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"DESIGN MODIFICATION AND ANALYSIS OF JCB 3DX EXCAVATOR BRAKING SYSTEM"

Makvana Vijay C, Mr. Kapil V. Lakhani, Mr. Prashant Salat

1PG Scholar, Arham Veerayatan Engineering College, Haripar, Mandvi

2 3Assistant Professor Mechanical Engineering

ABSTRACT

Brake is a device to stop and reduce speed of the vehicle. It is vital for the automobile. In JCB braking system hydraulic brake are used. For the JCB braking system friction plate and counter plate are vital component. In JCB braking system five friction plates and six counter plates are used for each side of tyre. Static analysis was carried out for various model and reduction of stress and deformation. By which the performance of the vehicle will be improved also Friction plate life will be improved.

Hydraulic Brake

Hydraulics is that branch of engineering and applied science which deals with the mechanical properties of fluid. The liquid under pressure is used to transfer force or motion, or to increase an applied force. The pressure that gets applied on a liquid is called Hydraulic Pressure. And the brakes which are operated by means of hydraulic pressure are called Hydraulic Brakes. These brakes are based on the principle of Pascal's law.

Pascal's Law

The pressure exerted anywhere in a mass of confined incompressible liquid is transmitted equally in all directions throughout the liquid such that the pressure ratio remains the same. The siphon, Hydraulic jack, Hydraulic press, hydraulic lifts and breaking system for automobiles etc. are some examples of hydraulic applications.

Pascal's law or the principle of transmission of fluid – pressure (also Pascal's Principle) is a principle in fluid mechanics that states, that a pressure change occurring anywhere in a confined incompressible fluid is transmitted throughout the fluid such that the same change occurs everywhere.

Master Cylinder in Action

In automotive engineering, the master cylinder is a control device that converts non-hydraulic pressure (commonly from a driver's foot) into hydraulic pressure. This device controls slave cylinders located at the other end of the hydraulic system.

Fig. Master Cylinder

Working of JCB Braking System

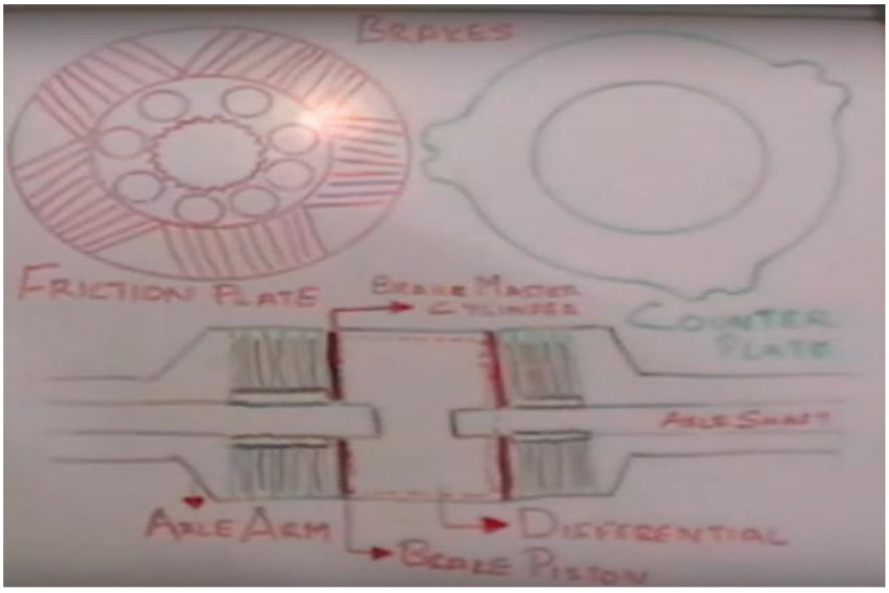


Fig. Friction plate, Counter plate and Brake mechanism

In JCB braking system there are two types of plate are used (1) friction plate (2) counter plate. When the pedal is applied it's also known as non-hydraulic pressure. At that time pressure is created due to master cylinder at the same time brake piston is move towards the plates (tyre direction). Due to Chamber fluid pressure the all plate are lock together and friction is generated therefore the axle is stop is called JCB hydraulic braking system.

