

## DESIGN OF FOOT OVER BRIDGE WITH THE VARIATION OF STIFFNESS TO WEIGHT RATIO WITH THE HELP OF TOPOLOGY OPTIMIZATION

K. HEMALATHA<sup>1</sup>, K. SAITEJA<sup>2</sup>, MD. MAHBOOBURRAHMAN

<sup>3</sup>, S. VIJAYKUMAR<sup>4</sup>, T. ANKITH SINGH<sup>5</sup>

<sup>1</sup> Assistant Professor, Dept. of Mechanical Engineering, St. Martin's Engineering College,

<sup>2,3,4</sup> Students, Dept. of Mechanical Engineering, St. Martin's Engineering College

### ABSTRACT

Footbridges are needed where there is a separate pathway must be supplied for human beings to move site visitors flows or some physical impediment, along with a river. The masses they convey are, with regard to toll road or railway bridges, pretty modest, and in most circumstances a reasonably light structure is needed. They are but, often required to give a protracted clear span, and stiffness then becomes a crucial consideration. The bridges are frequently required very virtually on view to the general public and consequently the advent deserves careful attention. Steel offers financial and appealing kinds of creation which suit all of the requirements demanded of a footbridge.

### INTRODUCTION

A footbridge (also a pedestrian bridge, pedestrian overpass, or pedestrian overcrossing) is a bridge designed solely for pedestrians.<sup>[1]</sup> While the primary meaning for a bridge is a structure which links "two points at a height above the ground", a footbridge can also be a lower structure, such as a boardwalk, that enables pedestrians to cross wet, fragile, or marshy land.<sup>[2]</sup> Bridges range from stepping stones—possibly the earliest man-made structure—to "bridge" water—to elaborate steel structures. Another early bridge would have been simply a fallen tree. In some cases a footbridge can be both functional and artistic.

### TYPES OF FOOT OVER BRIDGES

Types of footbridges include but are not limited to:

- Beam Bridge
- Boardwalk
- Clapper bridge
- Plank road
- Corduroy road
- Moon bridge
- Simple suspension bridge
- Living bridge
- Simple truss

## **PROJECT DESIGN**

CATIA(ComputerAidedThree-dimensionalInteractiveApplication)isamulti-platformCAD/CAM/CAE commercial software suite developed by the French company Assault Systems.Written in the C++ programming language, CATIA is the cornerstone of the Assault Systemsproductlifecyclemanagement softwaresuite.

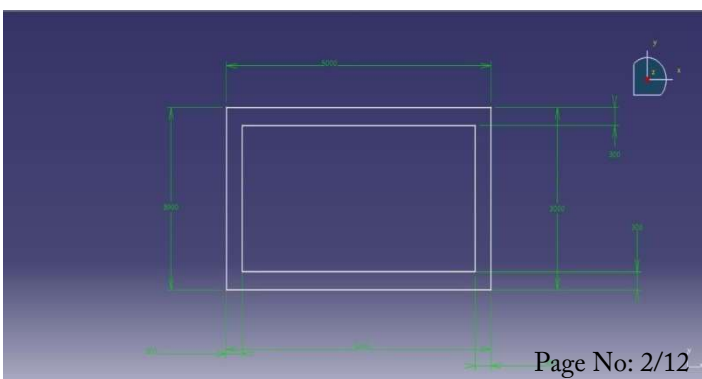
CATIAcompetesintheCAD/CAM/CAEmarketwithSiemensNX,Pro/E,AutodeskInventor,andSolidEdgeas well asmany others.

|                 |                           |
|-----------------|---------------------------|
| Developer(s)    | DassaultSystems           |
| Stablerelease   | V6R2011x/November23, 2010 |
| Operatingsystem | Unix/Windows              |
| Type            | CADsoftware               |
| License         | Proprietary               |
| Website         | WWW.3ds.com               |

## **MEASUREMENTS:**

| MEASUREMENTS | VALUES |
|--------------|--------|
| Length       | 30m    |
| Width        | 5m     |
| Height       | 3m     |
| Thickness    | 0.3m   |
| Force        | 41678N |

