



DESIGN, STRUCTURAL ANALYSIS OF PELTON TURBINE BUCKET

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ABSTRACT

A Pelton turbine pail is the individual segment which makes up the turbine section of a pelton turbine. Vitality is extricated by cutting edges from high weight water delivered by the spout fly. The pelton container are regularly constraining part of pelton turbines. To get by in this troublesome environment, sharp edges routinely use phenomenal materials. In this errand, we understand that the efficiency is particularly related to material execution making the material choice of essential significance.

Solid metal and Steel are the materials considered for sharp edge in this study. The best material is chosen by the playing out the couple field examination on the turbine basin. The fundamental point of this venture is to perform coupled field investigation of pelton wheel basin for various materials and shifting the quantity of cans on the pelton wheel for finding the effectiveness, high anxiety taking care of variables. The plan model of pelton wheel basin is done in Catia V5 R20. Singular parts are composed to some degree plan workbench and after that get together is made by bringing in the part outlines in the gathering outline workbench. Investigation is done on pelton wheel pail in Ansys 14.5 to know the high anxiety districts furthermore the burdens instigated in that.

I. INTRODUCTION

Hydro-drive is an old resource of green power. Water from the waterways, lakes, lakes and plants disperses in view of daylight warming. This makes ascent of water vapor against gravitational draw of earth. In the atmosphere, it cools and accumulates into drops of rain and snow, which falls on inclines and mountains. A ton of daylight vitality is still held in the water as gravitational potential vitality. In this way, daylight vitality is a conclusive wellspring of hydro vitality which on a very basic level addresses set away gravitational vitality. It is understood that water unendingly streams on the earth surface to accomplish the sea. This happens accordingly of the round condition of the earth that tenders a trademark gravitational draw on surface water. The measure of set away hydro vitality is particularly relating to the stature and measure of the water above sea level. A turbine is the mechanical contraption which exhausts the hydro vitality of a raised water level by strategy for weight vitality (because of a reaction turbine) or by technique for element vitality (by virtue of an inspiration turbine). The hydro energy consumed by a turbine is gone to the electrical generator shaft as mechanical vitality. A Pelton-

wheel is a digressive stream free-fly drive turbine named after an American specialist, Lesser Pelton. It is fundamental, effective and the primary water fueled turbine which works profitably on high heads in wealth of 450 m. The working weight in this turbine stays air in a manner of speaking. It has fundamental advancement and smooth running components with incredible execution characters.

The Pelton wheel separates vitality from the motivation of moving water, rather than its weight like conventional overshot water wheel. Albeit various assortments of motivation turbines existed before Pelton's design, they were less proficient than Pelton's diagram; the water leaving these wheels generally still had speed, and conveyed an extraordinary part of the vitality. Pelton's oar geometry was plot so that when the edge continues running at $\frac{1}{2}$ the rate of the water fly, the water leaves the wheel with low rate, removing most of its vitality, and considering an outstandingly effective turbine.

Turbines can be by and large named steam and pressure driven turbines. The pressure driven turbines are turning machines which change over the potential leader of the water into helpful types of vitality, for example, mechanical vitality and electrical vitality. The pressure driven turbines are again sub separated into motivation and response turbines. The pelton wheel turbine which is managed in this diary is a motivation kind of turbine and to be extremely exact this is a Micro hydro turbine. Small scale hydropower plants are a noteworthy wellspring of vitality in the provincial ranges of northern India and Nepal. The pelton turbine comprises of principally the accompanying parts: -

1. Containers
2. Spouts
3. Governors
4. Valves.

The can is of the sort of a twofold hemispherical glass fitted onto a runner. The water plane strikes the splitter at the interface of the two sections. The water plane in the wake of striking the splitter it goes through the can profile outwards. The splitters maintain a strategic distance from the water at an edge between 165-175. The effect vitality is changed over into mechanical vitality which is used to turn the runner which will be connected with a generator to make the required AC current.