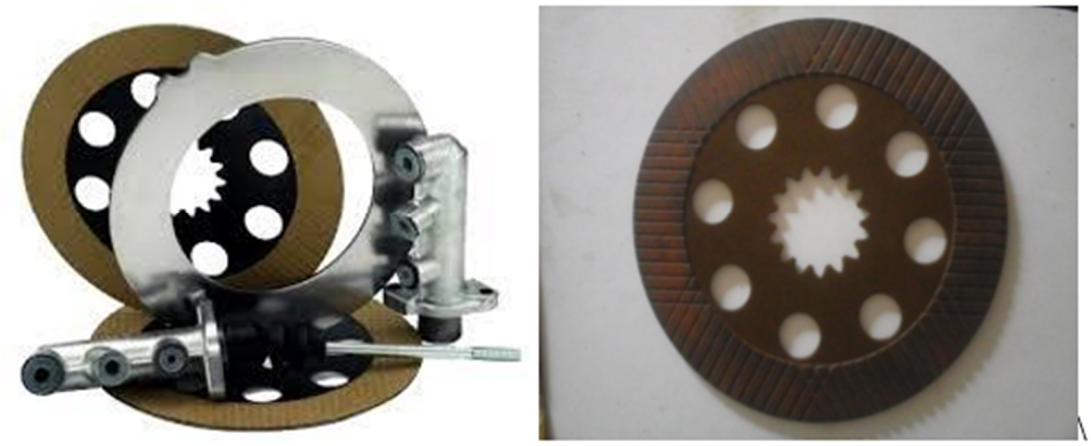


Fig. Friction plate, counters plate and master cylinder

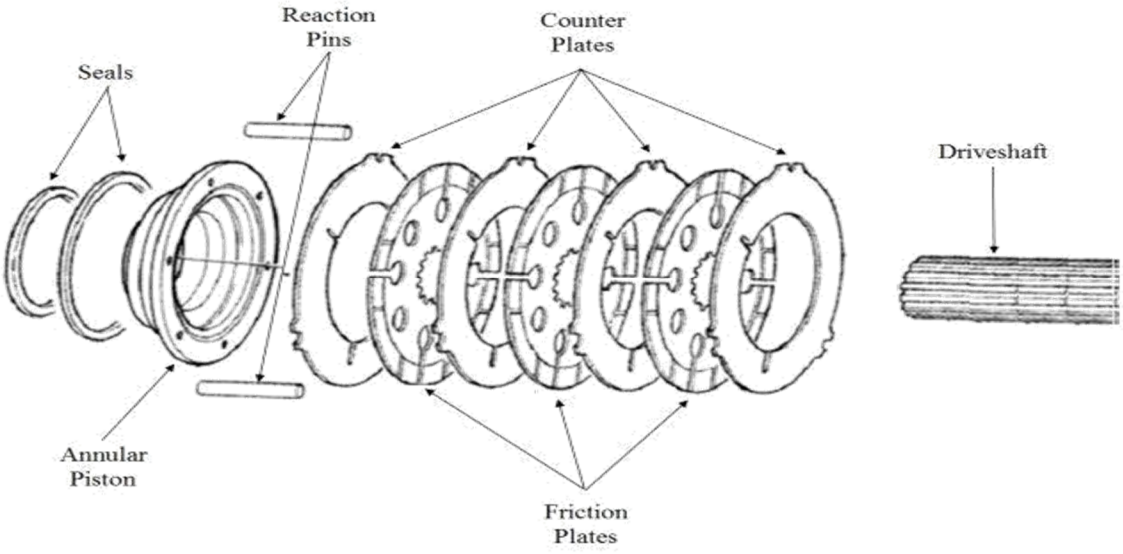


Fig. Plate assembly

ROOT CAUSE ANALYSIS

Root Cause Analysis is a method that is used to address a problem or non-conformance, in order to get to the "root cause" of the problem. It is used so we can correct or eliminate the cause, and prevent the problem from recurring.

Traditional applications of Root Cause Analysis is Resolution of customer complaints and returns. Disposition of non-conforming material via the Material Review process. Corrective action plans resulting from internal and customer audits.

Objective of Root Cause

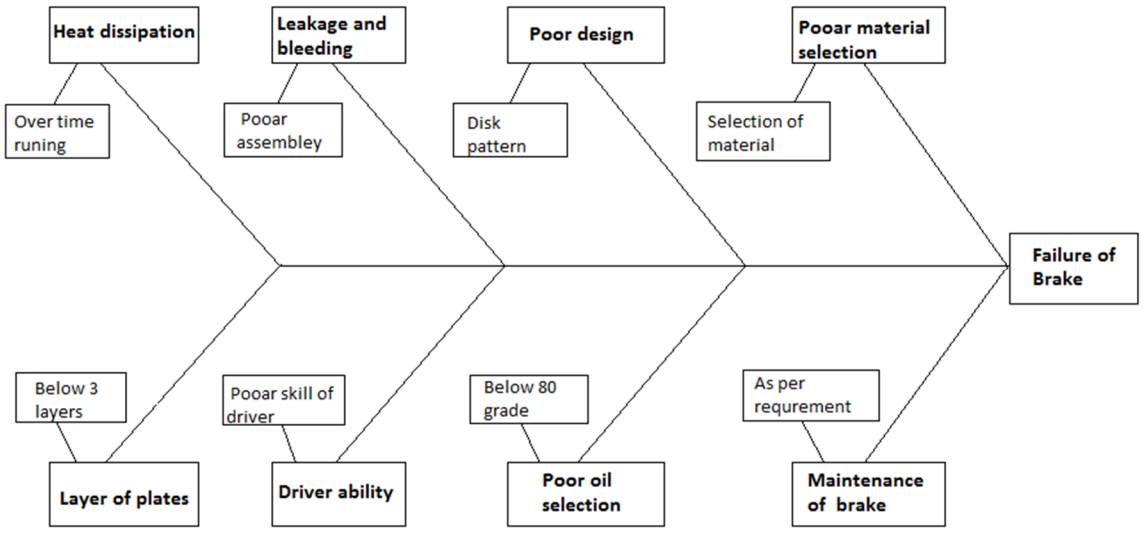
Through this training course, you will: Understand the meaning of "Root Cause". Know the steps used to identify the root cause of problems. Root Cause Analysis is a method to focus our efforts on the true "Root Causes" of escapes, so that we truly prevent their reoccurrence. Root Cause Analysis helps us reduce turn backs and frustration, maintain customer satisfaction, and reduce costs significantly. Each problem is an opportunity. It contains the information needed to eliminate the problem. But to identify the root cause, we have to ask "Why?" over and over, until we reach it.

Fishbone Diagram

The Fishbone Diagram (also known as the Cause & Effect Diagram) is a technique to graphically identify and organize many possible causes of a problem (effect).

