Engine Design Project

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ABSTRACT

- Tasked to design a full-sized car engine.
- Performed thermodynamic calculation for the engine.
  - Horsepower - 360.4 HP
  - Torque - 380.6 ft-lbs
- Performed stress and strain calculations on the piston connecting pin.
  - Stress - 0.099748 psi
  - Strain - 1.7198E-8
- Goal: Design an engine that can withstand the greatest number of RPM.
- Our engine successfully reached 1710 RPM.

INTRODUCTION

- Objective: design an engine that can replace the 5-liter Coyote V8 in the 2015 Ford F150.
- Car engines convert heat energy into mechanical energy to move the wheels.

RESULTS

- 3 bank W shape, 90 degrees between banks.
- Final dimensions of 30x24.78x20.04 inches.
- Produced 360.4 HP and 380.6 ft-lbs of torque.
- Pin connection experiences 0.0099748 psi of shear stress and 1.7198E-8 strain.
- First test resulted with 1710 max RPM.

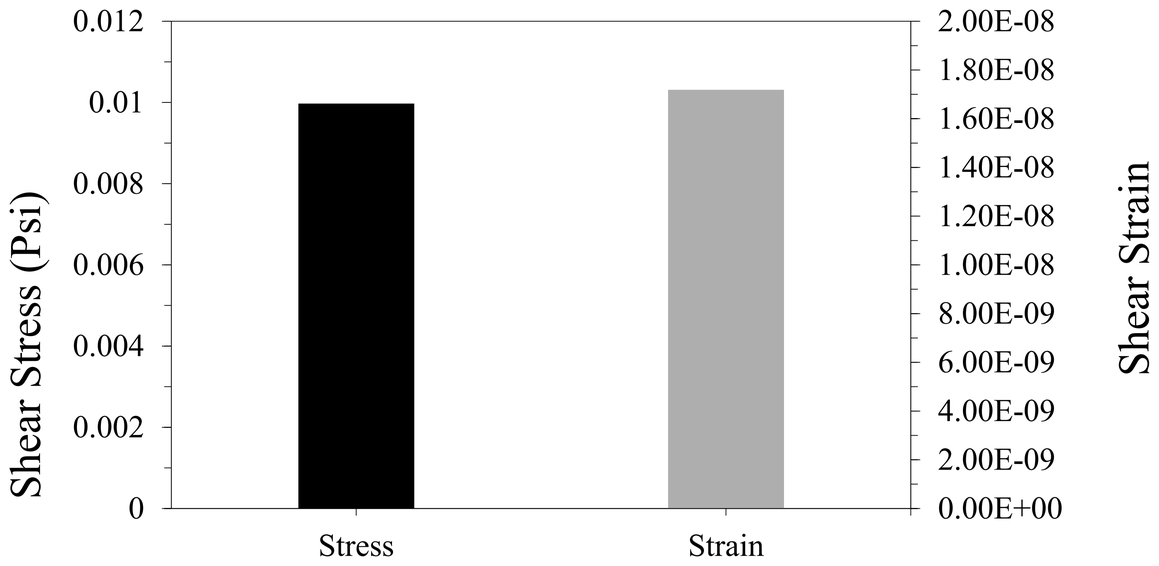

Fig. 1. Comparison of the stress and strain values that were calculated in the piston connection pin. Calculated using shears Hooke's law

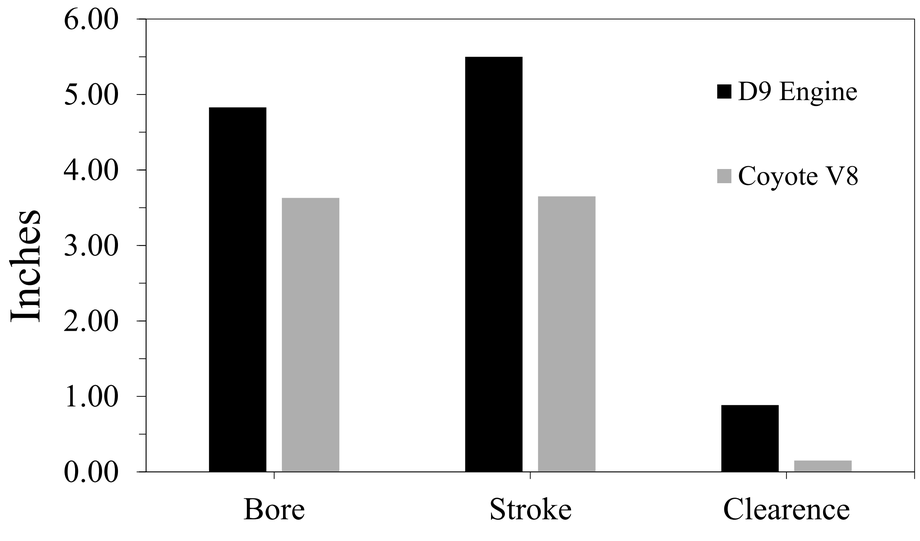

Fig. 2. Comparison of the bore, stroke and clearance of our D9 engine to the Ford Coyote v8. Resulted in similar power and torque values despite size differences.

