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Design Feasibility Validation of Composite Disk Breaks In Two Wheelers

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ABSTRACT:

At the IAA in Frankfurt in 1999, the carbon-ceramic brake disk had its world premiere. The use of the high-tech material had revolutionized the brake technology: In comparison to the conventional grey cast iron brake disk the carbon-ceramic brake disk weighed round 50 per cent less reducing the un sprang mass by almost 20 kilograms. Further significant advantages are: improved brake response and fading data, high thermal stableness, no hot judder, excellent pedal feel, improved steering behavior, high abrasion resistance and thus longer life time and the advantage of avoiding almost completely brake dust. At first Porsche AG built the carbon-ceramic brake disk in 2001 into the 911 GT2 as series equipment. Since that time also other premium brands use the advantages of this innovative brake technology for more security and comfort. These are for example sports cars and luxury class limousines from Audi, Bentley, Bugatti and Lamborghini.

In this paper we will design a disk break using composite materials for high speed two wheelers. The main aim of this paper is to design a composite disk break with least possible production cost and long life, for achieving this goal we will compare different structural models of disk brakes with different materials finally we conclude the best model and material based on the thermal behavior and stress concentrations of each model, for designing disk brakes we use Catia V5 R20, and for analysis we use Ansys 14.5

I. INTRODUCTION

Brake is a Mechanical Device used to stop or slowing down the Vehicle or a body in motion. A disc brake is a type of brake that utilizes calipers to clutch pairs of pads alongside a disc in arrange to create friction that retards the rotary motion of a shaft, for instance a vehicleaxle, moreover to retard its rotational speed or to seize it stationary.Hydraulic disc brakes are the a large amount universally used form of brake for motor vehicles but the ideology of a disc brake are appropriate to almost any rotating shaft. Brakes generally use friction amid two surfaces hard-pressed together to renovate the kinetic energy of the moving vehicle or body into heat.

Brakes may be described as using friction, pumping, or electromagnetic. One brake may use a number of principles: for instance, a pump may pass fluid through an orifice to create friction.

Ceramics and their Characteristics

Ceramic materials are the inorganic compounds of metallic and nonmetallic elements and their atoms are held together by ionic or covalent bonds these are stronger than metallic bonds. These are hard and brittle with high melting points.

- Resistance to high Temperature
- Low electrical and Thermal Conductivity
- Resistance to wear and corrosion
- Low ductility

Some distinguishing Characteristics of ceramics
Composites is a material composed of two or more different materials bonded together with one portion as

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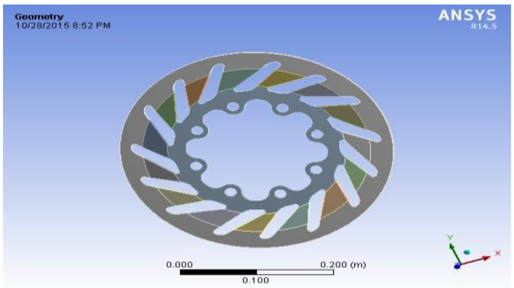
the continuous matrix and other as a reinforcing material. The properties of composites are much superior to individual material properties. One of the prime purposes of producing ceramic matrix composites is to improve the toughness. The main purpose of using reinforcement (such as fibers, particles and whiskers) in polymer matrix composites (PMCs) and metal matrix composites (MMCs) is to increase the strength of the composites whereas, the reinforcement used in ceramic matrix composites (CMCs) increases toughness of the composites.

