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RESEARCH ARTICLE

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DETERMINATION AND COMPARATIVE ANALYSIS OF NATURAL FREQUENCIES OF THE TWO WHEELER FRAME

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ABSTRACT

Objective of this research to study vibration of two different types of frame one is square and other is tubular frame. In this work we will going to compared natural frequency of vibration between a tubular and square frame and trying to take some conclusion. In this analysis we will obtain vibration behaviour of motorcycle frame with different cross-section. In this research we took two materials one is aluminium and other is steel.

Introduction

In this research we compare two frames with natural frequency and vibration. The first frame is made of steel which has tubular profile while the second frame made of aluminium which has square profile. Both are drawn by Cre-o Parametric 2.0 and then analysed by ANSYS 14.0 with their belonging forces. Some hypotheses are considered to do the analysis a bit less complex. A dynamical analysis includes the study about performance of the system with an external perturbation applied on it. Talking about it, natural frequencies and vibration modes (sometimes they are all included in same group called vibration modes) are really important to be studied and to know them because then it can be known when the system can vibrate so some dynamical problems can be corrected or fixed during designing or testing process modifying the original structure like adding more mass, changing materials, unions... Vibration frequencies generated when frames (formed by distort elements) are oscillated, by external efforts, in different ways (if there is more than one) with stationary waves. They depend exclusively of geometry, materials and system configuration. For each frame (structure) exists only a group of frequencies that are only for it.

Procedure

This research completed in below points:

- We have taken actual measurement of motorcycle frame and considered standard values of measurement.
- We made model in Creo 2.0 with standard dimension. And created two geometry one is tubular and other is square in cross section
- Then we considered some hypothesis regarding frame geometry.
- After that for analysis purpose we used ANSYS 14.0
- We analyse both frames with different parameters.
- After Results compared both frames.
- Concluded what we got in results

ANSYS is used to perform Finite Element Analysis. Finite Element Analysis consists of the following steps:

Pre-processing

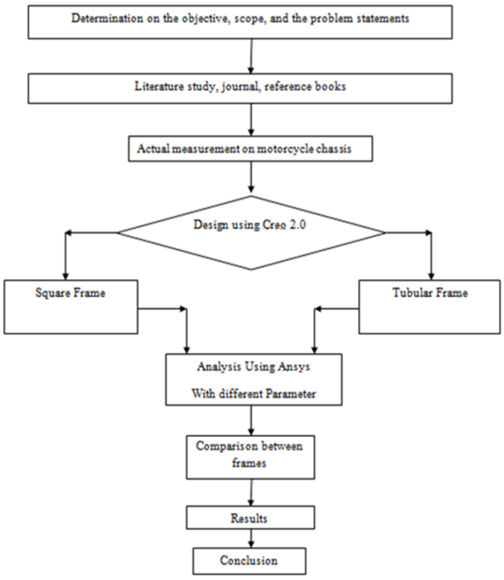
1. Discretization
2. Apply constraints

3. Processing
4. Post processing

This discretization dividing up the model into elements consisting of nodes. The processing step solves equations for respective nodes and gets results.

Meshing is discretization. It is the most important part of an analysis and can determined the efficiency and effectiveness of an analysis. Therefore, a lot of time is given to meshing of complex models.

We have made tubular frame with steel and square frame with aluminium.



Flow chart

FINITE ELEMENT ANALYSIS

Finites elements programs have different steps as a process to obtain final result:

- First it is needed the geometry that will be analysed (here done by Creo).

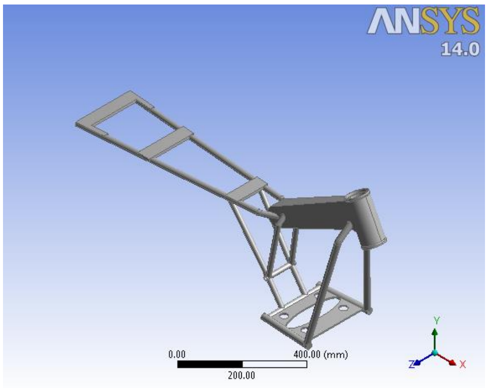


Fig.1 Tubular frame geometry

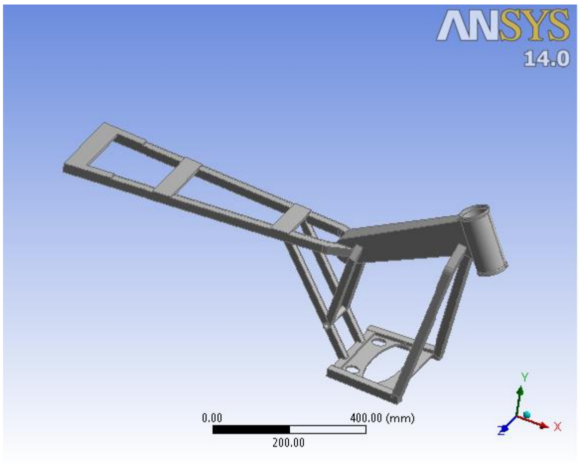


Fig. 2 Square frame geometry

- Then it is necessary to mesh it but here must be needed two sub steps. The first one, making a general mesh and after getting the first results (parts that are more important to be studied need a special mesh because then results are safer), so the second step is meshing another time but only at some special places.

