This excerpt is from the project entitled "Door Speed Control Device"

Element E: Application of STEM principles and practices

This entry would be likely to receive a score of 1, based on the EDPPSR. The engineering educators who reviewed this entry noted that it included misdefined equations and incorrect calculations. (The formula for centripetal force listed should be $Fc=m(V^2/r)$ and to achieve the results posted the entry would need to post the values of the missing variables and of several of the variables they identified i.e. "show the work"

The entry does illustrate an attempt to substantiate with STEM principles/practices a few functional claims and design requirements of the proposed solution to unrestrained car door movement (swinging open). However, there is no evidence that the application of those principles and practices has been reviewed by any expert(s).

Engineering Design Process Portfolio Scoring Rubric
Component and Element Titles

Component I: Presenting and Justifying a Problem and Solution Requirements

- Element A: Presentation and justification of the problem
- Element B. Documentation and analysis of prior solution attempts
- Element C. Presentation and justification of solution design requirements

Component II: Generating and Defending an Original Solution

- Element D: Design concept generation, analysis, and selection
- **Element E: Application of STEM principles and practices**
- Element F: Consideration of design viability

Component III: Constructing and Testing a Prototype

- *Element G: Construction of a testable prototype*
- Element H: Prototype testing and data collection plan
- Element I: Testing, data collection and analysis

Component IV: Evaluation, Reflection, and Recommendations

- Element J: Documentation of external evaluation
- *Element K: Reflection on the design project*
- Element L: Presentation of designer's recommendations

Component V: Documenting and Presenting the Project

- Element M: Presentation of the project portfolio
- Element N: Writing like an Engineer

Please Note: Elements M and N require no submission from the portfolio author(s) and are intended to be scored based on the portfolio work as a whole from what has been submitted from Elements A through L

Element E: Application of STEM principles and practices

5 The proposed solution is well-substantiated with STEM principles and practices applicable to all or nearly all design requirements and functional claims; there is substantial evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by two or more experts (qualified consultants and/or project mentors) and that those reviews provide confirmation (verification) or detail necessary to inform a corrective response.

4 The proposed solution is generally substantiated with STEM principles and practices applicable to some design requirements and functional claims; there is some evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least two experts (qualified consultants and/or project mentors) and that those reviews provide confirmation (verification) or some detail necessary to inform a corrective response.

3 The proposed solution is partially substantiated with STEM principles and practices applicable to at least a few design requirements and functional claims; there is some evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least one expert (qualified consultant or project mentor) but this review may not provide clear confirmation (verification) or at least some detail to inform a corrective response.

2 The proposed solution is minimally substantiated with STEM principles and practices applicable to at least a few design requirements and functional claims; there is minimal evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least one expert (qualified consultant or project mentor) but there is no evidence of confirmation (verification) or any detail to inform a corrective response.

1 The proposed solution is minimally substantiated with STEM principles or practices applicable to at least a few design requirements and functional claims; however, there is no evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by an expert (qualified consultant or project mentor).

0 The proposed solution is not substantiated with STEM principles or practices applicable to any design requirements and/or functional claims.

Learning about single processor Microcontrollers:

The Arduino Rev 3 Board uses the ATMega 328 Microcontroller chip in conjunction with other components to produce a functioning, programmable controller for prototyping platforms.

Arduino R3 specs:

- Operating Voltage - 5v
- Recommended Input Voltage 7-12v
- Input Voltage Limits 6 20v
- 14 Digital I/0 Pins
- 6 Analog Input Pins
- I/0 Pin DC Current - 40mA
- Current for the 3.3v Output Pin - 50mA
- 32KB of Flash Memory
- 2KB of SRAM
- 1KB of EEPROM
- 16MHz Clock Speed

Because of the 40mA limitation on the Digital I/0 pins we had to be careful with powering the TIP 120 Transistor from Pin 13 on the board, to reduce all chance of damaging our board we used a 220 Ohm resistor to lower the current (I=V/R, so increasing resistance lowers current where I=Current, V=Voltage, R=Resistance).

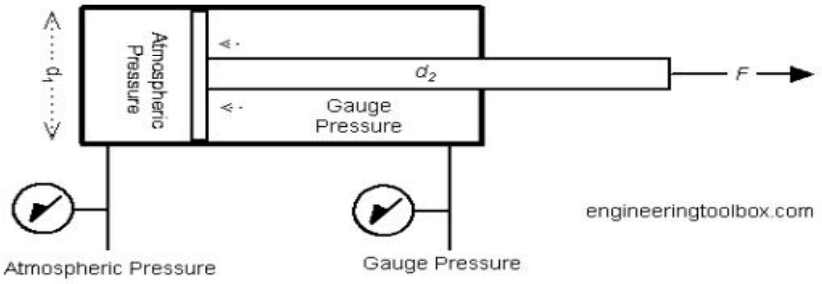
Cylinder Calculations:

$F = p \pi (d_1^2 - d_2^2) / 4$

where

d_1 = *full bore piston diameter (m)*

d_2 = *piston rod diameter (m)*



During testing we used 120psi which will generate a force approximatly 8.16 times that atmospheric pressure alone inside the cylinder.

Vehicle Door:

Vehicle Door:

Many factors play in how much force is generated when wind catches a car door such as weight of the door, surface area, and aerodynamic potential.

Using the formula for centripital Force, $Fc = mv^2/r$

where:

m = the mass of the door

v = speed of the door

r = the radius of the circular path about the joint the door travels in

We can calculate how much force would need to be counteracted by the cylinder.