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The Evaluation of Structural Analysis on Bicycle Frame using Steel Alloy and Titanium Alloy

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Abstract: Analysis of Bicycle Frame by using 3D CAD MODELLING TOOL In this project we are going to design Bicycle Frame by using 3D CAD Modelling tool i.e., CATIA V5 R20. After completion of design we are going to do structural analysis on frame with the use of existing material and proposed material and we'll conclude why the proposed material better than the existing material.

Keywords: bicycle, modelling and Frame.

I. INTRODUCTION

A bicycle frame is the main component of a bicycle, onto which wheels and other components are fitted. The modern and most common frame design for an upright bicycle is based on the safety bicycle, and consists of two triangles: a main triangle and a paired rear triangle. This is known as the *diamond frame*. Frames are required to be strong, stiff and light, which they do by combining different materials and shapes.

A frameset consists of the frame and fork of a bicycle and sometimes includes the headset and seat post. Frame builders will often produce the frame and fork together as a paired set.

The length of the tubes, and the angles at which they are attached define a frame geometry. In comparing different frame geometries, designers often compare the seat tube angle, head tube angle, (virtual) top tube length, and seat tube length. To complete the specification of a bicycle for use, the rider adjusts the relative positions of the saddle, pedals and handlebars:

A. Frame size

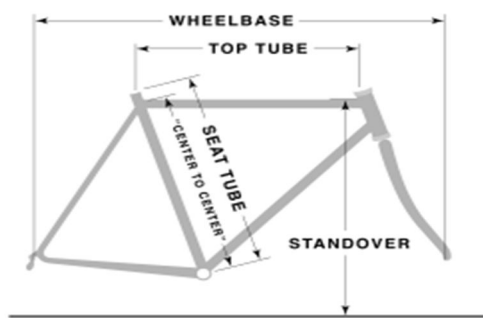


FIG1-Commonly used measurements

Frame size was traditionally measured along the seat tube from the center of the bottom bracket to the center of the top tube. Typical "medium" sizes are 54 or 56 cm (approximately 21.2 or 22 inches) for a European men's racing bicycle or 46 cm (about 18.5 inches) for a men's mountain bike. The wider range of frame geometries that now exist has also led to other methods of measuring frame size. Touring frames tend to be longer, while racing frames are more compact.

B. Frame Materials

Historically, the most common material for the tubes of a bicycle frame has been steel. Frames can be made of varying grades of steel, from very inexpensive carbon steel to more costly and higher quality chromium molybdenum steel alloys. Frames can also be made from aluminum alloys, titanium, carbon fiber, and even bamboo and cardboard. Occasionally, diamond (shaped) frames have been formed from sections other than tubes. These include I-beams and monocoque. Materials that have been used in these frames include wood (solid or laminate), magnesium (cast I-beams), and thermoplastic.

In this paper we are using these materials for making bicycle frame in CATIA modelling software. These are Steel alloy, alloy steel super alloy A286 and Ti-12Mo-6Zr-2Fe-Titanium alloy.

