

# Study of Materials' Impact Properties for Arctic Marine Structures

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## Abstract

It is well understood that ice-infested waters are one of the biggest problems in safety and reliability of ships and marine structures operating in Arctic seas. Specially designed ships, also known as 'icebreaker', are usually used to provide clearance to make way for merchant and cruise ships. Even then, the ship staff has to be extremely careful with the speed and steering. Heavy impacts of ice result in fatigue damage in the hull, which may lead to serious damage to the integrity of the ship. This work is to study alternative materials that may be applied to the ship hull for providing an extra layer of protection.

In this study, an effort is being made to look at the impact resistive properties of two different materials. The first contestant is carbon fiber reinforced polymer (CFRP). CFRP is proven for its strength to weight ratio and already in use in many applications, such as aviation industry, professional sports, etc. The second contestant is a non-toxic material 'SK One Component Polyurethane (SOCP)' developed by China Institute of Water Resources & Hydropower Research (IWHR). This material is light and can be applied as a coating. Also, this material has proven to have good abrasion resistance even in temperatures as low as  $-45^{\circ}\text{C}$ .

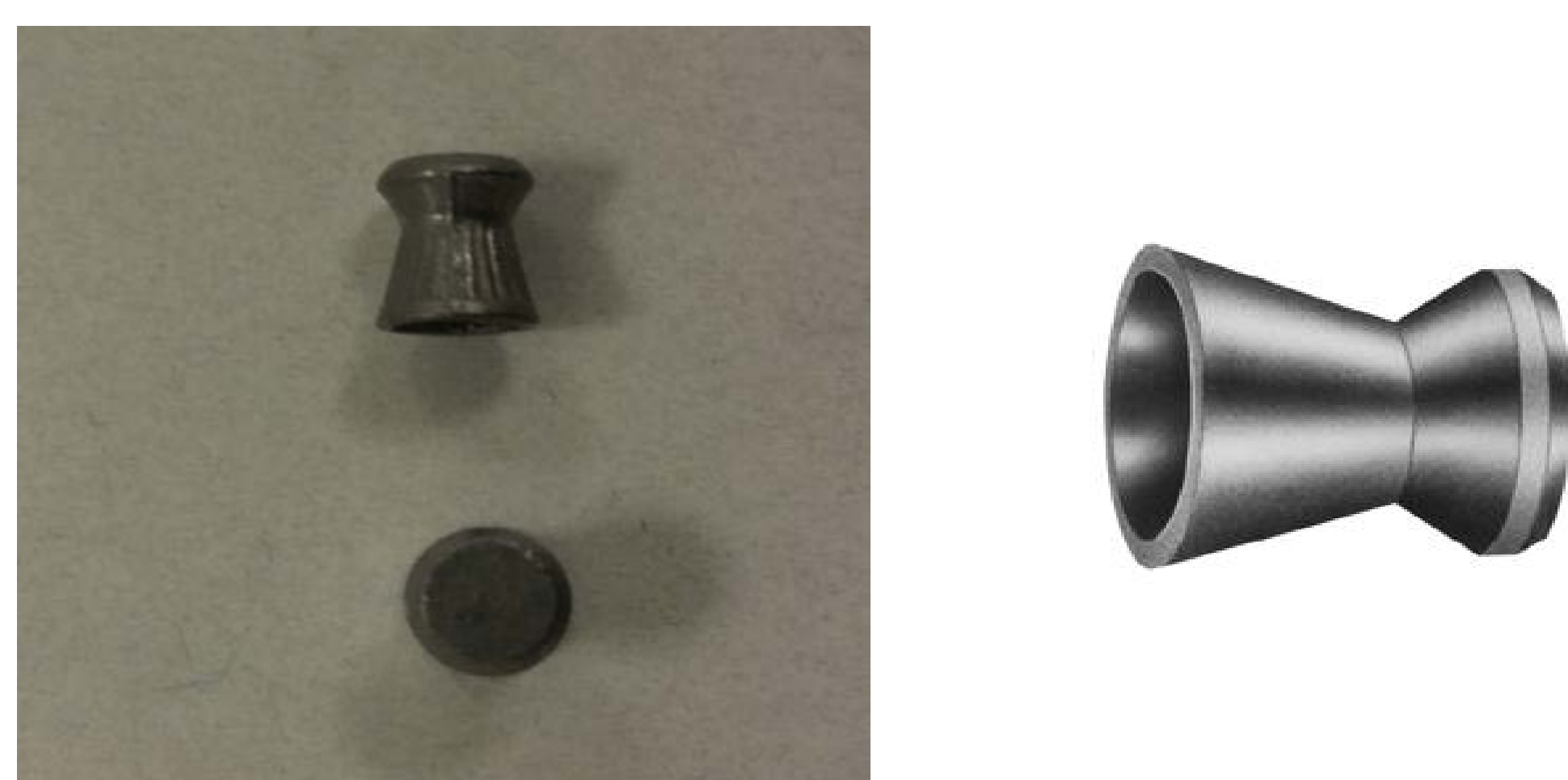
In this work, we plan to perform experimental and numerical analysis. In an experimental study, Diablo pellets of 0.5 g will be fired at a speed of 160 m/s on the samples of CFRP and SOCP using an air gun. The tests will be carried out on various thicknesses of materials and in room as well as cold temperature conditions. In the numerical study, simulations will be performed using ANSYS® Workbench simulation software.

