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Design and Manufacturing of Pole End Plate for Cost Cutting

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A B S T R A C T

Computer Numerical Control (CNC) machining is a manufacturing process in which pre-programmed computer software dictates the movement of factory tools and machinery. The process can be used to control arrange of complex machinery. The process can be used to control a range of complex machinery, from grinders and lathes to mills and CNC routers. With CNC machining 3-D cutting tasks can be accomplished in a single set of prompts. **Lathe** is a machining tool that is used primarily for shaping metal or wood. It works by rotating the work piece around a stationary cutting tool. The main use is to remove unwanted parts of the material, leaving behind a nicely shaped work piece.

CNC is costly but take less time to manufacture and Lathe have less cost to manufacturer but takes more time than CNC. In this paper we understand how CNC and Lathe machine helps us to find method of making pole end plate (used in rotor of hydro generator) with cost cutting. And we make it effective by joining both methods.

Keywords: CNC, Lathe, generator

1. Introduction

1.1 What is hydro power generator?

Hydroelectric power, also known as hydropower, is electricity generated by generators powered by turbines that convert the potential energy of falling or fast-flowing water into mechanical energy. Hydroelectric power was the most widely used renewable energy source in the early twenty-first century, accounting for more than 18 percent of the world's total power generation capacity in 2019.

Water is collected or stored at a higher elevation and led downward through large pipes or tunnels (penstocks) to a lower elevation to generate hydroelectric power; the difference between these two elevations is known as the head. The falling water causes turbines to rotate at the end of its journey down the pipes. The turbines, in turn, drive generators, which convert the turbines' mechanical energy into electricity. The alternating voltage suitable for the generators is then converted by transformers to a higher voltage suitable for long-distance transmission. The powerhouse is the structure that houses the turbines and generators and into which the pipes or penstocks feed

1.2 Where is pole end plate located?

Turbine is very essential part in hydro power generator. In rotor section pole end plate is used as clamping purpose and lowering the axial component of magnetic flux density and the average stator end parts heating house.

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1.3 What's main Aim?

The main aim of pole end plate used in "rotor of hydro power generator" in this paper is make such design and create such management of manufacturing for cost cut .We are doing whole research by some practical approach and on ground research for data. Reason for the innovation of this process or method is that pole end plate in hydro power generator is very small part and so expense on such thing make whole generator costly. Pole end plate which is used as:

> One part of end plate, nearest to stator, was manufactured from nonmagnetic material. Application of complete pole end plates allowed decreasing the Axial component of the magnetic flux density and the average stator end parts heating.

So for cost cutting we join two methods together in is conventional lathe and CNC. We just manage the order of the process of manufacturing. We do in such a way that cost should be decrease on comparison with full CNC which is costly but takes less time, and we also manage to compensate the time by not using fully conventional lathe. We used both but in systematic manner.

2. Drawing

This DRAFT is helpful dassault system software CATIA for 3d drawing.

