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Configuration and analysis of bicycle frames using ANSYS software

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ABSTRACT

In this study, three dimensional geometric representations of early composed bicycle edges are broke down with ANSYS program. Stress investigation of the models have been brought out through presenting them to powers, which qualities are given in the norms worried with the resistance of bicycle undercarriage. In this manner, the spots of the greatest burdens that happened in models have been identified and the outcomes have been examined. Amid the study, another bicycle frame development has been produced for kids, with a creative methodology, taking the simple manufacturability, the welding quality and stress and basic weight investigation into the record.

KEY WORDS: ANYSIS, CATIA, bicycle frame, design and analysis, FEM.

1. INTRODUCTION

As it is known, the innovation has been quickly enhancing and getting reestablished in paralleled with the advancement of frame and estimation procedures with PC. A standout amongst the most vital reasons of this is examining the configuration, which has been arranged without the trouble of re-creating, by taking all the outside impacts into thought and framing the ideal frame by giving input. In this appreciation, firstly 3D models of the presently accessible and proposed bicycle edges are made to be broke down with a FEM (Finite Element Method) in light of a PC program

The choice of the right sort of component, the determination of right investigation calculation and limit conditions are imperative in FEM based programming dissimilar to other displaying programs. Consequently, the examiner who does the examination with this technique ought to be master on the hypothetical foundation of FEM strategy and designing parts of the investigation he is dealing with. The stacking states of the bicycle being broke down have been gotten from the test conditions decided by principles.

BEAM189: BEAM189 is a component appropriate for breaking down thin to decently squat/thick shaft structures. This component depends on Timoshenko beam hypothesis.

Timoshenko hypothesis: The model checks shear distortion and rotational bowing impacts, making it appropriate for portraying the conduct of short bars, sandwich composite shafts, or beams subject to high-recurrence excitation when the wavelength approaches the thickness of the bar. In static Timoshenko beam hypothesis without pivotal impacts, the removals of the bar are thought to be given by

$$u_x(x,y,z) = -z\,\varphi(x)\;;\;\; u_y(x,y,z) = 0\;;\;\; u_z(x,y) = w(x)$$

where (x, y, z) are the directions of a point in the beam, ux, uy, uz are the segments of the dislodging vector in the three direction bearings, φ is the edge of revolution of the ordinary to the mid-surface of the shaft, and w is the uprooting of the mid-surface in the z-course.

The representing conditions are the accompanying uncoupled arrangement of normal differential conditions:

$$\frac{\mathrm{d}^2}{\mathrm{d}x^2}\left(EI\frac{\mathrm{d}\varphi}{\mathrm{d}x}\right) = q(x,t)$$

$$\frac{\mathrm{d}w}{\mathrm{d}x} = \varphi - \frac{1}{\kappa AG}\frac{\mathrm{d}}{\mathrm{d}x}\left(EI\frac{\mathrm{d}\varphi}{\mathrm{d}x}\right)$$

The twisting minute M_{xx}

$$M_{xx} = -EI\,\frac{\partial\varphi}{\partial x}$$

Shear deformation effects are include. BEAM189 is a quadratic beam element (3-node) in 3-D with six degrees of freedom at each node. The degrees of freedom at each node includes translations in x, y, and z directions, and rotations about the x, y, and z directions. Warping of cross sections is assumed to be unrestrained. This element is well-suited for linear, large rotation, and/or large strain nonlinear applications.

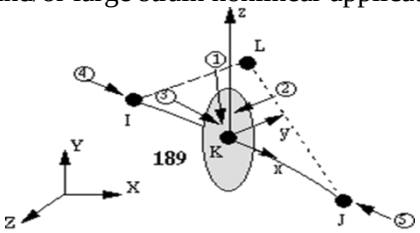
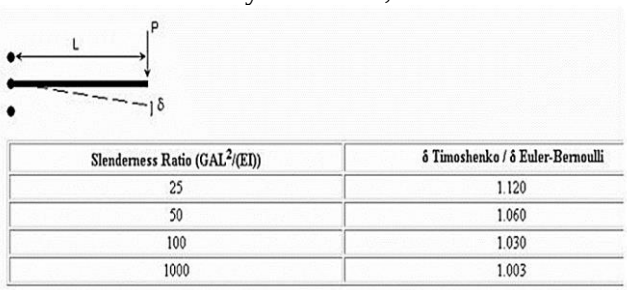


Figure.1. The view of the node points and axis Group pertaining to the beam 189 element type

BEAM189 includes stress stiffness terms, by default, in any analysis with NLGEOM**,** ON. The stress stiffness terms provided enable the elements to analyze flexural, lateral and torsional stability problems.



