

e-ISSN: 2319-8753 | p-ISSN: 2320-6710

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International Journal of Innovative Research in SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

808

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 4, April 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

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ISSN: 2319-8753, p-ISSN: 2320-6710 www.ijirset.com | Impact Factor: 7.512

|| Volume 10, Issue 4, April 2021 ||

DOI:10.15680/IJIRSET.2021.1004067

Design and Analysis of Disc Brake in Metal Matrix Composites

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ABSTRACT: In this project analysis the behaviour of the brake disc made of cast iron compared with aluminium metal matrix composite material in software **ANSYS20.0**.Modelling of the disc brake rotor is done using **SOLIDWORKS 2010**.Finally a comparison is made between cast iron and aluminium metal matrix composite materials and the best material for making disc brake have been suggested based on the magnitude of Von misses stresses, temperature distribution and deformation from the analysis result. We have taken case study on Hyundai car i20 front disc brake.

KEYWORDS :Hyundai i20,soild works , Ansys

I. INTRODUCTION

Aluminium Silicon carbide metal matrix composites are widely used in engineering structures, industry electronic applications, sporting goods and aerospace etc. It's properties mostly depend on the processing method and the different compositions which is capable of producing desired properties to meet the industry need. Al-SiC composites can be more easily produced by the stir casting technique due to itsgood casting ability and relatively inexpensive. Analyzing the wear properties of Al-SiC composite is found that wear rate decreases linearly with increasing SiC content. Mechanical characterization of Al-SiC composite like density, hardness, elongation%, toughness, bending, poission ratio, modulus of elasticity, young's modulus and tensile strength were evaluated. The improved value of tensile strength is one of the key reason they are widely used in industry. It has been found that particle reinforced Aluminium matrix composites can improve considerably the strength and hardness of Aluminium and its alloys. But at the same time, the plasticity and ductility is substantially reduced and thus it severely affects the safety and reliability of components fabricated from Aluminium matrix composites (AMCs).

II. METHODOLOGY

Material properties required for selection: The properties that need to be considered by designers when specifying steel construction products are: Strength, Toughness, Ductility, Durability. Aluminium (Al) metal matrix composites (MMCs) with ceramic particulate reinforcement such as silicon carbide (SiC) have long been considered as significantly lighter weight, potentially longer lasting and more environmentally favorable automobile brake discs

In this project analysis the behaviour of the brake disc with aluminium metal matrix composite material and conventional grey cast iron material in software ANSYS 2020.Modelling of the disc brake rotor is done using SOLIDWORKS 2010.Finally a comparison is made between cast iron and aluminium metal matrix composite materials and the best material for making disc brake have been suggested based on the magnitude of Von misses stresses, temperature distribution and deformation from the analysis result.



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1 ANSYS ANALYSIS RESULT DIAGRAMS:

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(Fig-11)

Directional heat flux:

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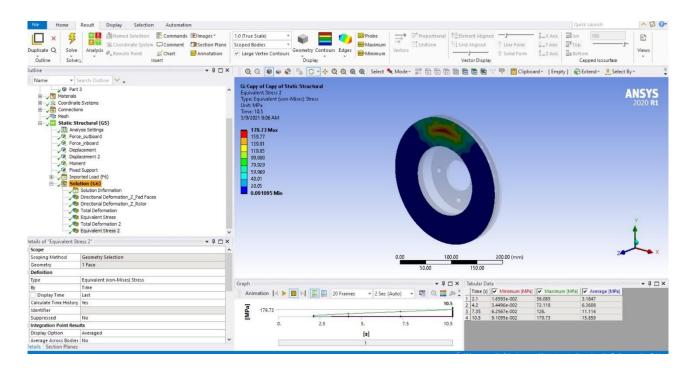




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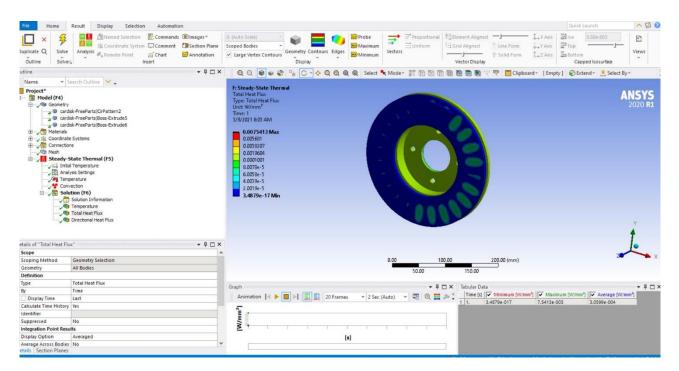
DOI:10.15680/IJIRSET.2021.1004067

Face stress:



(Fig-13)

Heat flux:



