Analysis and Performance Evaluation of Serrated Moulded Friction Lining Band In Band Brakes

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Abstract- *This paper proposes a new method for evaluating the braking system on de-coiler machine rotor brake, where in the braking force though not very high, but frequency of braking per minute is dependent on production cycles per min. This frequent braking results into excessive heat leading to brake glaze. Here the heat dissipation by the band brake plays a significant role in service life of the band. The Evaluation indexes, braking capacity, response speed control accuracy and braking efficiency, are put forward accordingly. The experimental apparatus to the performances of brakes was built by measuring the relation between the braking effort, torque and rotation speed. Theoretical analysis and experiment is based on maximum effort applied on the band moving end to bring the rotor to zero from top speed .Quantitative analysis, the value analysis is done to evaluate the indexes. Selection of material, geometry and then modelling –analysis is done to evaluate the theoretical and analytical strength parameters.*

Keywords– Braking, Braking Performance, Braking Systems, Model and Analysis.

I. INTRODUCTION

Band brakes find application in braking in various field of application such as material handling equipment, lifts and hoist. Material transport equipment like conveyors, trolleys etc. Many machines use a continuous feed arrangement with intermittent brake for product forming. Band brakes are common in these examples but with applications where the braking effort is not important but the frequency of braking leads to excessive heating the problem of band glazing is frequent. Glazing reduces the coefficient of friction between the brae drum and the liners leading to slip and thereby inaccurate positioning of the said load.

Conventional geometry liners are made as plain geometry. Due to this geometry the heat produced and no ventilation leads to a partial vacuum created between brake liner and the drum which will lead to brake liner sticking on to drum leading to brake ‘jab’ 0r brake lock, which further leads to inaccuracy of machine.

It is the friction pads or facings that really absorb the power from the drum to stop the machine. There are gaps between the pads brake facings. These gaps prevent the pads from sticking to the brake lining onto the drum. The gaps break any vacuum that might form and cause the facing to stick to drum.

The specific geometry pattern under discussion is as shown below.

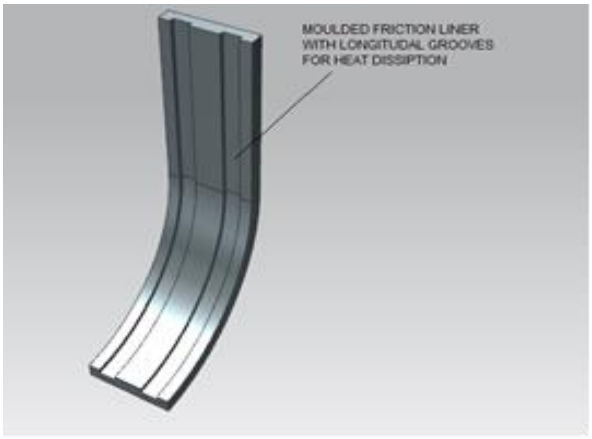

Fig.1 Friction Pad/Facing With Grooves

II. DESCRIPTION OF TEST RIG AND EQUIPMENT

The following figure shows the setup required for testing and performance analysis of band brake liners-

Fig.2 Test-Rig Used For Testing of Band Brake

The test rig is mainly consist of a single phase AC motor with variable speed. This motor is coupled to an open belt drive that further drives a spur gear train which finally drives a drum on which the friction band that operated for braking. The band here used is of molded condition with the selected friction material. The application of the braking force is done using a electrical solenoid. The assembly issupported using a frame work mounted on the base plate.

DIMENSIONAL SPECIFICATION OF LINER

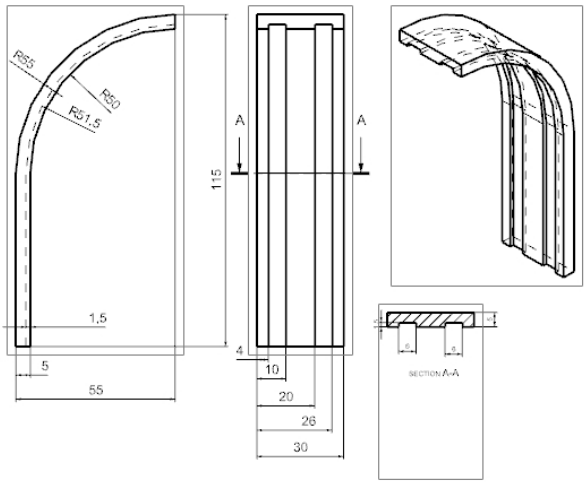

Fig.3 Specificaion of Liner

Dimensions of brake pads are as per the design. Thickness of liner is 5mm. Grooves of 6mm and 1.5mm in depth are provided for preventing the band liner to stick to the drum surface.