The study will reveal the impact resistive properties of the materials, which will help identify their application towards marine applications in the Arctic region.

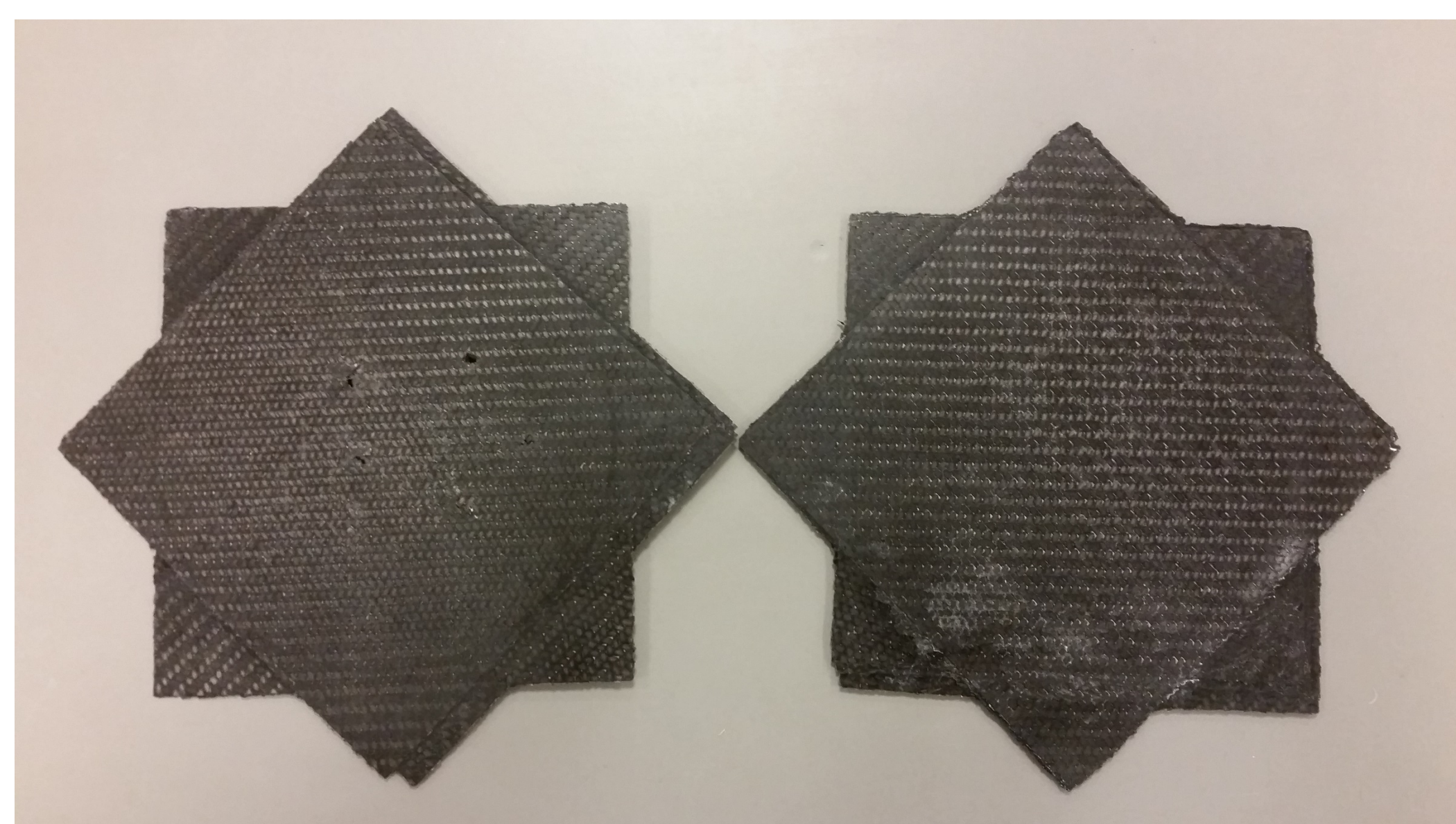
## Experiment Equipment



Air Rifle with 