II. DESIGN STEPS OF A PELTON BUCKET

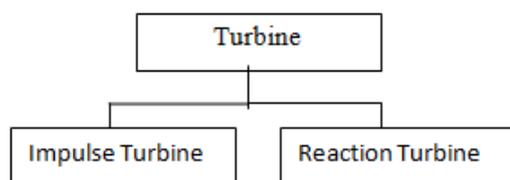
Considering the underlying working condition of the turbine; the runner container is stationary at starting stage. The water plane leaves the spout at a fast and hits the pail with high dynamic speed. Amid the common running of a pelton turbine a steady fly of water at various speed is kept up for the ceaseless revolution of the runner. Regardless it is the principal stream of water that strikes the container which has the best effect on the can profile, this is by virtue of the main water fly needs to crush the inertiaforces of the runner. In fact it is the principal water plane fly which conveys the rotational vitality and torque required for the turn of the runner. This workdeals the development of a pelton pail for considering first impactforce of water fly.



Fig. Pelton Runner Model

III. CLASSIFICATION OF HYDRAULIC TURBINES

Hydraulic turbines are classified accordingly to the type of energy available at turbine inlet, flow direction through vanes, head at turbine inlet and turbines specific speed. Below shown are some of important classification



Classification according to action of fluid on moving blades

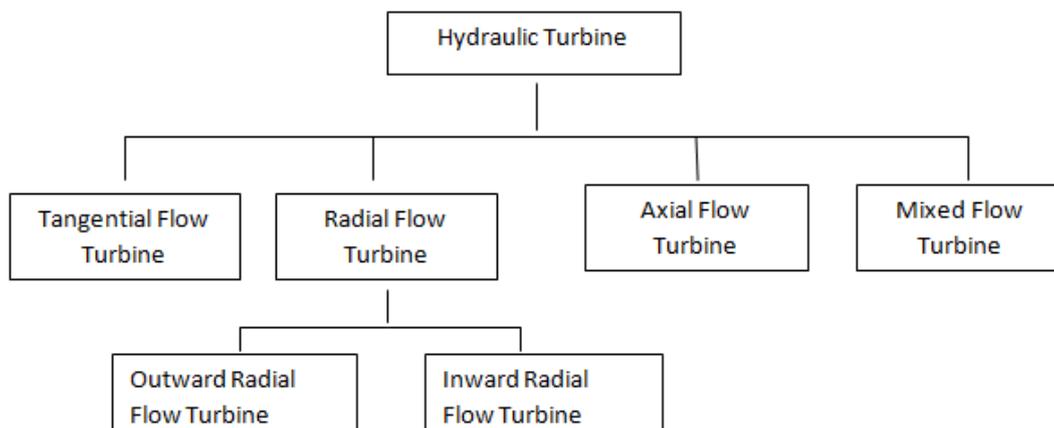


Fig. Classification according to direction of flow of fluid in the runner

3.1 Pelton Turbine Operating Principle

The Pelton turbine is an impulse turbine that only converts kinetic energy of the flow into mechanical energy. The transfer of the total energy from the nozzle exit to the downstream Reservoir occurs at atmospheric pressure. The jet stemming from the injector impinges on buckets, located at the periphery of a wheel.

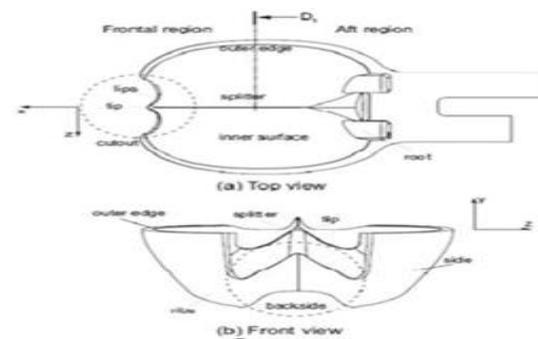


Figure 3: Buckets Geometric Definitions

IV. INTRODUCTION TO CAD

French association Dassault Systems made multi-organize CAD/CAM/CAE business programming CATIA (Computer Aided Three-dimensional Interactive Application). This is made in the C++ programming dialect; CATIA is the essential consequence of the Dassault Systems thing lifecycle organization programming suite. In 1977 a French air make producer Avions Marcel Dassault, started CATIA as an in-house progression around then customer of the CADAM CAD programming to develop Dassault's Mirage contender plane, then was grasped in the shipbuilding, auto, flying and distinctive business wanders.