Fishbone Diagrams help identify the most likely ROOT CAUSES of a problem. They can also help teach a team to reach a common understanding of the problem. This tool can help focus problem solving and reduce subjective decision making.

When the need exists to display and explore many possible causes of a specific problem or condition. This diagram allows the team to systematically analyze cause &affect relationships. It can also help with the identification of ROOT CAUSES.



Fig, 3.2 Fish born Diagram

Main eight causes are in failure of braking system

1. Driver ability,
2. Heat dissipation,
3. Leakage and bleeding,
4. Layer of plate,
5. Performance Issues
6. Poor Oil Selection,
7. Maintenance of brake,
8. Poor material selection,
9. Poor design.

Input Parameters for Calculations

1.	Mass of the vehicle (m)	7450 kg.
2.	Initial Velocity (u),	30 km/hr.
3.	Final Velocity (v),	0 km/hr.
4.	Friction plate diameter (d),	220 mm.
5.	Friction plate radius (r),	110 mm.
6.	Acceleration due to gravity (g)	9.81 m/s^2.
7.	Coefficient of friction (μ)	0.14
8.	Paddle pressure	40 N
9.	Master diameter	10 mm
10.	Cylinder diameter	195 mm
11.	Cylinder force	15200 N

Generated Models

Due to stress and deformation performance of the vehicle gets decreased so to resolve this problem we have made various models. On this various models we are going to perform static structural analysis and the model that has a less stress will be considered as final model.