II. MODELING OF CYCLE FRAME

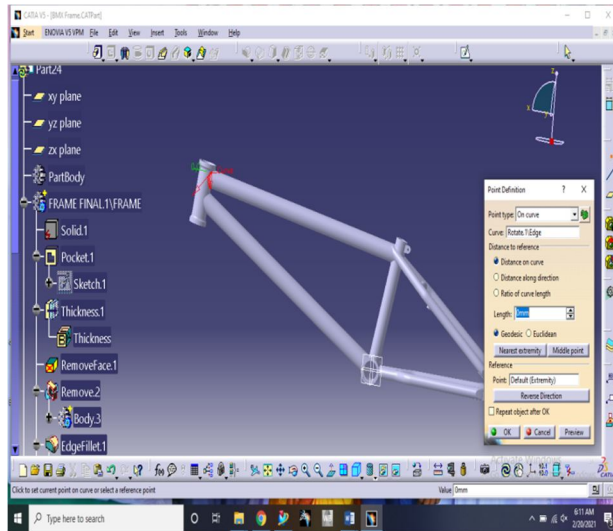


FIG2-Point1

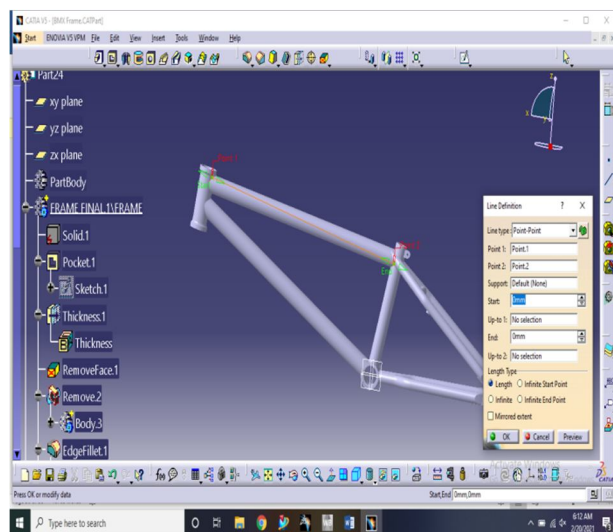


FIG3-Line 1

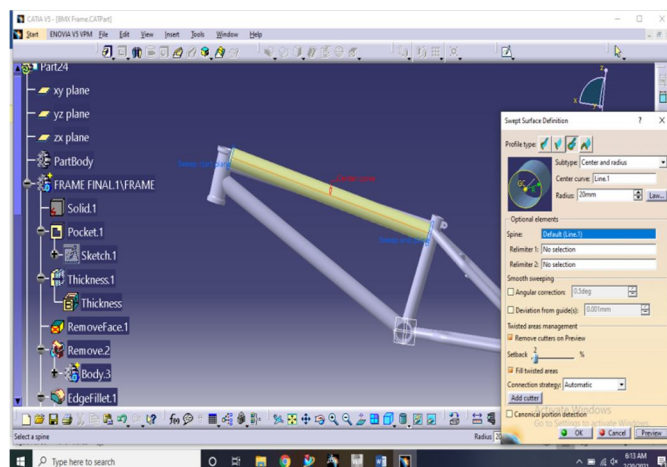


FIG4-Sweep 1

IV. PROJECT ANALYSIS

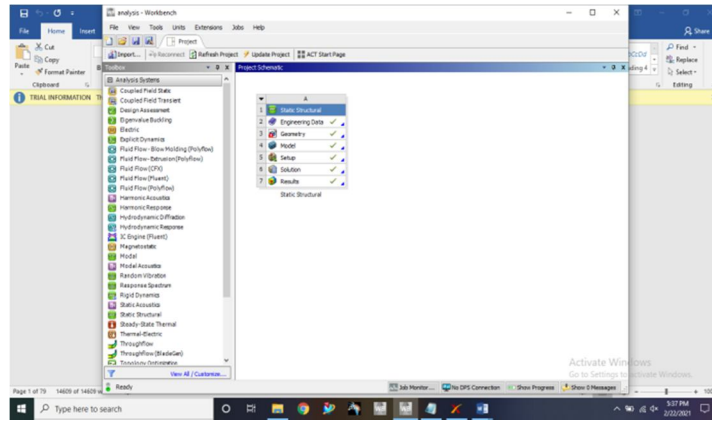


Fig10-Engineering Data

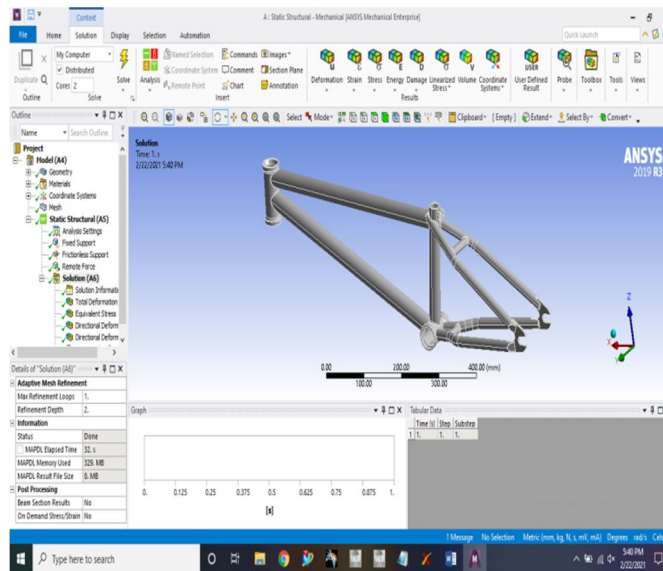


FIG11-Geometry

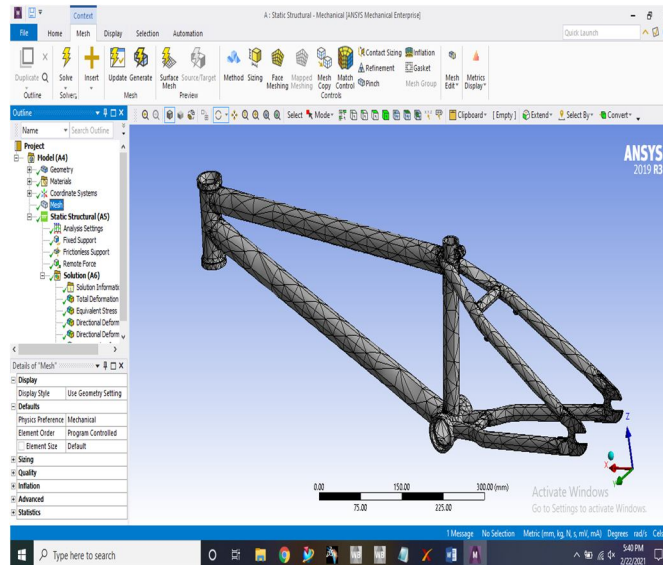


FIG12-Mesh

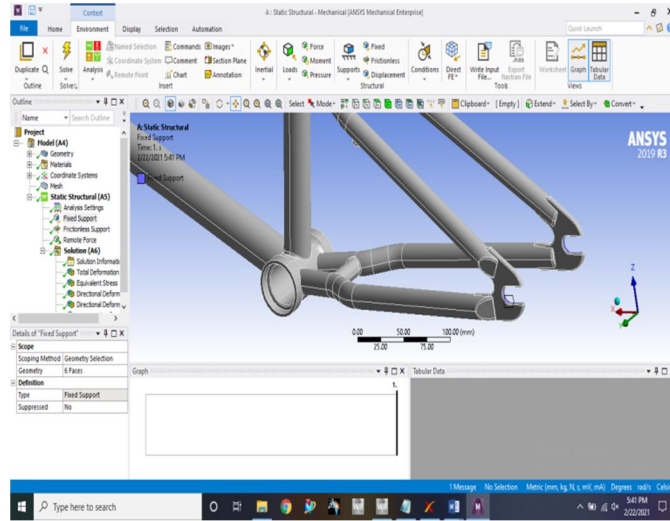


FIG13-Fixed Support

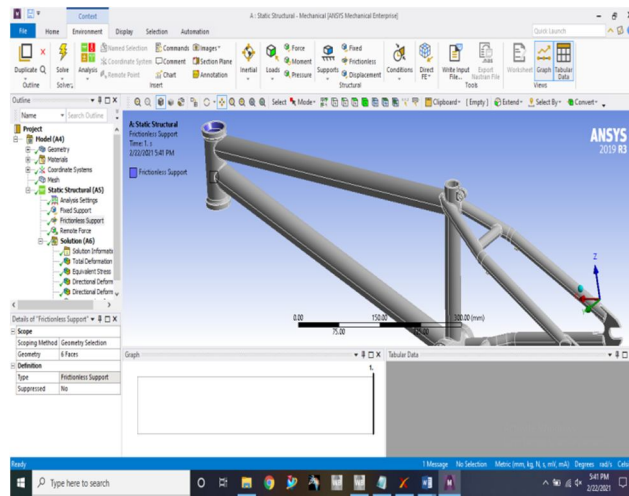