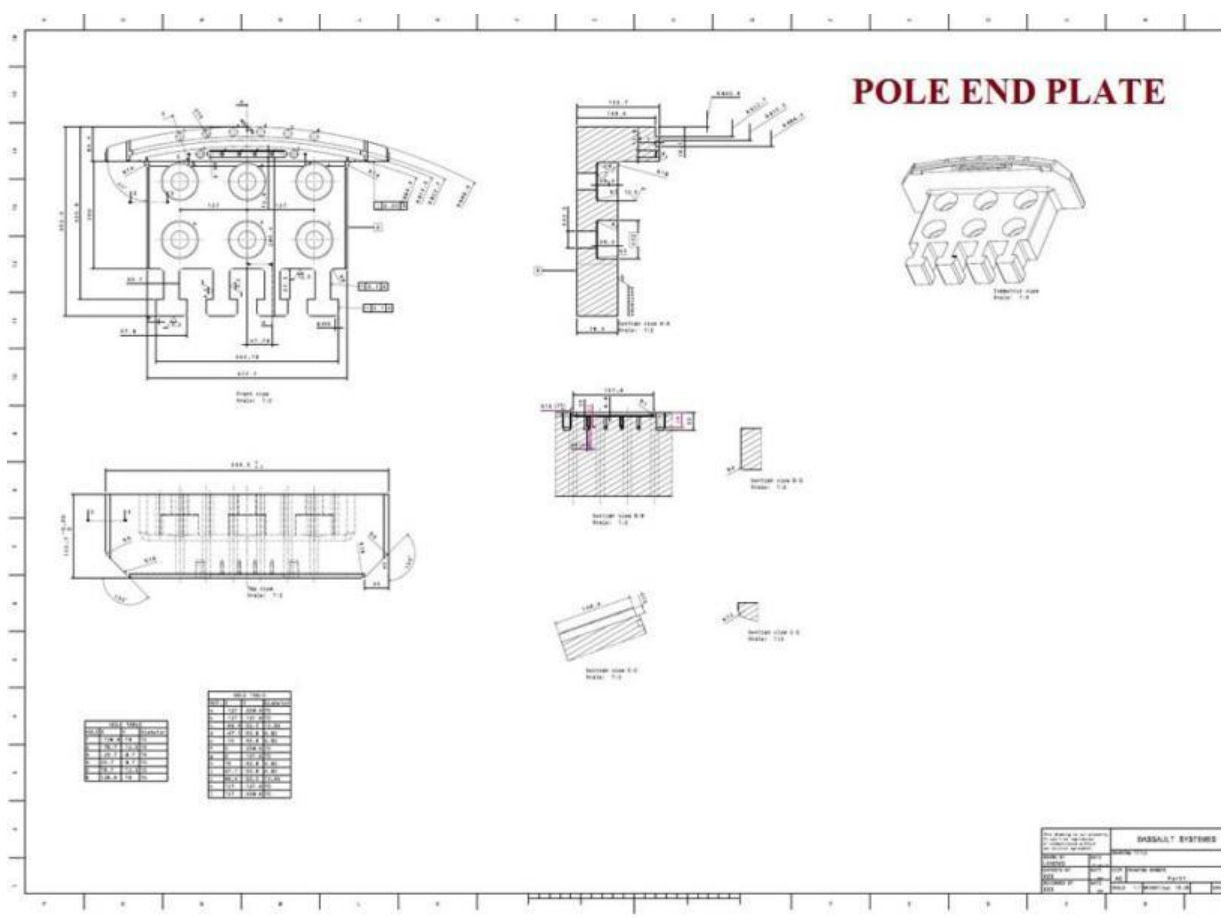
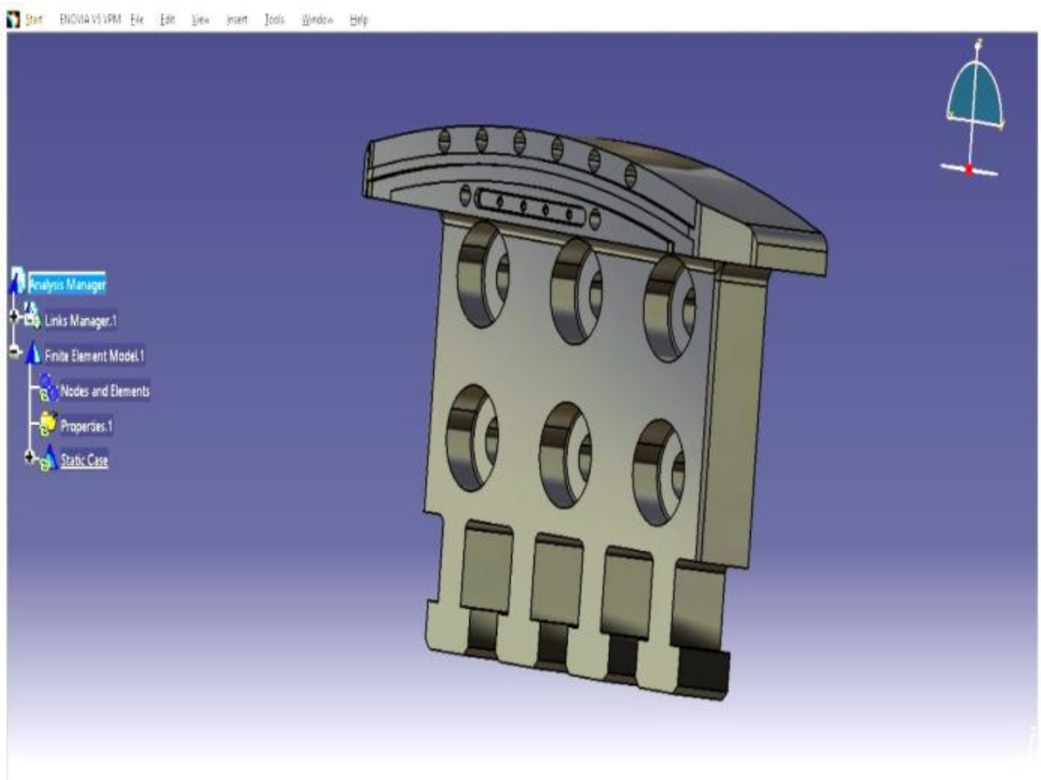


