



Analysis and design of a V configuration motorcycle engine.

Simon Hughes

Malcolm McDonald

School of Engineering

BEng Motorcycle Engineering

Introduction

To create a Solidworks based engine model linked to an excel workbook with in depth calculations on as major parameters of the internal components.

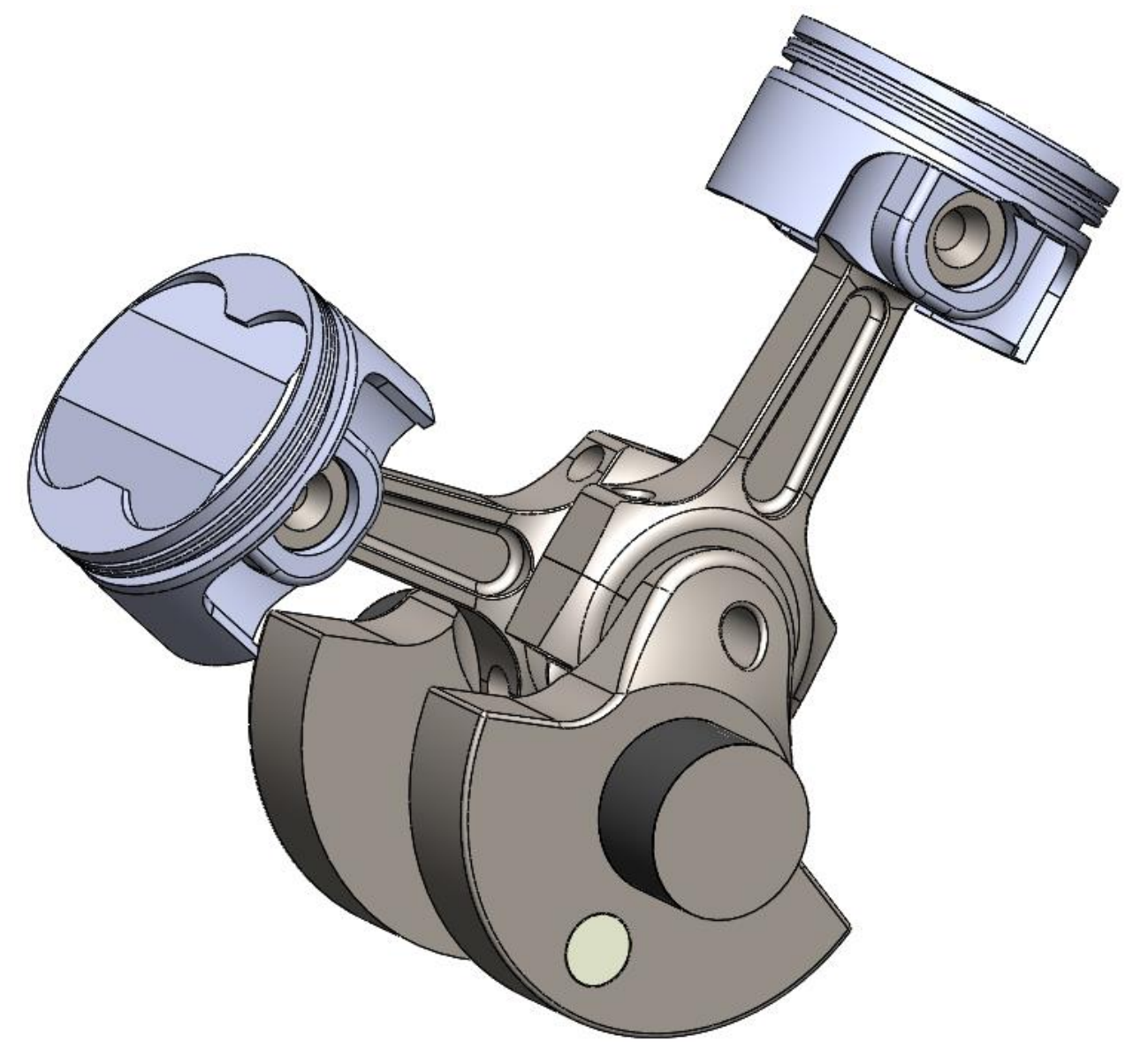
The aim is to create a 450cc v-twin that is lightweight and can enter any 450cc capacity limited Supermoto race series.

