

This form must be completed and submitted by **all teams no later than the date specified in the Key Dates document on the Formula Student website**. This Impact Attenuator Data (IAD) Report and supporting calculations must be submitted electronically in Adobe Acrobat Format (\*.pdf). The submissions must be named as follows: carnumber\_universityname\_IAD.pdf using the complete university name, e.g. 087\_UniversityofAnytown\_IAD.pdf. **Submit the IAD report as instructed on the event website**. The IAD Judges will review all submissions. In the event that the judges request additional information or calculations, teams have **one week from the date of the request** to submit the requested information or ask for a deadline extension.

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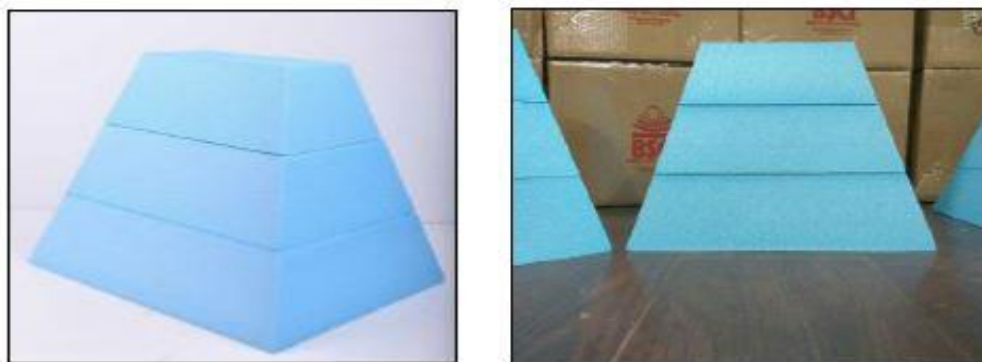
Material(s) Used	Dow Impaxx® 700 foam
Description of form/shape	Standard FSAE IA
Length (longitudinal) / mm	355.6 mm
Width (lateral) / mm	304.8 mm
Height (vertical) / mm	254 mm
IA to Anti-Intrusion Plate mounting method	3M™ Scotch-Weld™ Epoxy Adhesive DP100FR
Anti-Intrusion Plate to Front Bulkhead mounting method	Electric Arc Welding
Peak deceleration ( $\leq 40$ g)	N/A
Average deceleration ( $\leq 20$ g)	N/A

Confirm that the attenuator contains the minimum volume 200mm wide x 100mm high x 200mm long ☒ Yes

Energy Absorbed (J): Must be $\geq 7350$ J	8200 J	Vehicle includes front wing in front of front bulkhead?	No
IA Max. Crushed Displacement (mm) <sup>1</sup> :	N/A	Wing structure included in test?	No
IA Post Crush Displacement - demonstrating any return (mm) <sup>2</sup> :	N/A	Test Type: (e.g. barrier test, drop test, quasi-static crush)	N/A
Anti-Intrusion Plate Deformation (mm)	N/A	Test Site:	N/A

**Introduction:**

For the season of 2022, despite the fact that the team is going with Standard FSAE Impact Attenuator, the team has been involved in self designing and testing of the IA, but due to certain reasons (mentioned below), the team intends to use the Standard FSAE IA.