4.5mm caliber is using in the experiment

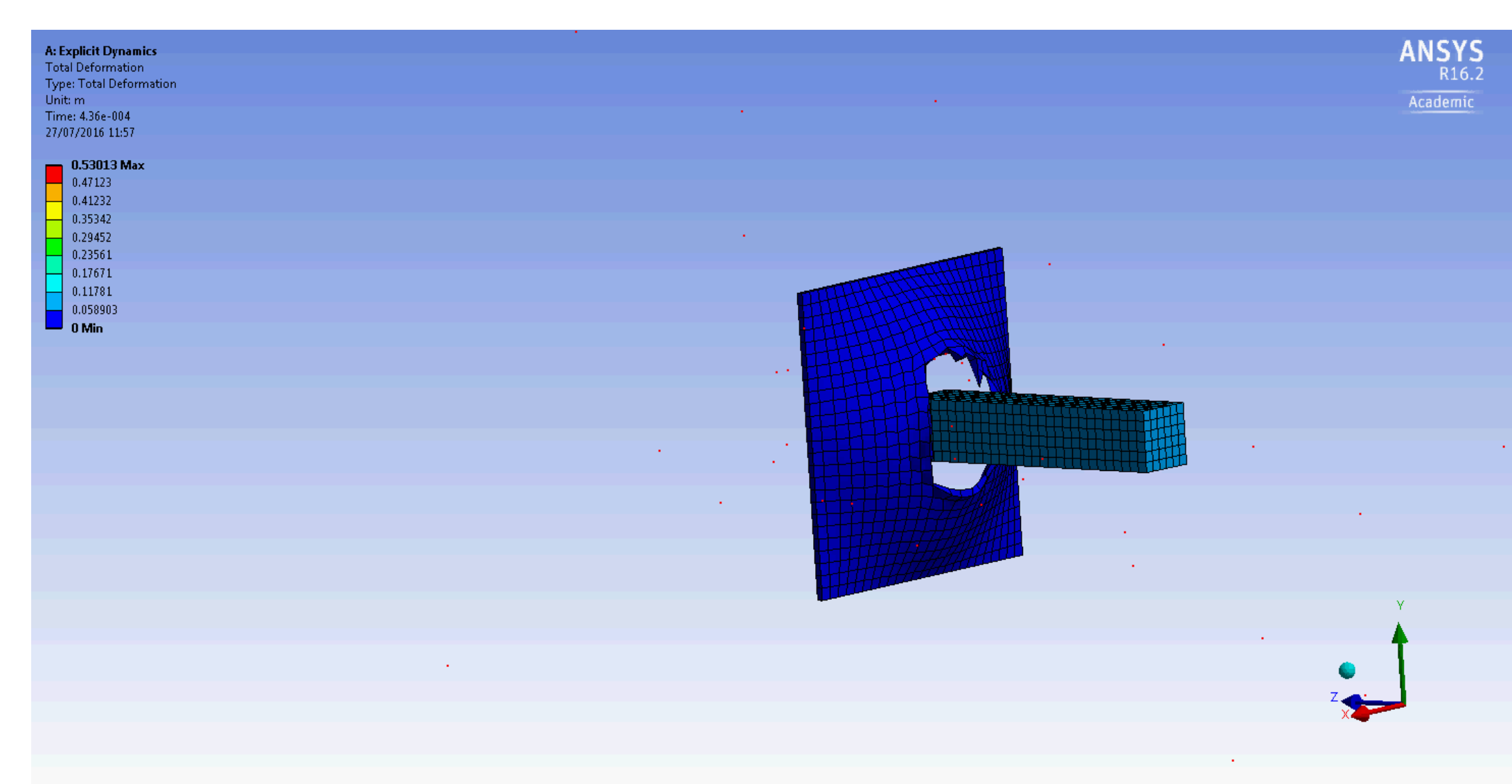
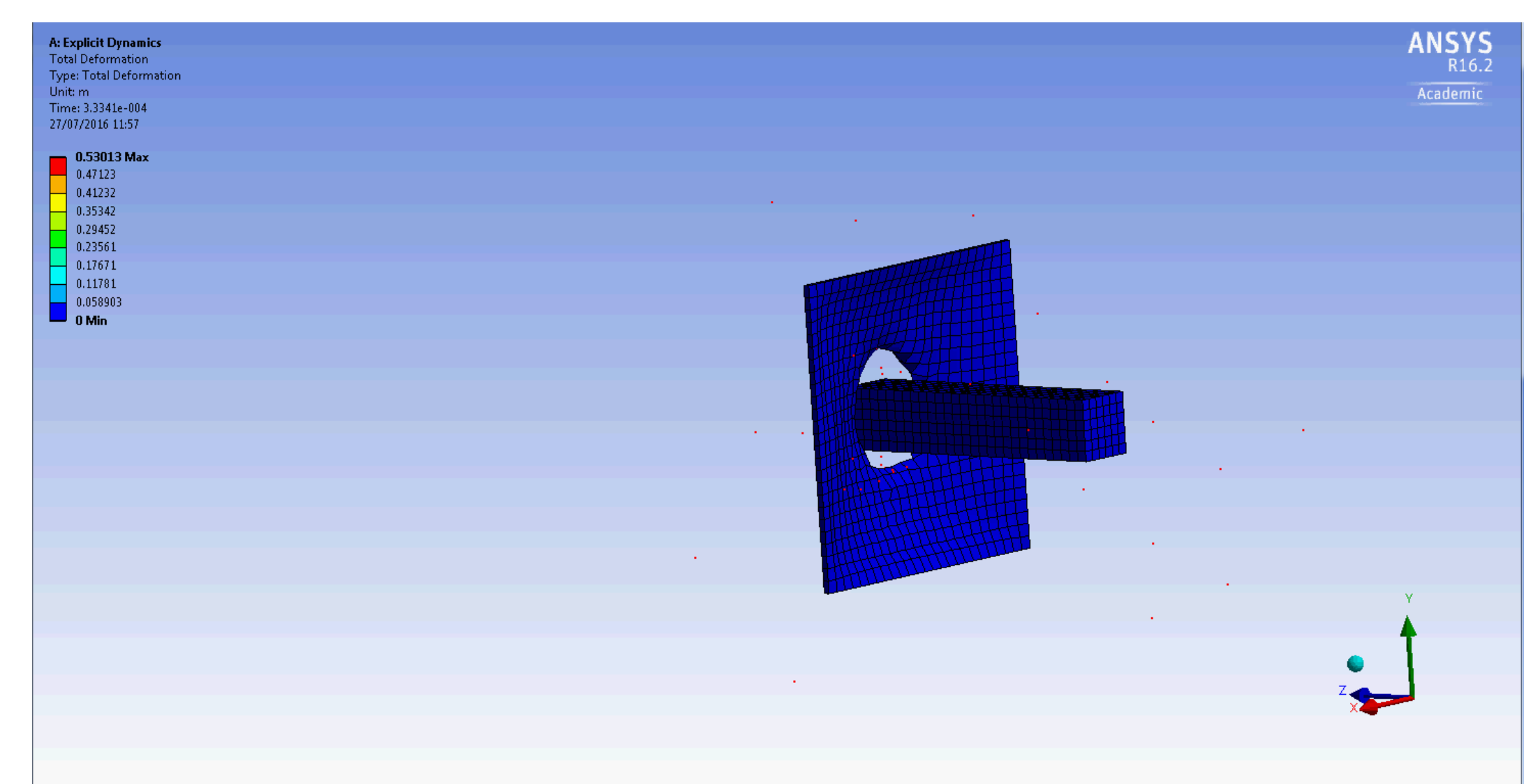
