Comparative analysis of different cross-sectional traditional diamond shape structure bicycle frame

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Abstract- **Bike weight is fundamental. If a bike is heavy, it cannot be made to go. The limiting factor is the human power plant. Gifted athletes are able to churn out 1.5 horsepower and more, but only for seconds; thereafter output rarely exceeds one-half horsepower, and one-quarter horsepower is more like it. Ordinary people make do with much less: on a steady basis, one-tenth to one-eighth horsepower. Thus, the objective of the present work is:**
"To evaluate the influence of key geometric parameters i.e. cross section (profile) of frame on as performance benchmarks for mass, strength, stress and strain characteristics and to compare these different cross sections to an optimized solution for a common diamond "safety" framed bicycle"

Index Terms- Geometric Parameters, stain, framed cycles, simulations etc.

I. INTRODUCTION

In the twentieth century, in the alleged third universe of undeveloped and rising nations where four-fifths of our planet's six billion individuals live, bicycles and human-controlled machines in a large number of structures are presently the staple of individual transport. 80% or a greater amount of the present worldwide bicycle armada is in creating nations.

Surge hour in, state, a foremost Indian city, with a huge number of bikes moving in steady streaming streams - many conveying whole families, or shocking burdens - is a sensational sight. For simplicity of make and progressing upkeep, a large number of these bikes are mechanically minimal not quite the same as those created c. 1910. Straightforward, emphatically made workhorse machines convey the greater part of the world's kin and light products. In the twentieth century, in industrialized nations, the bike experienced further sensational innovative advancement, yet its job in the public eye was influenced by two world wars, and significantly affected by the ascent of the automobile. Amid the 1914 – 18 and 1939-45 clashes general bike fabricating was suspended for creating war materials, however in times when petroleum and mass transportation were rare, bikes demonstrated more valuable than any time in recent memory.

1.1Bicycle Frame Geometry

Generally bike outlines were works in different sorts of plan and geometry. It is on the grounds that, the bike was worked by the measure of clients and as per their determination. The cylinder size of the edge additionally has numerous factors of breadth and divider thickness. Likewise, the bicycle outline includes many sub structures as demonstrated the Figure 1.1

The head tube edge in the image is the point at which the head tube is to the ground. The head tube edge can be balanced by the style of riding and tracks, the more extreme head point, there is less exertion required to guide it which implies the bicycle has quicker controlling. While, the good-for-nothing head point will require more exertion to control it and the bicycle has slower directing. For examination of head tube plot for various bikes as precedent Touring bikes around 71-72 degrees, Road bikes around 73-74 degrees and Cyclo-cross or CX around 72-73 degrees.

The directing can be quicker when the fork rake is expanded, while, the guiding turns out to be slower when the fork rake is diminished. It is plainly demonstrating that the head tube point and the fork rake as the estimation of the speed of directing. The Touring bikes have more rake than street and Cyclo-cross bikes to build their wheelbase length, give more

toe leeway and to expand the forks comfort. The wheelbase length is the separation from the focal point of front tire to the focal point of back tire.

One of the more vital estimations on an edge bicycle is the chain-stay length. A more drawn out chainstay length is attractive to expand the wheelbase (making the bicycle increasingly steady) and to give abundant heel freedom from the panniers. Impact point freedom is particularly critical for riders with substantial feet. Chain-stay all the more precisely known as the back focus. This is the even estimation between the focal point of the back haggle focal point of the Bottom Bracket (BB). Short back finishes are not really something to be thankful for in light of the fact that they make a bicycle circle out more effortlessly on trips and, in opposition to mainstream thinking, don't resist to corner. It is a confounded issue, yet together with the front focus, the chainstay length figures out where you are on the bicycle (focal, further back, further forward). There is no set in stone here, yet more noteworthy length can assist a bicycle with feeling increasingly stable slipping, and furthermore help hold the front end down when climbing. As a harsh guide, 450mm is the standard on most 29ers, 435mm on 650b bikes.