Maximum effort applied on the brake is 5.4 kg to bring the brake drum running at top speed of 600 rpm to zero. Thus the band brake will be tested for two conditions namely the compressive nature of load when brake effort is applied and the moment applied by the motor system. The liner will be analysed using ANSYS 16.0 to find the maximum stress and maximum deformation under both conditions.

III. MATERIAL

Brake lining HC AF 393 is a rigid moulded Non-Asbestos friction material in a dark grey color. It contains short filament of synthetic man made mineral fibers and organic fibers with highly thermally stable “novalak” phenolic powder resin as a binder and fused in a matrix which contributes to the strength and performance in terms of friction/wear properties.

Compo HC AF 393 has excellent fade and wear resistance and good recovery characteristics.

A. Physical Properties

Density	: 1.9
Coefficient of friction	: 0.42
Hardness	: 85 in Rockwell HRL
Cross Breaking Strength	: 400 kg/cm^2

IV. MODELING AND ANALYSIS OF BRAKE LINER

A. *3D MODEL of BRAKE LINER*

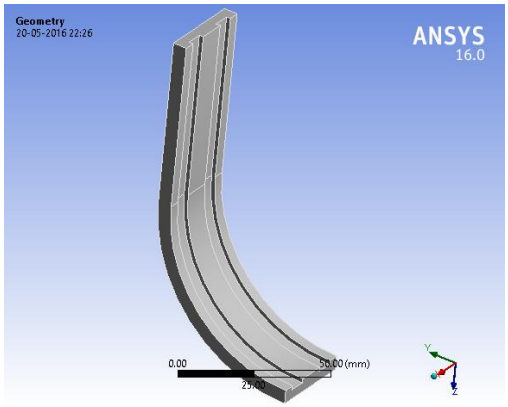

Fig.4 3D Model of Brake Liner

B. ANALYSIS OF LINER CONSIDERING MAXIMUM EFFORT

The analysis of brake liner was carried out using ANSYS-16. Analysis was carried out for maximum effort applied to brake to hault the drum. Effort of 5.4 kg was applied to brake and the analysis was carried out.

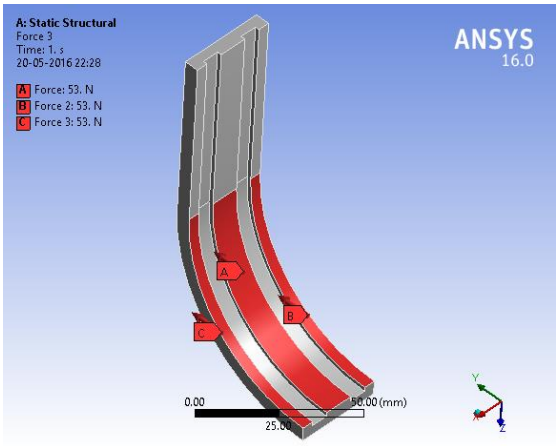

Fig.5 Force Applied on Liner

The force of 5.4kg was applied to braking pad as shown in fig. The result for which were obtained as given in below figures.

Maximum stress produced on liner was 0.364 N/mm^2.Thus the max stress on liner is far less than allowable stress which is 36 N/mm^2. So the liner is safe under the action of maximum braking effort.

The total deformation observed due to maximum effort is negligible shown in fog.