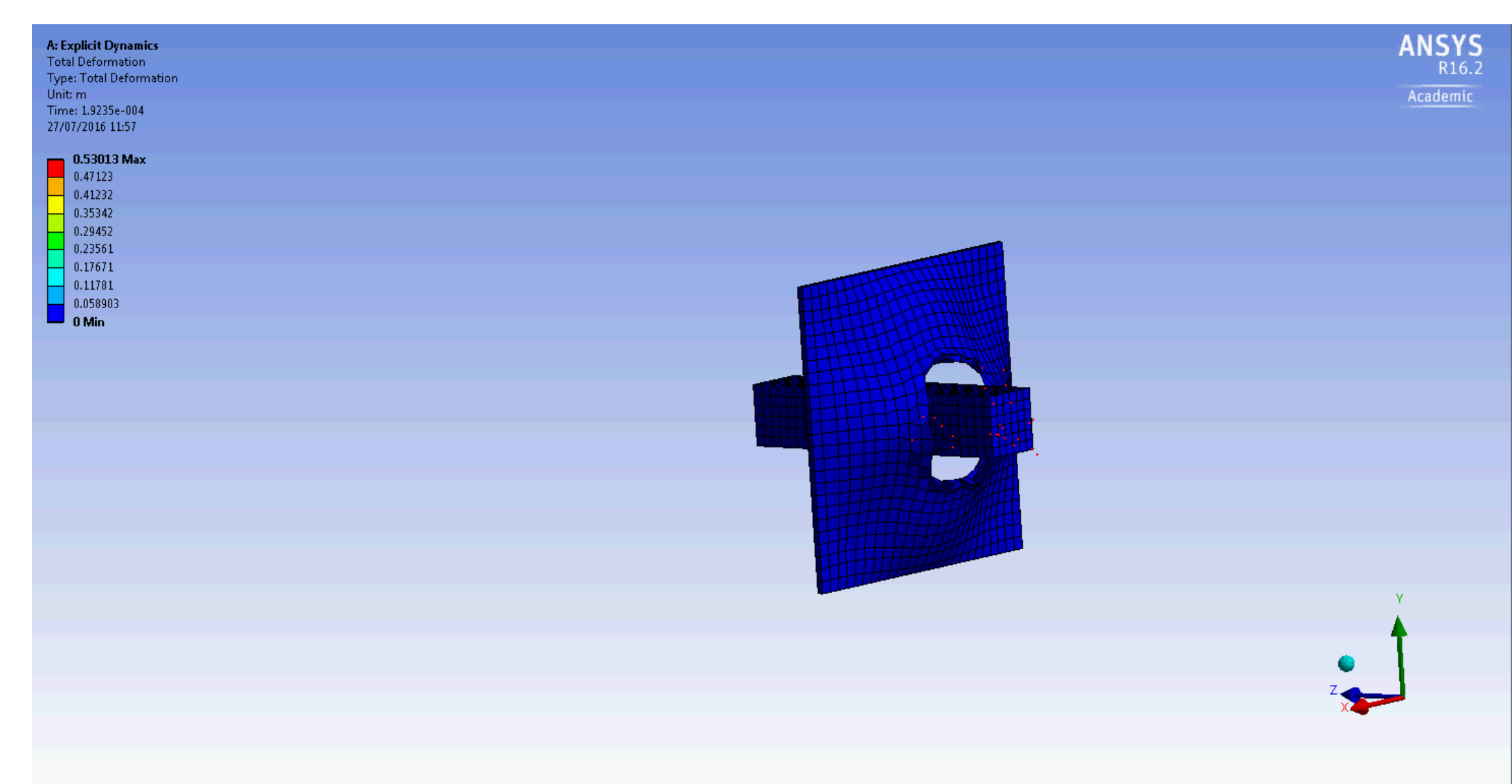
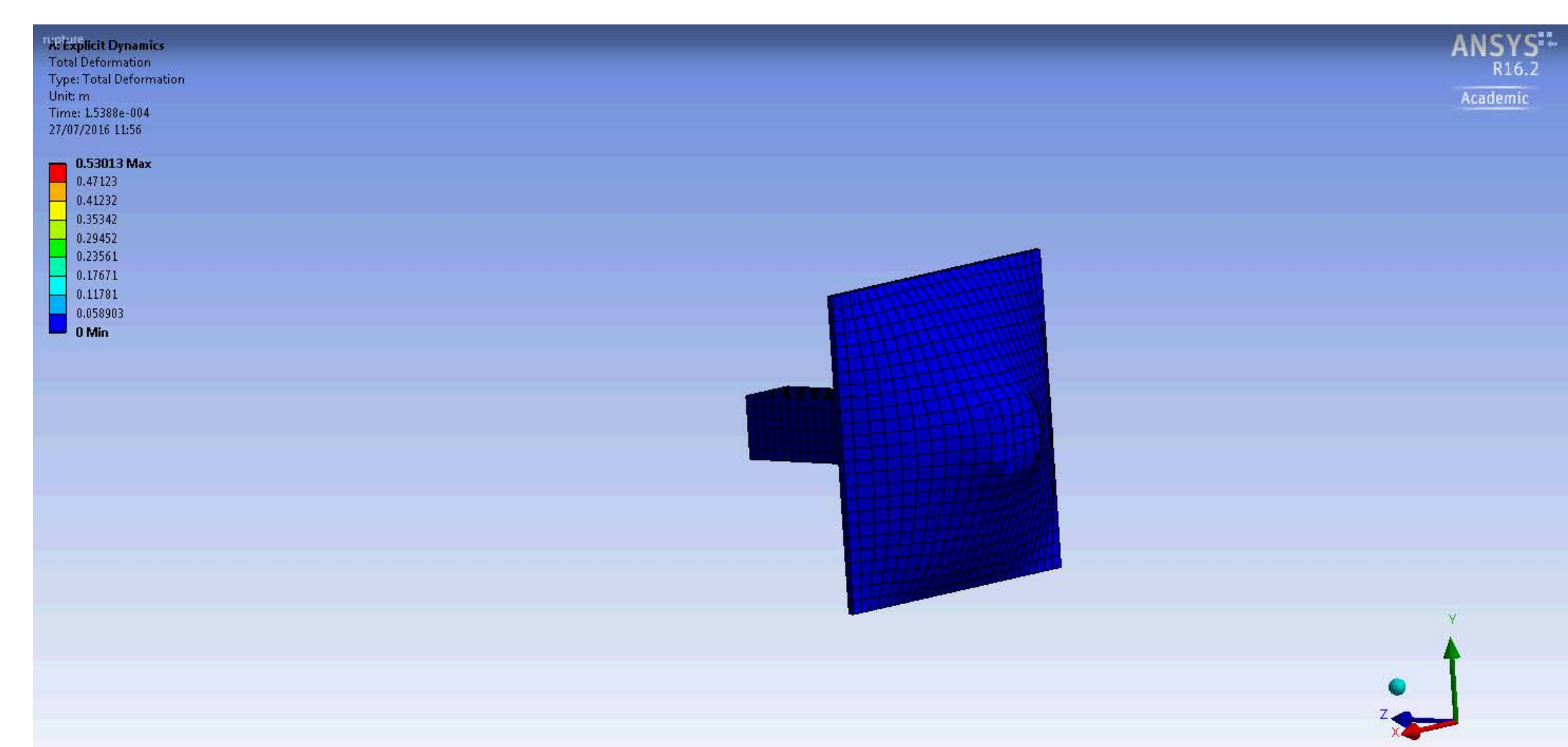


4.5 mm diablo match pellet (weight: 0.5g)



Carbon Fibre Sample pictures

## ANSYS® Structural – Dynamic Simulation



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