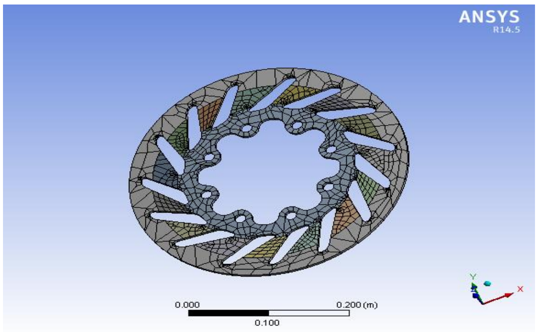
Ceramics can be embedded with particles or fibers to produce ceramic matrix composites. These are light weight composites and offers High resistance to temperature. This Retains strength up to 1700^{0}C are silicon carbides, silicon nitrides and Aluminum oxide. They are reinforced with fibers, glass fibers and ceramic whiskers. These increases Directional Strength, Toughness. Manufacturing cost of these composites is high.

THERMAL ANALYSIS OF MODEL 1 DISK OF AL2O3/SIC

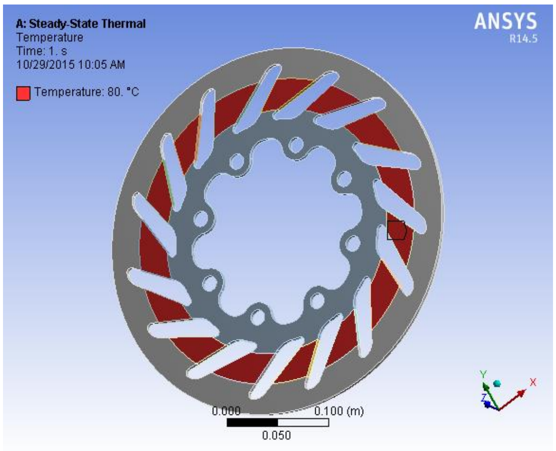
IMPORT MODEL



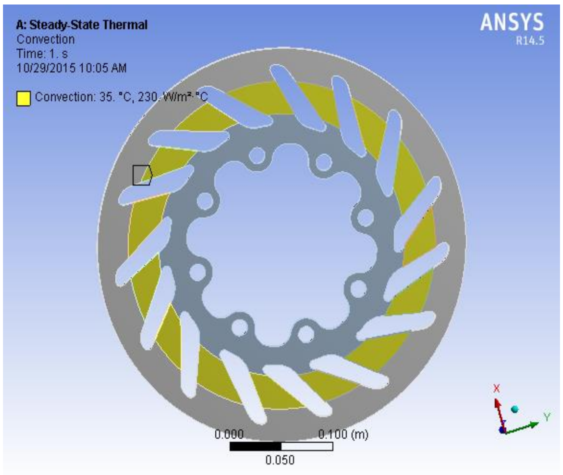
MESH MODAL



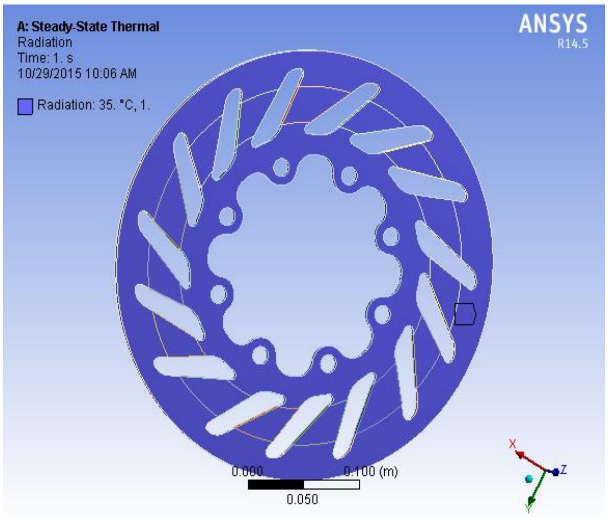
TEMPERATURE



CONVECTION



RADIATION



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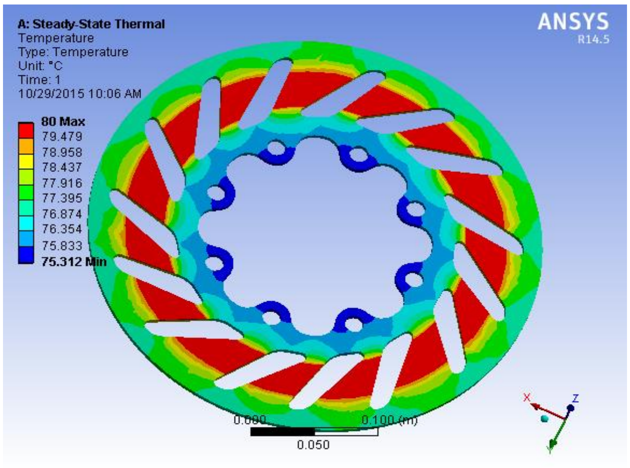
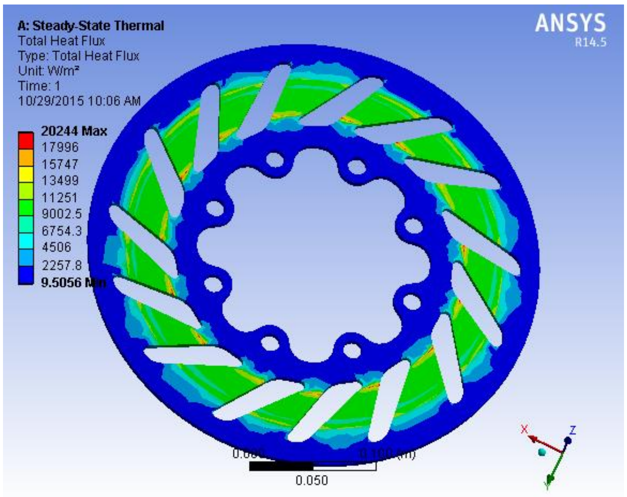
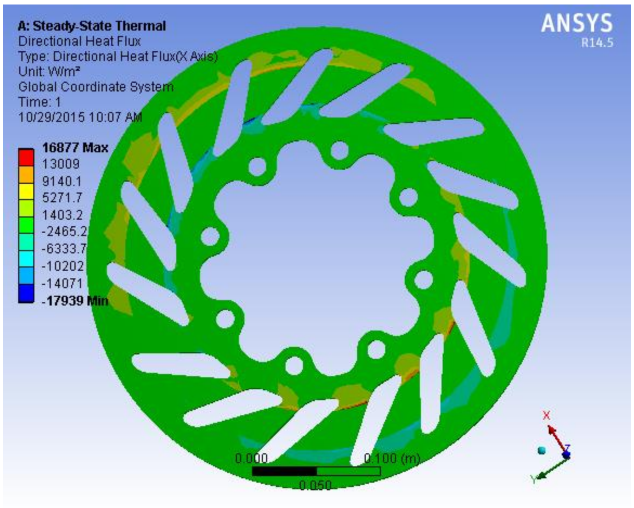
TEMPERTURE