## **DESIGN:**

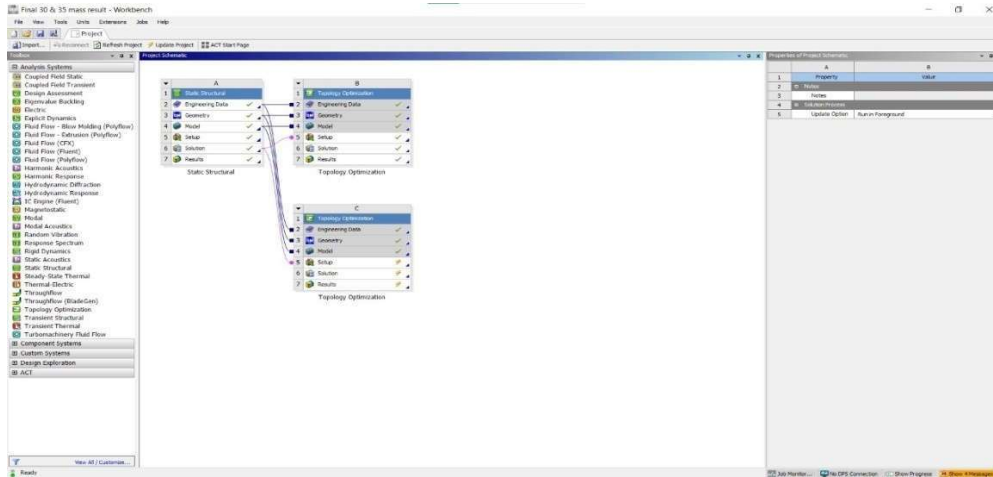




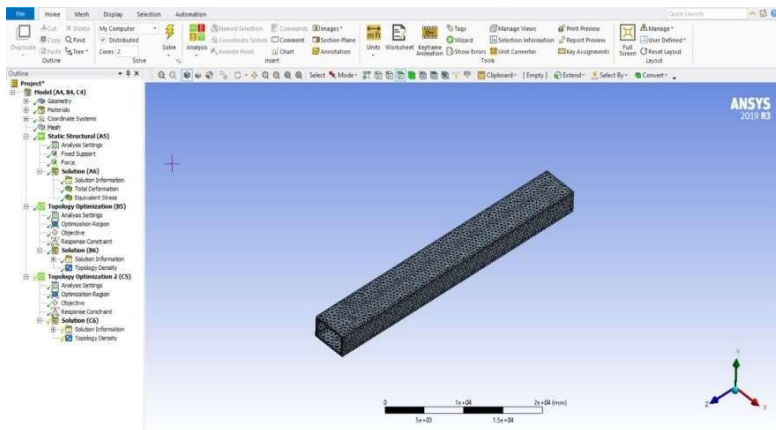


## PROJECTIMPLEMENTATION

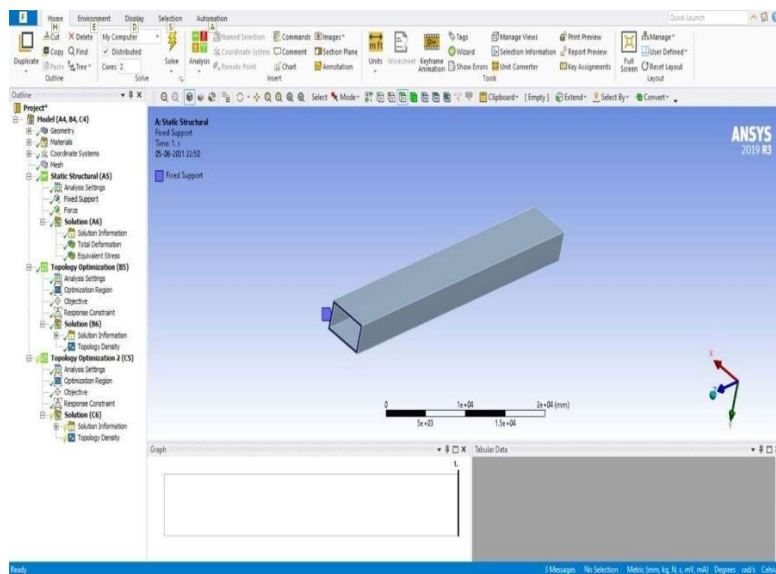
### ANALYSINGEXPERIMENTALDATA:



## MESH:



## FIXEDSUPPORT:



## LOADACTING:

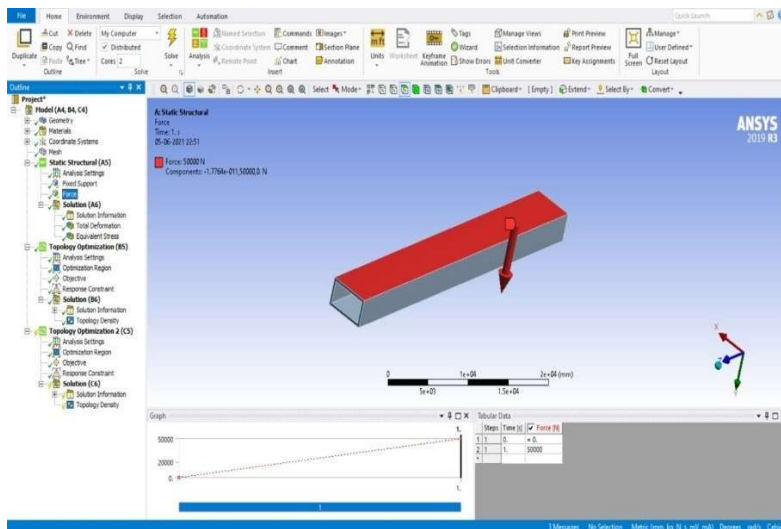
Average weightxNo.of peoplexGravitational force=

$$\text{Force(Load)} 85\text{kgs} \times 50 \times 9.81 = 41678\text{N}$$

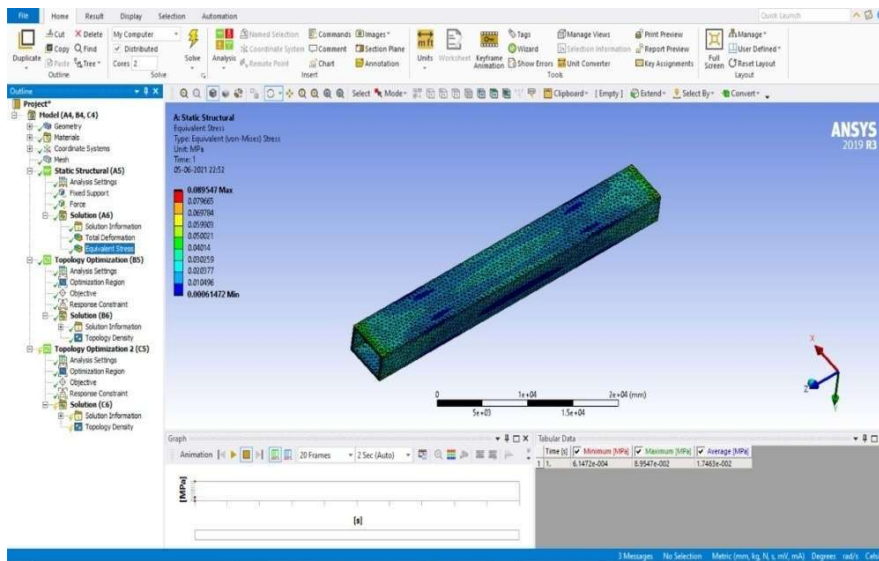
Force(Load)=Deformation41678

$$\text{N} = 0.0085297\text{ra}$$

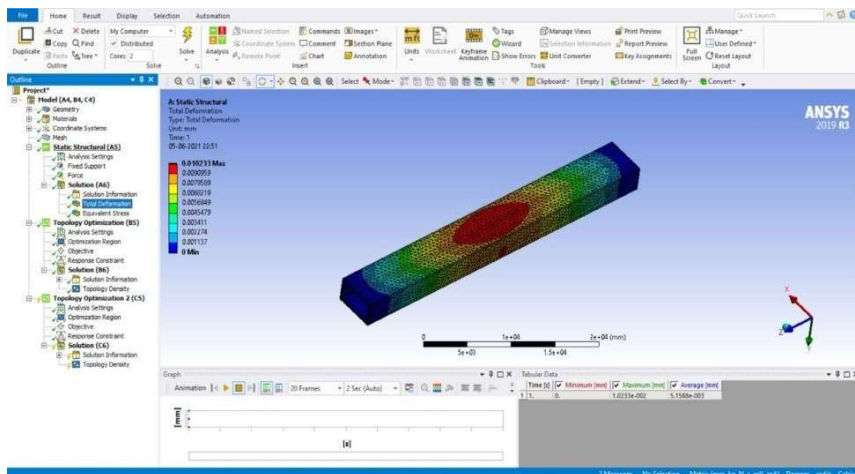
## FORCE:



## EQUIVALENTSTRESS:



## TOTALDEFORMATION:



## DEFORMATIONSAMPLES:

| LOAD   | DEFORMATION |
|--------|-------------|
| 40000N | 0.0081863   |
| 42000N | 0.0085956   |
| 44000N | 0.0090049   |
| 46000N | 0.0094143   |

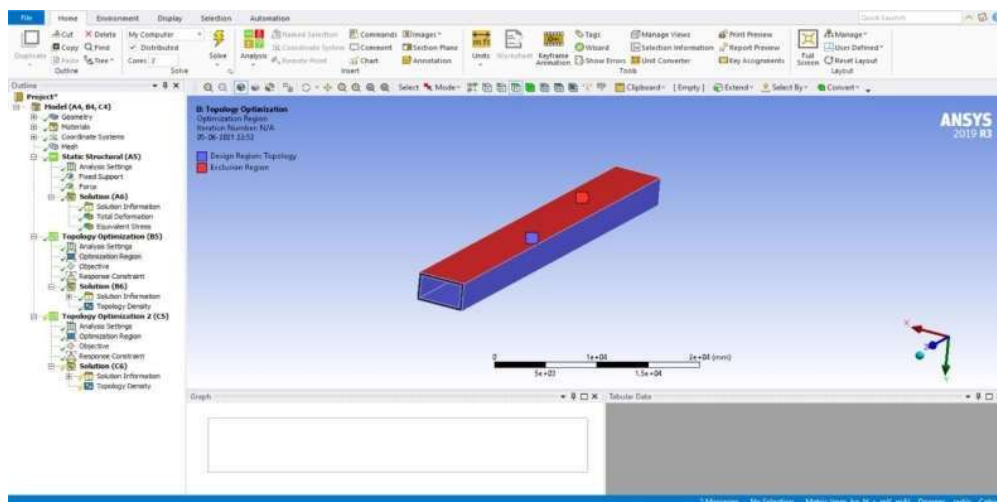
|        |           |
|--------|-----------|
| 48000N | 0.0098236 |
| 50000N | 0.010233  |

## TOPOLOGYOPTIMIZATION:

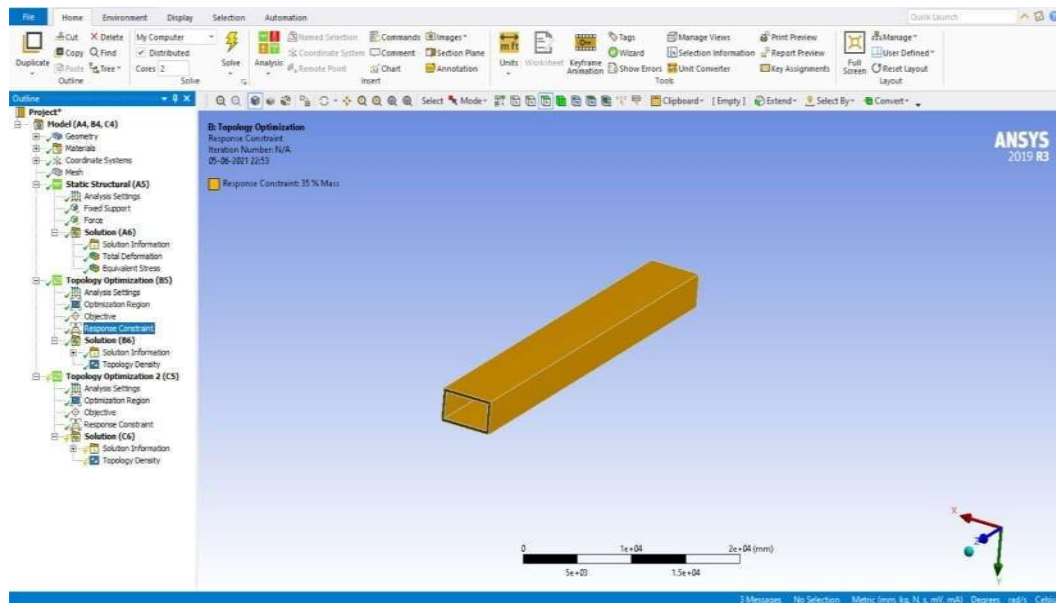
The study of topology optimization is making difference in weight (mass) without any change in dimensions.

Removal of excess material where there is no stress acts on it, it is also called topology optimization. It is also used to reduce the weight (mass) in case of getting good performance.