**Pictures:**

*Figure 1: FSAE Standard Impact Attenuator*

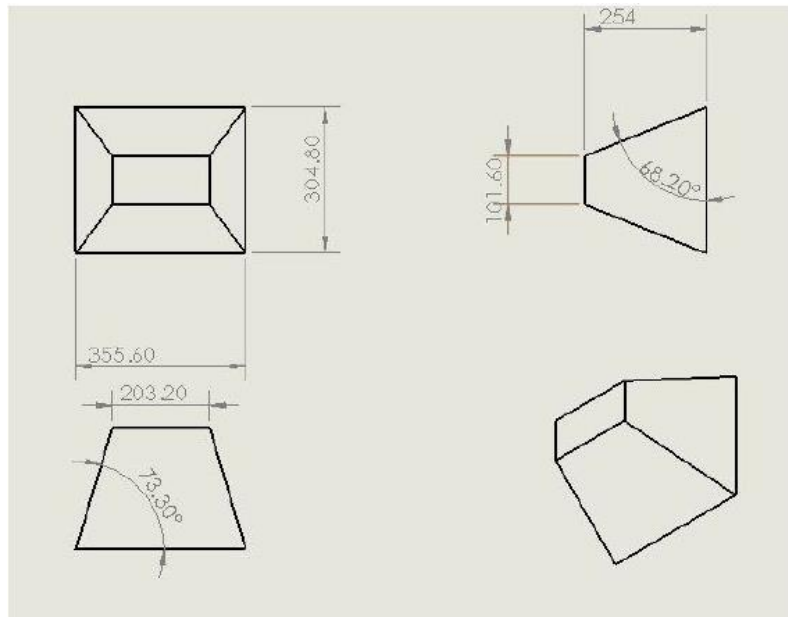
**PICTURES OF THE ATTACHMENT ON THE CAR:**

We are currently in the process of ordering a Standard FSAE Impact Attenuator, but due to logistic supply chain issues, there has been a delay of 3 weeks in this process. We will install the Standard IA on our chassis, and will provide all relevant proofs before the competition.

**Receipt/Proof of Purchase:**

We are currently in the process of ordering a Standard FSAE Impact Attenuator, but due to logistic supply chain issues, there has been a delay of 3 weeks in this process. We will install the Standard IA on our chassis, and will provide all relevant proofs before the competition.

