NASA Challenge: Spacecraft Docking Adapter with a Flexible, Load-Bearing Floor

Challenge ID: NASA – Deadline: September 7, 2022

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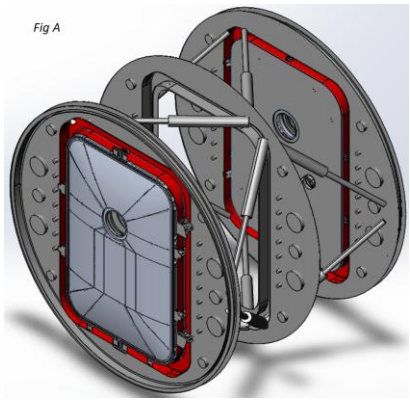
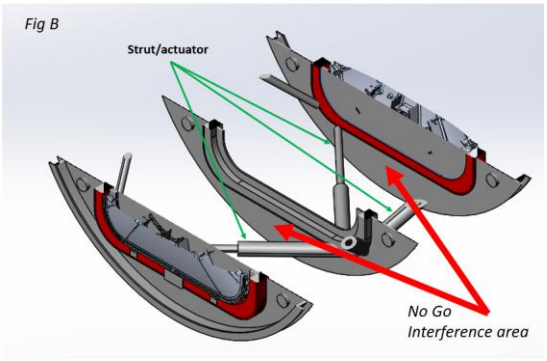
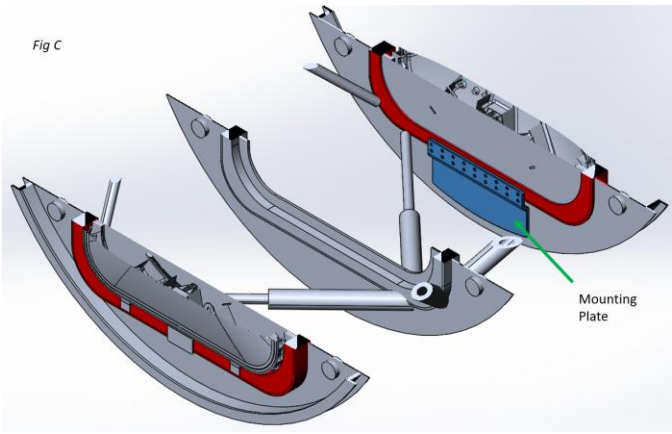
***Abstract* - NASA is seeking to challenge the GrabCAD Community to design a flexible, but load-bearing floor for use in both microgravity and gravity as part of a docking system that can articulate dock elements that are not perfectly aligned. For purposes of this challenge, all hatches shall be assumed to have an opening described by a rounded rectangle, 60 inches in height by 40 inches in width, with a radius of curvature of 5.9 inches at each corner. All vertical passages between decks have the same size openings – anything that can pass through a hatch on one deck can be transported through a vertical passage to another deck. Vertical passages are generally not adjacent to a wall but are instead near or at the center of the deck. Assume a habitat with 3, 4, or 6 decks and a floor-to-floor distance of 2.5 meters. (Number of decks is a trade study currently in progress and the solution must work regardless of the habitat height ultimately selected.)**







I. Introduction

This solution will consist of a gimbaled multi-axis extendable platform. The system will package within the Multi-Gravity Active-Active Mating Adapter (MGAAMA) as currently designed. It should be noted that as currently designed the MGAAMA hasn't sufficient package space to permit any structures to package or function outboard of the flange of either hatch (*Fig A, B.* – red regions). The design solution will be packaged above the "struts/actuators" The exception is the area adjacent to the bottom of the hatch flange. It is positioned such that interference with the struts should be avoided.

II. The Solution

The system is attached to the Mating Adapter by using industrial or structural adhesive applied to the back of the Mounting Plate(s) Fig C. The Mounting Plate area for the is approximately 75973.19mm^2 This should provide ample area to secure the attachment of the Mounting Plate to the Mating Adapter. The Mounting plate is to be installed in four places. In this example, it is placed on the inside of each outer bulkhead and on either side of the middle bulkhead.

