Design and Optimization of a Composite Exospine Structure for Soldier Rehabilitation and Support

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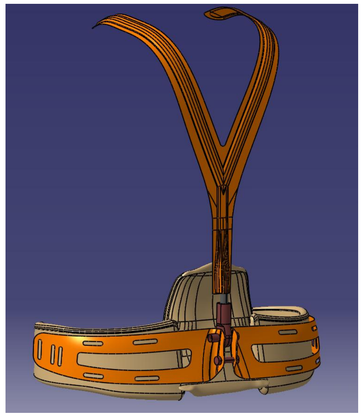
Exospine Justification

- On today's battlefield the soldier is being asked to carry more and more weight. This includes not only the backpack weight but also that of the body armor.
- This program proposed to design a composite exoskeleton structure that ties into the existing body armor and take the weight of that armor and backpack from the shoulders and back and transfer it to the waist.
- The key to success of this design is that the exoskeleton structure should sit off the shoulder with an air gap that then carries load with minimal deflection under compression.

The Integrated Support System (ISS)



Lightweight composite exospine structure that takes the weight of the shoulder and translates it to the hips

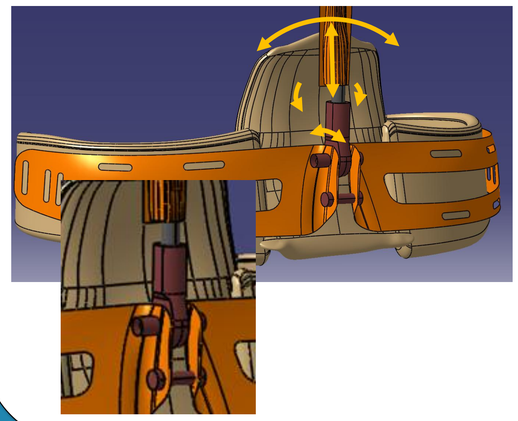
Benefits

- Decreases axial compression on the body
- Protects shoulder girdle
- Increases Endurance/ Performance Breathing Efficiency and ballistic protection
- Adds capability to attach equipment through harnessing with ISS

Requirements

- Running, Vehicle Jump, Drop to knee, 2-4 miles running/day,
- Flexibility: +/- 30° side, +/- 30° twist, -30° + 60° back/forward
- Average load in Afghanistan 63-125lbs with capability to carry an injured buddy for up to 2 hours
- Worst case scenarios: 250lb man with 150lb load jumping over a 6 foot wall landing on his feet.
- Salt water immersion capable (Body sweat salt as well as sea water environments)
- Altitude 25,000ft, Thermal: 125° F (within vehicles reaching 150F), Cold - (-40F)
- Does not impede fast roping or rappelling

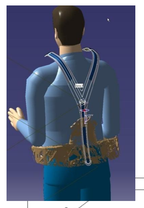
Novel Hinge Concept developed by UD-CCM

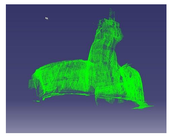


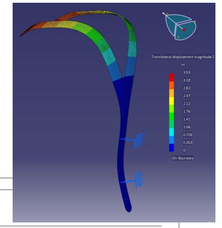
Simplicity in Hinge Design

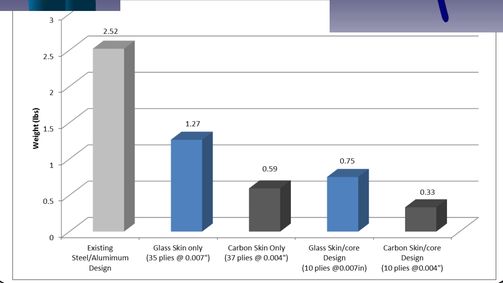
- Simple three part 2 pin linkage with easy adjustment to spine or waist components for different size soldier
- Flexibility requirements in all directions met
- Low cost, each element is replaceable
- System can fold and is fully disassembled in minutes
- Waist components can be composite or mass produced SMC
- Pin locations are mostly in compression and have good bearing surface area

FE Design and Optimization

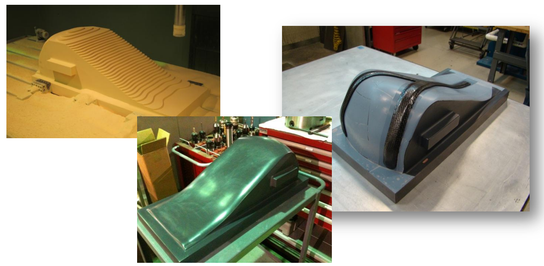








Low Cost Tooling and Fabrication



ACKNOWLEDGEMENTS

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