Modules like 3D portrayals, part configuration work seat, structure or tooling parts for making of 3D sections like gatherings and formed are accessible in CATIA. The instruments in the CATIA empower useful resistances, Kinematics definition and item definition. CATIA can be associated with a wide assortment of business endeavors, from flying and guard, auto, and current apparatus, to bleeding edge, shipbuilding, customer stock, plant layout, buyer packaged items, life sciences, building outline and improvement, methodology compel and petroleum, and organizations.

Displaying Of Pelton Bucket in Catia

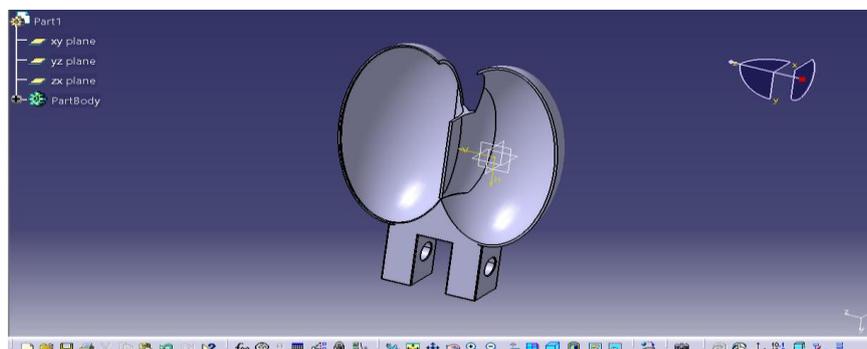


Fig. Pelton Wheel Bucket

V. FEA

FEA is the effective usage of the Finite Element Method (FEM), which is used by architects, and scientists to scientifically model and numerically understand extremely complex structural, liquid, and multi phase issues. The FEA programming is used in wide range of businesses yet is most generally utilized as a part of the aeronautical, biomechanical and locomotive industries.

An arrangement of points in finite element (FE) called “hubs” which make the state of the outline. The finite element mesh is formed by joining the hubs by finite elements themselves and contains the material and basic properties of the model, characterizing response of it in specific conditions. The finite element mesh may vary for different materials depend on the foreseen change in stress levels of a specific part.

Areas that experience high changes in stress for the majority part require a higher mesh density than those that experience little or no stress variation. Purpose of interest might incorporate crack purpose for before tried material, corners, fillets, complex purpose of intersect, and high-stress regions.

Structural Analysis of Pelton Wheel Bucket

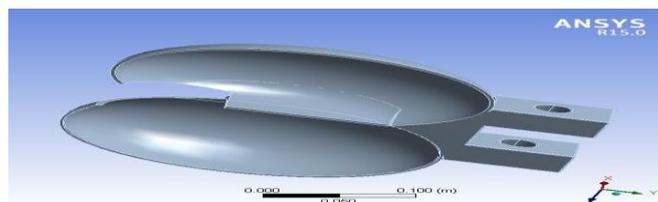
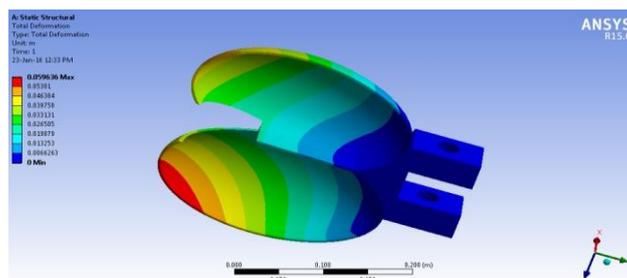


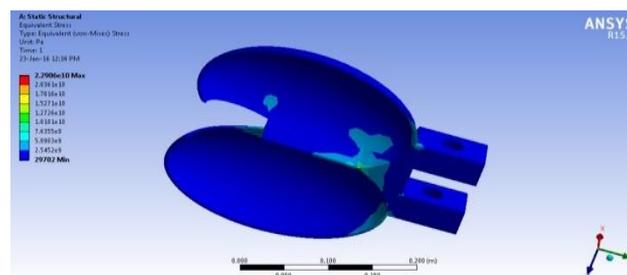
Fig. Imported model of Pelton wheel bucket in Ansys.