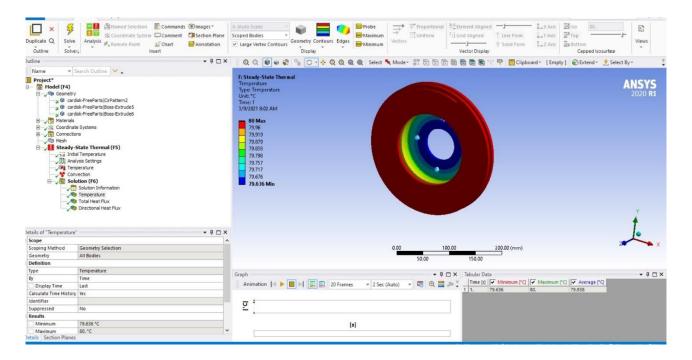


ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 7.512|

|| Volume 10, Issue 4, April 2021 ||

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Thermal distribution:



(Fig-15)

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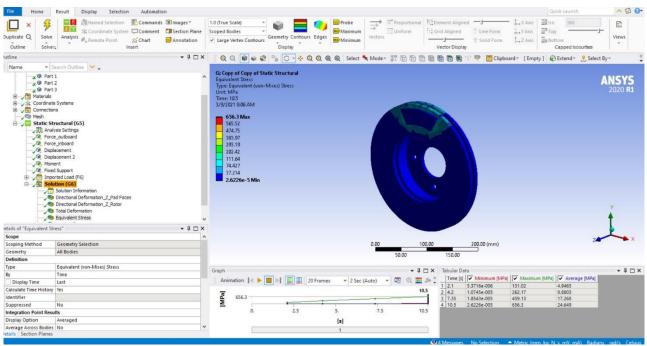
Directional deformation pad force:



ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 7.512| || Volume 10, Issue 4, April 2021 ||

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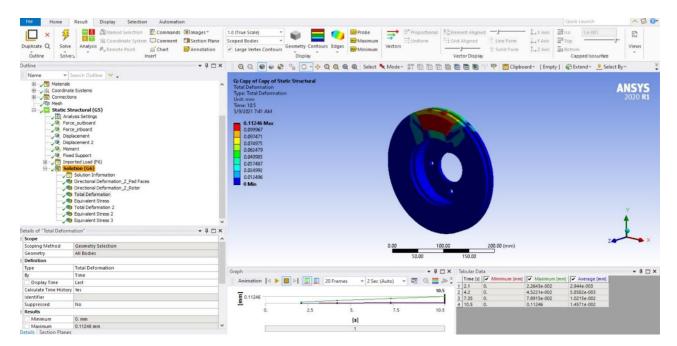
Von misses stress:



(Fig-17)

10.2.Al 90% Sic 10% composition :

Deformation :



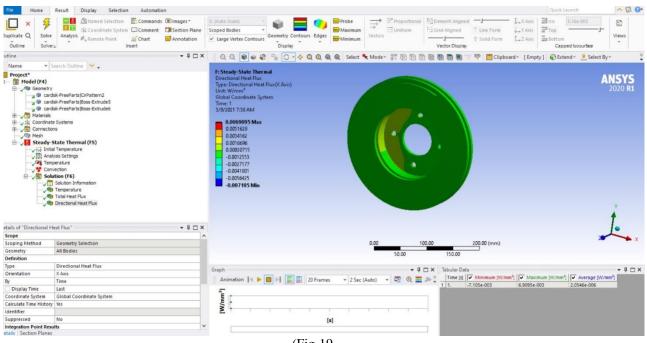




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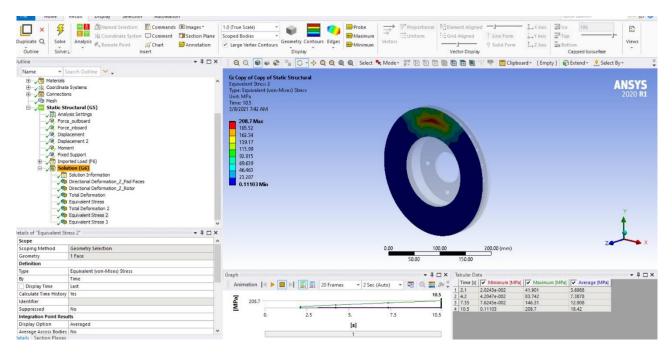
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Directional heat flux:



(Fig-19

Face stress:



(Fig-20)

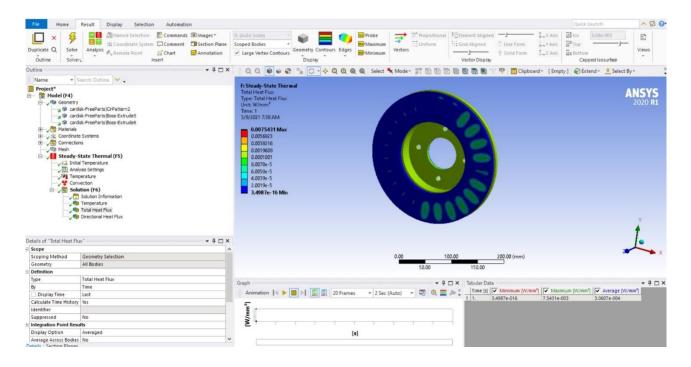


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|| Volume 10, Issue 4, April 2021 ||