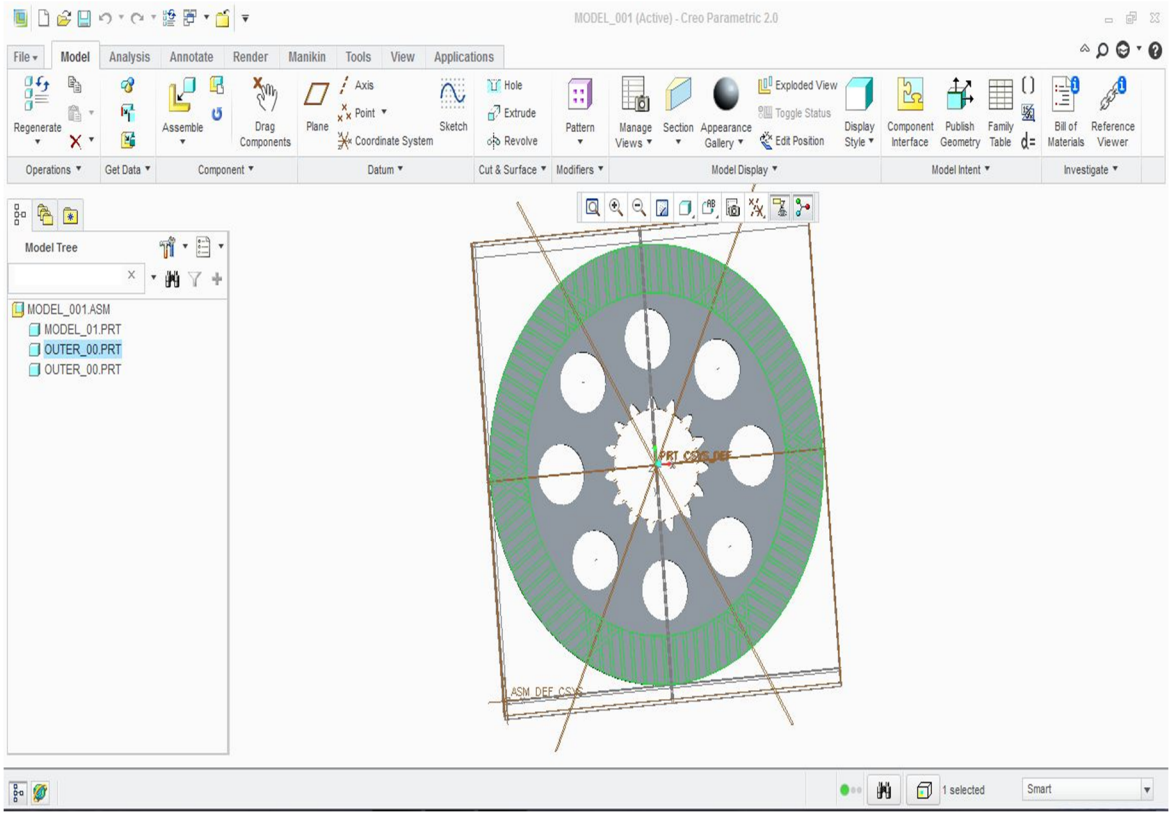


Fig. 5.1 Actual Model of Friction Plate

The modified model-1 has four slots

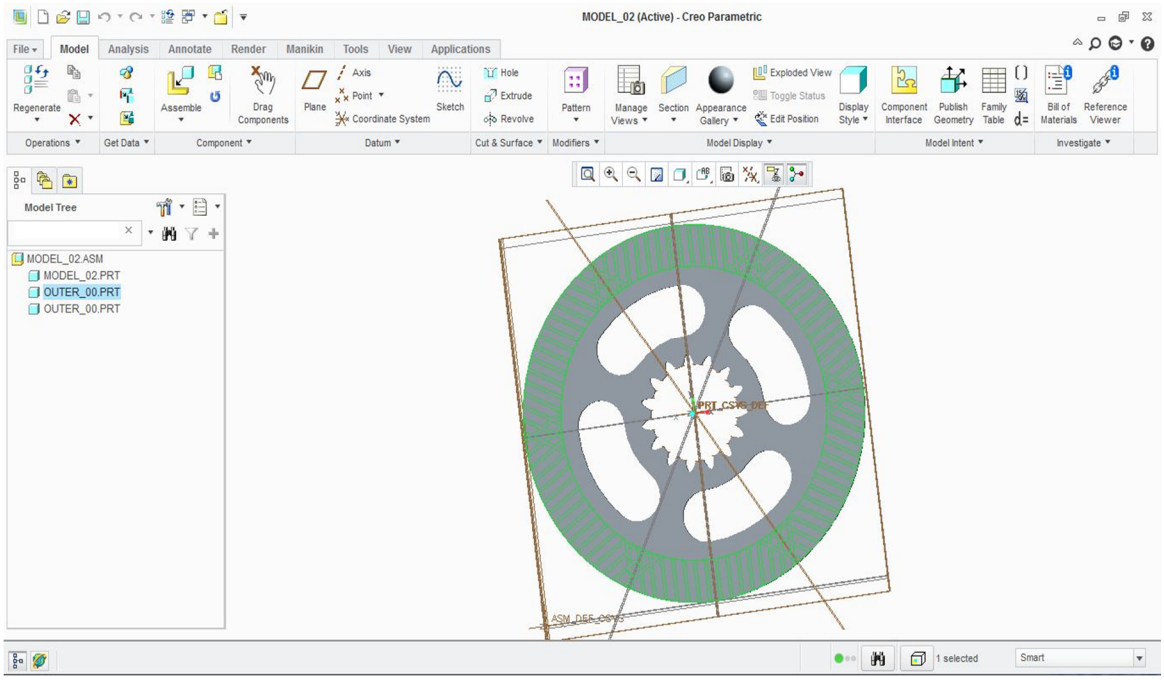


Fig. 5.2 Modified Model-1 of Friction Plate

The modified model - 2 has 2 slots and 4 holes

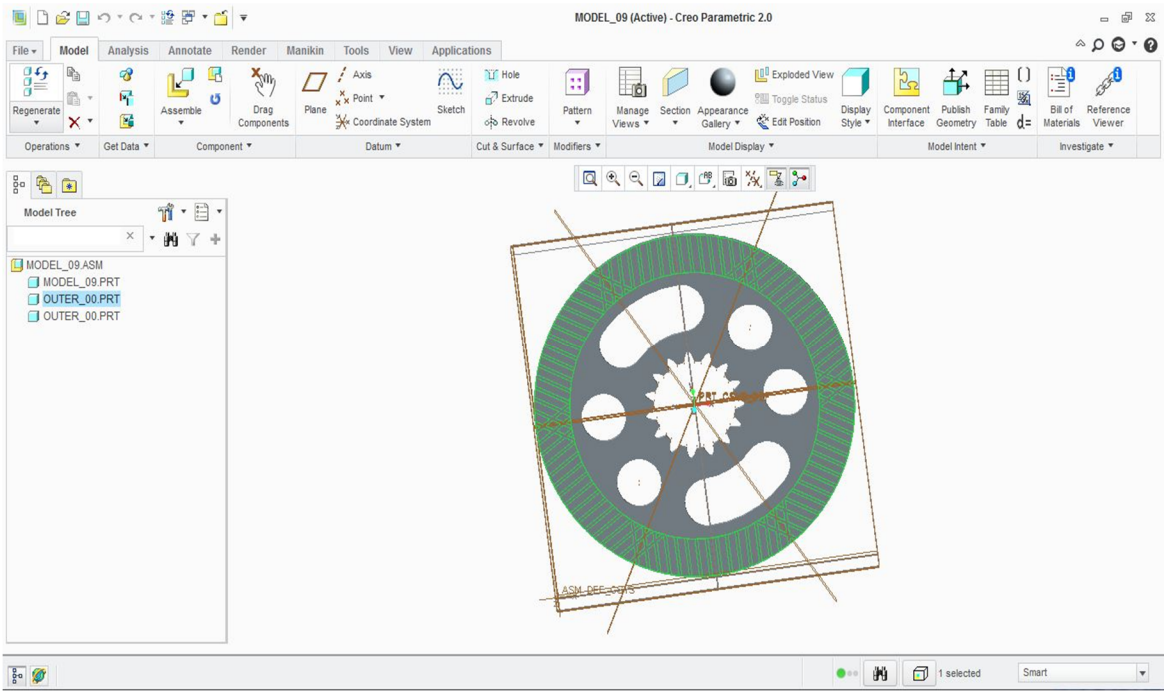


Fig. 5.3 Modified Model-2 of Friction Plate

The modified model - 3 has 4 holes.