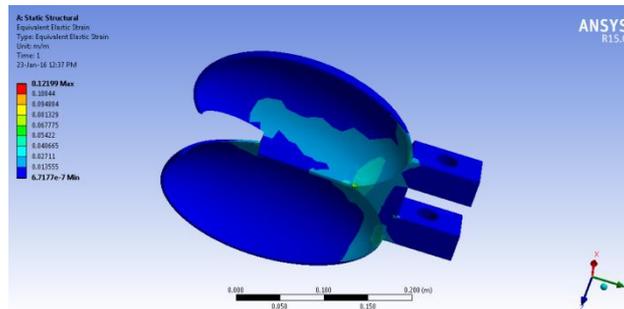
Material Type : cast iron

Total deformation



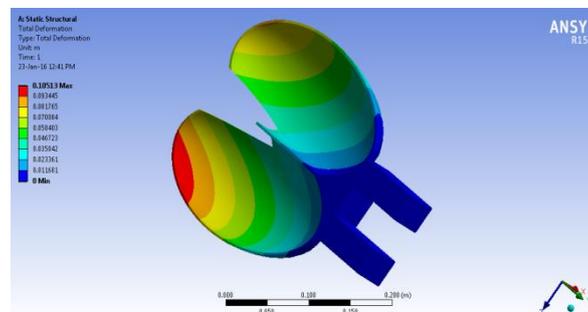
Equivalent Stress



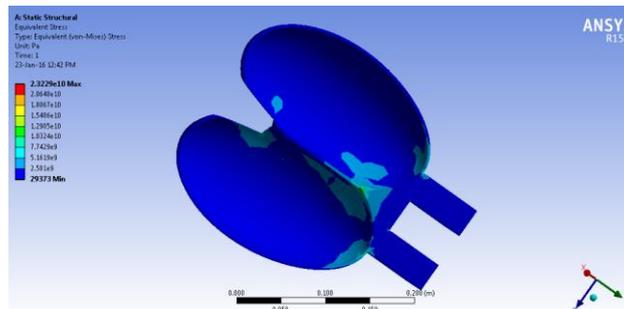


Material Type: fibar glass

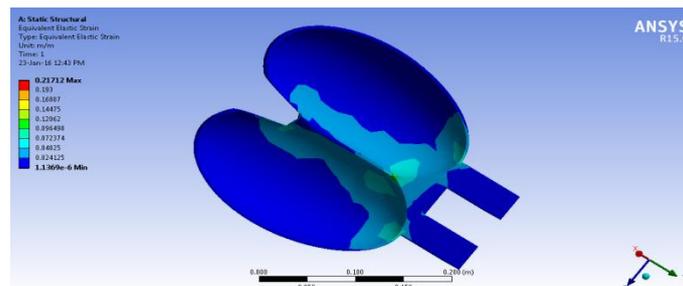
Total Deformation



Equivalent Stress



Equivalent Strain



VI. RESULTS AND DISCUSSION**6.1 Numerical Values Obtained During Analysis****Values observed during structural analysis of Pelton wheel Bucket**

S.No	Material type	Displacement (mm)	Von-Mises stress	Strain
1	Grey Cast Iron	0.01795	3.1431e9	0.033813
2	fiber glass	0.0098788	3.1587e9	0.018487

VII. CONCLUSION

Our project is to plan and examination of both pelton can on various material in cast iron and fiber glass strengthened plastic. We have planned cylinder utilizing CAD programming to be specific CATIA V5 and investigation is done utilizing ANSYS 14.5 and the static examination id drawn under required limit conditions. We have watched that fiber glass strengthened plastic shows great outcomes when contrasted with other material and general utilizing material ie cast iron. In static investigation fiber glass fortified plastic shows bring down disfigurement and less influenced to anxiety variables when thought about various materials

REFERENCES

- [1] A.AtishGawale, A. Shaikh and VinayPatil, "Nonlinear Static Finite Element Analysis and Optimization of connecting rod WorldJournal of Science and Technology, Vol. 2(4), pp .01-04, 2012.
- [2] A. R. Bhagat, Y. M. Jibhakate, Thermal Analysis and Optimization of I.C. Engine Piston Using Finite Element Method, InternationalJournal of Modern Engineering Research (IJMER), Vol.2, Issue.4, pp.2919-2921, 2012.
- [3] Kamo R., Assanis D.N., Bryzik W.: Thin thermal barrier coatings for engines. SAE Transactions 1989, No 980143.
- [4] EkremBuyukkaya, "Thermal Analysis of functionally graded coating AlSi alloy and steel pistons", Surface and coatings technology (2007)

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