INTRODUCTION:
When most people hear the word chain they imagine a short-link chain, which consists of connected metal rings, or the type of chain used on a motorcycle. A chain is a reliable machine component, which transmits power by means of tensile forces, and is used primarily for power transmission and conveyance systems. The function and uses of chain are similar to a belt. Motorcycles are high-speed applications that operate in tough conditions—rain, dirt, sand, and high shock loads. These specially developed chains are used as the part of the drive train to transmit the motor power to the back wheel. Motorcycles are getting faster and more powerful. Therefore, Motorcycle Chains must have greater durability. At the same time, motorcycles are getting lighter and smaller. Roller chains are widely used as pulling and driving members of chain mechanisms in motorcycle. Roller chain is content of inner link plate, outer link plate, pin, bushing, and roller. Manufacturers are working on new materials, sizes, and heat treatments to improve the performance of the chain. Roller Chain is under tension which causes failure of chain assembly which is the major problem for automobiles and industrial sector. Causes of this failure are improper design. It is important to study the influence of these parameters. All these parameters can be considered simultaneously and chain link design optimally in drive chain for 220CC/250CC for new TVS motorcycle is expected launched in year 2015-2016.

Optimization is the process of obtaining the best result under given circumstances in design of system. In optimization process we can find the conditions that give the maximum and minimum value of function. Study a shape optimization process is used for the design of roller chain link for minimization of failure modes. This process various design variables, such as width of inner link plate and outer link plate, height of inner link plate and outer link plate, thickness of inner link plate, thickness outer link plate, inner diameter of bush, outer diameter of bush, diameter of pin, length of pin, geometry of inner link plate and outer link plate breaking area of link and shape of the link. The aim of the work is to find the strength for the chain link to be used for the demanding application without failure. Severe loading conditions exist during the usable life of the chain. The chain to be analyzed using F.E. Methodology for the given application. While deciding the shape optimizations of roller chain link for improve strength of motorcycle chain link.

RELEVANCE / MOTIVATION
The warranty claims received by the company over the past years shows increased incidence of chain failure during service its life. The secondary claims related to accidents and/or incidents causing injury pose a threat to the reputation of the Company along with financial liability. The problem needs to be looked into and investigated for identifying causes for failure. Similarly, upcoming variants to be incorporated with the new solution to eliminate such challenges in the future.

Any catastrophic failure in the chain used in power transmission of a motorcycle could lead to a safety hazard. Determining safe load for the chain and the ability of the same to withstand the using Finite Element Modeling would be the core objective of this work. An existing chain link would be used for benchmarking the research work. Suitable Finite Element Analysis tools like HyperMesh and RADIOSS or suitable solver would be deployed to find the performance of the link under tensile loads. Recommendation over the best suited geometry and material would be presented to conclude the work. Experimentation is planned over the benchmark chain link for the validating the methodology in the first phase of the research work.

LITERATURE REVIEW
The research started from developing theories related to general motorcycle chain and is now moving towards optimizing design parameters according to applications.

M. Korayet, et al., published a paper on Study Stress Distribution of the Chain Link by Means of Boundary Element Method. Roller chains which are used as pulling and driving members of materials handling mechanisms are inspected. Stress analysis of a standard roller chain link is performed using both boundary and finite element methods. The mechanical behaviors of a standard roller chain which is loaded by the maximum allowed load are considered. Comparing the results of the both techniques with each other and the results of literature, the appropriate method for the roller chain problem is proposed. Pulling and driving members of escalators, roller chains are considered in this study. Two dimensional geometrical model of the chain link is formed and stress analyses are performed using both boundary element and finite element methods. Noguchi S., et al., have investigated Static Stress Analysis of Link Plate Roller Chain using Finite Element Method and some Design Proposal for Weight Saving. Study some method of weight saving for roller chain. This method based on finite element method analysis of stress and deformation in link plate of a roller chain. The Authors suggest some approaches for reducing stresses and weight saving in link plate of roller chain.

Tushar D. Bhoite and Prashant M. Pawar [4] published the paper on Finite Element Analysis based study of Effect of Radial Variation of Outer Link in a typical Roller Chain Link Assembly. Studied the scope of this paper is to review the applications in the...
industry and explore the design considerations that go into the design of the assembly. Finite Element Analysis (FEA) has been used to conduct shape optimization. In this study the focus has been narrowed down to specific component of outer link. Within the outer link, most dimensions in the industry are parametrically defined, however one dimension, the radius that is in between the inter connecting holes is left to manufacturer convenience. We assess the impact of this radius on the stress in the system and see if material saving and consequently efficiency increment is possible. Though this optimization seems insignificant on its own, it must be noted that in a typical industrial application, thousands of such links will be needed. The weight saving thus achieved will have a significant impact on cost of the chain, and more importantly with a lighter chain, the cost savings during operation will also be significant. Fujiwara et al.[5] have investigated Bearing Roller Chain which is seal mechanism which prevents entry of foreign substances from the outside and leakage from the outside and leakage of lubricating oil leakage from the inside to the outside, resulting in an improvement in wear resistance of the bearing roller and avoidance both of rotation failure of the roller and of increased traveling resistance of chain.

From the literature survey it can be seen that the motorcycle chain link has been topic of interest for many researchers. From the brief review of some of the literature from it can be noted that, even though several patents are filed on roller chains, most of the patents based on improvement of efficiency and performance. Hardly here are very few patents available which focuses on improving life of the chain and minimization of its failure. It can also be noted that the analytical work in the literature is focused on load estimation. Very few researchers have explored the fatigue life estimation and stress analysis for the chain assembly. Work is to find the strength for the chain link to be used for the demanding application without failure and severe loading conditions exist during the usable life of the chain. The chain to be analyzed using F.E. Methodology for the given application. Results obtained by the Numerical Methodology shall be compared with the Experimentation methodology using the Physical Experimentation for given application.

