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Synchronous Machine Design Software

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Abstract : The Synchronous machine are which are used to convert mechanical power to ac electrical power. Synchronous generators are the most important source of electrical energy that we consume today. The programming language used in this project is DART, It's a client-optimized language for developing fast apps on any platform. Main goal is to provide most productive language for multi-platform development, with flexible execution runtime for app framework. This project presents design of synchronous machine. Mathematical equations will be used in adjudicating the dimensions electrical parameter and satisfy specification such as rating, speed of machine, etc. as per design. Design calculation can be hectic process manually and errors may occur during some complicated calculations. This software is design in such a way that the user can enter maim specification as per requirement and the software will run the calculations in back end and provide the user with specific result.

Keywords - Synchronous machine, Software, DART language, Computer aided, Educational tool.

I. INTRODUCTION

In this review paper, we are going to introduce the easiest way to calculate important parameters required for Designing Synchronous Machine. Main Focus Behind this Project is to Display electrical parameters and dimensions using DART.

Designing a Synchronous Machine is very Complicated Process and might have some error While calculating, so in this article we are presenting the idea of Software that can do this process very accurately and within very less time. While designing a basic Synchronous machine these are the parameters that need to be considered Main dimensions of the stator frame, Length of air gap, Complete details of the stator windings, Design details of the rotor and rotor winding, Design of salient pole and cylindrical pole rotor, Performance details of the machine.

2.1 Working

II. METHODOLOGY

The program is coded to calculate the size and electrical parameter of a machine. Select the type of Rotor and enter the data as per the specified design requirement, if any input is not available the user can use the standard data provided and proceed further. Hence the design parameters are calculated automatically and the values are displayed. Basic idea of this software is to give the user easy way to design a synchronous machine as per requirement.

2.2 Flowchart

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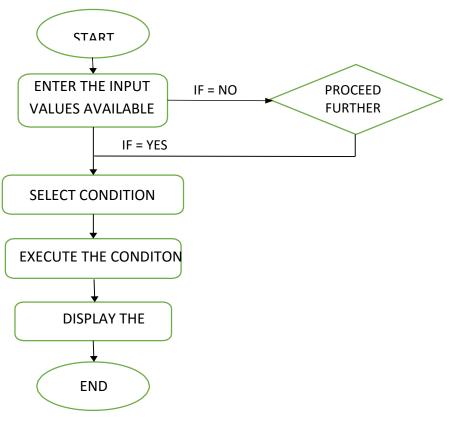


Fig. 1. Flow Chart

2.3 Design of synchronous machine

Synchronous machines designing software are used to obtain the following information:

- (i) Main dimensions of the stator frame.
- (ii) Design details of the rotor and rotor winding.
- (iii) Complete details of the stator windings.

III. TABLE

Main Dimension	
Output Equation	$Q = (11 \text{ Bav } q \text{ Kw } x \ 10^{-3}) D^2 L \text{ ns}$
D & L	$D^{2}L = Q/Cons$
Peripheral Velocity	$V = \pi D n_s$
Stator Winding Design	
Flux Per Phase	$\Phi = Bav x \pi DL/p$
Turn Per Phase	Tph = $E_{ph}/4.44$ f Φ Kw
Current Per Slot	$I_{ph} = \text{KVA} * 10^3 / 3 * E_{ph}$

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Stator Slot Design					
Stator Slot Pitch	$Y_s = \pi D$ /Numer of stator slots				
Width of slot	$b_s(\max) = Y_s - b_t(\min)$				
Tooth width	$b_t = \frac{\phi}{(\psi * s/p * Li * 1.8)}$				
Rotor Design	1.SALIENT POLE ROTOR DESIGN				
Sectional Area	$A_{\rm P} = \varphi_{\rm P}/B_{\rm P} \ m^2$				
No load field MMF	$AT_{fo} = SCR \times (2.7 \times I_{ph} \times T_{ph} \times Kw)/P$				
Height of field winding	$H_{\rm f} = AT_{\rm fl} / (10^4 \sqrt{(S_{\rm f} \times d_{\rm f} \times q_{\rm f})})$				
Radial length of Pole	$h_{pl} = h_f + h_l + 0.02 m$				
	Design of Field Winding				
Length of Mean Turn	$L_{mtf} = 2L_m + \pi(b_p + 0.01 + d_f)$				
Voltage Across each field coil	$E_{\rm f} = [(0.8 \text{ to } 0.85) V_{\rm e}] / P$				
Area Of Field Conductor	$a_f = AT_{fl} \times (g \times L_{mtf}) / E_f$				
Field Current	$I_f = \delta_f \times a_f$				
No of Field Turns	$T_{f}=AT_{fl}/I_{f}$				
Resistance of Field Winding	$\mathbf{R}_{f} = (\mathbf{g} \times \mathbf{L}_{mtf} \times \mathbf{T}_{f}) / \mathbf{a}_{f}$				
Temperature Rise in Field Winding	$Q = (Q_f \times C_f)/S$				
	2. Design of Cylindrical Rotor				
Full Load Field MMF	$AT_{fl}=2 \times AT_{a}$				
Voltage Across Each Field Coil	E _f =(0.8 to 0.85)V _e /P				
Length of Mean Turn of Filed Winding	$L_{mtf}=2L+2.3\tau+0.24$				
Cross Section Area of Field Coil	$a_f = AT_{fl} \times (\varrho \times L_{mtf}) / E_f$				
Total no of Field Conductor	$2 \times (AT_{fl} \times P)/(\delta_f \times a_f)$				
Total No of Field Conductor Per Slot	$2 \times (AT_{fl} \times P)/(\delta_f \times a_f \times S_r)$				

