Design Selection:

We decided to use the same Aluminum honeycomb from our 2014 vehicle, as that attenuator performed well. Again, we opted for the industry standard pre-crushed 8\*8\*4 in aluminum 5052 5.7pcf 3/16” honeycomb because of its abundance and low-cost compared to a custom-built honeycomb.

To calculate the necessary length of our impact attenuator, we used the equation:

The data sheet for our aluminum honeycomb states that the honeycomb crumples at a minimum pressure of 2.327 MPa. Multiplying this pressure by our cross-sectional area of 0.021 m2 yields a minimum compression force of 48.9 kN. For this force, equation 1 yields a necessary minimum length of 0.16 m. After accounting for the roughly 75% stroke efficiency of the honeycomb (see attached data sheet) and 1 cm pre-crushed region, we concluded that we our impact attenuator must be at least 0.236 meters, or 9.3 inches long.

After adding a 15% safety margin we decided to stack another 2.6 in honeycomb with identical properties on top of the 8\*8\*4 block, thereby giving rise to our new impact attenuator with dimensions 10.6\*8\*4. This safety margin allows our car to strike a wall at 20 degrees and still absorb all of the vehicle’s Kinetic Energy.

We bonded these pieces with WEST SYSTEM® Six10® Thickened Epoxy Adhesive. To increase surface area and improve resistance to shearing forces, we placed a 0.1 inch thick aluminum plate between the honeycomb pieces. Detailed information regarding the equivalency of the epoxy to the (4) 5/16 Grade 5 bolts stated in the rules T3.20.3 can be found in our SES rev1.

To attach the honeycomb system and the aluminum L brackets that help support the honeycomb on the anti-intrusion plate we again used WEST SYSTEM® Six10® Thickened Epoxy Adhesive. The aluminum L brackets provide an additional level of protection against shearing forces and enhances stability in the event of a linear impact.

We used 4 mm-thick aluminum for our anti-intrusion plate to facilitate bonding with the honeycomb and the L brackets, since they are aluminum as well.

In summary, the impact attenuator we designed for our 2016 car was optimized in terms of cost, weight and use of materials. We emphasized safety as a key point and thus over-engineered both our honeycomb system and our anti-intrusion plate to outperform the criteria of Formula SAE, as we believe that a few pounds and a few dollars are well spent to protect a human life.