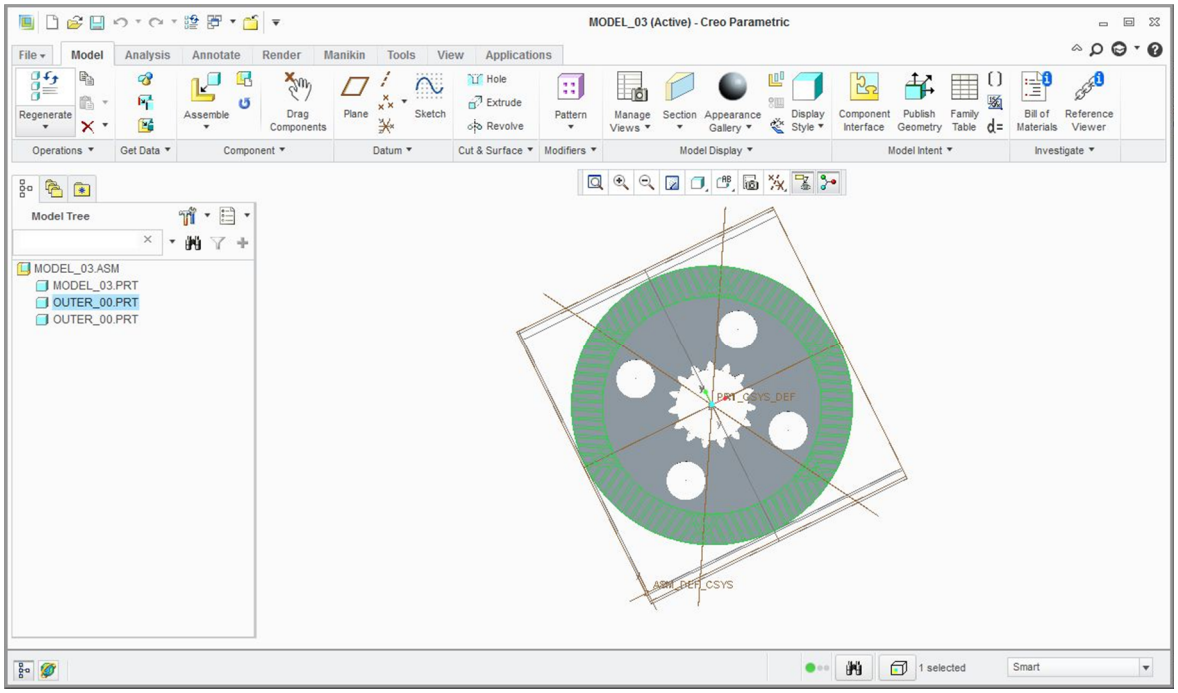


Fig. 5.4 Modified Model - 3 of Friction Plate

The modified model - 4 has 6 holes.

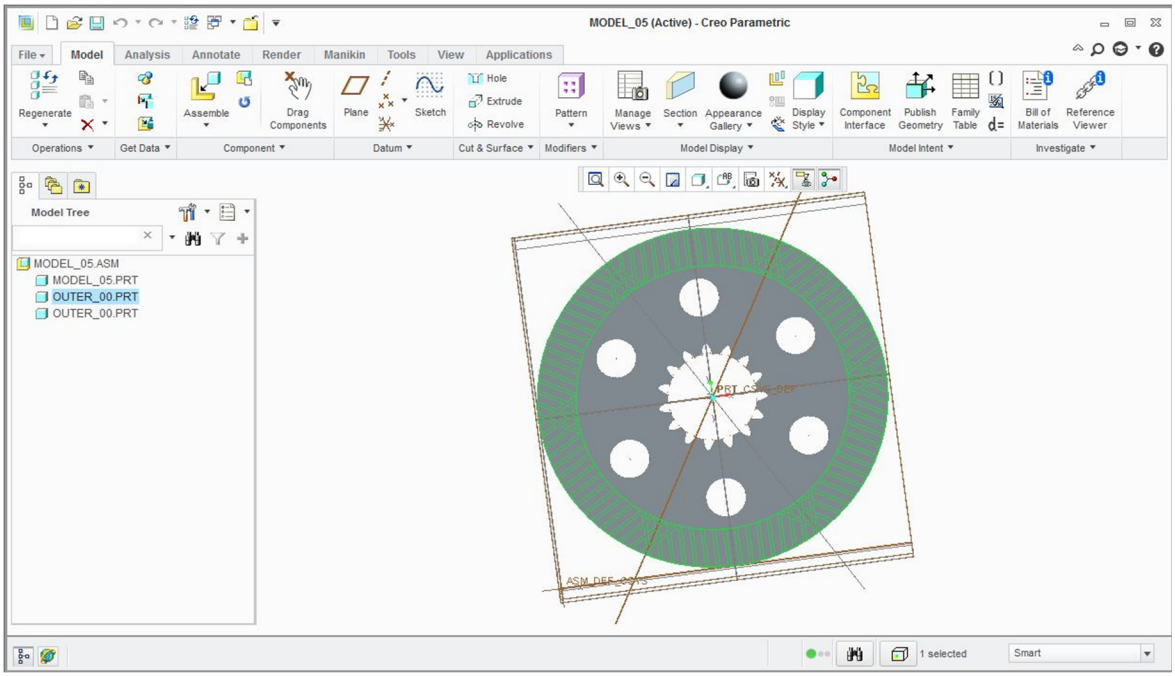


Fig. 5.5 Modified Model - 4 of Friction Plate

The modified model - 5 has 6 Pattern.

