Using of Ansys Program To Calculate The Tensile and Compressive Properties of Structural Steel

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Abstract – *Human designers are able to perform design analysis and synthesis only for simple objects with ideal application scenarios. The majority of textbook problems fall into this category. These problems are used by instructors to illustrate physical principles, mathematic models, and solving processes. However, the geometric shapes of real-world products or systems are generally too complex for manual solutions.*

Taking an example of conventional machine design, students are taught to calculate physical quantities such as stress distribution, deflection, and fatigue life using theoretical and empirical equations when the dimensions and loading conditions of machine elements are given. Most importantly, it becomes impractical when the part geometry becomes complex, and/or a large number of design candidates in the solution space are evaluated and compared. Cae becomes ideal tools when a large number of constructions are evaluated to determine the best solution subjected to given constraints. As a summary, integrated computer aided techniques are essential parts of engineering designs for modern products and systems.

Keywords- *tensile and compression properties of Structural steel.*

I- INTRODUCTION

Ansys is an American company based in Canonsburg, Pennsylvania. It develops and markets cae/multiphysics engineering simulation software for product design, testing and operation and offers its products and services to customers worldwide. the company acquired numerous other engineering design companies, obtaining additional technology for fluid dynamics, electronics design, and physics analysis.

Ansys develops and markets engineering simulation software for use across the product life cycle. Ansys mechanical finite element analysis software is used to simulate computer models of structures, electronics, or machine components for analysing strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow, and other attributes. (1) Ansys is used to determine how a product will function with different specifications, without building test products or conducting crash tests. For example, ansys software may simulate how a bridge will hold up after years of traffic, how to best process salmon in a cannery to reduce waste, or how to design a slide that uses less material without sacrificing safety.(2)

Benefits of CAE

The major benefits of computer aided design is that it helps to reduce the cost of production and the time it will take to complete it. At the same time they help to ensure that the products come out with higher quality and better durability. Designs with cae will also help design and engineering teams manage performance implications and risks of their design. Also, designers can make use of computer based simulations to refine and evaluate their

designs instead of relying on money and time consuming physical prototype testing.

- Stress and dynamics analysis using finite element analysis
- Fluid and thermal analysis through computational fluid dynamics
- Multibody dynamic and kinematic analysis
- Mechanical event simulation
- Manufacturing process simulation
- Product optimisation

Tensile strength - Tensile strength is the ability of a material to withstand a pulling (tensile) force and refers to the breaking strength of a material when applying a force capable of breaking many strands of the material simultaneously, at a constant rate of extension/load. It is customarily measured in units of force per cross-sectional area.(3)

The tensile strength is the maximum tensile stress that a material can be subjected to before failure, although the actual definition of failure usually varies according to the material's type and design. Reduction in ductility and an increase in brittleness are associated with an accelerated corrosion rate, which in turn can change the failure of the material from a ductile failure to a much more dangerous brittle failure.

Compression strength -Compressive strength is the maximum compressive stress that, under a gradually applied load, a given solid material can sustain without fracture. The formula for calculating compressive strength is:

CS = F / A

Where in compressive strength (CS) is equal to the force (F) at the point of failure divided by the cross sectional area. Compressive strength tests must be performed with equal opposing forces on the test material. Test materials are normally in cylinders, cubes or spheres.(4)

Structural steel - Structural steel is a category of steel used for making construction materials in a variety of shapes. Many structural steel shapes take the form of an elongated beam having a profile of a specific cross section. Structural steel shapes, sizes, chemical composition, mechanical properties such as strengths, storage practices, etc., are regulated by standards in most industrialized countries. The ability to mould and bend steel into different shaped sections

means that steel is one of the most structurally sound materials used in construction. The mechanical properties of steel are derived from an array of constituents, including its chemical makeup and its manufacturing process and heat treatment.

A major element in the composition of construction steel is iron; however, the strength of steel can be markedly increased by the addition of various alloys, such as manganese and niobium. While these elements may ultimately strengthen steel, they can also have negative effects on other properties like ductility and weldability. (5)

Work process -

In this research the ansys program version 19.0was to calculate the tensile strength of material Structural steel. specific properties of the material was input in database of ansys program as well as standard shape of sample , and apply different types of load to make the therotical emulation to experimental tensile test , and then draw the obtained data after applied the load. (6)

