ABSTRACT

Nowadays gear designs are becoming challenging in order to meet increasing performance requirements such as high load capacity, high endurance, low cost, long life and high speed.

In gears the dynamic load creates bending stresses at the tooth root which can lead to fatigue failure. One of the major concerns in the design of power transmission gears is the reduction of dynamic load and weight. Research work has revealed that the basic mechanism of noise generated from gears is due to vibration excited by the dynamic load. The life and reliability of a gear transmission is reduced by high dynamic load and more weight. Minimizing gear dynamic load and weight will decrease gear noise, increase efficiency, improve pitting fatigue life, and help prevent gear tooth fracture.

There are various methods of optimizing spur gear design; one such method is reduction of weight. An attempt is made in this work to study the effect of weight reduction on performance of gear with several modifications in the gear tooth without affecting the involute profile such as axial holes, radial holes and split gears. Studies have been carried out on the effect of these modifications on stress relief in critical area of gear tooth; say at the root of the tooth. The influence of change in gear geometry in improving durability, strength of gear and reduction in weight is studied.

A three teeth gear model with 5.5 mm module was used which adopts the finite element method using ANSYS V9.0 for predicting the root stress distribution, bending stress and deflection of tooth. Various combinations of holes with different sizes varying from 0.3 times the module to 0.5 times the module were used in the FEA model and analysis was carried out to study the

performance. The position of holes were also varied along the tooth depth such as on the pitch circle diameter, above the pitch circle in the double teeth contact zone and below the pitch circle and the position of hole varies from near contact point to away from the contact point. The max bending stress, stress at the root, deflection and weight variation of each model were determined and compared with the standard solid gear tooth.

From the investigations carried out, it is found that the introduction of circular discontinuity of 0.5 module diameter below the PCD not only reduces the stress at the root but also gives a weight reduction of 62 grams. Hence with the modified gear tooth with circular discontinuity of size 0.5 times the module is considered for experimental testing.

Both the gear boxes, the one with standard gear and other with modified gear are subjected to endurance run for 322 hours. The maximum torque given is 75Nm at 3000 rpm. The gear boxes are run at no load as well as at full torque at various gears

From the above experimental testing it is found that the introduction of circular discontinuity of 0.5 times module below the pitch circle diameter not only gives weight reduction but also does not affect the performance of the gear.