Investigation of design parameter of two wheeler frame through comparative analysis

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Abstract: - *Now a day there are mainly two types of frames developing one is square frame and other is tubular frame. In this work we will going to be compared what are the mechanical differences between a tubular and square (no tubular) frame and trying to take some conclusions. In this research we took two materials which are used mainly in two wheeler frame. That is aluminium and steel. We used Creo for modelling and ANSYS for analysis.*

I. INTRODUCTION:-It's the static and dynamic comparison between two frames. The first frame is made of steel and its tubular profile while the second one is a frame made of aluminium and its square profile. Both are drawn by Cre-o Parametric 2.0 and then analyzed by ANSYS 14.0 with their belonging forces. Some hypotheses are considered to do the analysis a bit less complex.

II. METHODOLOGY:-

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

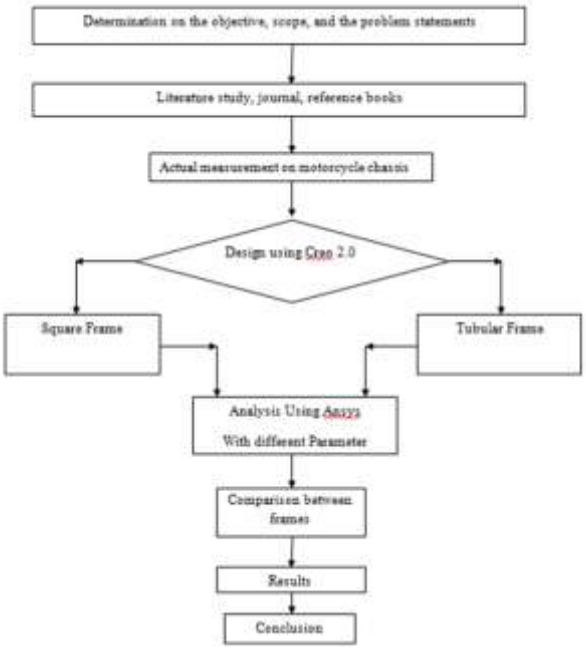
ANSYS is used to perform Finite Element Analysis. Finite Element Analysis consists of the following steps:

1. Pre-processing
    1. Discretization
    2. Apply constraints
2. Processing
3. Post processing

This discretization is the process of dividing up the model into elements consisting of nodes. The processing phase solves equations for these nodes and obtains 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

III ANALYSIS:-Once external forces in different situations are obtained, now is the moment to apply these forces with both frames and analyse the results with finites elements program.

Anyway, before introducing forces to it, it is needed a schema for each situation to determinate the real force that acts on each frame (internal forces).

Engineering has as main targets: Getting the base that governs the behaviour of a system and transforming it into a mathematical model composed by equations that could be solved. Then, it can be

gotten some results as a prediction of qualitative and quantitative performance, always looking for the best prediction, as here by ANSYS. If the system was easy, finite elements wouldn't be needed but in this case there are many degrees of freedom so they have to be solved by a central processing unit (CPU).

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).
- 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.
- 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. At this research, the analysis is composed by security factor, equivalent stress and total deformation.

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.

At this point, are considered these situations for each frame:

- Maximum acceleration
- Maximum braking to the front axle

At each case is considered each frame without the engine structure. That's done to realize mechanical properties that engine adds at the global features itself. From these results will be possible to introduce external conditions at ANSYS program so to do finites elements

Maximum acceleration:-This particular study about forces that act on the frame when there is maximum acceleration period is interesting because there is an important solicitation created at the axle, where frame (rear part) and swing arm are attached each other, so it is produced a solicitation that must be considered.

