**Aaron Van de Graaf**

**Research Question:** What can we do to our formula car to make it place better than the ODU formula cars in the past?

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|  | **Source/Evidence/ Data #1** | **Source #2** | **Source #3** | **Source #4** | **Source #5** |
| **Citation** | Journal of Fluids Engineering, v 132, n 7, p 071103 (8 pp.), July 2010 | Engineering Failure Analysis, v 16, n 2, p 608-617, March 2009 | Engineering Failure Analysis, v 14, n 2, p 321-348, March 2007 | Proceedings of the 7th Biennial Conference on Engineering Systems Design and Analysis, ESDA 2004, v 2, p 475-481, 2004 | 2012 International Conference on System Simulation (ICUSS 2012), 4 pp., 2012 |
| **Purpose** | 1) to “understand the advantages of having a more aerodynamic formula car”  2) to “gain ideas on how to design a formula car to be more aerodynamic”  3) to “take in to account how certain materials have done in the past when it comes to air resistance” | 1) to “inform ourselves of what can lead to crack growth in formula 1 race cars”  2) to “figure out which materials are less likely to undergo crack growth in formula cars”  3) to “figure out how we can prevent our formula car from becoming too heavily stressed”  4) to “become aware of the harm that can be done if our car was to become cracked” | 1) to “figure out how bonding joints on a load bearing structure can be built without failing”  2) to “determine which type of bonding would be the most appropriate” | 1) to “understand the importance that the frame has in the formula car’s performance”  2) to “learn how the measurements for the frame are to be obtained” | 1) to ‘understand how crosswind stability can be improved”  2) to “become capable of understanding installation” |
| **Why is the study necessary?** | - In order to place better in the competition, we must construct our formula car to be as air resistant as possible  - We need to comprehend what causes drag to increase/decrease  - A more air resistant vehicle makes for a safer environment for the driver when it comes to heavy winds. | - excessive cracking in our car can damage the interior and cause operating errors  - if operating errors were to occur, it would but the driver’s life in risk | - bonding is a beneficial method when it comes to assembling components together  - it is important that the components are bonded together correctly, so that they stay in tact | - we need to understand the theoretical attributes that go behind the making of the frame  - to take into account how we should draw our dimension for the frame | - we want the car to be as stable as possible  - we want to make sure that we have correctly installed the pieces |
| **Methods** | - test our different designs, and how take note on how they do against the wind | - test out various composite materials to see how resistant they are to cracking  - calculate the maximum bending stress that the suspension can undergo  - come up with a safety factor so that the design load can be obtained | - make sure that the materials have smooth surfaces | - getting images of the interior of the formula car to see how the pieces connect to each other | - to design a prototype of the car and make sure the center of gravity is balanced |
| **Results** | - after testing out different designs, a superior design is able to be picked and chosen  - the car’s resistance to air can vary depending on the material of the car | - the article suggests using 1.3 as a safety factor when calculating the designed load  - once the structure can no longer support the designed load, the composite with fail due to compression.  - the crack growth is similar to fatigue in metals  - changing the composite enabled the component to avoid failure | - the bonding reduces weight and part count  - the stress distribution is more uniform after the bonding process  - fatigue resistance is increased | - it is determined that the purpose and necessity of the frame is to help the car handling ability  - the dimensions that are used for the frame vary on what type of suspension you are using  - the dimensions that are used for the frame also depend on the dimensions of the suspension, since they need to be able to fit together | - programs will come in handy when it comes to building a prototype of the car, because you can test for failure without having to spend money  - realized that we need to make sure that our center of gravity is centered, so that it doesn’t lean to one side |
| **Discussion/Conclusion** | - when we are preparing the design for the car, we should make sure we have tested all our designs and compared their ability to resist air  - either through research or testing, we should be able to come up with a material to use that is both air resistant and affordable | - It is important to test out the type of material that you use and make sure it can complete “x” amount of cycles without failure  - the safety factor for the design must be large enough to make up for any human errors in the load calculation | - it appears that adhesive bonding is a very beneficial method of combining components together  - after the bonding, there is generally little finishing that is required | - after reading this article, I have learned the importance that the frame actually holds | - stability is a key factor in our car and should definitely not be overlooked  - |
| **How can this help my senior project?** | - the better the air resistance that the car has, the better that it will be able to place in competitions | - by testing the materials before selecting a specific composite material we can test for failure, to avoid spending money on bulks on a material that will fail  - it gives us a “heads up” on being careful with the suspension, and to pick a safety factor that is big enough to make up for any calculated error | - after reading this article, I think that adhesive bonding would be a great option for assembling our car together  - although this article was able to list the pros of adhesive bonding, it didn’t get into specifics, so I would need to research it a bit more to make sure that it is safe and cost efficient | - my subgroup in particular is working on the framing, so it was important to know the frames importance  - since it is responsible for how well the car can be handled, it is necessary for us to design the frame so that it makes it easiest for the driver  - the driver needs as much control as possible to place better | - if we can become familiar with a program that will allow us to build a prototype, it would allow us to do trial and errors for each piece  - we need to make sure that the car is balanced evenly, to give better control to the driver |