TOTAL HEAT FLUX

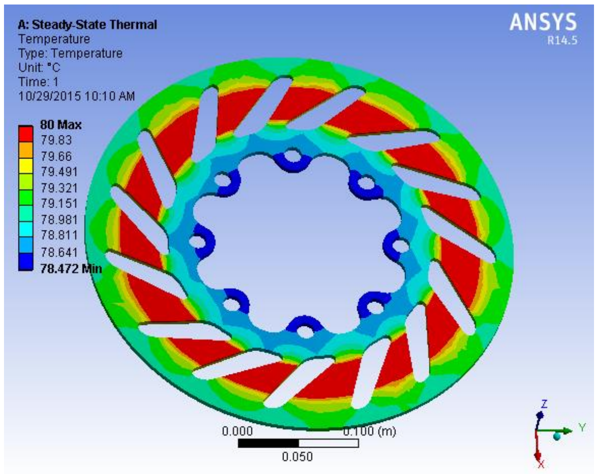


DIRECTIONAL HEAT FLUX

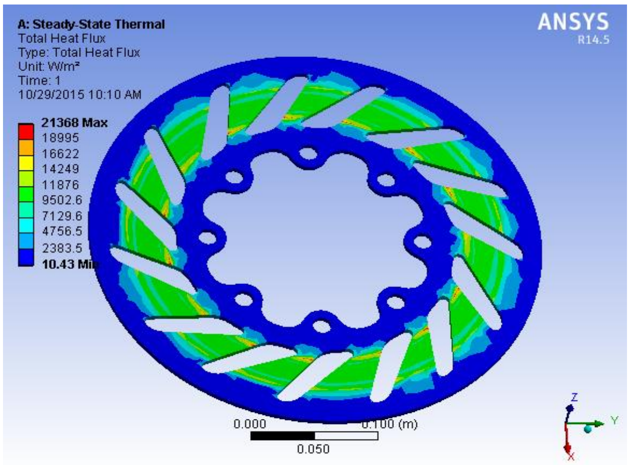


THERMAL ANALYSIS OF MODEL 1 DISK OF CARBON CERAMICS

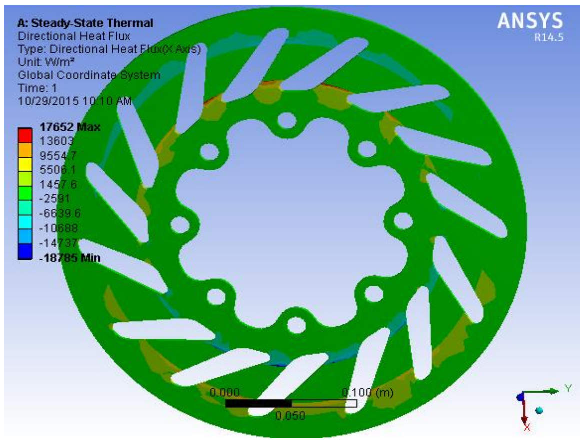
TEMPERTURE



TOTAL HEAT FLUX



DIRECTIONAL HEAT FLUX



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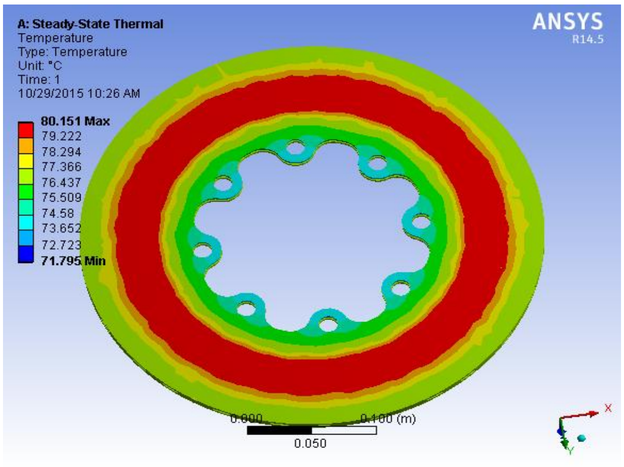
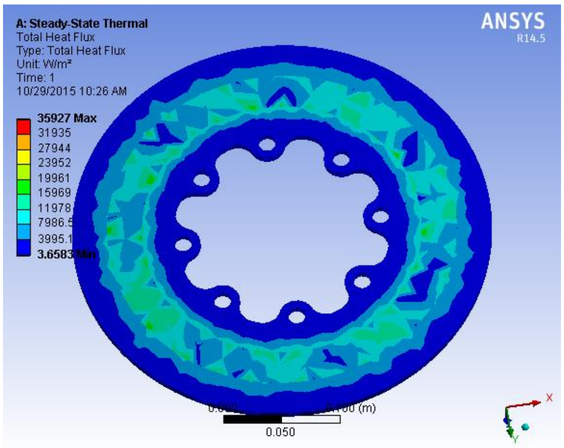
THERMAL ANALYSIS OF MODEL 2 DISK OF AL2O3/SIC

