

Chapter 8: Engine Design Parameters

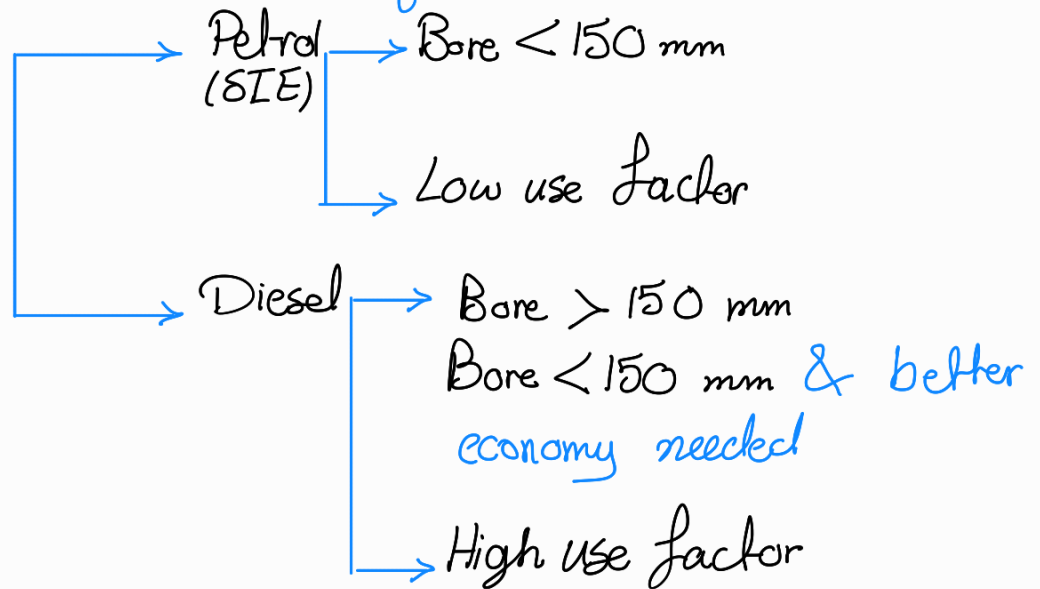
8.1: Basic decisions

1. Reasons for new design
2. Type of service
3. Engine type (power and fuel economy requirements)

► Diesel or Petrol

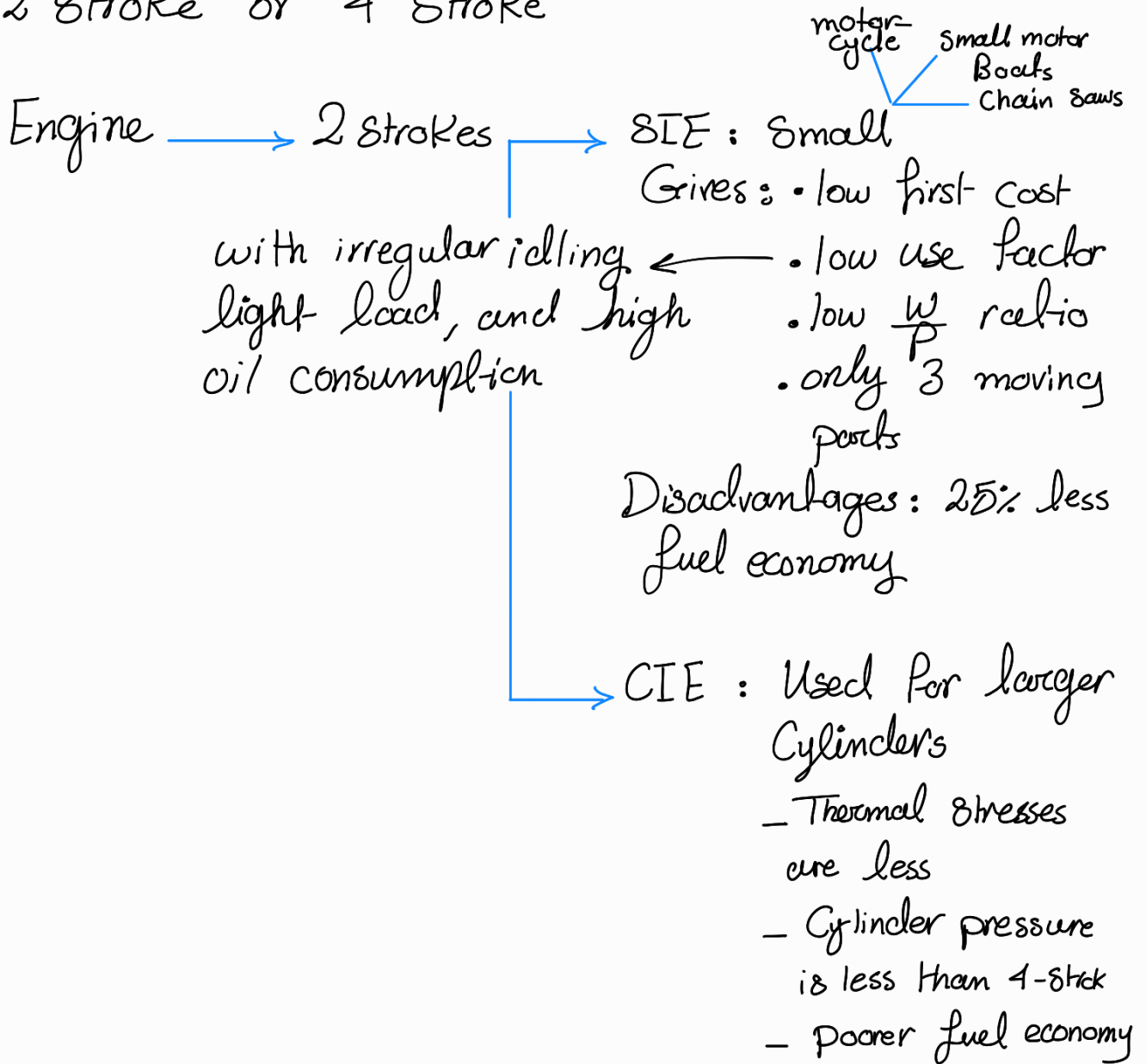
- Important - to decide engine size

- Engine type



Note: Low use factor is related to uncritical fuel economy

▶ 2 Stroke or 4 Stroke



▶ Supercharging or not

Engine type

→ SIE : Compromise with efficiency
Cases:

1. Air craft :
 - provides High specific output for take-off
 - Compensates for low P_a
 - High octane fuel is used → To solve detonation
2. Racing cars :
 - provides High specific output
 - Special fuel type of fuel is used → To solve detonation
3. Large Natural Gas engines
 - Saves weight and bulk
 - Special fuel type of fuel is used → To solve detonation
 - Engines rated higher than 500 hp are supercharged

→ CIE :

- Used to reduce weight and size

- The larger the engine is, the cheaper the design

▶ Number and arrangement of cylinder

hp

Rated Power	No. of Cyl.	Cyl. Arrangement
0 - 3	1	I
3 - 30	1 - 4	I, O, V
30 - 50	4 - 6	I, O, V
50 - 100	4 - 8	I, O, V
100 - 200	6 - 8	I, O, V
Over 200	6 - 16	I, O, V, R, OP
Over 2000	12 - 24	I, V, R, OP

I = in line vertical or horizontal

O = opposed cylinders

V = V arrangement

R = radial

OP = opposed piston (2 cycle)

stroke

Cylinder arrangements

1- In line engines

- 2 or more cylinders
- Good balance and vibration
- Not light weight- Nor compact but has mechanical simplicity with easy maintenance

2- V- engines

- 8 cylinders or more