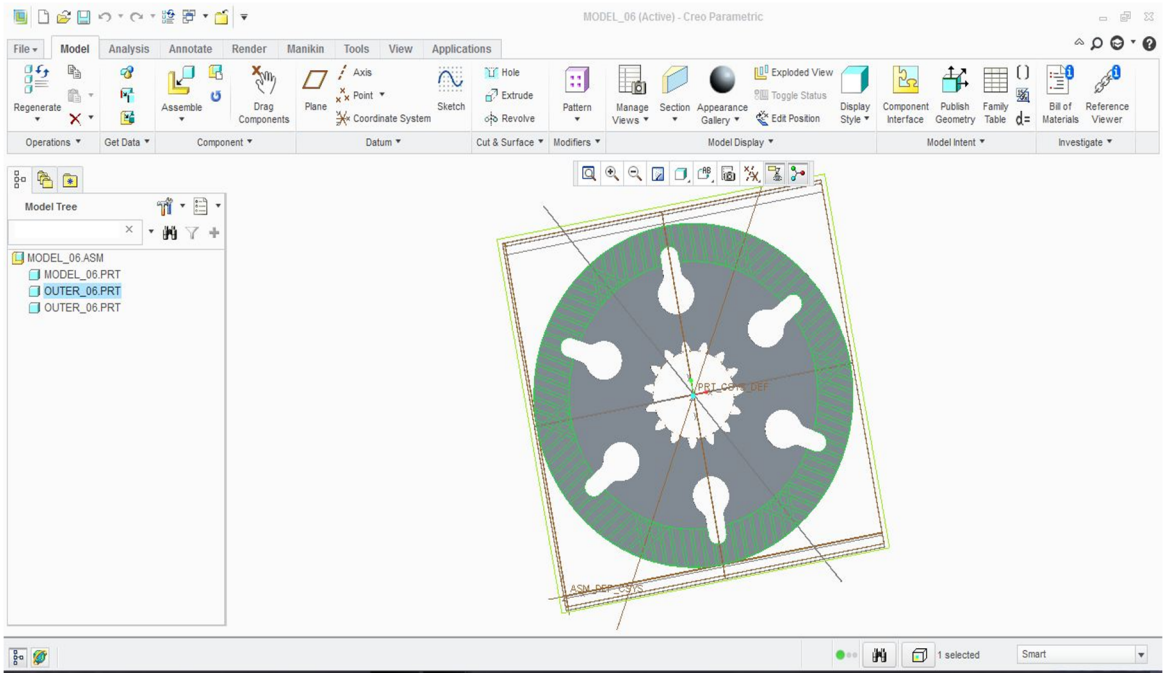


Fig. 5.6 Modified Model - 5 of Friction Plate

The modified model - 6 has 5 Vertical Slot Pattern.

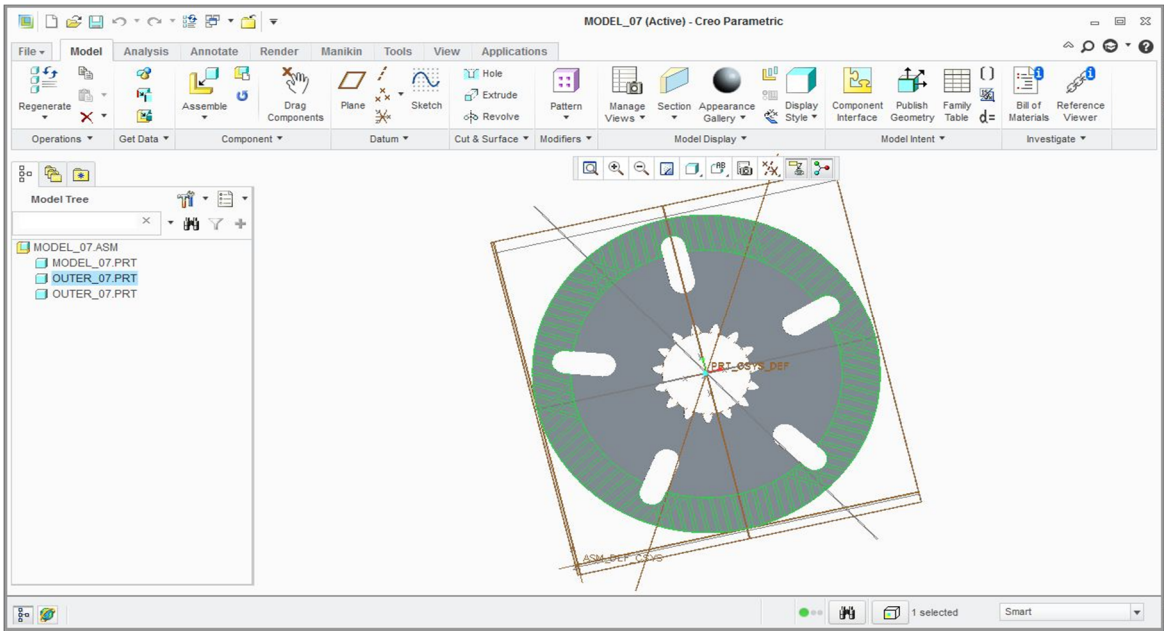


Fig. 5.7 Modified Model - 6 of Friction Plate

The modified model - 7 has 14 Holes.