Top cylinder is additionally the principle geometry in the bike outline. Top cylinder can be partitioned into two classification which is Top Tube length (TT) and Effective Top Tube length (ETT).

1.2 The Kinds of Cycles

Once there were nevertheless two essential sorts of bikes: sport bikes with drop handlebars and derailleur gears, and regular roadsters with level handlebars and center apparatuses. Game bikes sub-separated into two fundamental gatherings: lightweight racers without any decorations, and all the more firmly constructed tourers furnished with pannier racks and mudguards. Roadsters were overwhelming and generally highlighted a chainguard, mudguards, a bearer rack, and conceivably implicit lights and a prop stand. There were further sub-types inside every classification, except just a look at a bicycle was expected to comprehend its type and reason.

Today there are increasingly broad classes and sub-types, and refinements frequently obscure; an off-road bicycle planned and prepared for visiting, for instance, might be like a street visiting bicycle in everything except little subtleties. A roadster city bicycle with center point riggings might be a quality lightweight well capable (different things being equivalent) to demonstrate its heels to a game bicycle or two. At that point there are human-fueled vehicles IHPVs), a catch-all classification which covers a wide scope of plans, from smooth, rapid streamliners to expansive four-wheel quadricycles made to convey cargo or travelers.

Commuter and City Bikes

It is now that life begins to wind up semantically precarious, on the grounds that the refinements between a worker bicycle, a town bicycle, and a city bicycle are very fine, and are promptly blended by makers in their inventories. The essential idea, however, is a bicycle which is an appropriate lightweight with a cro-mo or aluminum casing and full-estimate 26-inch or 700C composite wheels, fitted with a semi-sleeping cushion seat and level handlebars for a completely upstanding riding position.

These bikes by and large gauge 25 to 30 lb and have a charmingly lively execution, and can adapt to day rides and light visiting (25 to 35 miles) and in addition standard driving and neighborhood utility use.

Commuter Bike

Derailleur gears, part-chainguard, 700C wheels with genuinely light 1.125-inch wide tires, caliper Vor cantilever brakes, mudguards, transporter rack, and perhaps, implicit lights. The inclination here is towards the execution of a quick street sports bicycle, and an essential use for normal voyages of some separation, express 7 to 8 miles or more. A decent model ought to be 26 lb or less. See likewise the passage for Cross or Hybrid Bike, beneath.

A few makers have had a go at creating top notch worker models, with a carbon-fiber or other cutting edge lightweight edge and light wheels, for a load of 23 lb and les s. Such machines are a genuine treat, however they are costly and insufficient interest has produced for them to end up accessible all the time - maybe a chicken-and-egg issue.

City Bike

As worker bicycle above, yet with 26-inch haggles or 1.75-inch wide tires - an apparently little however critical distinction. Where the worker bicycle is

family to the quick street bicycle, the city bicycle is obviously gotten from the extreme, go-anyplace trail blazing bicycle, and can adapt all the more capably to the spiked surfaces and profound pot-openings of mean urban roads. A city bicycle has firm, stable taking care of. On a dull night nearby when the climate has all of a sudden transformed dreadful and the street has declined into a precarious minefield of road works and pot-gaps, and different vehicles are breathing down your neck, an unfaltering and solid, certainty rousing bicycle is an appreciated companion.

A city bicycle can likewise be okay in the wide open. With smooth city tires and tight mudguards, it can't cover indistinguishable range of unpleasant territory from a legitimate cross country off-road bicycle, yet it will helpfully take to harness ways, trails, and the open farmland, and with a little ability, can be pushed shockingly far in increasingly extraordinary conditions.

The thing to look for in this sort is weight. In presenting the city bicycle as a reason structured model with implicit bearer rack, lights, and different highlights, a few makers have attempted to a low value point by utilizing hello ductile steel outlines - not adequate for a bicycle to be both light and intense. Press for a model with a cro-mo or aluminum casing, or purchase a superior review trail blazing bicycle and set it up as a city bicycle.