Maximum braking at front:-Contact forces from the floor against the tyre are transmitted to the frame through wheel, brake, front suspension, shank and steering. The points of applications of these forces to the frame are both steering bearings where axle direction is installed**.**

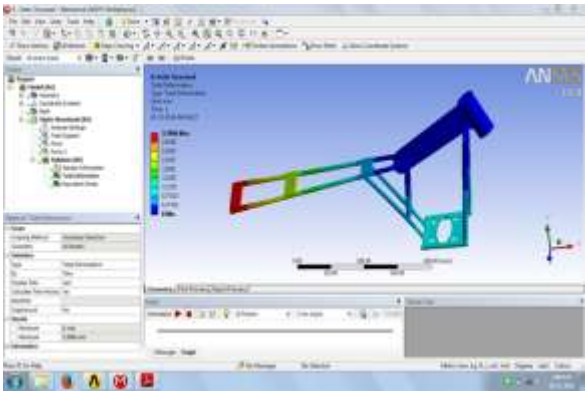


Fig 1 Total deformation for tubular frame (Maximum acceleration)

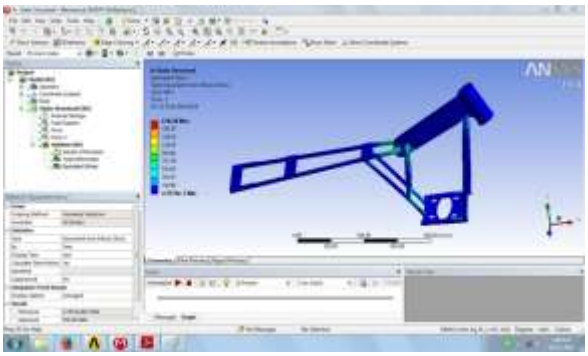


Fig 2 Equivalent stress for tubular frame (Maximum acceleration)

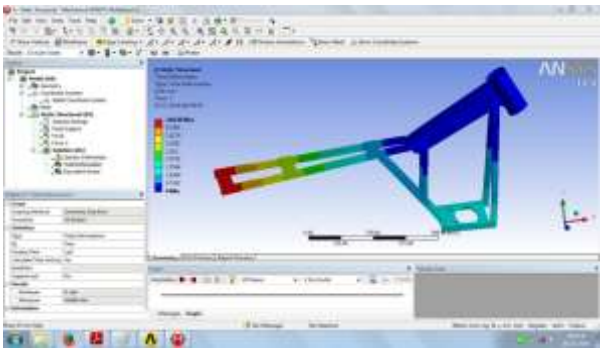


Fig 3 Total deformation for square frame (Maximum acceleration)

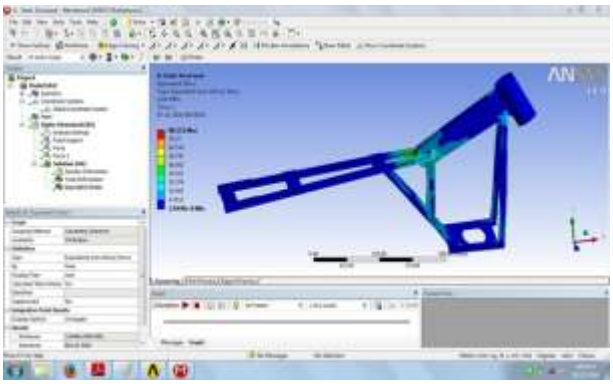


Fig 4 Equivalent stress for square frame (Maximum acceleration)

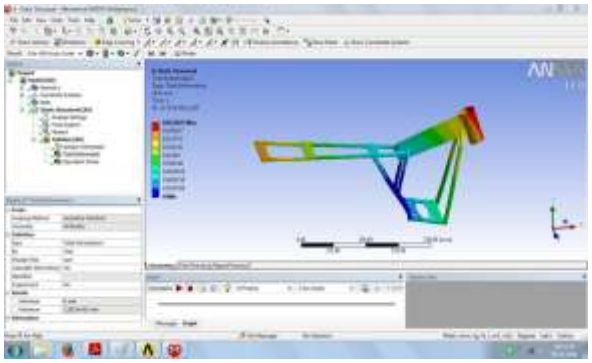


Fig.5 Total deformation in front braking (tubular frame)