Fig.1 Draft of pole end plate

3. CAD model and Analysis

Below image of pole end plate in CAD software and fig.2 is analysis image in ANSYS software with proper practical conditions data.



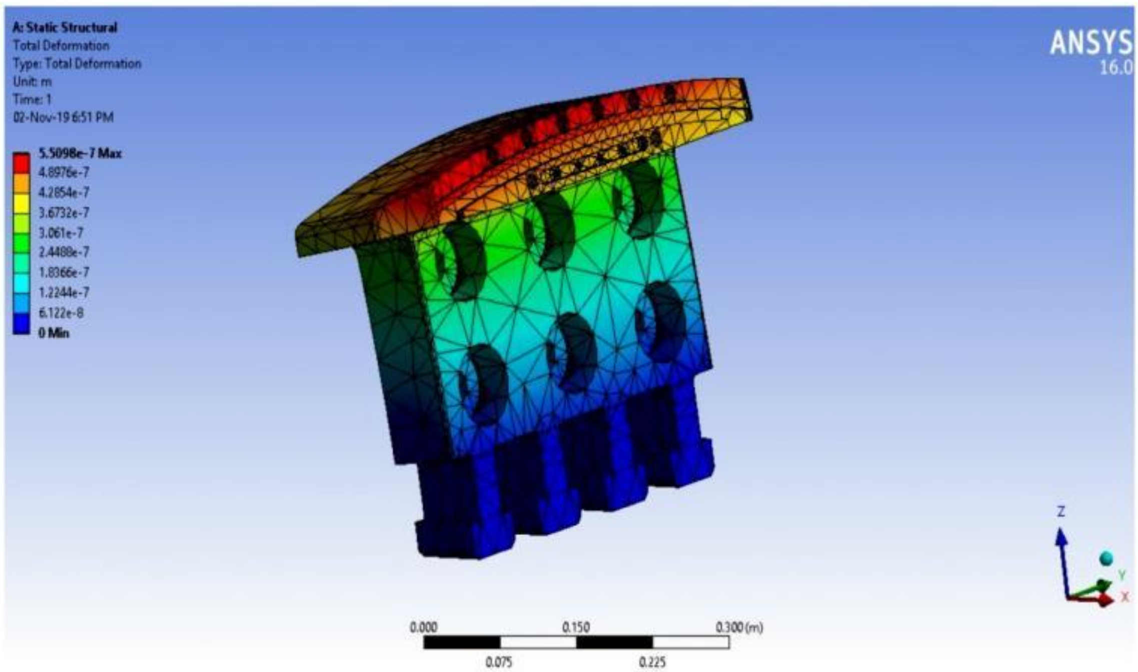


Fig...2 ANSYS DRAWING

4. Material properties

Material should be mild steel

4.1 Why mild steel?

1. High tensile strength.
2. High impact strength.
3. Good ductility and weldability.
4. A magnetic metal due to its ferrite content.

5. Operation sequence and equations

5.1 Pre-machining on conventional machine:-

We remove the extra material with conventional machine. Thus we reduce the cost of product and save external Cost of C.N.C. machining.

Machine Name: Horizontal Milling Machine
Operation:_Thickness & Side Maintain
Basic Size: 156.50, 90.00
After Removing: 146.5 ±.5, 0, 80.00 ±0, .5
Clamping System: C-Clamp
Tools: Inserted Cutter ϕ100, Dial Gauge
R.P.M.: 460-500
Feed: 300-400
Time: 4 hrs.