1.3The Elements of a Bicycle

A bike consists of the:

- Frame;
- Suspension (optional);
- Wheels (hubs, spokes, rims, tyres);
- Transmission (pedals, chain set, gear changers, chain, freewheel);
- Brakes;
- Handlebars stem and saddle.

The frame carries the maker's brand name –Raleigh, Trek, Giant, Fisher, Cannondale, Condor, etc. – and the rest of the components are known as the specification. Some bicycle manufacturers make their own frames, others buy them from outside builders, and many do both. Frames vary in quality from crude through to ultra-fine, and are produced by firms that range from lone builders through to huge factories. Components are supplied by specialist companies, in various designs and quality grades. Some firms produce specific components such as rims or brakes; others produce group sets containing all the components of a complete specification. Group sets are identified by a name or model number, as in Campagnolo Chorus or Shimano 105, and are ranked by design and quality, or cost. Sources of components are diverse, but volume sales to bike manufacturers are dominated by the Japanese firm Shimano. Equipping frames with components from various sources is a method of manufacture somewhat unique to lightweight bikes; the majority of the over 110 million bikes produced each year are simple machines made in factories that are as self-contained as possible. Until recently however, a hand-made frame was a necessary prerequisite for a quality bike, and since this market sector was relatively small, specialization was inevitable. One person or outfit did frames, others did the bits. Nowadays quality frames are mass-produced, yet almost paradoxically, the growth in size of the market for good bikes means that specialization in components is still cost-effective. Enough bicycle manufacturers need, say, lightweight rims, to give capable rim manufacturers the sales volumes to realize greater cost efficiencies than a single bicycle maker might achieve.

Bikes are often judged more on the components than on the frame, which up to a point is quite legitimate. Specialization and the need to have real products to sell has led components manufacturers into making substantial, sometimes even extraordinary, technical advances. At the same time, for the sake of marketing, they've introduced spurious gimmicks. For a bicycle manufacturer, re-tooling to accommodate annual model changes in components can cost millions. As you can imagine, relations between bike manufacturers and components suppliers are sometimes sweet, and sometimes strained and agitated, as one group or the other tries to maintain market control.

To avoid being a dog wagged by the tail, many bicycle companies make a policy of sourcing components from several different firms. Makers of bicycles range in size from individual builders producing just a few machines a year, to multi-national corporations producing hundreds of thousands and even millions of bikes annually. Small builders, shops, and firms tend to concentrate on a few models in one or two categories; middle-size

firms tend to specialize in a few categories, such as racing, touring, or mountain bikes, and large manufacturers with extensive distribution networks tend to offer models in every category and price range.

II-LITERATURE REVIEW

Motor motorcycle is the only famous transportation in Indonesia. Due to required gasoline as an strength source, it will become unfriendly to the environment. Nowadays peoples start to understand; pedal bicycle is right for fitness and surroundings-pleasant. To build bicycle to work in each day tradition isn't always easy. An electric powered vehicle for transportation is the great invention to increased transition from motor motorcycle culture to emerge as bicycle to work way of life. Electric bicycles and motorcycles have emerged as a probable manner of enhancing the transportation gadget sustainability.

Sukmaji Indro Cahyono; 2017 offers a simulation Finite Element Analysis (FEA) model of electrical trike frames. The model of electric trike frame is a general bicycle body with addition modification at the again facet for battery percent factor and passenger hundreds. The electric powered motor is driven to put in front wheel for smooth renovation. Due to gain maximum safety inside the passenger vicinity and smooth assembling, the body is manufactured via round steel tube inside the front facet and rectangular metal tube within the again side. FEA simulation has been investigating right model based on metal tube profile. The profiles are circular and oval metallic tube 1.65mm thickness, (1, 1 ½, and 1 ½) inch diameter in front and rectangular metal tube 2 mm thickness, (30x30, 40x40 and 50x50) mm size in the back. The aid tube of the electric bicycle body is similar to the National Standard street bicycle (SNI). The validation of this simulation is the use of experiment technique and adaption method for optimizing new release time and accuracy. The result of the simulation is a element of safety. Von misses strain distribution from simulation result is showed the critical are in becoming a member of tube below driving force of the body structure. The oval tube is reached safety aspect higher than the circular tube, and it's had a better overall performance towards the vertical load. The nice variable is variable three oval tube fifty six.6x40 mm diagonal size with 1.Sixty five thickness. Its maximum passenger load is 700Kg. It may be a advice to remodel destiny frame of the electrical bicycle.