Slenderness Ratio ($GAL^2/(EI)$)	δ Timoshenko / δ Euler-Bernoulli
25	1.120
50	1.060
100	1.030
1000	1.003

Figure.2. BEAM189 3-D Quadratic Finite Strain Beam

Shear avoidance impacts are frequently noteworthy in the parallel diversion of short beams. The noteworthiness diminishes as the proportion of the sweep of gyration of the beam cross-segment to the shaft length turns out to be little contrasted with solidarity. Shear avoidance impacts are actuated in the firmness networks of ANSYS bar components by including a nonzero shear diversion steady (SHEAR_) in the genuine consistent rundown for that component sort. The shear redirection consistent is characterized as the proportion of the genuine beam cross-sectional territory to the viable range opposing shear twisting. The shear consistent ought to be equivalent to or more noteworthy than zero. The component shear solidness diminishes with expanding estimations of the shear diversion steady.

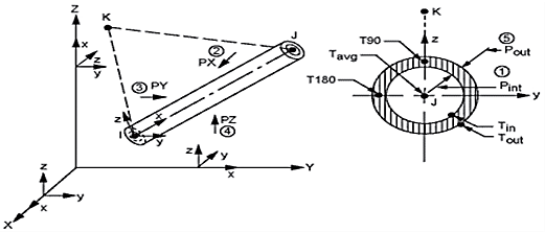


Figure.3. The view of knot point and axis group pertaining to the pipe 16 element type

Beam 189 component is appropriate torsion, clasping, vast revolution, and/or huge strain and abundance disfigurements and nonlinear applications. Since the investigations will be done under the yield point, in this appreciation, unmistakably the funnel 16 component sort is more appropriate for the examination. Funnel 16 component sort comprises of the capacities of strain pressure, torsion and bowing in its calculation. In addition, it ways to deal with the genuine results by tackling fever conditions doing symmetricity reasoning as a consequence of its temperament. There is no compelling reason to incorporate distorting and clasping impacts on account of the stacking and limit conditions. This requires less procedures to achieve the arrangement. This likewise give us not to have high arrangement cost on the PC premise. The hub purposes of the component sort and their game plans on hub set are found in Figure.3. There are 6 opportunity degrees on the every hub point in this component sort as moves and pivots. Besides, it has the ability to figure estimated surface strain and present them outwardly in spite of the fact that it contains the arrangement strategy relating to the shaft component sort in its calculation.

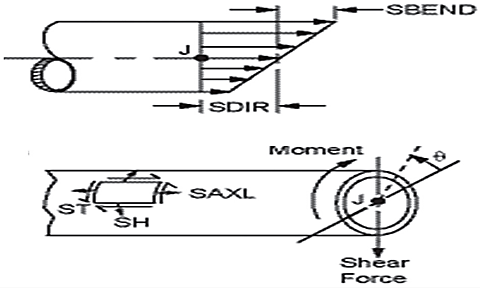


Figure.4. The surface strain caused by the shear force and torsional moment

Analysis: Investigation of current child bicycle frame In this study, three dimensional models of present and recently composed bicycle frame models have been produced with ANSYS examination programming and the anxiety examination of these models have been acknowledged by method for presenting them to the test loads which their qualities given in the principles identified with the resistance of bicycle casing. Along these lines, the areas of the greatest burdens that happened in both models have been recognized and the outcomes have been surveyed whether these most extreme anxiety values surpassed the points of confinement or not. The areas where the burdens concentrated are the basic zones. The displaying of the edge by limited component strategy and its investigation on a PC keeping in mind the end goal to distinguish the distortions and anxiety fixation ranges is one of the present day frame strategies. The DIN EN 14764 standard has been checked amid the determination of the heaps that the edge

would be presented to. It is expressed in DIN EN 14764 standard that in the led tests in which 3000N power is connected for the static resistance of the bicycle frame, there might be no breaks or obvious splits in any part of the skeleton or interfacing parts and no changeless shape distortion above 10mm at any bearing ought to. Hence, the resistance of the present and created frames under 3000N static burden has been dissected by ANSYS examination programming. In Figure 5, the perspective of the casing, at present underway, partitioned by limited components and measurements are portrayed.