Cutting parameter selection:-

*** Cutting speed v = πDN /1000 m/min**

*** Feed F= f x z x n mm/min**

*** Feed/tooth f = F/Z x N mm/ tooth**

*** Time** $T = \frac{L + B}{F} \times i$ **min**

Where:

V = cutting speed (m/min)
D = cuter diameter (mm)
π = 3.14
N = spindle speed (rpm)
f = feed per tooth (mm/tooth)
Z = number of insert
T = time taken (min)
L = length to be cut (mm),
I = no. of passes,
B = ideal length of tool movement
F=Feed per minute (mm/min)

5.2 OPERATION SEQUENCE FOR C.N.C. MACHINING:

A) First setting operation sequence are following on C.N.C MACHINE.

No.	Operation in sequence	Tools	Feed mm/min	R.P.M.	Depth of Cut mm	Time (Min)
1	Job Load ,Clamping Right angle	Dial Gauge				30 Min.
2	C.D. Check	Center Drill	300	1000	.5mm.	10 Min.
3	Side Radius	ϕ20 End mill	745	2786	0.5 mm	35Min.
4	Side Radius	ϕ10/ϕ12 End mill	500	2000	40mm.	25 Min.
5	Damper Drill	ϕ18,ϕ20.5, ϕ21.5 Drill	20	500	5mm.	15 Min.
6	Helix ϕ40.5	ϕ20 Inserted Cutter	1200	1800	.5mm.	1 Hrs.
7	Outer	ϕ50 Cutter	1000	1000	1mm.	2 Hrs.
8	Drill	ϕ8, ϕ6 Drill	20,20	800,900	5mm	30 Min.
9	Dowtail Rough	ϕ20 Cutter	1000	1800	.5mm	1:30 Hrs.

B) Second setting operation sequence are following on C.N.C MACHINING.

No.	Operations in sequence	Tool	Feed	R.P.M	Depth of Cut	Time
1	Center Drill	ϕ 11.5 Drill	20	1000	5m.m	20 min
2	Remer	ϕ12 End mill	20	2000	direct	10min
3	Slot	ϕ12End mill	600	2000	.5m.m	30min
4	Taper	ϕ50 Round Inserted	1500	100	.5m.m	60min
5	Helix	ϕ32S.P.M.T Inserted		1200	.5m.m	20min
6	R2 (Radius)	ϕ20Inserted cutter	800	1500	.5m.m	20m
7	Sleeting	ϕ80Sleeting Cutter	150 to 180	500	4m.m	90min
8	Damper Slot	ϕ25Inserted Cutter	800	1600	.5m.m	120min
9	U Drill	ϕ32 inserted U drill	30	1000	2m.m	30min

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6. Calculation

CALCULATION OF MACHINING CHARGE:

Time for IST setting =1st Setting Time +Machining Time
=30 min +470 min=500 (In Minute)
=8:20 Hrs.

Time for IInd setting = 2nd Setting Time + Machining Time
=30min + 360min= 390 (In Minute)
=6:30Hrs.
Total time = 8:20 + 6:30
= **14:50 Hrs**

Design Cost = **Rs/Hr** 500 X 9 hrs
= Rs.4500

Machining Cost = Conventional M/c Time x Conventional Marching charges (Tool Cost) + 1stSetting Time x CNC Machining charges (tool cost) +2ndSetting Time x Tool Price
=3x200 +8:20x600 +6:30x600
=600 + 4920 + 3780 =**Rs.930**
Over Head Cost = (Tool Cost + Administration cost + etc)
= 30% of Machining Charge
= 9300*30/100
= Rs2790
Total cost = 9300 + 2790+ 4500
= Rs 16590. Per Pole end Plate
Estimated machining cost for pole end plate is **Rs**. **16,590** per piece which is best price in competitive market.

7. Conclusion

This project was completed successfully and within the time frame specified. In this project, POLE END PLATE, we reduce the cost of the product by removing excess material using a conventional machine. As a result, we save the external cost of CNC machining. To conclude, we would like to express our gratitude to everyone who assisted us in completing this project paper.

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