**Diagrams:**



**Rule Compliance:**

Bulk head dimensions: 362mm\*322.7mm

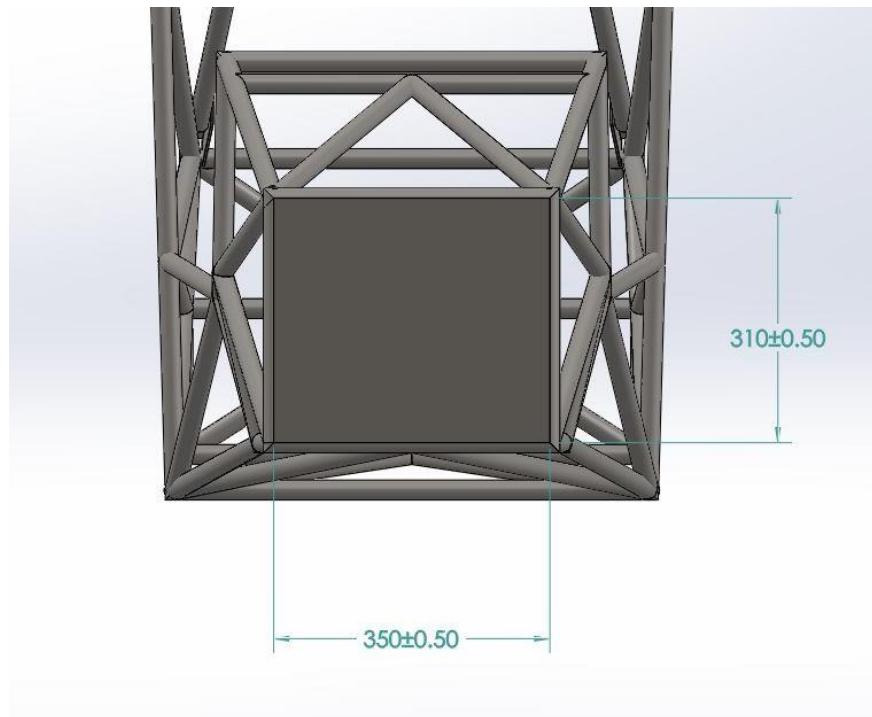
Structural Members used: 25.4mm\*1.6mm

Diagonal bracing: 512.93mm\*25.4mm\*1.6mm

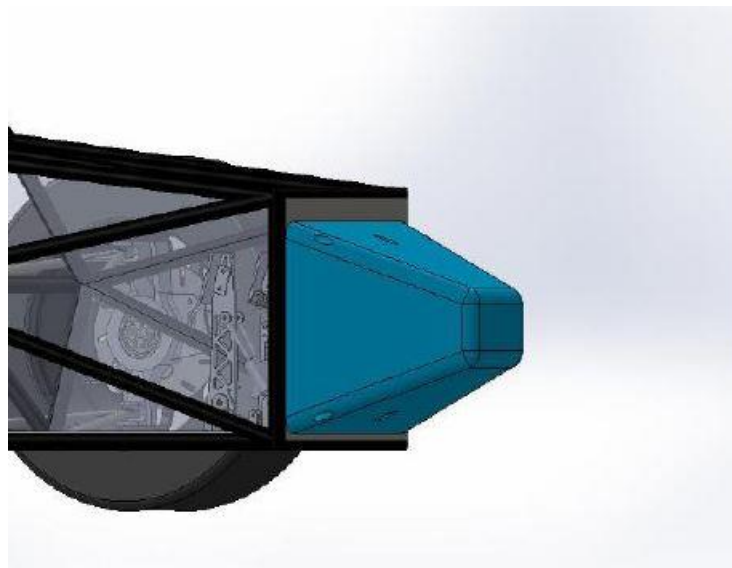
AIP Dimensions: 350mm\*310mm\*1.5mm

AIP Material: AISI-1020

AIP to Bulkhead mounting method: Electric ARC welding



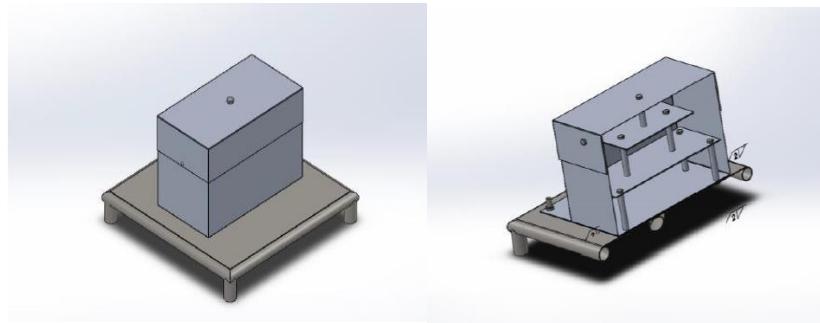
*Figure 3: Front view of Chassis with AIP (Note: all dimensions in mm)*



*Figure 4: Impact Attenuator Mounted on Vehicle (CAD Model)*

### Self-Designing Approach

The team had the following design for a self-designed IA.