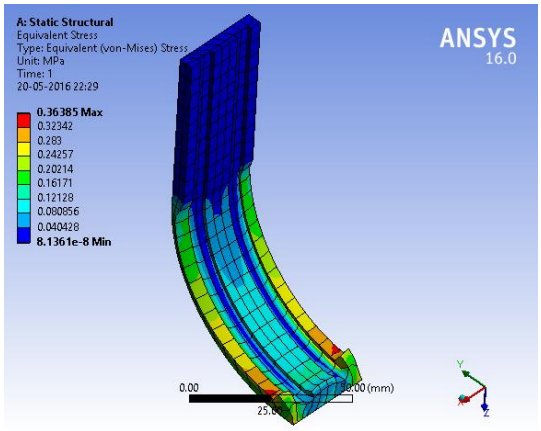

Fig.6Result For Stresses

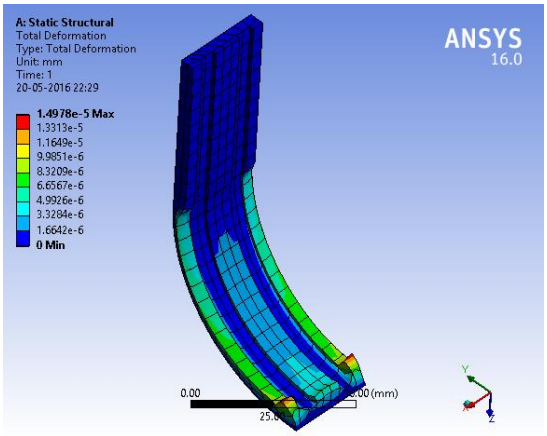

Fig.7 Result for deformation

C. ANALYSIS OF LINER CONSIDERING MAXIMUM MOMENT ACTING ON LINER DUE TO POWER TRANSMITTED BY DRUM

Analysis was carried out for maximum braking moment acting acting on liner due to power transmitted by drum. Moment of 1200 N-mm was applied on axis of curved liner and the analysis was carried out.

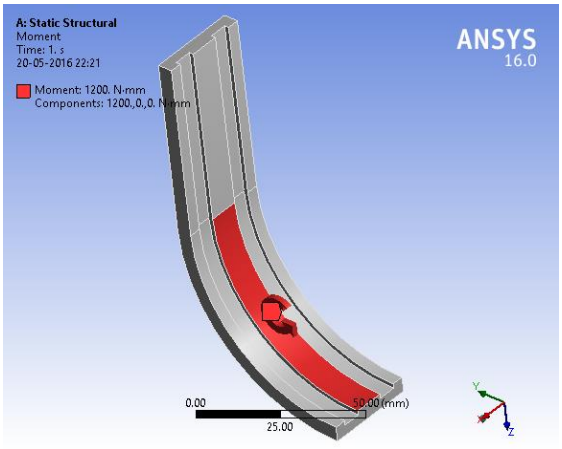

Fig.8 Moment Appliction

The moment of 1200N-mm was applied to axis of braking pad as shown in fig. and the results for which were obtained as given in below figures.

Maximum stress produced on liner was 0.144 N/mm^2.Thus the max stress on liner is far less than allowable stress which is 36 N/mm^2. So the liner is safe under the action of maximum torque transmitted by the system.

The total deformation observed due to maximum effort is negligible.

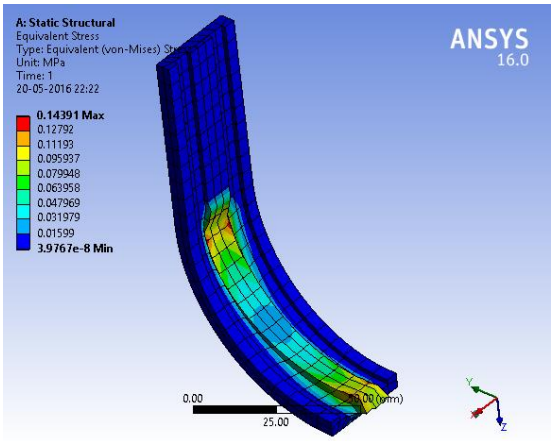

Fig.9 Result for Stresses

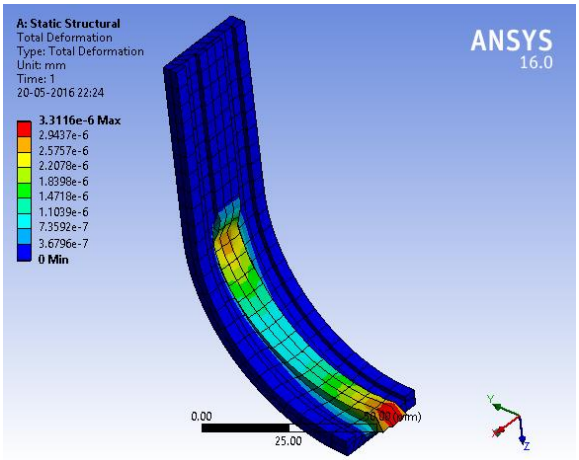

Fig.10 Result for Deformation

V. TESTING AND PERFORMANCE EVALUATION OF SERRATED LINERS

Input Data

Diameter of load drum = 100 mm

Procedure for Testing

1. Start motor
2. Load the loading pan on to the effort lever
3. Add 1.0 kg weight to the load pan
4. Note speed of drum
5. Add 0.5 kg load
6. Note speed of drum
7. Plot graph of Load Vs Speed
8. Plot graph of Power Vs Speed
9. Plot graph of Brake power Vs Speed