Analysis

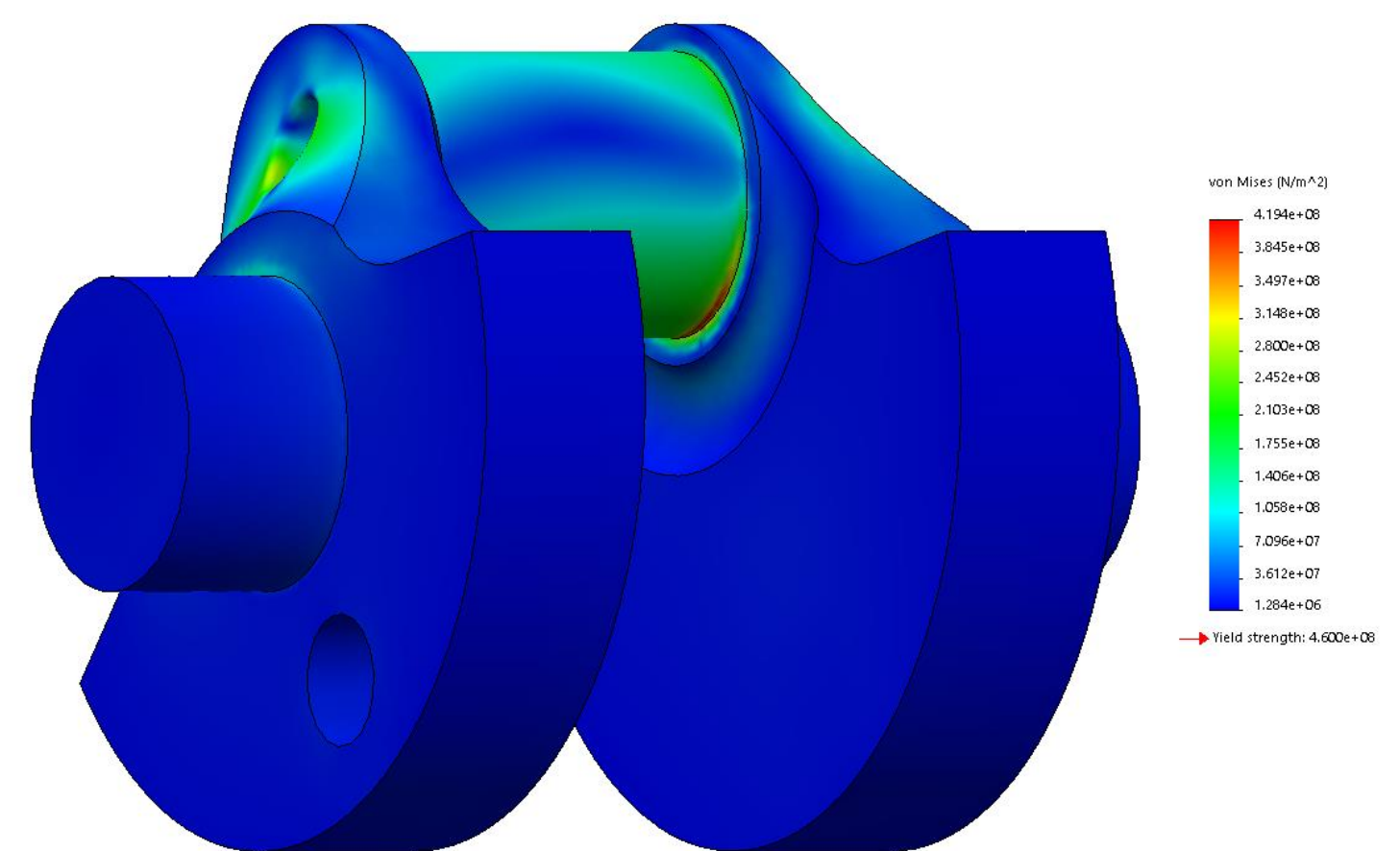
To create the mathematical model used to create the CAD model several engines were analysed to create a baseline for several different parameters.