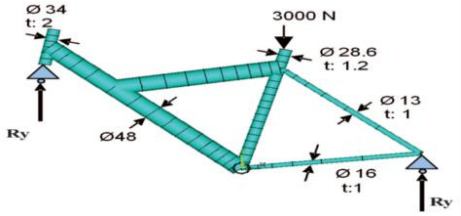


Figure.5. A child bicycle frame in production at present

The stress distributions, which obtained as a result of ANSYS analysis process, on the currently available child bicycle frame are shown in Figure.6.

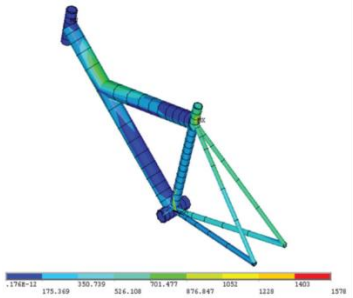


Figure.6. Stress distributions on the currently available child bicycle frame model

St37 mechanical sort steel channels are utilized as a part of the creation of present bicycle frame. As indicated by the DIN 17100 gauges, yield purpose of the steel is 2.304x1011 MPa and its versatility module is 2.059x1014 MPa. At the point when the anxiety conveyance on the present bicycle frame model is investigated, it is seen that the greatest estimation of weights on the casing is recorded as 1.548x1011 MPa, which is underneath the yield point (see Figure 5). At the point when the anxiety graph of the present casing is analyzed the most extreme misshaping (DMX) under the heap of 3000 N is seen as 0.66240 mm. Present casing model is a model which is as of now underway and utilized, and not surprisingly, it exceedingly acclimates the required gauges concerning static edge quality

Examination of the recently created child bicycle frame: In the recently planned child bicycle frame display, the material sort, measurements and casing geometry of the present bicycle frame model are protected as it seems to be, however some essential changes have been considered for the top tube, seat stay and chain stay tubes. As found in figure, two tubes reach out from the down tube to the back dropouts. Measurements of the seat stay tubes in the present model were 13 mm and their thicknesses were 1mm. These seat stay tubes' distance across expanded to the 32 mm and thicknesses to 2 mm and they have been stretched out and associated with the down tube. The chain stay tubes stretching out from the oar section to the back dropouts, which have 13mm in breadth and 1mm in thickness, are evacuated in the recently created child bicycle frame.

Figure.7. Meshed view of newly developed child bicycle frame model

The stress values in this area may reach up to 204,55 MPa only in a tiny area under a static load of 3000 N. The yield stress of the tube material is 250 MPa. That means occurred maximum stress value, obtained as a result of the analysis, is below the yield stress of the material

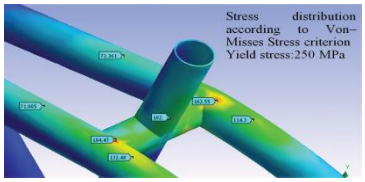


Figure.8. Stress value and location on the bicycle frame

2. CONCLUSION

Alterative investigations have been completed for the tubes, reach out from the down tube to the back dropouts, composed on the premise of the examination results furthermore symbolize the creative frame approach and in the end 32mm of width and 2 mm thickness was gotten. Amid the investigation, it was accomplished to locate an ideal cross-area that permits drawing closer to the yield point. This is an essential paradigm of the improvement particularly for a child bicycle with a specific end goal to give a light weight bicycle frame. The made model of the recently composed child bicycle frame, which tubes measurements and cross-areas characterized as an aftereffect of the investigations, is portrayed

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