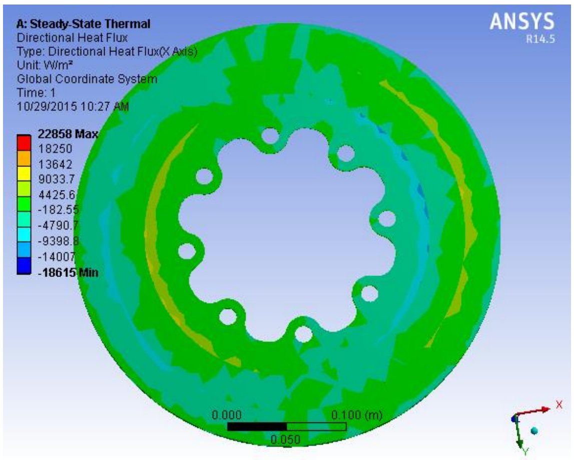
TEMPERTURE



TOTAL HEAT FLUX

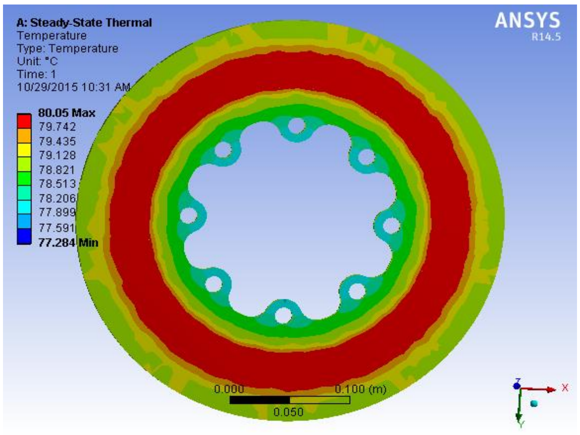


DIRECTIONAL HEAT FLUX

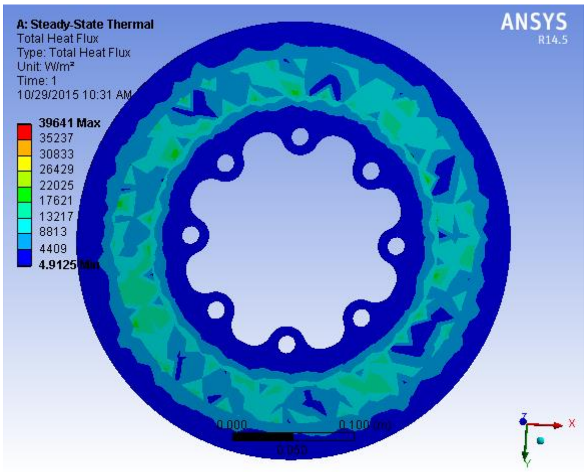


THERMAL ANALYSIS OF MODEL 2 DISK OF CARBON CERAMICS

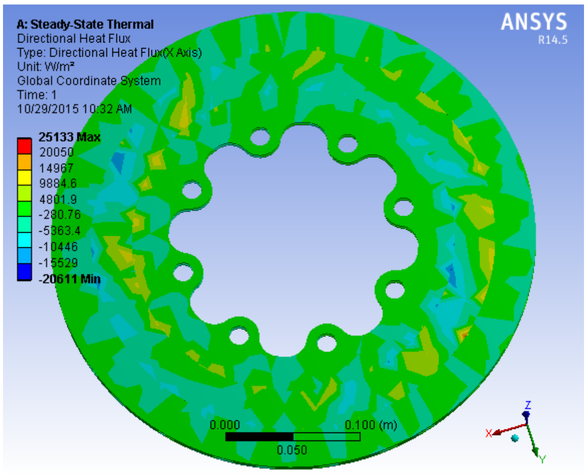
TEMPERTURE



TOTAL HEAT FLUX



DIRECTIONAL HEAT FLUX



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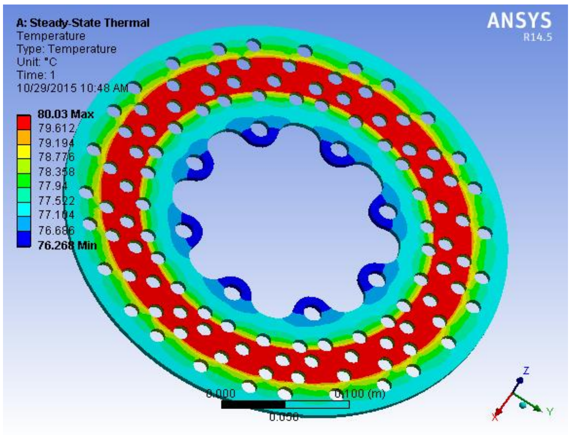
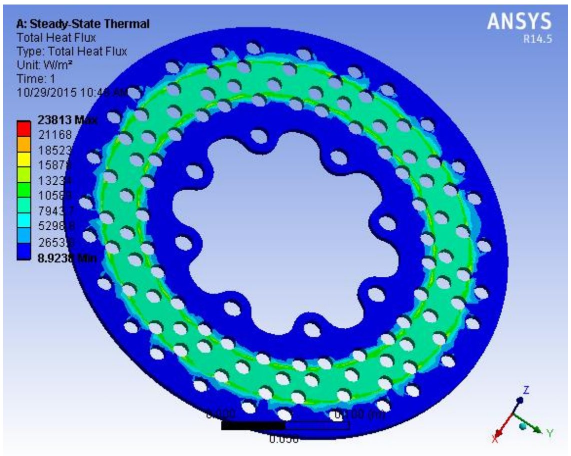
THERMAL ANALYSIS OF MODEL 3 DISK OF AL2O3/SIC