FIG14-Frictionless Support

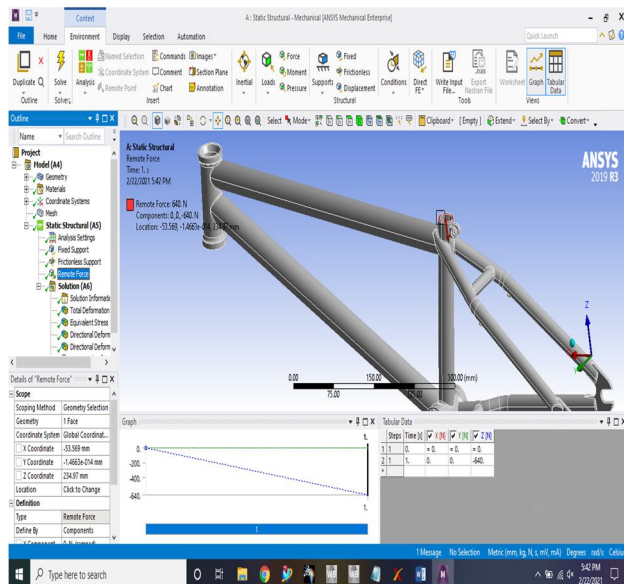


FIG15-Remote Force

V. RESULT AND COMPARISON

A. Steel Alloy

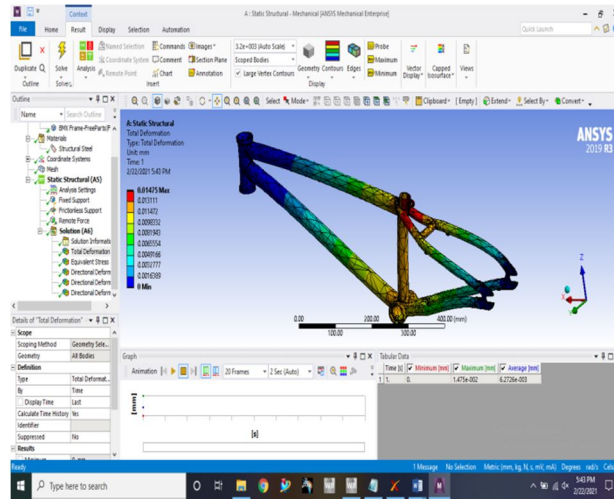


FIG16-Total deformation

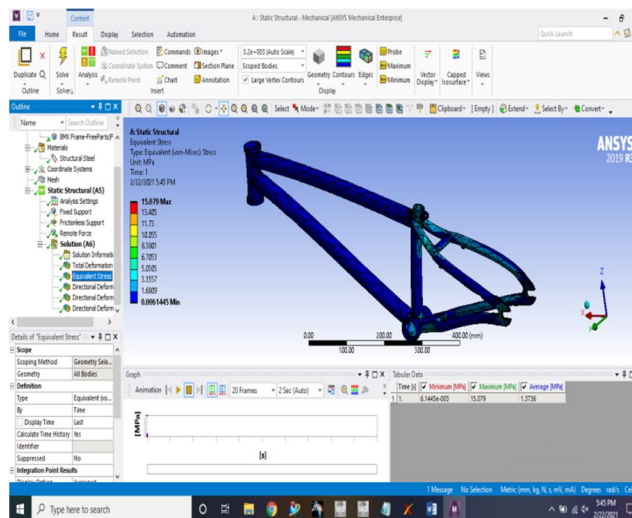


FIG17-Stress

B. Alloy Steel Super Alloy A286

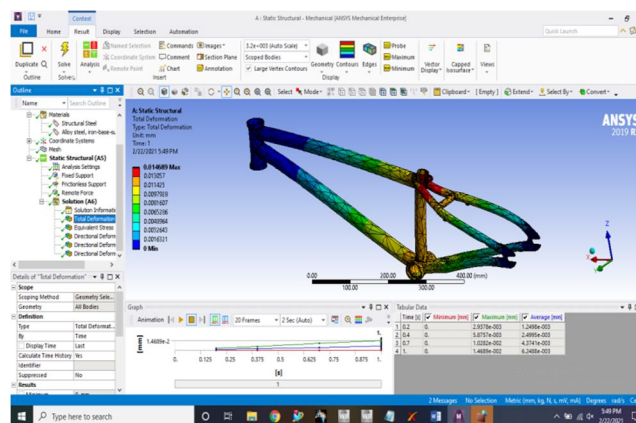


FIG18-Total Deformation

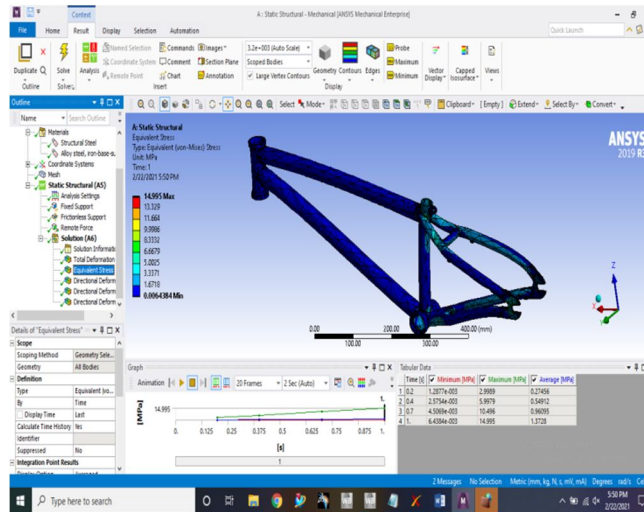


FIG19-Stress

C. *Ti-12Mo-6Zr-2Fe-titanium alloy*

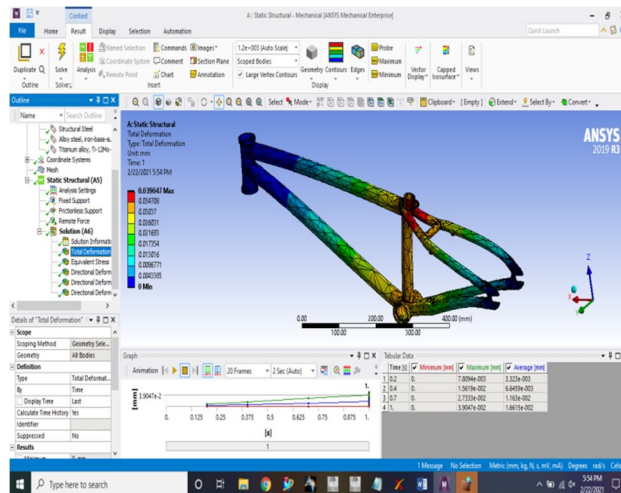


Fig20- Total Deformation

