

# Design and Fabrication of Six Speed Constant Mesh Gear Box

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## Abstract

All the automobile vehicles available are always set to changing speed and torque between engine and driving wheels. Torque is not directly changed but it can be done in the form of power using a suitable device. It is a very useful method that we adopt, and it is also easily affordable. Many other alternative, even though more elegant, and appear to be more effective are not feasible when it comes to transmission. This project mainly focuses on the design and fabrication of a gear box that can transmit torque to the maximum and also help to do some useful work in automobile where power transmission is a major factor. The transmission of power is done in six speeds in this project. This setup uses two shafts and thirteen gears arranged in suitable distance to achieve the desired torque and speed.

**Keywords:** Gear, Shaft, Dog clutch, Ball bearing, lever.

## 1. INTRODUCTION

The present day world is moving towards globalization. Now to keep at par with the global market, the countries follow a different set of standards. The main purpose of these standards is to make a product available in every nook and corner of the world with exactly the same specifications without any single change. The standards are being adopted in each and every field of technology and science. These changes, especially in automobile next to the clutch are the transmission in the transmission system of a motor vehicle. The word „transmission“ is used for a device that is located between clutch and propeller shaft. The device used for the transmission is Gear Box.

## 2. PURPOSE OF THE GEAR BOX

The purpose is to provide high torque at the time of starting, accelerating and pulling load. When the vehicle is starting a high torque is required at the driving wheels. Hence a device must provide to permit the engine crankshaft to revolve at a relatively high speed, while the wheels turn at high speeds. This is obtained by a set of gears called a transmission or gear set. The gear set is enclosed in a metal box called a Gear Box. It helps to reduce the engine speed in the ratio of 4:1 in case of passenger cars and in a greater ratio in case of Lorries. It helps to turn the drive around 90° and to drive the driving wheels at different speeds.

## 3. THE WORKING OF 6 SPEED CONSTANT MESH GEAR BOX

This six speed constant mesh gear box has two shafts, one for the input and the other for output. Six gears are mounted on both the shafts and are in constant mesh. Ball bearings are connected to the gears on the output shaft which make them rotate freely on the output shaft.

The output gears have extensions on one side for the engagement purpose. The clutches are engaged and disengaged with the gears by the use of levers. The clutches are keyed to the output shaft. The engine flywheel is connected to the input shaft.

The gears on the output shaft rotate freely on the bearings. In order to engage the dog clutch with the gear the respective lever is moved. This moves the clutch toward the gear and the dog gets engaged with the extensions on the gear. The rotation is transferred to the output shaft. The wheels connected to the output shaft are also rotated.

## 4. DESIGN PROCEDURE

### 4.1. DESIGN CALCULATION

PINION C45 steel

$$\sigma_u = 630 \text{ MPa} \quad \text{HB} = 215$$

GEAR: C45 steel

$$\sigma_b = 210 \text{ MPa} \quad E = 2.15 \times 10^5 \text{ N/mm}^2$$

[DATA BOOK Pg No. 8.4, 8.5, 8.14]

GEAR RATIO

$$i = 1.4$$

NUMBER OF TEETH: Teeth on Pinion: 3 Teeth on Gear: 54

TANGENTIAL LOAD

$$\text{Power to be transmitted} = 1.5 \text{ kW} \quad \text{Input speed} = 750 \text{ rpm}$$

$$K_o = 1 \text{ (steady load)} \quad F_t = (P/V) K_o$$

$$F_t = [(1500) / ((\pi m (38)(750) / 60 \times 10^3))] \times 1$$

$$V = (\pi d_1 N_1 / (60 \times 10^3))$$

$$F_t = 1005.16 / m \quad V = (\pi m Z_1 N_1 / (60 \times 10^3)) \quad \text{INITIAL DYNAMIC LOAD:}$$

$$[C_v \text{ - From Data Book Pg No. 8.51}] \quad F_d = F_t \times C_v \quad \text{Assume } V_m = 3 \text{ m/s } V_m < 10 \text{ m/s} \quad F_d = (1005.6/2) \times 2$$

$$C_v = (3 + V_m) / 3 \quad F_d = (2011.3 / m) C_v = 2$$

**BEAM STRENGTH:**

$$[F_s \text{ from Data Book Pg No. 8.50}] \quad s = [\sigma_b] \text{ by } [\sigma_b = \sigma_o / 3] \quad [\sigma_b] = [(\sigma_u) / 3] = 210 \text{ MPa}$$