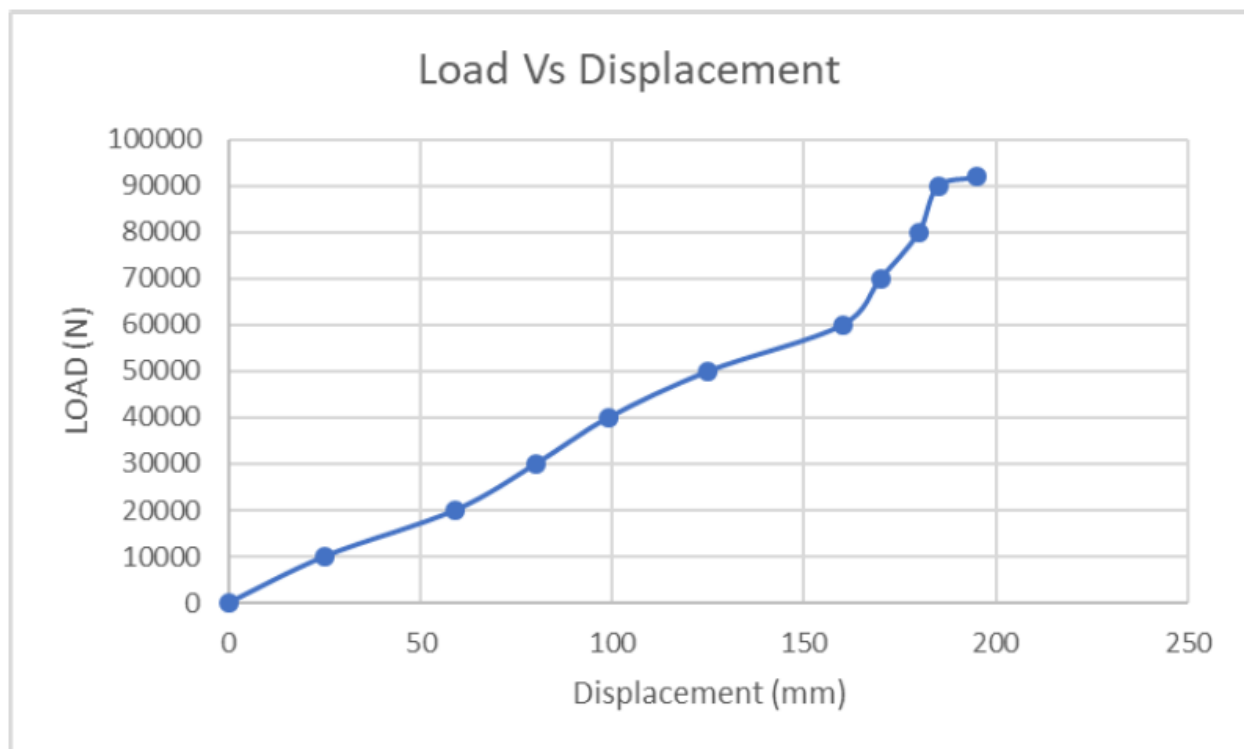
*Figure 5: CAD Model and section view of Self-designed IA*

The design consists of a pyramid structure of aluminium pipes and sheets enclosed in an Aluminium housing as shown.

<b>Material(s) Used</b>		Aluminum 6061 T6	
<b>Description of form/shape</b>		Aluminum housing with pyramid structure of aluminum pipes and sheets	
<b>Length (longitudinal) / mm</b>		274.56mm	
<b>Width (lateral) / mm</b>		148.6mm	
<b>Height (vertical) / mm</b>		220mm	
<b>IA to Anti-Intrusion Plate mounting method</b>		4 x 8.8 grade M8 bolts with NY-lock Nuts	
<b>Anti-Intrusion Plate to Front Bulkhead mounting method</b>		Electric Arc Welding	
<b>Energy Absorbed (J): Must be &gt;= 7350 J</b>	7410 J	<b>Vehicle includes front wing in front of front bulkhead?</b>	No
<b>IA Max. Crushed Displacement (mm)<sub>1</sub>:</b>	195mm	<b>Wing structure included in test?</b>	N/A
<b>IA Post Crush Displacement - demonstrating any return (mm)<sub>2</sub>:</b>	189mm	<b>Test Type: (e.g. barrier test, drop test, quasi-static crush)</b>	Quasi-static crush
<b>Anti-Intrusion Plate Deformation (mm)</b>	23mm	<b>Testing Site:</b>	Pakistan Council of Scientific & Industrial Research, Karachi