DISCUSSION

- "D9" - Diaxial with 9 cylinders
- W shape created for balance and compactness.
- Failure occurred at crank shaft from poor crankshaft design.
- High stress at pin caused fracture and binding.
- Dimensions of cylinder gave larger Vmax than Ford.
- Experimental velocity and acceleration were lower due to friction

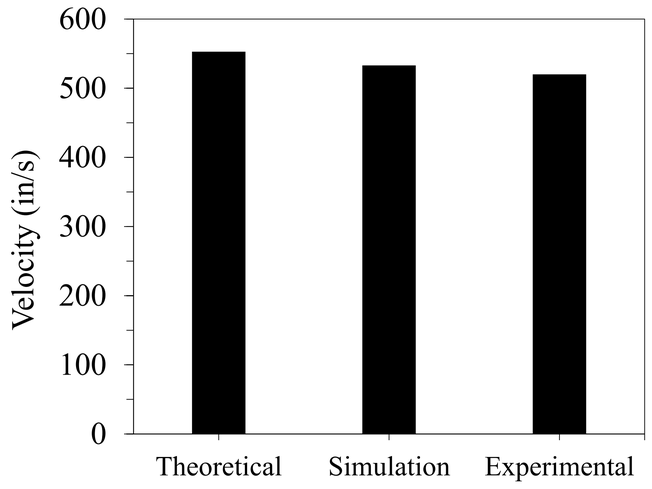

Fig. 3. Velocity across 3 trials. Experimental was the lowest from friction on the parts.

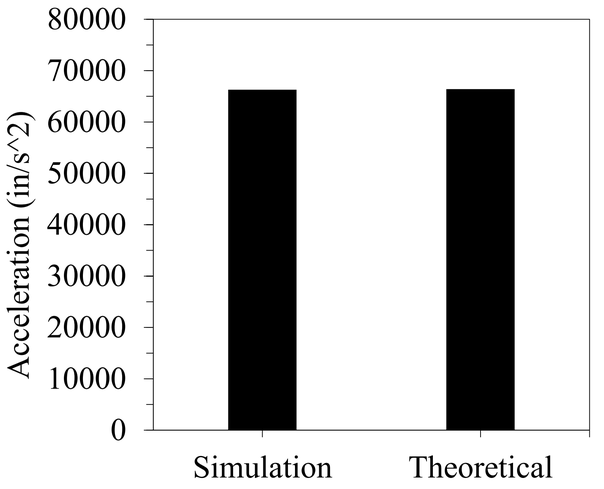

Fig. 4. Acceleration across 2 trials. Theoretical is slightly greater because of rounding.

METHODOLOGY

- Cannot be V8 or flat-8 configuration.
- Max size of 30x25x25 inches using PLA.
- Max compression ratio of 14:1.
- Used High RPM electric motor for test.
- Incremental testing.
- Performed Thermodynamic calculations
- Calculated Shear Stress and Shear Strain.
  - Used definition of τ
  - Used Shear Hooke's Law

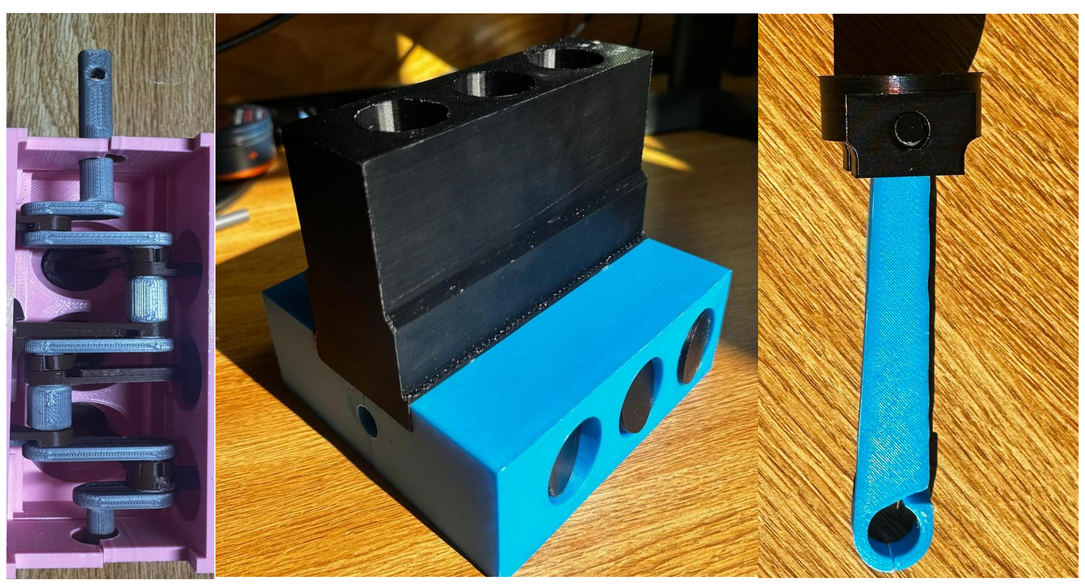

Fig.5. Crank shaft, engine block and piston assembly. By creating a cad design, adjusting tolerances, and adjusting the 3D printer settings, a working 15% scale model was able to be printed.

CONCLUSION & FUTURE WORKS

- Demonstrates problem solving and overcoming design challenges
- Bolstered abilities in CAD, thermodynamics, dynamics, and strength of materials.
- Improve piston head design
  - Avoid binding
- Better tolerancing
  - Achieve desired fits