Engine Design

Chapter 010: DESIGN TRADE-OFFS AND RATIOS

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Introduction

- In the design of any components or systems there are always conflicting demands, requirements, or desires which must be traded off to achieve the best design **compromise**.
- There are two dimensionless design ratios which can be used to characterize an engine's dynamics behaviour in a general way.

Main reference:

1. R.L. Norton, 2013. Kinematics and Dynamics of Machinery, McGraw-Hill Education; 2nd edition in SI units.

The Ratios

- $\frac{crank}{conrod} = \frac{r}{l}$;
- $\frac{conrod}{crank} = \frac{l}{r}$;
- $\frac{Bore}{Stroke} = \frac{B}{S}$

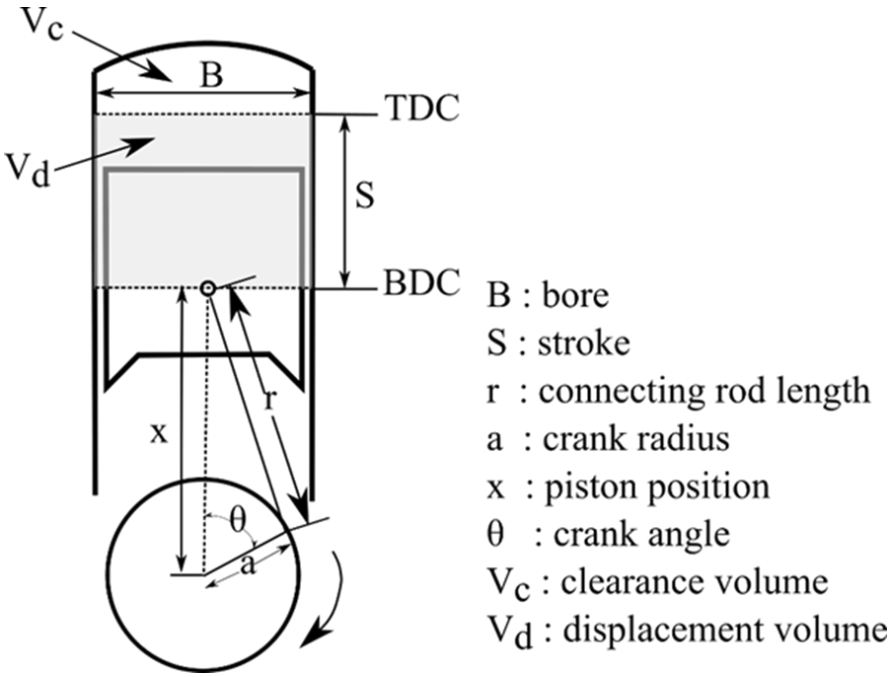

Fig.10.1 The crank-slider engine parameters

Anatomy of a connecting rod

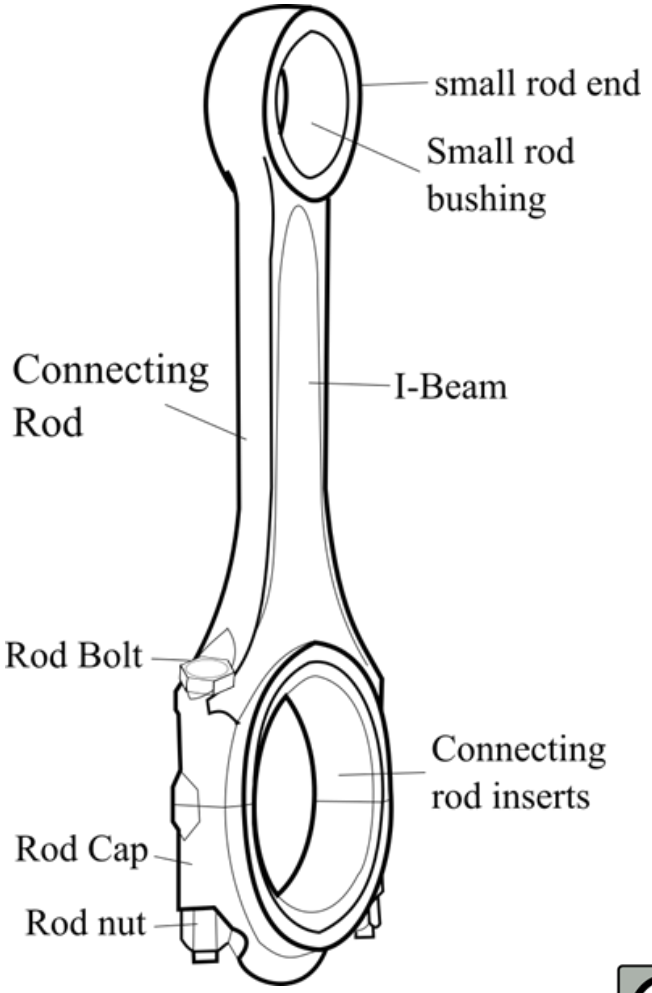

Fig.10.2 The connecting rod

Conrod to crank ratio

- Crank/conrod ratio appears in all the equations for acceleration, forces and torques.
- Smaller r/l resulting in smoother acceleration function.
- Optimum values of r/l: 1/5 to 1/3
- Optimum values of l/r: 3 to 5.

Bore to stroke ratio

- A large Bore with small Stroke will result in **high gas force**.
- A large Stroke and small Bore will result in **high inertial force.**
- **Optimum B/S is between 0.75 to 1.5.**
- **Please investigate the effects of variation in the B/S and l/r ratio on forces and torques in the system using the matlab codes in earlier part of the course.**

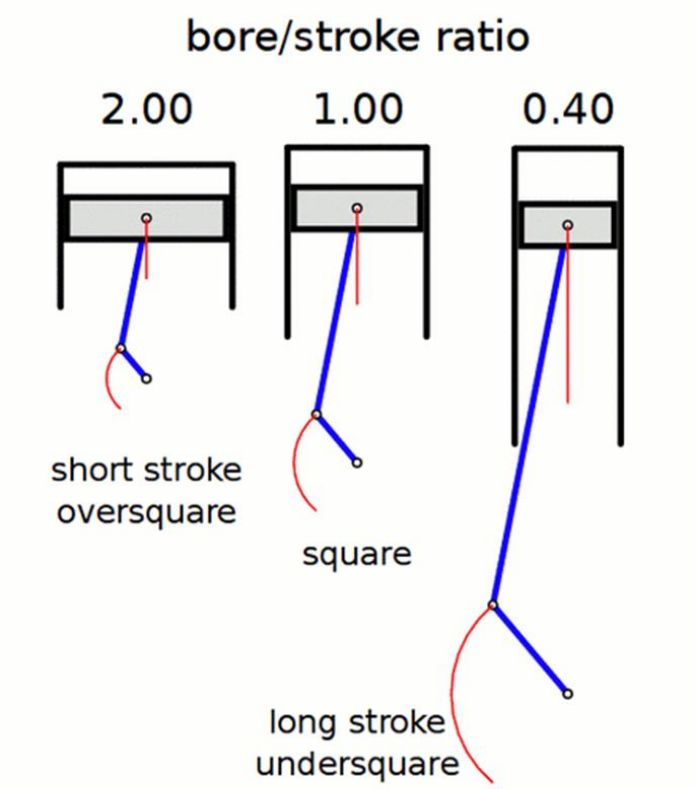

Fig.10.3 The bore to stroke ratio

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