

## Lecture 12

3<sup>rd</sup> Semester M Tech. Mechanical Systems Design

Mechanical Engineering Department

Subject: Advanced Engine Design

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### Topic: Layout of Engine Cylinders

#### Objective:

1. Possible layout of the engine cylinders for different applications.
2. Selection of number of cylinders corresponding to total displacement volume.

#### Types of Layout of Engine Cylinders

1. In-line engines
2. Vee Configuration
3. Horizontally opposed engine
4. Compact W configuration

#### 1. In-line engines

##### (a) Single bank of cylinders

- (b) The **simplest** configuration

Because only bank of cylinders must be served with:

- (i) Intake manifold
- (ii) Exhaust Gas Manifold
- (iii) Cooling Systems

The above three systems are easily configured with the single bank of cylinders.

- (iv) The **engine height** creates packaging **challenges** in **some applications**.
- (v) As the **number** of cylinders **increases**, **length** may become **prohibitive**.
- (vi) The **height** is sometimes **reduced** by tipping the engine in a **slant mounting** or
- (vii) By **mounting** it **horizontally**
- (viii) The reduced height comes at the price of **increased width**.
- (ix) **The crankshaft is initially supported by two main bearings at its two ends.**
- (x) **Further each cylinder is supported between a pair of main bearings.**
- (xi) **Suitable both for medium duty and heavy duty applications.**

## 2. Vee Configuration.

- (a) **It has two banks of cylinders**
- (b) The Vee configuration allows a reduction in both height and length.
- (c) The width is increased.
- (d) The two banks of cylinders need to be supported by intake manifold, exhaust gas manifold and cooling systems.
- (e) This system now becomes **complex**. It needs **two exhaust gas manifolds** for two banks.
- (f) It has the **disadvantage** of a **reduced crankshaft bearing area**.
- (g) In Vee configuration **two cylinders** are supported **between** each **pair of main bearings**.
- (h) This **reduces the bearing area** for **big end** of the **connected rod**.
- (i) This type of engine design is **suitable for automobile engines**.
- (j) **Not suitable** for **heavy duty applications**.

## 3. The Horizontally Opposed Engine.

- (a) **Two banks of cylinders at an angle of 180 degrees with each other.**
- (b) Length of the engine is reduced to half like that of a Vee engine.
- (c) The height of this type of engine is minimum.
- (d) The width required with this type of engine design is quite large
- (e) It faces similar bearing area challenges as in the case of a Vee engine.
- (f) The maximum physical distance between the cylinder banks with this type of engine design will require:
  - (i) Separate intake manifold for each bank of cylinders
  - (ii) Separate exhaust gas manifold for each bank of cylinders
  - (iii) A separate or a complex cooling system for this type of engine design.

## 4. W Configuration

- (a) **Four banks of cylinders**
- (b) Can be thought of as two Vee engines placed side by side with a single crankshaft.
- (c) The length is reduced to one fourth
- (d) The Width gets increased further
- (e) It also faces the challenge of the requirement of a complex design of the following:
  - (i) Intake manifold
  - (ii) Exhaust gas manifold
  - (iii) Engine cooling system.

**Conclusions:**

1. The packaging of the engine as a power plant with its corresponding length, width and height is established.
2. The requirements for the installation of intake manifold and exhaust gas manifold of the engine are finalized with the drawing based design for the layout of engine cylinders.
3. The engine drawings with the layout of its cylinders decides the connections of the cooling system with each bank of engine cylinders.
4. The need for duplication of some systems like the exhaust gas manifold for a vee engine is known.
5. The number of cylinders needed for a certain displacement volume should be even for any type of multiple bank cylinder based engine design.
6. The odd number of cylinder is suitable with a single bank of cylinder based engine design.

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Text Book:

Vehicular Engine Design

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