- Excellent balance with freedom from vibrational problems
- Compact, high specific output- and low cost

- ### 3- Opposed Cylinder engine
- Suitable for air cooling
 - Used for light- weight and short length
- {

 motor cycles
 Rear engine automobiles
 Light- airplanes

4. Radial engines → Aircrafts

- Convenient- shape
- Lowest- weight- per unit displacement-

5. Opposed piston engine

- 2 cycle diesel engines
- Heat- losses are reduced

→ large marine engines
→ Locomotive engines
→ military engines

- Two crank shafts geared together are required (Disadvantage)

8.2: Basic performance Factors

Select numerical values of main characteristics:

► Mean effective pressure

For Diesel engines

Four Stroke engines

Unsupercharge

I m.e.p = 6 - 8 bar

Supercharged

I m.e.p = 9 - 12 bar

Two stroke engines

• Uniflow scavenging

Unsupercharged

I m.e.p = 5.5 - 8.5 bar

Supercharged

I m.e.p = 9 - 16 bar

• Loop scavenging

Unsupercharged

I m.e.p = 5 - 8 bar

Supercharged

I m.e.p = 8 - 14 bar

Spark ignition engine

I m.e.p = 6 - 12 bar

► Mean piston speed

$$V_p = 2 \frac{NL}{60} \text{ m/s}$$

→ RPM
→ Stroke

Low speed engines	N = 100 - 300 rpm	4 - 6 m/s
Medium-speed engines	N = 300 - 1000 rpm	4 - 9 m/s
High speed SIE engines	N > 1000	9 - 15 m/s
High speed CIE engines	N > 1000	9 - 15 m/s

► Stroke - bore ratio L/D

- In high speed engines, the ratio should be minimized → To reduce piston speed and increase force acting on piston

Low speed engines	1.2 - 2
Medium speed	1 - 1.5
Petrol & high speed engines	0.7 - 1.2
* Compressors	0.6 - 1.8
* Pumps	1.5 - 3