[y - From Data Book Pg No. 8.50]

$$b = 10 \text{ m} \quad [\text{Assumption}] \quad y = 0.154 - (0.912 / z_1) = 0.13 \quad [\text{Take } 20^\circ \text{ INVOLUTE}]$$

$$F_s = [210 \times 10 \text{ m} \times 0.13 \times] \times m$$

$$F_s = [857.22 \text{ m}^2] \quad \text{EVALUTE}$$

$$F_s = F_d$$

## 5. FABRICATION PROCESS

The material for shaft and gear are taken as C45 steel. The gears and the shafts are fabricated in the following method.

### Gears

Machining, drilling and boring

These operations were done in gears at centre to produce hole in the gear to hold on the shaft.

### Shafts

#### Turning-These

operations are done in lathe for the shaft in which the cylindrical objects may be produced. With the work piece rotating and in single point cutting tool

**Welding-** This sort of operation is done to fix the gears onto the shaft.

### Assembly

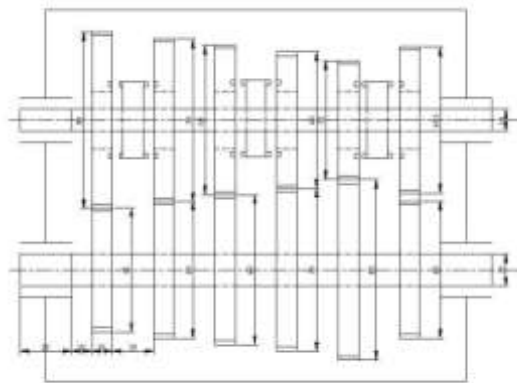
After machining the components, they were assembled.

At first, the gears are mounted on the shafts as a preliminary process that two dog clutches are mounted on the shaft. One in the input shaft and another in the output shaft.

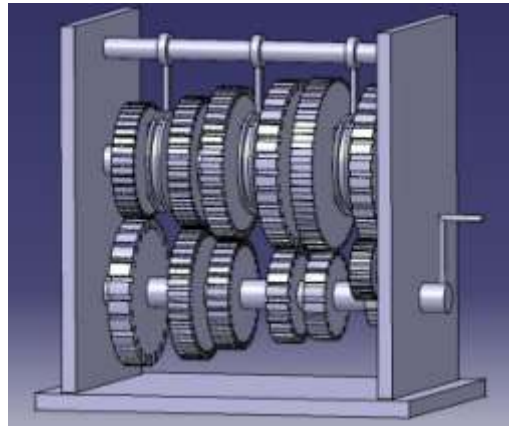
For the rigid support of gears on the splines shaft a bearing is provided over a dog clutch.

The bearings are fixed to the mounting on the shaft.

The gear shift lever is fixed, in the assembly for engaging gears.



**Fig.1 CAD Model of Six speed constant mesh Gearbox**



**Fig.2**CATIA Model of Six speed constant mesh Gearbox

## 6. CONCLUSION

Although there are much advancement in the field of designing and fabrication of gearboxes, the constant mesh gear box is one of the most efficient gear boxes. The Project was an exposure to the world of practical working knowledge. It gives us an opportunity to apply the theories studied in the curriculum in a practical situation. It also gave an opportunity to know the practical difficulties that arise in the process of designing and fabrication. A gear box can also be designed and fabricated for 4, 8, 12, 16, etc. as per the requirement using the same principle and method.

## 7. FUTURE SCOPE OF THE PROJECT

The future scope of the project is by replacing the material of the components with low weight and high strength materials. The dog clutch can be engaged or disengaged by hydraulic or pneumatic systems with the help of sensors. We can also reduce the number of gears and obtain the same number of speeds. The type of engagement between the dog clutch and the gear can also be improved by some other means.

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