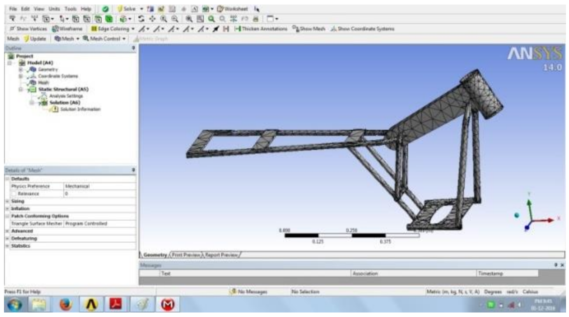


Fig.3 Meshing of tubular frame

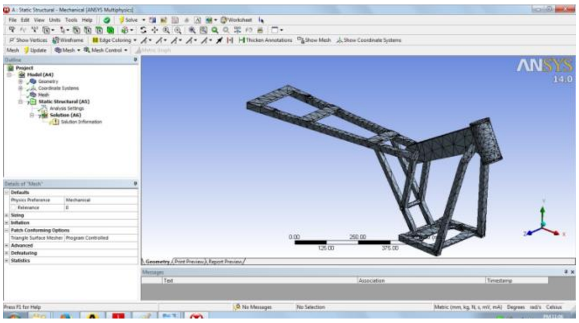


Fig. 4 Meshing of square frame

- After meshing, it has to be described which are the local conditions (which are the places where doesn't exist displacement or other conditions (constraints) and which are the external condition as forces or moments).

- Finally, the system must be solved and then an analysis about each result obtained is done. After having the solution, some conclusions should be taken and then could be done some optimization processes about each frame where they can be improved.

A dynamical analysis includes the study about performance of the system with an external perturbation applied on it. Talking about it, natural frequencies and vibration modes (sometimes they are all included in same group called *vibration modes*) are really important to be studied and to know them because then it can be known when the system can vibrate so some dynamical problems can be corrected or fixed during designing or testing process modifying the original structure like adding more mass, changing materials, unions...

Vibration modes are frequencies induced when frames (formed by distort elements) are oscillated, by external efforts, in different ways (if there is more than one) with stationary waves. They depend exclusively of geometry, materials and system configuration. For each frame (structure) exists only a group of frequencies that are only for it.

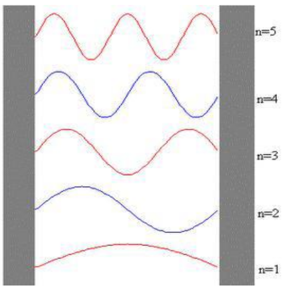
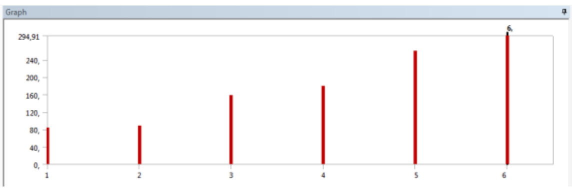


Fig.5 Different natural frequencies models

RESULTS

Results are obtained through ANSYS program and they are shown here:

Tubular frame



Graph.1 Natural frequency of tubular frame

TABLE 1: Natural frequencies for tubular frame

Mode	Frequency [Hz]
1.	84.153
2.	88.537
3.	158.6
4.	179.49
5.	259.76
6.	294.91

Square frame

Graph.2 Natural frequency of square frame

TABLE 2: Natural frequencies for square frame

Mode	Frequency [Hz]
1.	82.001
2.	83.729
3.	89.881
4.	111.17
5.	181.36
6.	182.69

Discussion of Results

Comparing both frames, it is clear that natural frequencies of tubular profile frame are much higher than beam profile, although the first two frequencies are quite similar but then there is a big increase of them.

Conclusions

As much high the natural frequencies are, more difficult is obtaining problems, for example, by chattering with the motorbike because it is needed an upper external disturbance (frequency) to get a vibration.

Normally a frame must have the first normal mode about 70 Hz to be sure that works well and can have a long live. Anyway, there are few cases which recommended natural frequency up to 80 Hz.

A problem to watch out for is with long tubes of small diameter is engine-excited resonance that is, severe vibration in the tubes caused by unbalanced engine inertia forces at a critical frequency. The solution is raising the tube's natural frequency, either by shortening it or increasing its diameter.

To sum up, theoretically these frames shouldn't have problems on vibrations but in reality it is sure that there are some different between real and theoretical model.

Natural frequencies are higher in tubular frame than square frame so it is more difficult that tubular frame be excited itself by external vibrations.

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