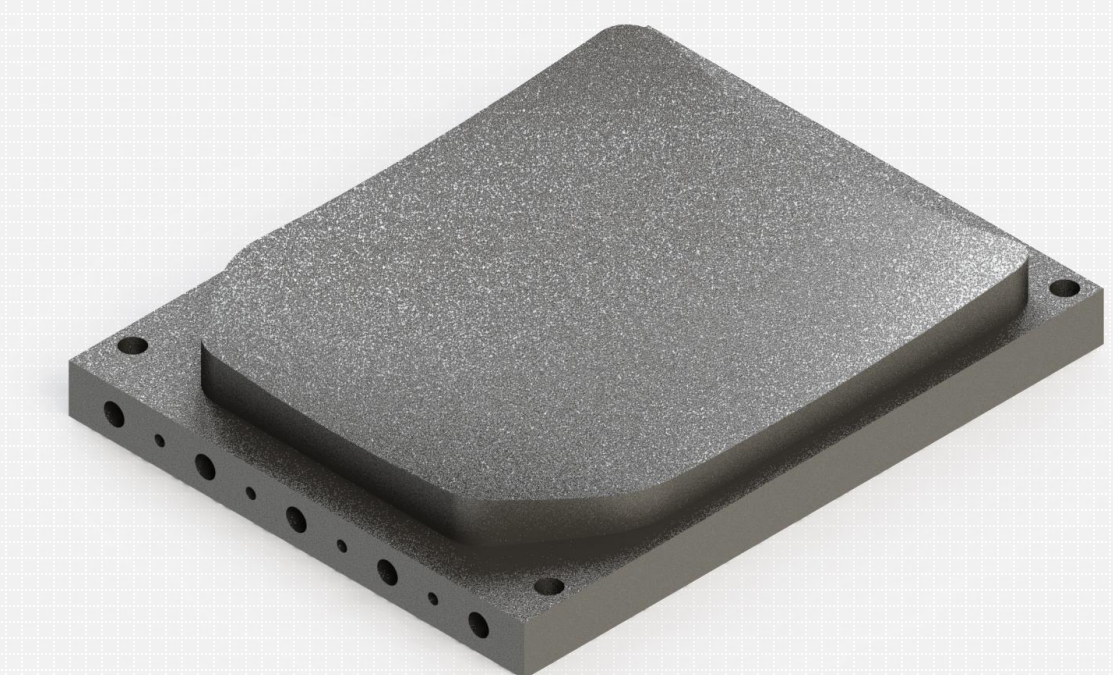


Side View

Top Platen



Bottom Platen



Future Work

Testing of the developed ballistic level III armor plate prototype is critical before it is used in the field. The following are the minimum outcomes to obtain from high-speed imaging during ballistic testing:

- Project erosion rates during impact
- Analysis of debris fields
- Fracture and damage accumulation in the body armor prototype