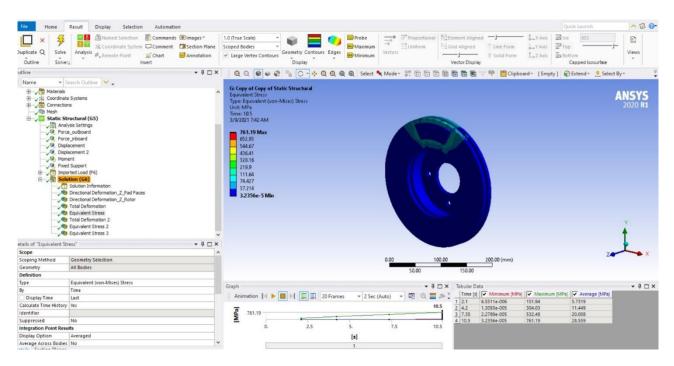
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Heat flux:



(Fig-21)

Stress:



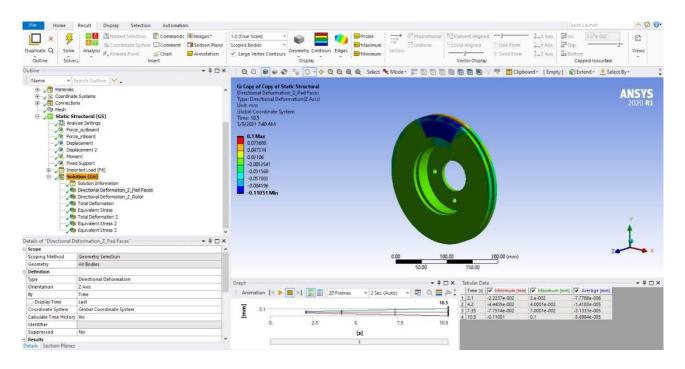


ISSN: 2319-8753, p-ISSN: 2320-6710| <u>www.ijirset.com</u> | Impact Factor: 7.512|

|| Volume 10, Issue 4, April 2021 ||

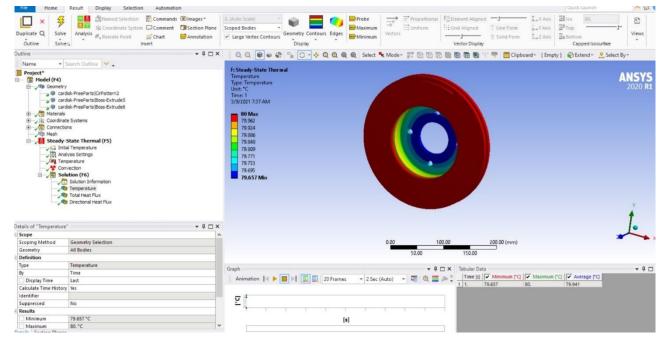
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Directional deformation pad force:



(Fig-23)

Temperature distribution:



(Fig-24)



ISSN: 2319-8753, p-ISSN: 2320-6710 <u>www.ijirset.com</u> | Impact Factor: 7.512

|| Volume 10, Issue 4, April 2021 ||

DOI:10.15680/IJIRSET.2021.1004067

III. RESULT AND DISCUSSION

		GREY CAST IRON	Al / 5% SiC	Al / 10% SiC
1	Temperature(°C)	70	78	80
2	Total deformation(mm)	0-0.000239	0-0.11246	0-0.11261
3	Total Thermal flux(KW/mm^2)	0.0005312	0.0030607	0.004002
4	Structural von-Mises Stress (N/mm ²)	0.12-181.87	0.11-208.7	0.09-179.3
5	Equvalent Stress (N/mm^2)	34.055	28.559	24.649
6	Directional heat flux(KW/mm ²)	0.002024	0.0020546	0.0020431
7	Directional deformation(mm)	-0.11-0.97	-0.11-0.1	-0.11-0.12

IV. CONCLUSION

1. Mechanical properties of AlSiC metal matrix composites are investigated.

2. It is found that the elongation tends to decreases according to the increase in weight percentage of silicon carbideand hence it leads to increase in hardness.

3. Density of the AlSiC with different composition of SiC metal matrix composites is investigated. Little increase in density, but very high increase in strength.

4. It appears that the hardness increases results to decrease inelongation % of AlSiC metal matrix composites.

5. Tensile strength of the aluminum silicon carbide metal matrix composites increases gradually at the increased composition of the silicon carbide in it but at 10% of SiC in Algive the best tensile strength as per the weight percentage.

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"International Research Journal of Engineering and Technology (IRJETVolume: 07 Issue: 03 | Mar 2020



ISSN: 2319-8753, p-ISSN: 2320-6710 www.ijirset.com | Impact Factor: 7.512

|| Volume 10, Issue 4, April 2021 ||

DOI:10.15680/IJIRSET.2021.1004067

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