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2.61 Internal Combustion Engines  
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MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Mechanical Engineering

2.615 INTERNAL COMBUSTION ENGINES

Homework Set #1

Due: 2/14/08

The purpose of this set of homework is to give you a feel for the design values of practical engines. *Not all the relevant numbers are given in the problem statement.* Make reasonable estimates and engineering judgments of the unknown parameters.

You have to calculate a lot of numbers. Use Matlab or Spreadsheet to do the calculations.

Problems:

- 1.2 Draw a free body diagram of the piston. Also calculate the magnitude of the gas loading force and the side thrust force due to the connecting rod at  $\theta = 45^\circ$  for the following:
  - (a) A SI engine with an 85 mm bore at a cylinder pressure of 20 bar (at  $\theta = 45^\circ$ ).
  - (b) A turbo-charged CI engine with a 150 mm bore at a cylinder pressure of 100 bar (at  $\theta = 45^\circ$ ).(You may also want to express the results also in lb-force or kg-force to appreciate the magnitude.)
- 2.5 Note the relative magnitude of the different terms in the road power requirement. Also estimate the force for accelerating the vehicle from 40 to 60 mph in 5 seconds.
- 2.8
- 2.11
- 2.13 See Figure 1-8 for timing information. (Note that the pressure values in that figure are for part-load and not for WOT operation. We are, however, only interested in the timing of the various processes; so the information is still useful.)

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Exercise that you do to enrich yourselves but you do not have to hand in anything:

Go to the 2.61 web site and under “good\_stuff”, look at the “engine performance specifications” spread sheet. Explore the spread sheet by sorting the data according to years, BMEP, peak power density, etc. Note some of the outliers, e.g. the Honda Formula One race engine. Get a feel for the peak power density and the max BMEP of the typical engines. (There are separate sheets for SI and light duty Diesel engines.)