## OPTIMIZATION REGION:



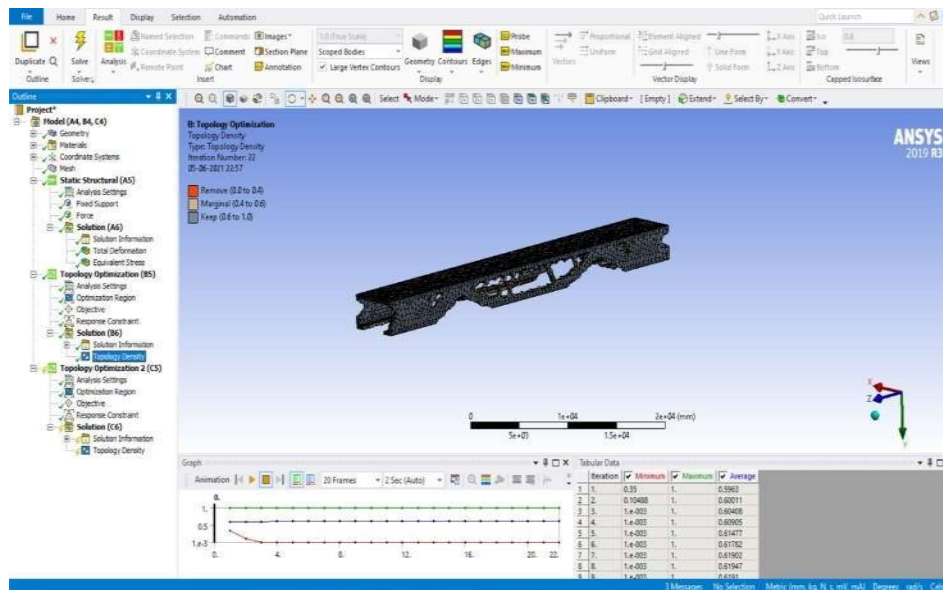
## RESPONSECONSTRAINT:



## TOPOLOGYOPTIMIZATIONRESULT:

| S.NO | MATERIAL            | DENSITY  | RESPONSE<br>CONSTRAINT | ORIGINAL<br>MASS | MASS<br>AFTER<br>TOPOLOGYOPTI<br>MIZATION | PERCENTAGE<br>OF<br>MASS<br>REDUCED |
|------|---------------------|----------|------------------------|------------------|-------------------------------------------|-------------------------------------|
| 1.   | Structural<br>steel | 8654.9kg | 30%                    | 1537.15kg        | 868.88kg                                  | 43.408%                             |
| 2.   | Structural<br>steel | 8654.9kg | 35%                    | 1537.15kg        | 919.06kg                                  | 40.208%                             |

## ANALYSING EXPERIMENTAL RESULT (FINAL RESULT):



## CONCLUSION

In this project we did design of a foot over bridge by using CATIA-V5-R2011. After the completion of design, we did analysis by using ANSYS Workbench with help of Topology optimization. We got a good performance of the foot over bridge by giving the measurements which we used in this Project and we also did the variation of Stiffness to Weight (mass) ratio. As a future scope of study, manufacturing techniques for Foot over Bridge could be used in all the heavy traffic routes, and also be able to construct strong enough to withstand.

## REFERENCES:

- 1) Gimsing N.J. (1997) Cable Supported Bridges Concept & Design, 2nd edn. Wiley, Chichester.
- 2) Podolny W., Jr. and Scalzi J.B. (1986) Construction and Design of Cable Stayed Bridges, 2nd edn. Wiley, New York, USA.
- 3) Troitsky M.S. (1988) Cable-stayed Bridges, 2nd edn. BSP, Oxford.
- 4) Walther R., Houriet B., Walmar I. and Morin P. (1988) Cable Stayed Bridges. Thomas Telford, London.
- 5) Fischer G. (1960) The Severin Bridge at Cologne (Germany). Acier-Stahl-Steel, No. 3, 97–107.
- 6) Leonhardt F. and Zellner W. (1980) Cable-stayed bridges. International Association for Bridge and Structural Engineering Surveys, S-13/80, in LABSE Periodica 2/1980.
- 7) Wenk H. The Stromsmund Bridge. (1954) Stahlbau, 23, No. 4, 73–76.
- 8) D.J. Farquhar Mott MacDonald Cable Stayed Bridges.
- 9) N. Krishna Raju, Design of Bridges.