Nondestructive assessment (NDE) is in recent times a fundamental technology to decide the satisfactory and look into the integrity of substances without damaging them. Nondestructive tests are used to discover defects, but additionally to save you screw ups so as to make sure safe lengthy-term operation. Major innovations have been performed on this subject in latest many years, main to important aggressive advantages.

III-RESEARCH METHODOLOGY

3.1 General

A Finite Element Analysis has been carried for the comparative analysis in between the different cross-sectional profile for Diamond Shape Bicycle frame.

3.2 Finite Element Method for Frame Analysis

A frame element is formulated to model a straight bar of an arbitrary cross-section, which can deform not only in the axial direction but also in the directions perpendicular to the axis of the bar. The bar is capable of carrying both axial and transverse forces, as well as moments.

3.3 Finite Element Analysis of Bicycle Frame

In the design of Bicycle Frame Analysis, the finite element method has turn out to be an essential tool. In this work, the investigation of a bicycle frame is carried out. A physical trial-and-error design process is costly and time consuming, and has its limitations, especially when new materials are introduced and when new applications or demands are placed on the structure. Hence, there is the need to use the finite element tool to help the designer come up with reliable properties in the design to meet the demands expected by the consumers. Using the finite element method to perform a virtual prototyping instead of a physical prototyping can save lots of cost, time and effort.

There can be numerous factors that are considered for the analysis like the weight of the frame, the maximum load carrying capacity of the frame etc.

The Finite Element Analysis of the cycle frame can be carried out in different stages:

3.3.1 Modelling

Geometry

Figure 3.1 shows the geometry of the Bicycle consisdered for the study.

The points have been imported in design modeler using Ansys workbench. The aim of the study is to examine the different cross section or profile for frame tube. There are four different hollow cross sections has been considered for the study i.e. circular section, Stretched circular cross section, Oval cross section and Ovoid Cross section. Figure 3.2 to 3.5 shows the circular section, Stretched circular cross section, Oval cross section and Ovoid Cross section profile.

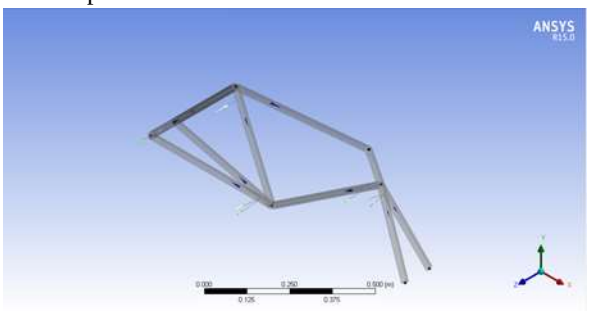

Figure 3.1 Geometry of Bicycle Frame

IV-RESULT ANALYSIS

In this study the four different cross-sectional frames have been considered for the comparative analysis. Three different weight categories of the rider are considered for the study. The following results have been obtained.

Results for Circular Cross Section Bicycle Frame

Results for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg

Figure 4.1 to 4.5 shows the Total Deformation, Total Shear Force, Total Bending Moment, Total Directional Axial and Total Directional Torsional Moment for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg.