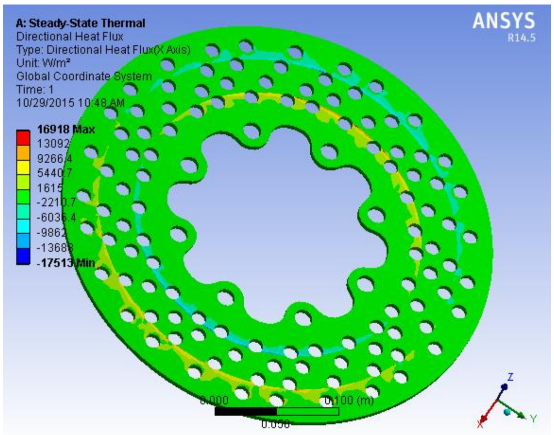
TEMPERTURE



TOTAL HEAT FLUX

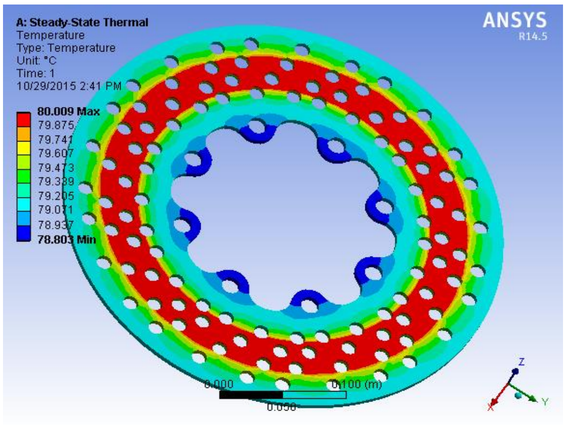


DIRECTIONAL HEAT FLUX

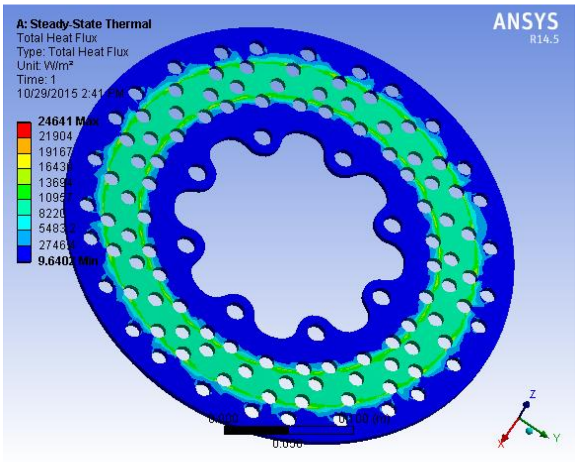


THERMAL ANALYSIS OF MODEL 3 DISK OF CARBON CERAMICS

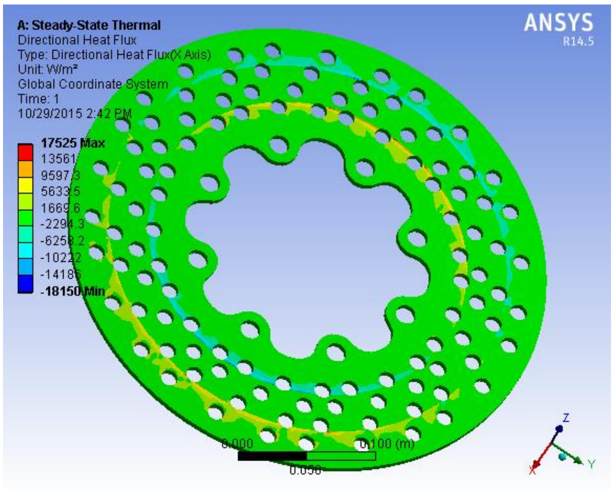
TEMPERTURE



TOTAL HEAT FLUX



DIRECTIONAL HEAT FLUX



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RESULT TABLE FOR MODEL 1

	TEMPERATURE		TOTAL HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
AL2O3/SIC	75.312	80	9.5056	20244	-17939	16877
CARBON CERAMICS	78.472	80	10.43	21368	-18785	17652

RESULT TABLE FOR MODEL 2:

	TEMPERATURE		TOTEL HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
AL2O3/SIC	71.795	80.151	3.6583	35927	-18615	22858
CARBON CERAMICS	77.284	80.05	4.9125	39641	-20611	25133

RESULT TABLE FOR MODEL 3:

	TEMPERATURE		TOTEL HEAT FLUX		DIRECTIONAL HEAT FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
AL2O3/SIC	76.268	80.03	8.9238	23813	-17513	16918
CARBON CERAMICS	78.803	80.009	9.6402	24641	-18150	78525

CONCLUSION

In this paper we will designed 3 different models of disk brake using carbon ceramic composite for high speed two wheelers. The main aim of this paper is to design a composite disk brake with least possible production cost and long life, for achieving this goal we will compare different models of structural models of disk brakes with different materials.

Here we have designed the disc brake using Catia V5, and thermal analysis is done in Ansys to the different models and the results are verified in a graph and tables.

As we observe in the first model the analysis is done with 2 materials i.e. with CARBON CERAMICS and AL2O3/SIC. As we observe in the results the material with AL2O3/SIC is the best product which increases the life as we compare the results in the heat flux (20244). So we can conclude that the material AL2O3/SIC is the best output for model 1

As we observe in the second model the analysis is done with 2 materials i.e. with CARBON CERAMICS and AL2O3/SIC. As we observe in the results the material with AL2O3/SIC is the best product which increases the life as we compare the results in the heat flux (35927). So we can conclude that the material AL2O3/SIC is the best output for model 2

As we observe in the third model the analysis is done with 2 materials i.e. with CARBON CERAMICS and AL2O3/SIC. As we observe in the results the material with CARBON CERAMICS is the best product which increases the life as we compare the results in the heat flux (23813). So we can conclude that the material CARBON CERAMICS is the best output for model 3

As we compare the 3 different models and their results for the best material outputs, here by comparing the obtained results we can conclude that the material AL2O3/SIC with the model 1 is the better product for the better life.

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