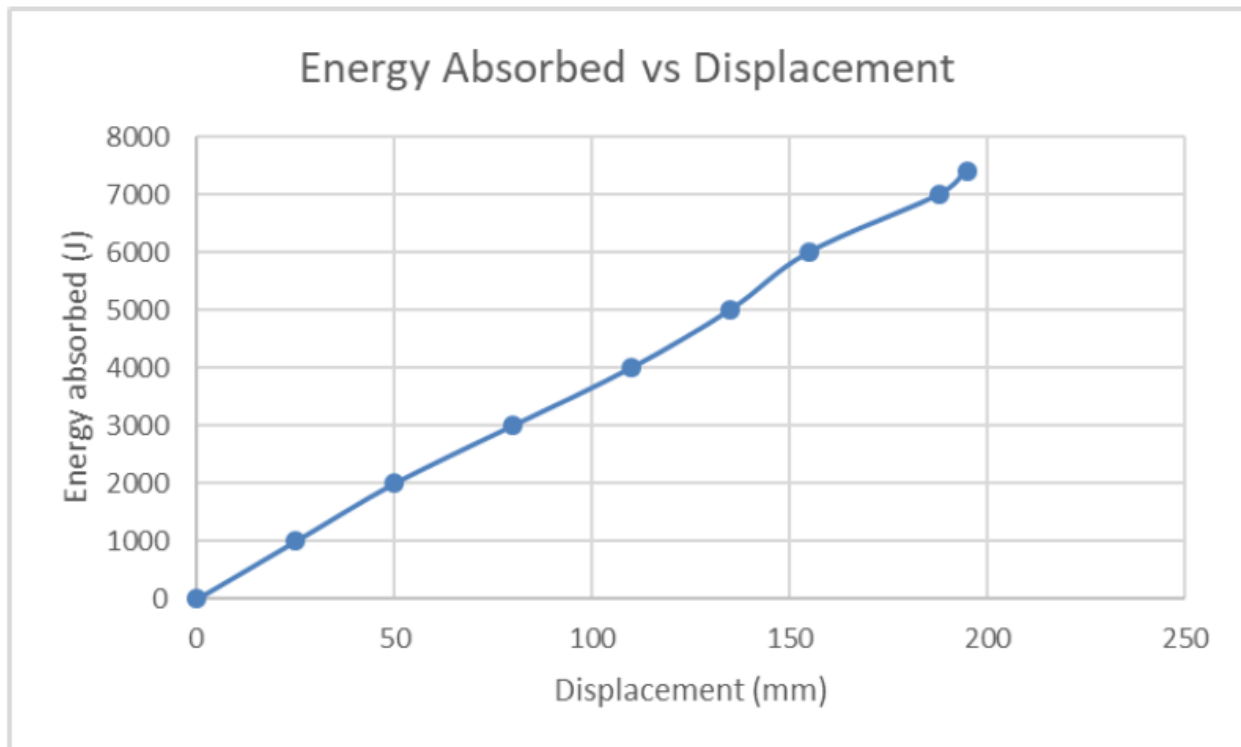


*Figure 6: Testing of Self-designed IA*



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*Figure 7: Load Vs Displacement Curve*



*Figure 8: Energy Absorbed Vs Displacement Curve*

**Calculations:**

Peak Load = 92000 N

Average Load = 46000 N

Mass = 300kg

Peak Deceleration (Should be < 40g):

Peak Load = Mass x acceleration

$$92000 / (300 \times 9.81) = 33.41g$$

Avg deceleration (should be < 20g):

$$\text{Avg Load} = \text{Mass} \times \text{acceleration} = 16.7g$$

Total deflection of impact attenuator = 195mm

Energy Absorbed: 7410 J

**Conclusion:**

Despite the efforts and accomplishments, the team has decided to go with the standard FSAE IA because of the following reasons:

- 1) Lesser weight of Standard FSAE IA.
- 2) Large AIP deflection in self-designed IA.
- 3) Due to COVID-19 outbreak, the team was unable to complete its design and manufacturing to improve the results.

**Testing Facility:**

The test was conducted at Pakistan Council of Scientific & Industrial Research, Karachi. It is a dedicated testing facility which is not part of or affiliated with the university. The test was conducted by the team under complete supervision and guidance of professionals.