The Bearing Plate is the key component to the Mounting Sub assembly (Figure D) The two sub-assemblies in tandem are the key elements to permit the rotational and translational movement of the walkway.

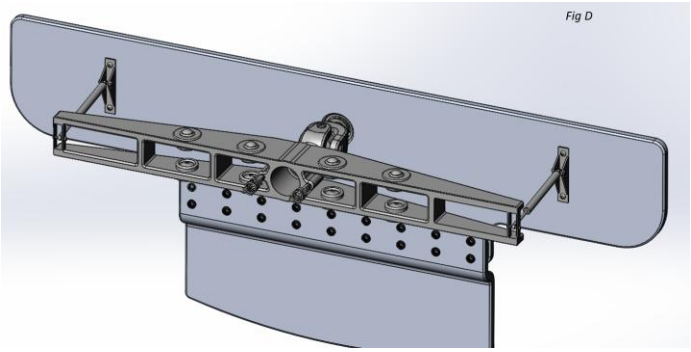
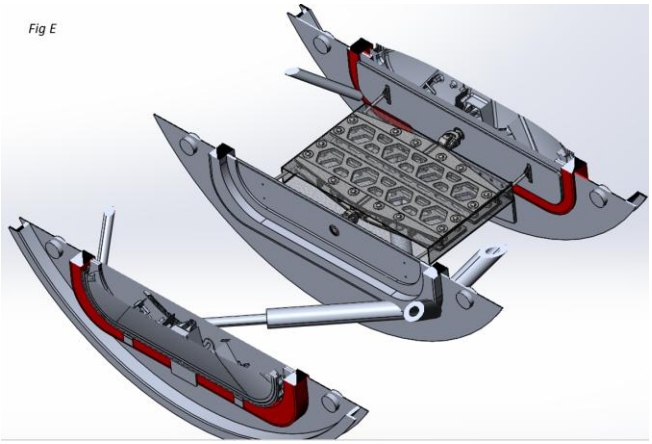
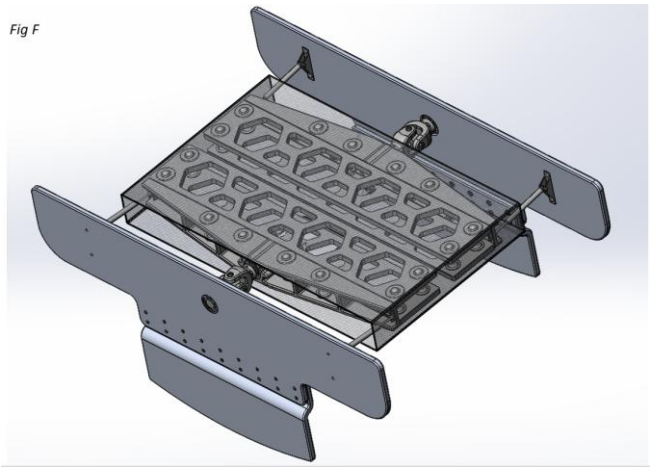


Figure E. shows the Mounting Sub-assemblies in tandem. (Walkway translucent.) Due to time restraints, Design was unable to provide a dynamic Assembly for motion study. It is proposed that as the MGAAMA rotates the assembly will align itself to its opposing mounting assembly, whilst remaining rigid and stable. **(Note that this solution must intrude on hatch area as not to impede or interfere with the free rotation of the hub rotation through 15 degrees of rotation as stated by the challenge requirements.)**



The gimbaled sub-assemblies are connected by a carbon fiber tube that slides freely over roller bearings, but its translational motion is restricted by springs. The springs are connected to the inside of the carbon fiber tube by epoxied bracket (not shown).

As conceptualized, (Figure F.) this system will be low maintenance, low cost, and efficient. It can be modified, as needed depending on the span requirements. Due to time constraints, additional variants were not included in this assembly.



The assembly's pitch and roll are restricted by heavy duty gas shock absorbers (outboard of the assembly.) Movement is directed through two cup bearings press fit into aluminum plate. Many of the components are off the shelf, but of high quality a rated in a broad range of environments.