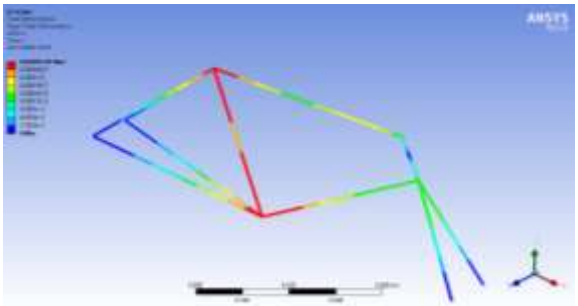

Figure 4.1 Total Deformation for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg

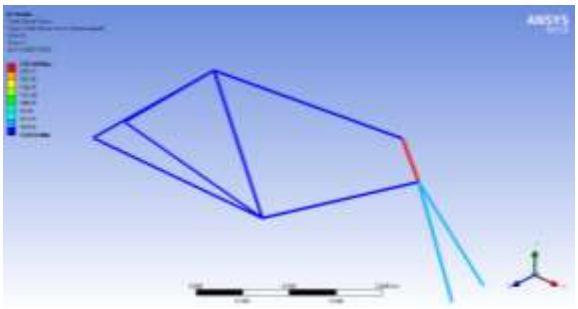

Figure 4.2 Total Shear Force for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg

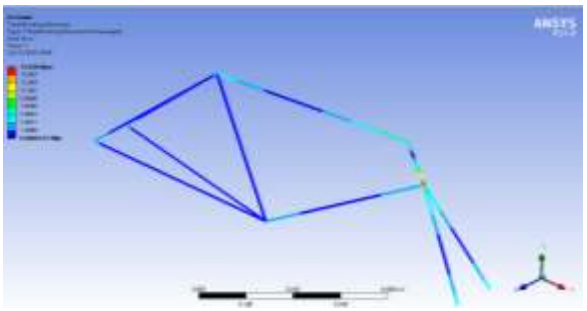

Figure 4.3 Total Bending Moment for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg

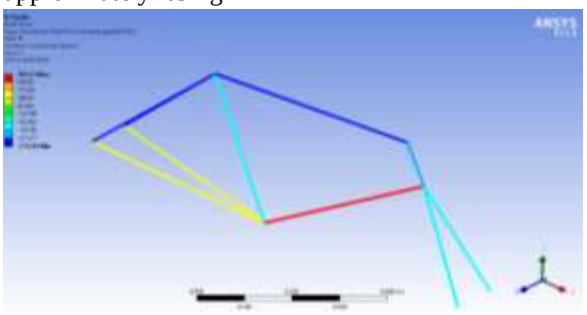

Figure 4.4 Total Directional Axial Force for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg

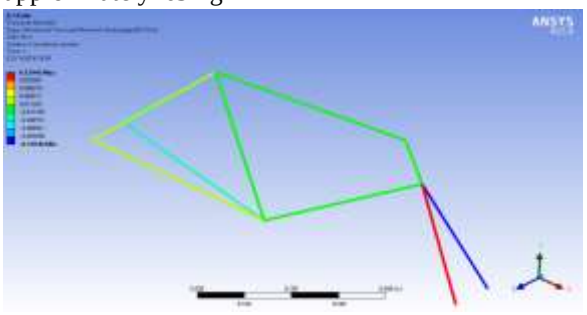

Figure 4.5 Total Directional Torsional Moment for Circular Cross Section Bicycle Frame and the Riders weight is approximately 65 kg

V-CONCLUSION

A finite element Analysis has been carried out to simulate the behaviour of a Diamond shaped bicycle frame of aluminium material under Riders weight for different cross-sectional shape of the bicycle frame tube. The four different cross section study i.e. circular section, For the comparative analysis the thickness has been varied for keeping the cross-sectional area constant. The following result has been found out:

1) Circular Cross-sectional frame shows the maximum total deformation compare then the other cross-sectional frame with respect to the variation in Weight of the riders.
   It has been observed that the shear force generation in the circular cross section frame is more compare than the other sections frame.

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