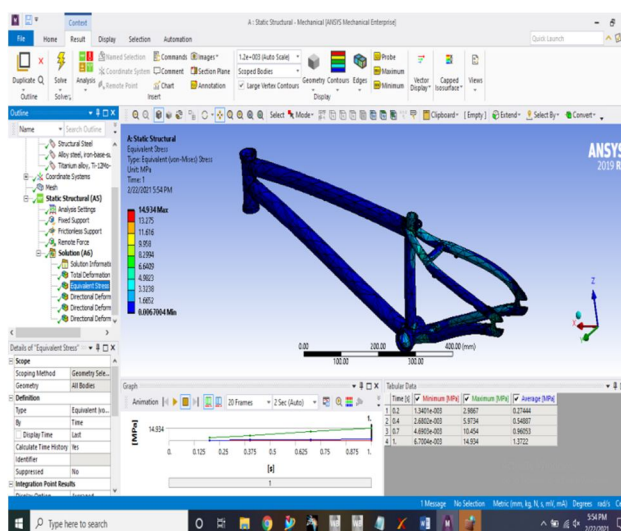


Fig21-Stress

VI. COMPARISON TABLE

SL.NO	MATERIALS	TOTAL DEFORMATION	Equivalent STRESS
1	STEEL ALLOY	0.01475	15.029
2	ALLOY STEEL SUPER ALLOY A286	0.014689	14.995
3	Ti-12Mo-6Zr-2Fe-titanium alloy	0.039047	14.934

VII. CONCLUSION

In this project we did design of Bicycle Frame by using Catia V5 R20. After completion of design we did structural analysis of bicycle frame with use of Steel alloy, Alloy steel super alloy a286 and Ti-12Mo-6Zr-2Fe-titanium alloy.

After completion of analysis we compared the results of all three materials in that we found that Ti-12Mo-6Zr-2Fe-titanium alloy have lesser deformation and less stress than the other materials .

By this we are concluding that we use Ti-12Mo-6Zr-2Fe-titanium alloy in the place of Steel alloy so that we can increase the life of component.

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45.98



IMPACT FACTOR:
7.129



IMPACT FACTOR:
7.429



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