DESIGN OF VERTICAL DAYLIGHT AND GRIPPER IN UNIVERSAL TESTING MACHINE: A REVIEW

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Abstract

Tensile testing of any material is very critical quality measures in many manufacturing industries and building construction works. Global competition and enhanced customer awareness has increased the need of better durability of materials in tension. Nowadays universal testing machine is one of the most popularmachines to test the different materials in tension. There is different type of material on which the tensile test has been done, there are limitations for selecting the dimensions of the test specimen because of the fixed body structure of the Universal Testing Machine (UTM). The UTM have fixtures for holding the test specimen called gripper in which the both ends of the test specimen fitted. Gripper cannot hold the test specimen of bigger size which limits to test such specimen. As the UTM are made very compact hence it acquires less floor space so the vertical daylight and diameter of the test specimen cannot exceed than the pre-defined values. To increase the vertical daylight and test specimen size, the change should be made in the gripper design. This paper provides valuable insights of gripper design.

Keywords- Vertical Daylight, Gripper, Universal Testing Machine (UTM), Tensile Testing, Topology

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1. Introduction

Universal Testing Machines are widely used for performing the tensile test on materials to measure the yield strength in tension. For many engineering applications, materials are selected on the basis of the yield strength in tension, i.e. rod for building construction application, wire rope for suspension bridge construction etc. UTM are made very compact with high power hydraulic units hence it occupies very less area of available floor space. Because of the compact design it provides limitation on the vertical daylight of the machine. The less vertical daylight controls the maximum length of the test specimen to be tested. Diameter of the test specimen is controlled by the gripper. The hydraulic unit which powers the UTM are capable for providing high power for testing the bigger dimension materials, but because of the limitation of the vertical daylight and gripper, it is not feasible.

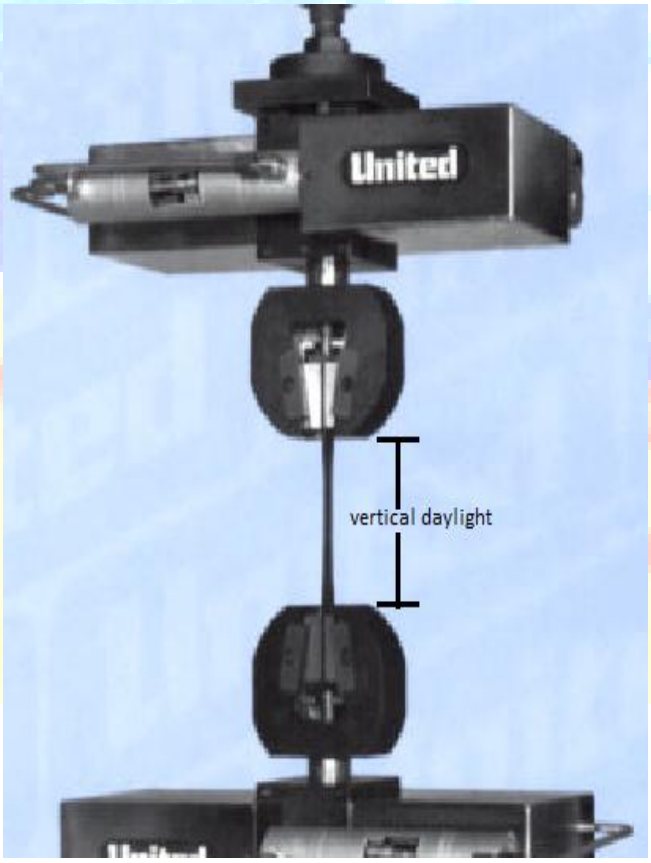

Figure 1: Universal Testing Machine

It can be solved by two ways as follow:

1. Redesignof frame
2. Redesign of gripper

Redesign of frame of UTM for higher vertical daylight is possible but at the same time it will increase the cost of the machine. By increasing the vertical daylight of the UTM, the compactness of the UTM will decrease hence redesign of the frame is not feasible option.

By redesigning the gripper, vertical daylight and maximum diameter of the test specimen to be hold by the gripper during tensile test can be increased. This can be done by changing dimensions of the gripper and providing the higher clamping force for holding the test specimen.

2. Literature Review

Prashant H. Patil et al. [1] studied on the horizontal band saw machine. It is an important machine tool in mechanical workshop. This paper is about weight reduction of moveable jaw of rear vice. Rear vice is used for clamping work piece during cutting operation. It has two jaws, one is fixed and the other is moving. Moveable jaw attached to hydraulic cylinder which applies force to hold work piece.Reduced weight of components help to minimize load on environmental recourses. By using topology optimization, weight can be reduced. Movable jaw has been modelled using solid works, by conducting analysis on existing jaws with calculating the forces acting on jaws in order to find out maximumdisplacement and stress induced. These analysis were carried using Altair Hyperworks. By conducting topology optimization with applying manufacturing constrains like minimum member size and single type draw direction, displacement and stress are lower than existing model. From results, it was found that current design is safe, save material and cost of component, finally reduction in total weight by 25% of existing model is obtained.