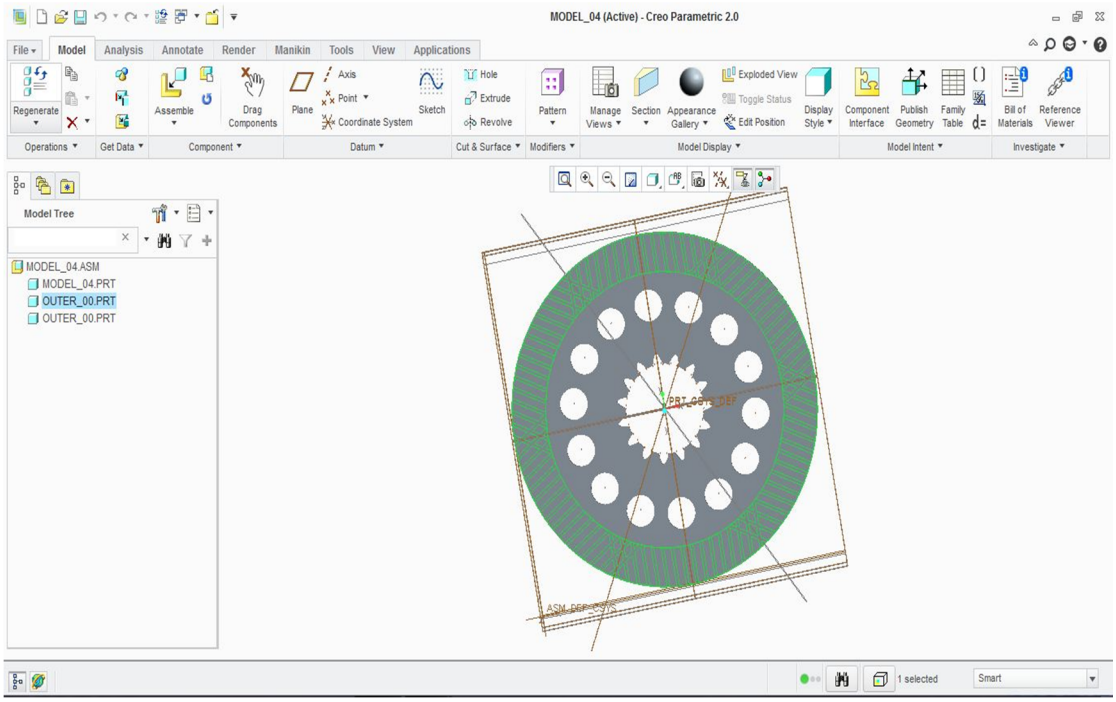


Fig. 5.8 Modified Model - 7 of Friction Plate

Actual plate result

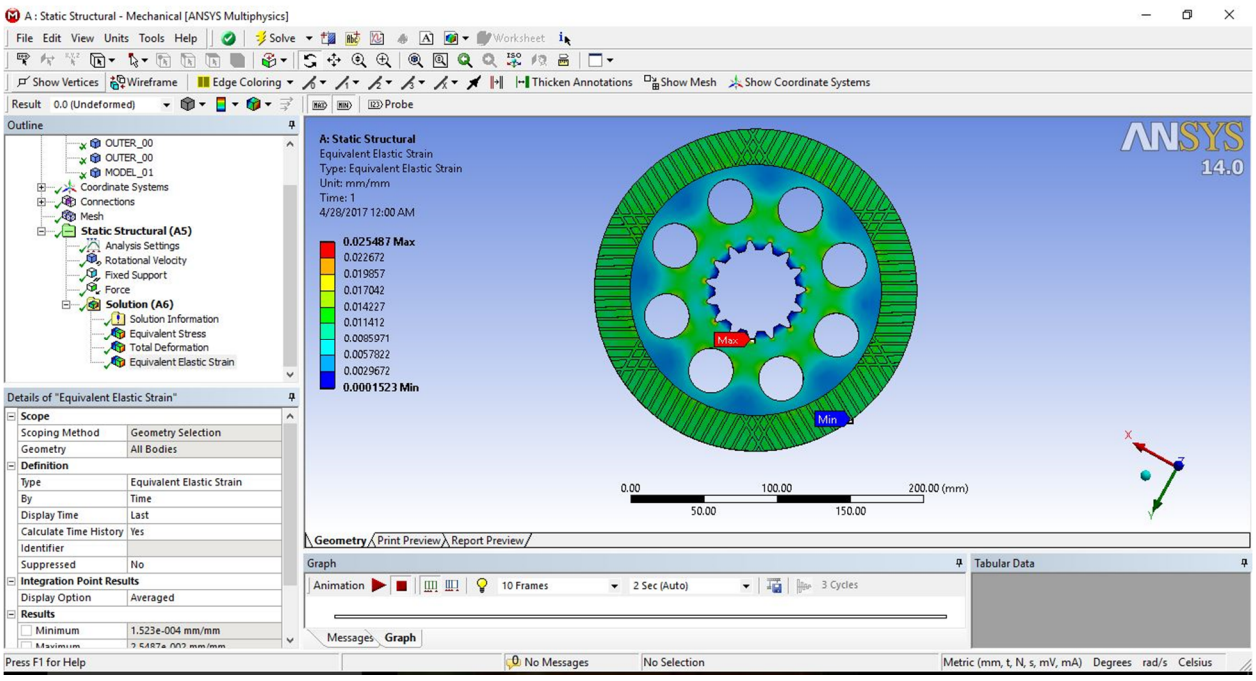


Fig. Strain

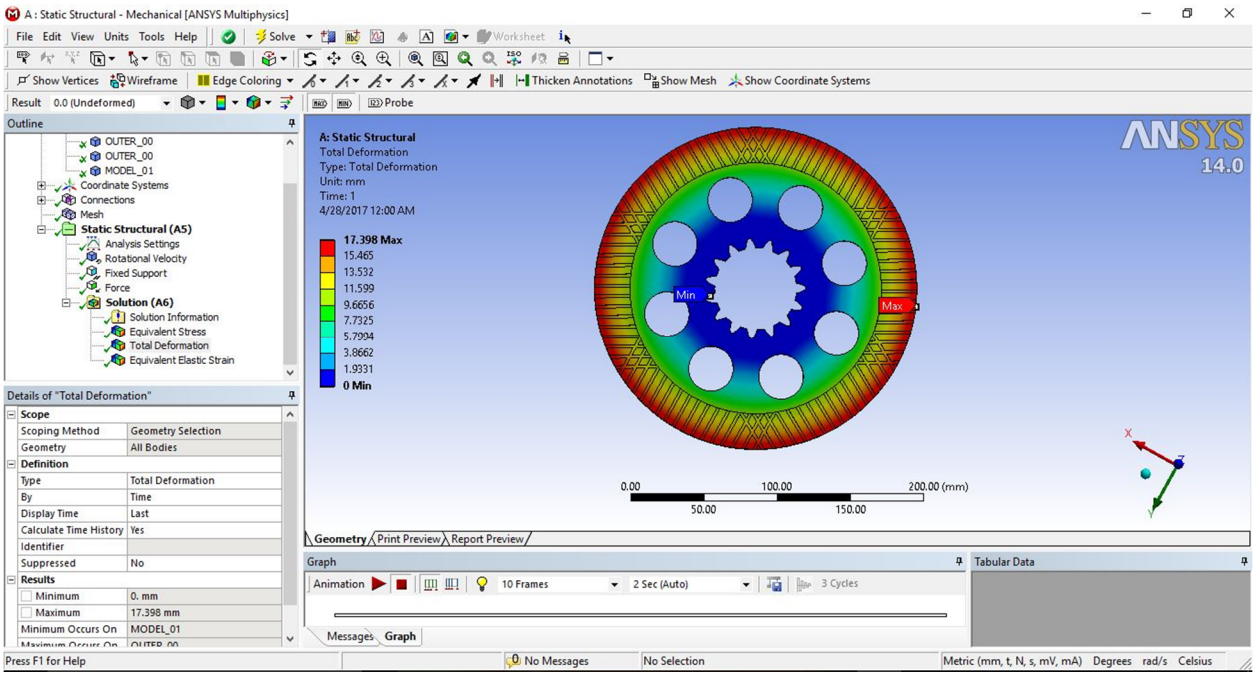


Fig. Deformation

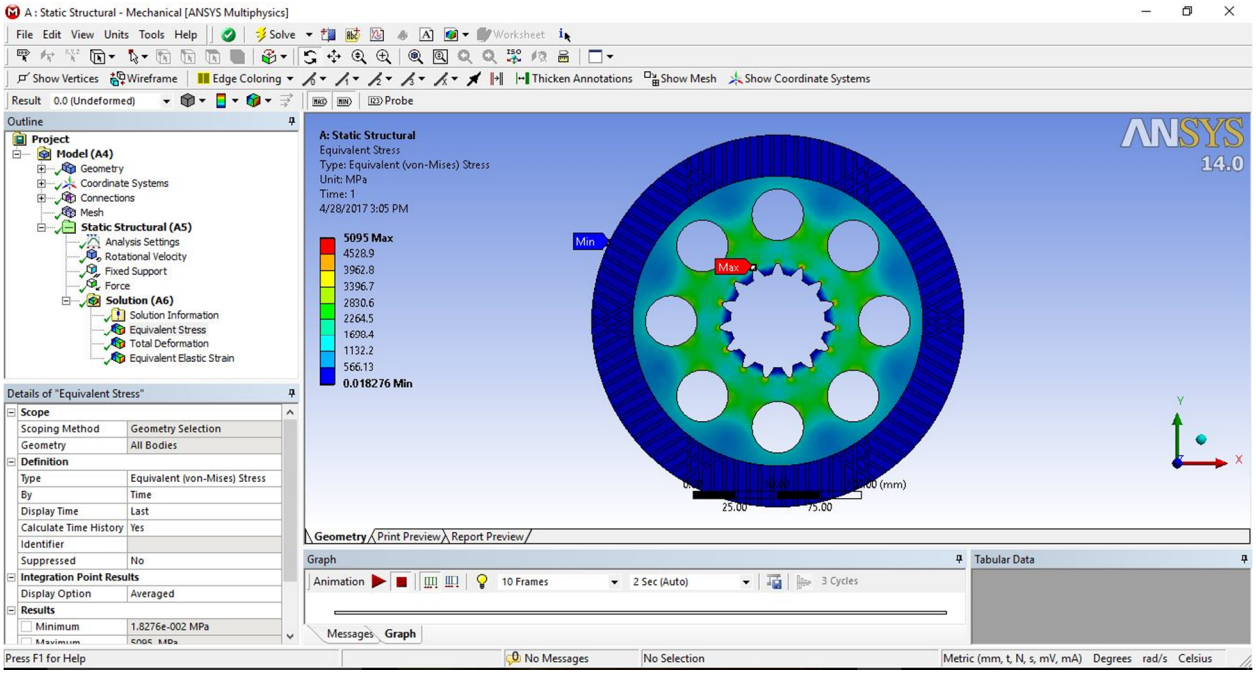


Fig. Stress

RESULT

Result Comparison

Model	Nodes	Element	Von-Mises stress Max(Pa)	Strain (mm/mm)	Total deformation Max.(M)
Actual model	120541	51857	5095	0.025487	17.398
Modified 1 4 slot	119551	51670	7973.7	0.039888	26.1
Modified 2 2 slot 4 holes	120245	51770	5883.4	0.030906	25.233
Modified 3 4 holes	121402	52009	5730.6	0.030724	11.908
Modified 4 6 pattern	115545	48297	5148	0.088349	13.534
Modified 5 5 vertical slot pattern	117631	49538	4837.8	0.037093	11.623
Modified 6 6 holes	122558	52150	4730.9	0.030412	11.67
Modified 7 14 holes	126237	52604	4736.4	0.038492	13.356

Conclusion

From the results we can see that model 6 and model 7 has less stress as well as deformation. Thus the best one among all of this is model 6.

Thus it is concluded that model 6 which has 6 holes is having low stress and deformation. This reduced stress and deformation will improve the performance of the friction plate; vice versa the life of friction disk will also be improved

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