II - RESULT

3d mesh part image :-
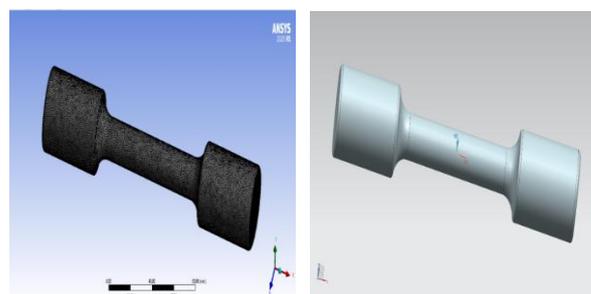
Test results :-

- **Material: structural steel**

    ultimate tensile strength: 250mpa

    ultimate yield strength: 460mpa

Fos = Tensile Yeild Strenth / Von Mises Stress

1) **Tensile test**

Applied load (n)	Equivalent stress (mpa)	Factor of safety	Total deformation (mm)
10000	40.133	6.2293	0.020
20000	80.266	3.1146	0.0401
50000	200.67	1.2557	0.1002

Impact Factor-4.013   *e-ISSN: 2581-6667*
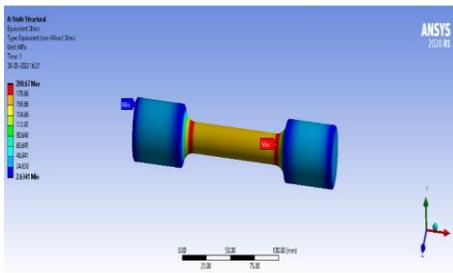*International Journal of Engineering and Creative Science, Vol. 5, No. 4, 2022*
www.ijecs.net

Fig Equivalent Stress
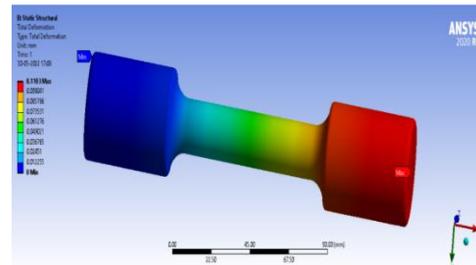

Fig factor of safety

Fig total deformation

2) **Compressive test**

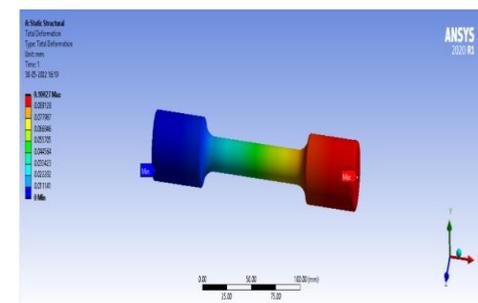| Applied load (n)	Equivalent stress (mpa)	Factor of safety	Total deformation (mm)
15000	60.2	4.152	0.0300
25000	100.33	2.491	0.0501
55000	220.73	1.132	0.1103

Fig equivalent stress
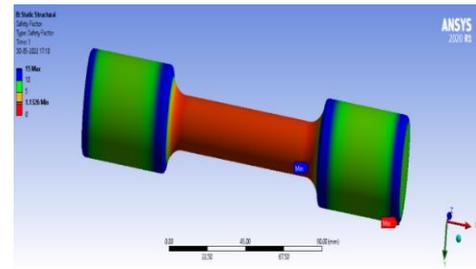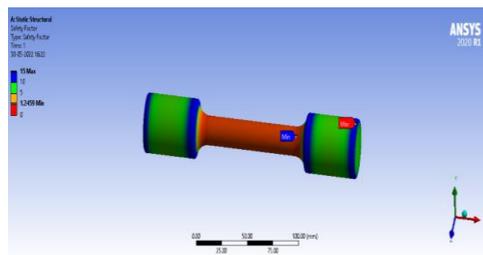
Fig factor of safety

Fig total deformation

III - CONCLUSION

Uniting engineering simulation and high-performance computing allows computer aided engineering to provide benefits across a range of industries. Creating time and cost savings in both design and product development, cae looks set to continue being an important part of the manufacturing and process improvement.

With innovative new methods of design and engineering being created, cae works to streamline and improve product development procedures through simulation while ensuring an overall standard of product quality.

o   Theous by using of ansys we can easily find or perform any test by using this simulation software
o   This technique is faster than other conventional system
o   Result accuracy of ansys testing is higher than other conversional   system
o   Energy consumption is less
o   Theous by using of ansys we can perform any test without manufacturing the product
o   In this process no physical test are perform
o   Its an totally safe to use or perform a test
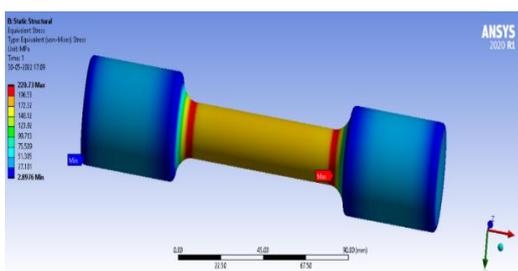
the technical knowledge to the partial fulfilment of the success of this paper is highly appreciated.

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