I.De Baere et al. [2] studied on fatigue testing of composite materials in tension and compression with the use of extra long wedge grips. This paper is about studying the effect of extra long wedge grips on static and fatigue strength of composite material. The main focus in this paper is effect of the gripper size on the fatigue life of the material to be tested. The FEM model is created and by simulation technique, it has been proved that change in wedge gripper length does not have any influence on the mechanical and tensile properties of the tested materials in static tensile testing.

John M. Curtis et al. [3] studied on grip assembly for use with tensile stress testing apparatus. It includes the housing for connecting the grip apparatus to the tensile stress testing apparatus. In this design, first elongated bore extends from the bottom of the housing through a portion of the housing parallel to the longitudinal axis of the housing to form a receptacle for a test specimen. Whereas, the second pair of elongated bores extend from the top surface of the housing, converging toward the bottom surface of housing. For tensile test of high strength material, earlier gripper was heavy and complicated to manufacture hence this design of the gripper is much better for light weight gripper.

John M. Curtis et al. [4] studied on improving the specimen grip apparatus for tensile stress testing machines includes replaceable grip inserts, which are able to accommodate wider than usual test specimens, particularly textile test specimen. The specimen grip inserts are threadedly retained on and may be substantially wider than their supporting jaw members. The grip housing, moreover, is provided with apertures for access to the treaded retainers for ease of grips inserts removal and replacement. In addition, fluid actuation is preferably provided for the jaw members of the improved grip apparatus and a thumb screw is also disclosed for temporarily locking the jaw members in a selected open position, when mounting test specimens or removing and/or replacing grips inserts

Luc hugelier et al. [5] studied on the grip performance of tensile tests on elongated specimens such as steel wires, wherein at least the face of the grip which has an engagement with the elongated specimen is provided with roughnesses. These roughnesses are virtual pyramids in shape, which at no point show an angle which is smaller than 100 degree. For preference the roughnesses have the form of truncated pyramids with an upper surface area of at least $0.0025mm^2$. Wear and breakages in the grip are considerably reduced.

3. Objective

The key objectives of these efforts are to carry out analysis of gripper of the UTM and also perform topology optimization for achieving weight reduction

- To determine the forces acting on gripper during tensile test.
- To prepare solid modelling of the gripper.

- To determine displacement and maximum displacement node number.
- To determine Von Mises stresses
- To prepare pattern of optimized model
- To perform experimental test on optimized model

4. Methodology

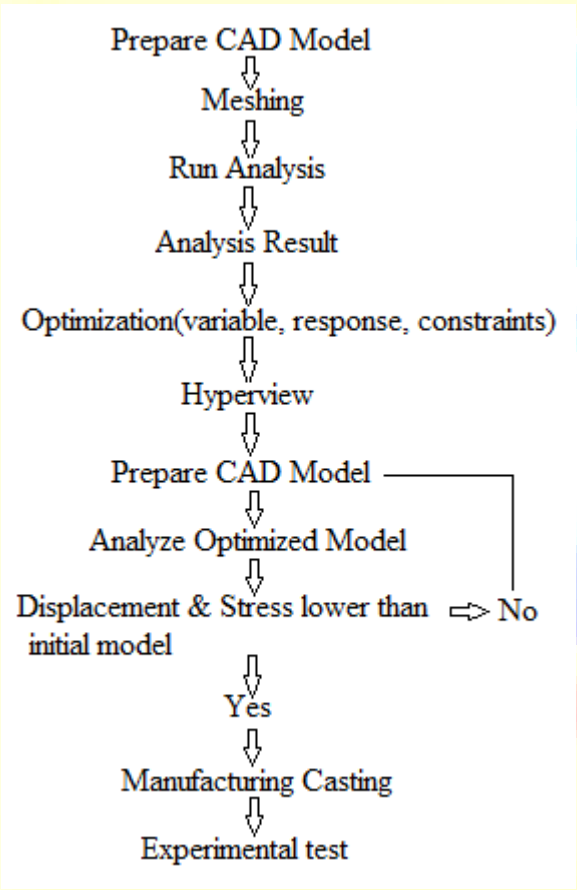

Figure 2: Work flow Diagram

5. Conclusion

The findings have shown that redesigning the gripper will provide the improved vertical daylight of the UTM and increased clamping force of gripper. By using Altair Hyperworkes, CAD modelling and FEM techniques, it is possible to improve the vertical daylight of the UTM by redesigning the gripper of the machine. It can be proved that gripper size has no influence on

mechanical and tensile properties of the test specimen. By designing different inserts for gripper, quick change for gripping different size of specimen can be done easily. Light weight gripper design saves the cost of manufacture and it is easy to replace gripper quickly in assembly.

6. References

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[3] United States Patent on "Grip assembly", By John M. Curtis, Patent No. 4662229, Date: 5 May 1987.

[4] United States Patent on "Test specimen grip apparatus" By John M Curtis, Patent No. 488995, Date: 26 Dec. 1989.

[5] United States Patent on "Grip for tensile test" By Luc Hugelier and devlaminck, Patent No. 5193397, Date: 16 Mar. 1993.