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Design, Static Analysis and Comparison of Materials on Train Breake Pad

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ABSTRACT:

Train is one of the major transportation which makes the things easier at low cost. This train moves by fossil fuel and the consumption of the fuel is depends up on the engine performance and braking system, as the kinetic energy of the train is to be reduced by breaking and electric system. This kinetic energy is to be converted into heat by contact material to the rotating wheels or discs which are attached to the axels. The friction which is created coverts the energy into heat and eventually the train slow down and the braking material is in the form of block or pad.

The braking systems are used in majority of trains which uses compressed air as the force to push pads on to discs, which are known as "air breaks" or "pneumatic breaks". The electricity is also been used to reduce the speed of the wheels by producing reverse current and because of this breakage and thermal cracks are reduced. But these are the effective drawbacks which are to be considered to increase the life and performance of the wheels.

In this paper the aim is to overcome the drawbacks by reducing the effect of break force on the brake block without affecting the existing designed (Braking function) requirements, design of brake pad is done by using CATIA software which is widely used for solid modelling. The material properties of the brake pad are low carbon steel, carbon fibre composites. To compare the results of both the materials in STATIC analysis are in ansys SOFTWARE.

INTRODUCTION:

Train braking system is very complex in design and the challenging.

The conversion of kinetic energy into heat is the simplest way but the situation that occurs thousands of times in every day. The vehicle course is a typical freight train. The control unit sends the air from compressor (power unit) to power the brakes through the brake pipe unlike truck brakes.

Some of the regenerative braking system energy is converted into useful electric energy. The straight air system evenly distributes force from one pressurized air cylinder to 8 or 12 wheels and sequentially to each car but the loss of air pressure could be occurred and the magnitude of braking force increases in steps with the corresponding pressure reduction in pipe pressure and vice-versa.

But the vacuum pressure uses the atmospheric pressure for the brake force (exhauster is mounted).Triple valve is used to control the system which applies and releases the brakes by three components became the piston valve, the slide valve, and the graduating valve. These operations are done by pressure values in brake pipe and reservoir and the both service and emergency brake systems are used according to the situations for stronger application.

AIR BRAKE SYSTEM:

The compresses air is used in air braking system that continuously charges the air in brake pipe throughout the length of the train. The feed pipe followed by the brake pipe through the auxiliary reservoir to the distributed valve into brake cylinder.

The brake application and releasing is done by dropping and maintaining the value to (5kg/cm2) through the driver valve. The following diagram contains the basic air brake equipment.

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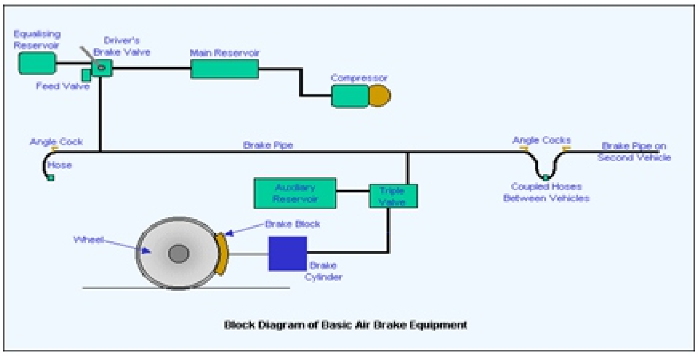

Figure 1: Block diagram of air brake equipment

In this air brake system the pressure is to be controlled between control reservoir (5kg/cm^2) and auxiliary reservoir (6kg/cm^2). Stages in this system are brake application and release stage where lap position is made to make the pressure constant. Some of the main advantages can be seen follows speed of the train increased, better reliability and safety. Compact and easy maintenance.

DESIGN OF TRAIN BRAKE:
Standard designed values and air brake details:

According to RDSO (Research and Development Standards Organization), Lucknow, the following are standard designed values for Railway air brake system.

- Brake cylinder diameter: 355.6 mm (14 inches).
- Effective piston force of brake cylinder: 3.6 tons.
- Number of brake cylinders per coach: 2
- Number of brake bogie levers per coach: 4
- Mechanical efficiency of brake rigging: 0.9.
- Brake rigging ratio: 0.9.
- Number of brake blocks per one coach: 16

Mechanical advantage of bogie Bogie leverage ratio X no. of bogie levers

Mechanical advantage of complete brake system
Mechanical advantage of bogie X Horizontal leverage ratio

- Theoretical brake force.
- Mechanical advantage of complete brake system X Effective piston force X No. of Brake cylinders per coach
- Minimum effective brake force
- Theoretical brake force X Brake rigging ratio X Mechanical efficiency of brake rigging.

RELATED WORK
CATIA

CATIA is a 3d modelling software widely used in the design process. CATIA is used by the automotive and aerospace industries for automobile and aircraft product and tooling design. The following snapshots contain the 3D computational model of brake pad and geometric views of it.

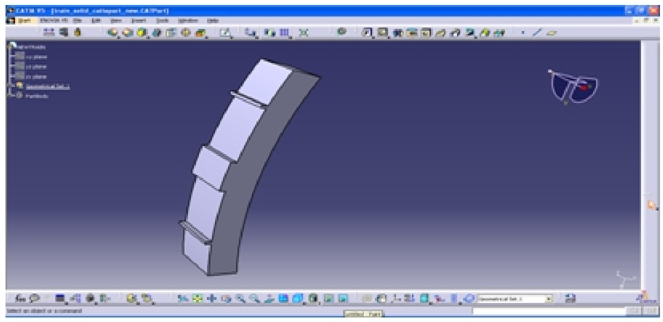

Figure 2: 3d solid modal of brake pad.