PROPOSED WORK

It is proposed to carry out “Structural Analysis to Simulate Stresses in a High Powered Motorcycle Chain link to improve strength and prolong its usable life” For this dissertation work, the proposed work is divided into the following phases.

Phase I:
Understanding the functional requirements of drive chain for 220CC/250CC motorcycle chain (roller chain). Inputs for Design would be secured from the Sponsoring Company. Study of existing motorcycle chain and list of advantages and limitation of existing design. Attempt to understand the formulation and application of empirical equations for the given case.

Phase II:
Components used for motorcycle chain like ,Roller chain link, Inner link plate, and Outer link plate, Roller, Bush and Pin etc. would be studied. Critical part/s would be undertaken for mathematical treatment. CAD software shall be deployed for geometry e.g. CATIA / UG.

Phase III:
Theoretical cases for the configuration at motorcycle chain of roller chain link, at design parameters may be in form of height of inner link plate, height of outer link plate, thickness of inner link plate, thickness of outer link plate, width of inner plate, width of outer plate, inner diameter of bush, outer diameter of bush , inner width of bush, diameter of pin, length of pin, geometry of inner link plate and geometry outer link plate and material selection of inner link plate, material selection of outer link plate, material selection of bush, material selection of pin. One or more parameters would be taken up for assigning levels as would be discussed with the sponsoring company.

Simulation for stresses shall be effected using RADIOSS / ANSYS or suitable.

Phase IV:
Experimentation over the test setup for above chain link for the relevant response discussed in advance.

Phase V:
Results of the benchmark (existing) Design would be compared with the experimentation methodology for concurrence of results. Validation would be effected through this comparison.

Phase VI:
The best configurations will be suggested to the company. This shall be done upon verifying the structural strength of the recommended solution.

SCOPE

- Well Definition of the problem.
- To study existing Roller chain in Indian market for possible design modifications.
- Learning and use of the ANSYS Software.
- The inputs for Design would be secured from the Sponsoring Company, typically the geometry (3D model). The same is normally created using a modeling interface like CATIA V5, Unigraphics, Solid Works, etc.
- The input geometry received shall be discretized using pre-processor like HyperMesh. The quality for the mesh shall be adhered to while meshing the geometry.
- Loads and boundary conditions shall be applied to the model in the pre-processor. The input deck for the designated solver shall be prepared.
- Suitable solver for structural analysis (like ANSYS) would be deployed for finding the solution.
- Post-processor in HyperWorks would be used to visualize the results.
- Recommendation to be made upon evaluating the results.
- Physical experimentation towards validation for the hypothesis proposed to be carried out.
- Conclusion to be inferred over the work done.

PROBLEM STATEMENT

The new motorcycle to be launched in the automobile market needs to be ensured for safety and efficiency. Chain drives being efficient means of power transmission are preferred for this product the limitation of course being catastrophic failure at...
virtually no prior notice. At high speed, accidents are very likely in case of failure in the chain link. The design for the chain would be subjected to F.E Analysis to find the effect of loads (tension) on the link. The link being a ‘unit’ of the existing chain would be assessed for performance while tensile loads are exerted at both its ends. Safe loads would be determined and the design tested for safe use in the Automobile. The problem for this work is being evaluation of the design using software in the FEA followed by experimentation to validate the theoretical outcome.

METHODOLOGY

a] Numerical Methodology (using Finite Element Analysis)

Numerical / Computational Approach:
The proposed method utilizes software in the FEA domain for analyzing the effects of the variation in the values of the design parameters influencing the performance criterion and corresponding stress would be recorded for changing load within given range. The FEM method is used to analyze the stress state of an elastic body with a given geometry, such as chain link. In this synopsis the analysis of chain link in motorcycle is intended for study using FEM software (HyperWorks/RADIOSS/ ANSYS or any other software).

Steps for Finite Element Analysis:

FEA is mainly divided into three following stages:

Preprocessing
- Creating the model.
- Defining the element type.
- Defining material properties.
- Meshing criteria.
- Applying loads.
- Applying boundary conditions.

Solution: Assembly of equations in the software interface and obtaining solution for structural analysis.

Post processing: Review of results.

b] Experimentation Methodology (using Physical Experimentation)

Benchmark chain link to be tested for Tensile Loading by using tensile load testing machine with Data logger suitable prototype would be built for testing purpose. The weakest element would be tested for comparing the results with those obtained by Numerical (Computational) Methodology.

PROPOSED ‘EXPERIMENTATION SET-UP

VALIDATION

The results obtained by the Numerical Methodology shall be compared with the Experimentation methodology using the Physical Experimentation. Typically, an error margin of say about 10–20% could be observed based on the nature of the analysis or the type of performance being evaluated. Prototype or the model for benchmark would be utilized for performing the Test. Test would be conducted at the Sponsoring Company or the authorized Test Lab nominated by the Company. The results would be shared as approved by the concerned authority. The graph for Load Vs Displacement or Load Vs Stress would be plotted for loads varying from the minimum to the maximum limit of loading. The same shall be compared with results determined by numerical methodology. The Test shall be witnessed in the capacity of a research student while the readings would be recorded for analysis / conclusion further.

REFERENCES