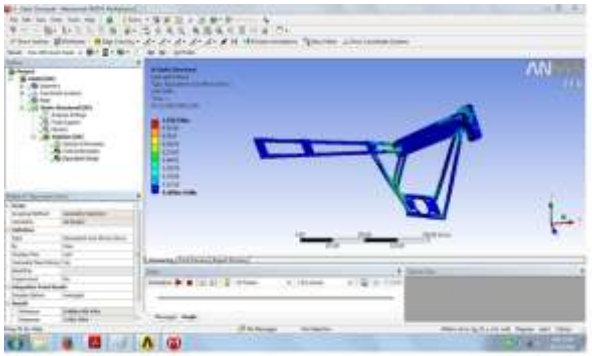


Fig. 6 Equivalent stress in front braking (tubular frame)

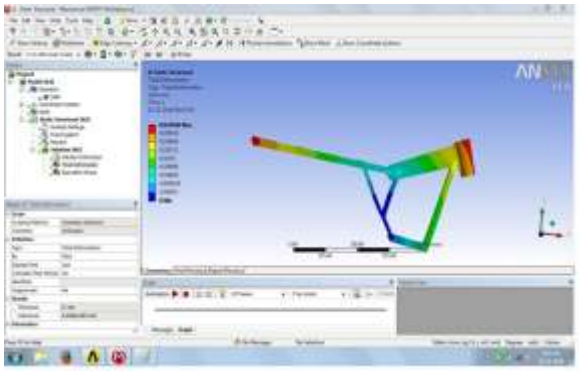


Fig 7 Total deformation at maximum braking at fron t(square frame)

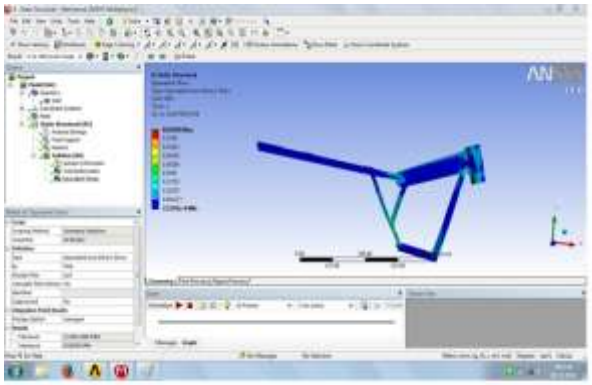


Fig 8 Equivalent stress at maximum braking at front (square frame)

IV RESULTS:-

Tubular frame	**Acceleration**	**Deformation [mm]**	0.27
		Equivalent Stress [MPa]	61.91
	Brake front axle	**Deformation [mm]**	0.07
		Equivalent Stress [MPa]	9.16
Square frame	**Acceleration**	**Deformation [mm]**	0.22
		Equivalent Stress [MPa]	56.36
	Brake front axle	**Deformation [mm]**	0.08
		Equivalent Stress [MPa]	11.25

V CONCLUSION:-

- There is a large type of different frames, each one useful for each kind of motorcycle depending on which activity is wanted to do.
- Geometric parameters change dynamics on motorcycle, so describes its behaviour in the different situations. Mainly, they are wheelbase, caster angle and trail. Other parameters that change dynamics are center of gravity and inertial moments.
- Materials are one of most important characteristics. Steel allows more resistance frame but more weigh. On the other way, aluminium allows a lighter frame but softer so must be more oversized than other one.
- Dynamical features can be really important to predict future behaviours.
- It's really important to know the external forces as better as possible to do an accurate posterior analysis.
- Tubular frame has more deformation and stresses than beam frame during acceleration, while during braking is the opposite. In curve, there is a higher deformation for tubular one but stresses are higher for beam one. As more rigid the frame is, it allows more speed in straight-line but less velocity in curve so that there is less energy spent on deformation.

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