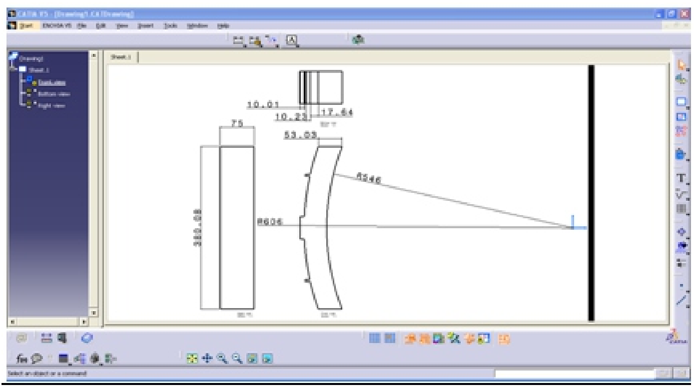

Figure 3: Geometrical views of a brake pad.

ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package.

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Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. ANSYS workbenches are used for static analysis for different materials and compare the results for future references in research and development centres.

STATIC STRUCTURAL
AISI 1018 mild (Low carbon steel)

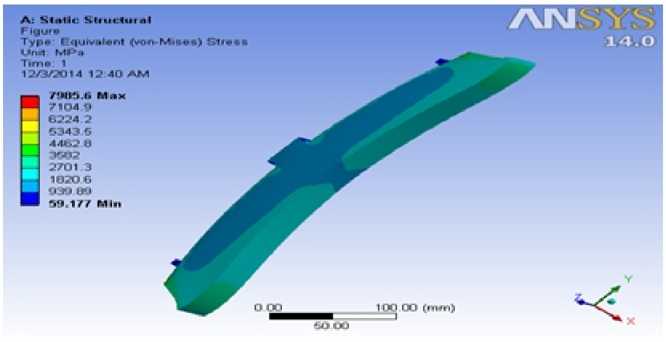

Figure 4: equivalent (von-mises) stresses.

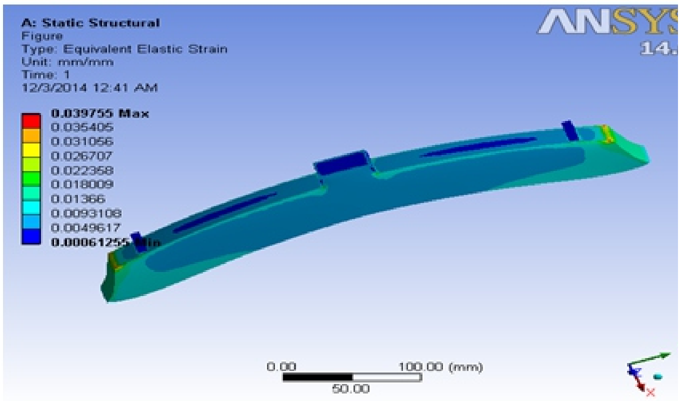

Figure 5: equivalent elastic strain

Carbon fiber composite (CF Fabric)

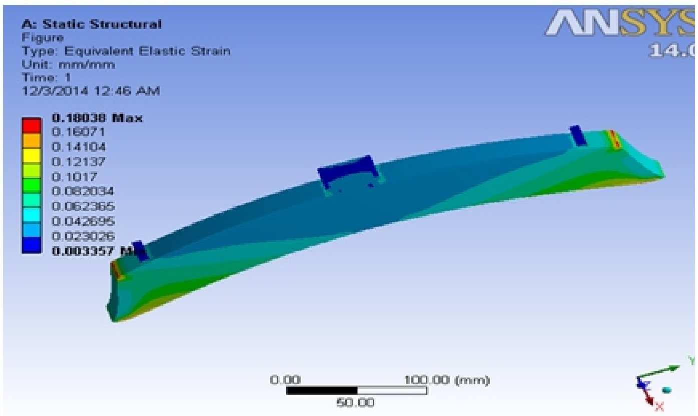

Figure 6: Equivalent elastic strain

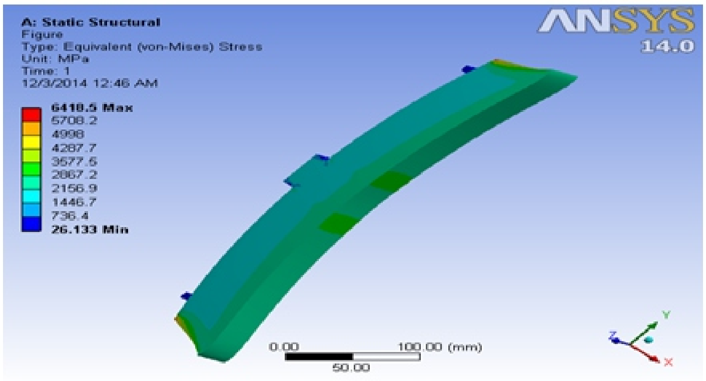

Fig 7 equivalent (von-mises) stress

CONCLUSION AND FUTURE SCOPE:

According to given data we draw the train break pad in catia, after that we will do analysis by using the low carbon steel(1018 mild) produces less displacement than the CF Fabric(carbon fibre composite) material, Hence 1018 mild(Low carbon steel is better than the cast iron and carbon fibre composite's. More number of materials can be tested in the same way for future scope and that can give more number of results and may improve the braking performance of brake pad.

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