The motorcycles analysed were an SXV550 from Aprilia, an SV650 from Suzuki and a VFR400 from Honda.

The SXV unexpectedly had the highest bearing pressures and the VFR as expected had the lowest.



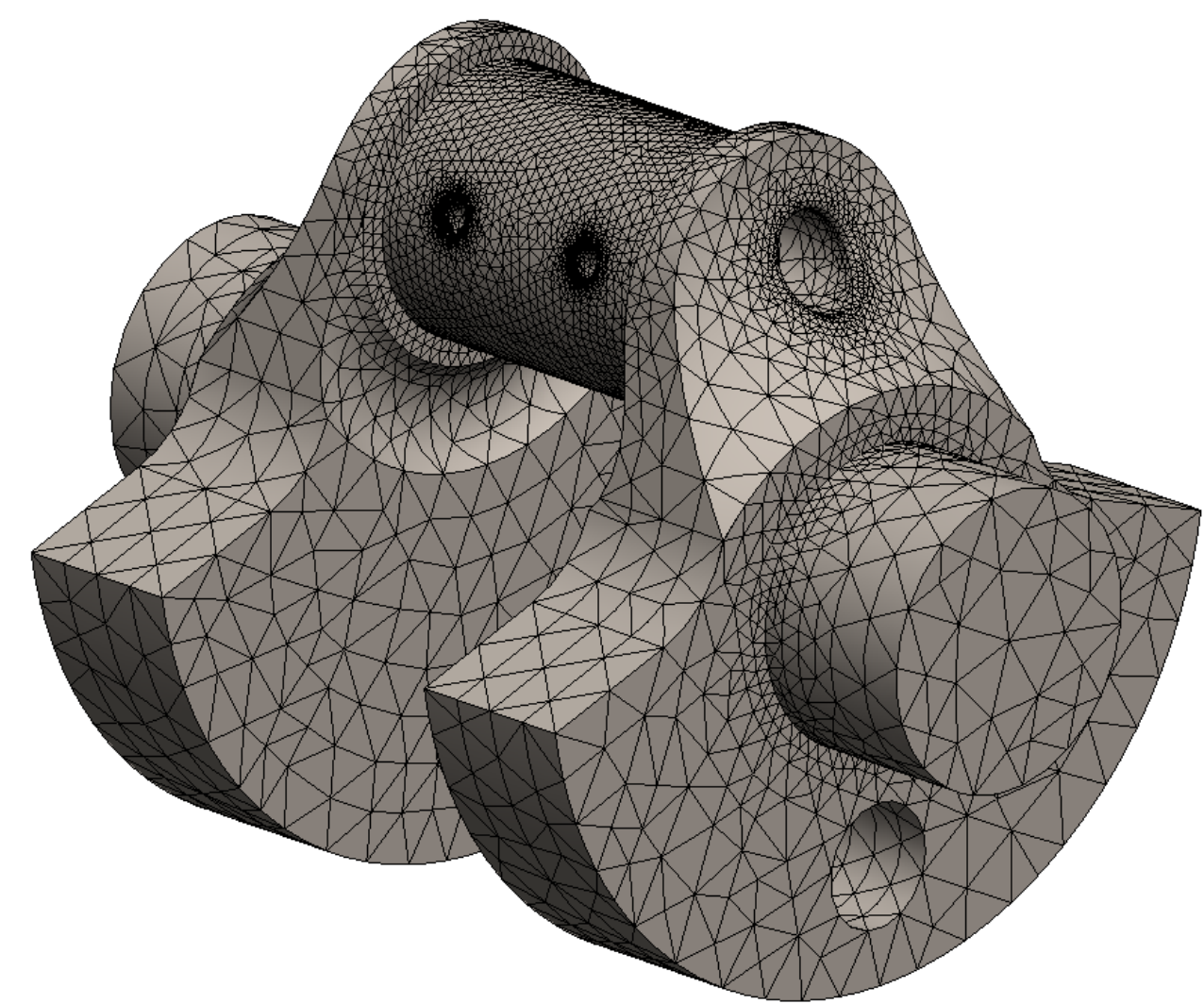
Final CAD design



Von Mises stress FEA on designed crank.