TABLE I TESTING RESULTS AND PERFORMANCE ANALYSIS

LOAD	SPEED	TORQUE	BRAKE POWER
1	518	0.40221	21.82064329
1.5	480	0.603315	30.32985168
2	440	0.80442	37.06981872
2.5	401	1.005525	42.23010599
3	347	1.20663	43.85191055
3.5	321	1.407735	47.32720606
4	265	1.60884	44.65228164
4.5	226	1.809945	42.8409155

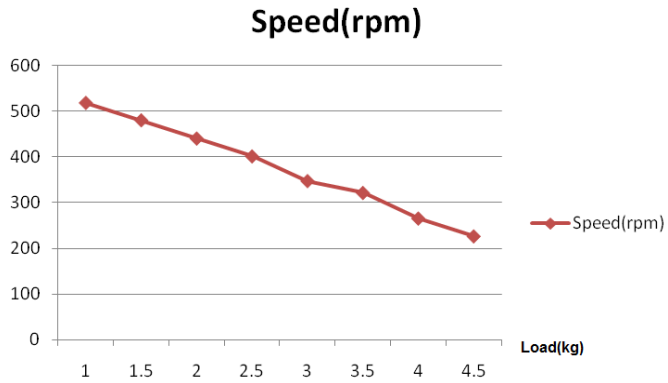

Fig.11Load Vs Speed Graph

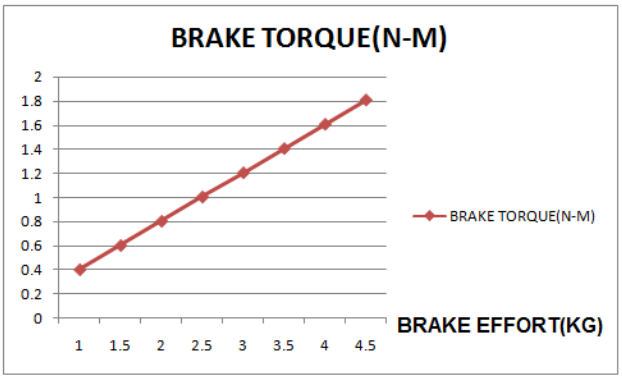

Fig.12 Braking Effort Vs Brake Torque

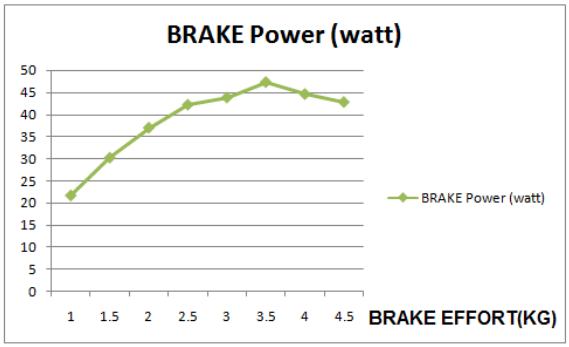

Fig.13Braking Effort Vs Brake Power

VI. CONCLUSION

- Serrated moulded brake liner is safe under action of maximum brake effort so also the deformation under the action of maximum brake effort.
- Serrated moulded brake liner is safe under action of maximum moment so also the deformation under the action of maximum moment.
- With increase in brake effort the speed of drum drops indicated good conversion of braking effort into retardation of drum.

- With increase in brake effort the brake torque applied also increases resulting into effective braking.
- Brake power absorbed is maximum upto 3.5 kg effort but slightly reduces thereafter indicating that 3.5 kg load is optimal effort for maximum braking effect.
- Serrated liner shows effective strength and braking properties for given application.

VII. FUTURE WORK

There is many scopes for working on this topic as-

Instead of using serrated band some other types like parted type band, uniform band, band with gesture can be used for testing and analysis.

Band with different materials will be analyzed and tested.

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