Crank balancing

When balancing a 90° V-twin there is no need for a balance shaft as all the force vectors that the engine produces are cancelled out by each other. This is not the case when the V angle is not 90°. The engine that has been designed would need a balance shaft as it is an 80° V-twin.



Crank with mesh and mesh control applied.

Meshing

When meshing the crank care was taken to add mesh control around known key areas of high stress concentration.

These areas are around the transitions from the big end and main journals to the crank webs and around the oil holes in the big end journal,

Stresses

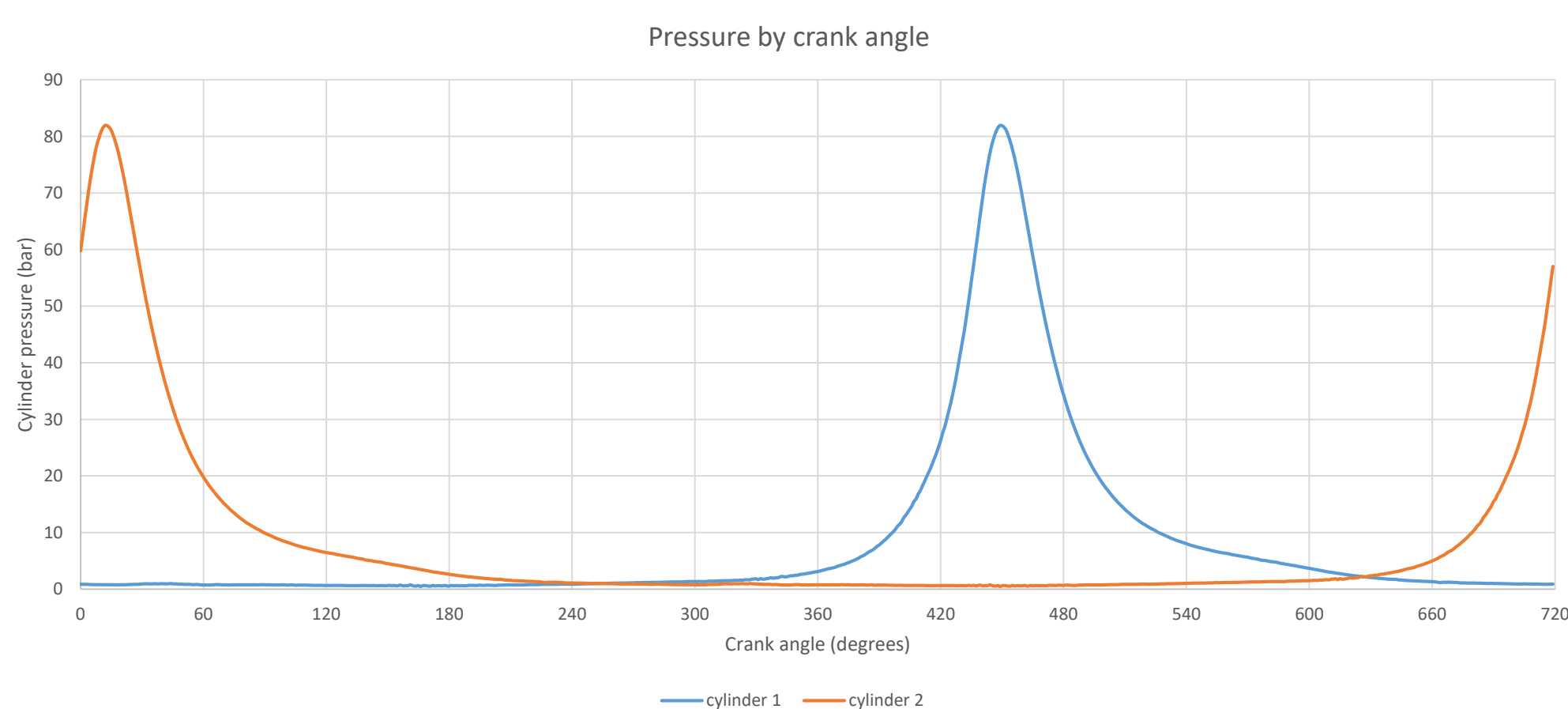
As can be seen on the FEA'd crank there is a small but high in magnitude stress concentration, this was an expected location.

The compressive stress reaches a maximum of 416KN/M², the yield of the selected 4340 steel is 710KN/M², The yield stress reaches a maximum of 181KN/M², this is far below the yield of the material.

The displacement reaches a maximum of 0.19mm though this is at the extremities of the crank webs.

Pressure data

The pressure data below was used in the FEA to give an accurate representation of the internal combustion forces for both cylinders.

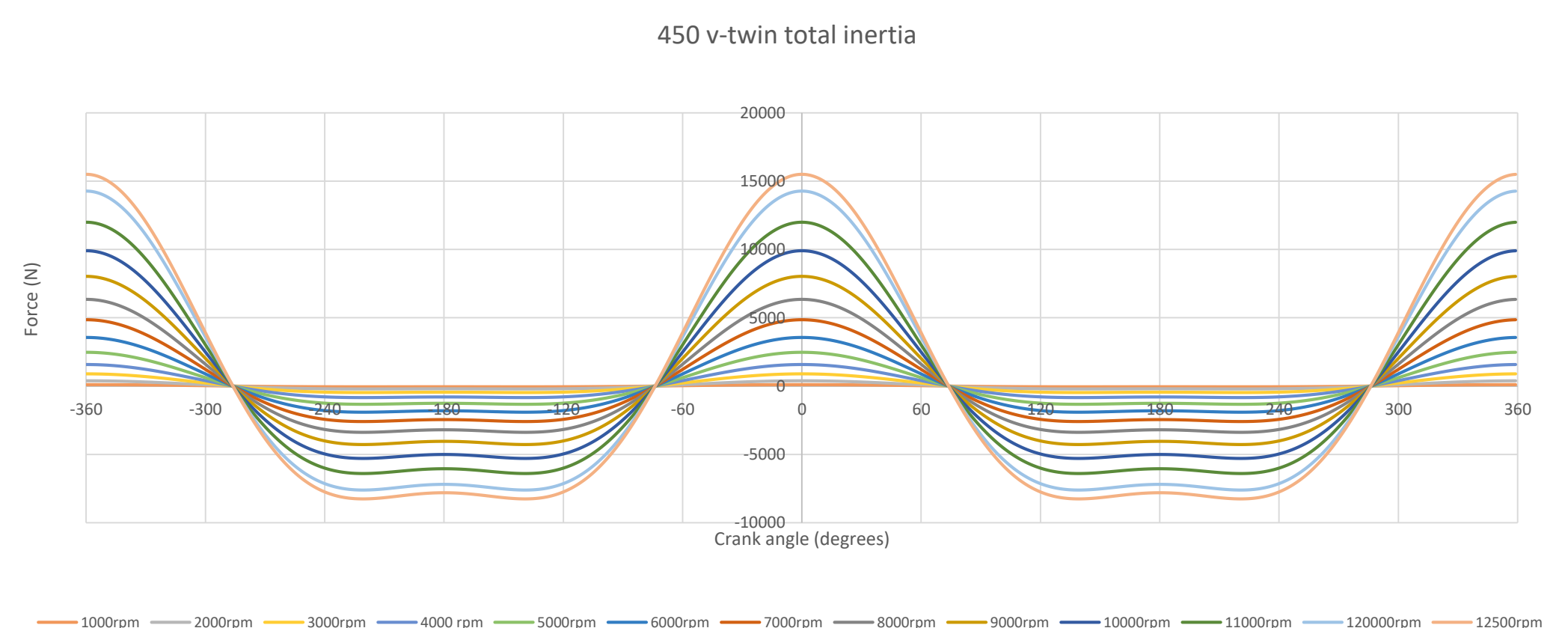


Pressure against crank angle of 80° V-twin

Inertia of an engine

$$F_{inertia \text{ first order}} = M_{rec} \times R \times \omega^2 \times \cos \theta$$

$$F_{inertia \text{ second order}} = \frac{R}{L} \times M_{rec} \times R \times \omega^2 \times \cos 2\theta$$



Inertia force for whole engine cycle