IV. RESULT

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#ii 5·21 🚓 ···· ㎡ 중 31% 💼	461 5:22 ^{0.60} ····
0	Connection Type:
	Star Connection 💌
3 Phase, 50 Hz	Specific Electric Loading
Type of Machine	26000
Hydro Generator 🔻	Range: 23,000 cand / m - 40,0
Power Output (Q):	Exciter Voltage (Ve):
(500.0) KVA	110
Range: 1.0 kVA - 500000.0 kVA	Range: 110 V - 440 V
Voltage (V):	Number of Solt/Pole/Pha
6.6 KV	2
Range: 3.3 kV = 13.8 kV	Range: 2 unit - 4 unit
Synchronous Speed (Ns):	Shape of Pole :
(500.0) rpm	Round Pole 👻
Range: 96.0 rpm - 1500.0 rpm	Pole Pitch Ratio (L/Tp):
Connection Type:	0.65
Star Connection 👻	Range: 0.6 unit -0.7 unit
Conseille Electric Londing (a):	. In the second second

Range: 2 unit - 4 unit	
Shape of Pole :	
Round Pole 👻	
Pole Pitch Ratio (L/tp):	
0.65	
Range: 0.6 unit - 0.7 unit	
Number of Ventilation Ducts (nd)):
2	
Range: 2 unit - 10 unit	
Width of Ducts (wd):	

Fig. 2. Input Page

5:16 x	(許令: 31% 🔔)	1	# 5:16 and	清余31% 🖬 👌		4	5:16 and	iii 令 31% 💷)
IAIN DIMENSION			STATOR DIMENSION				Total Number of Conductor -	2418
lumber of Pole :	12		Main Flux (Φ) :	0.0445 Wb			Slot Loading :	1487.11 amp
/pos of Pole :	Salient		Total Number of Stator Slot (Ss) :	72			Number of turns per phase (Tph)): 408
utput Coefficient (C_0) :	163.878		Slot Pitch (Ys) -	0.0563 m			Pole Pitch (τp) :	0.337975 m
4L x	0.366 m ^a		Full Load Current (Iph) :	43.74 amp			Mean Lenght of Turns (Lmt) :	1.764306 m
ore Length (L) :	0.220 m		Cross Section Area (az) :	16.82 mm ¹			Net Core Lenght (L) :	0.201284 m
ore Diameter (D) :	1.291 m		Total Number of Conductor :	2418			Tooth width (bt) :	0.031527 m
heripheral Velocity :	33.796 m/s		Slot Loading :	1487.11 amp			Width of Slots:	0.056329 m
STATOR DIMENSION			Number of turns per phase (Tph)	408			Area of Stator Core :	0.017 mm ²
			Pole Pitch (tp) :	0.337975 m			Depth of Stator Core (dc) :	0.085 m
ROTOR DIMENSION (Salie	ent Rotor)		Mean Lenght of Turns (Lmt)	1.784306 m			Longth of Air Gap (ig) :	1065.292 mm
			Net Core Lenght (Li) :	0.201284 m			Resistance of stator winding (R)	0.2399 Ω
			Tooth width (bt) :	0.081527 m			Copper loss :	459.03 watt
	% 5:16 ***	₩**3	Tooth width (bt) :	0.031527 m		深 令 31		459.03 watt
		猴 (President Rotor)			le (T.p)	(4 * 3 1 0.210	9. (II)	459.03 watt
	ROTOR DI	and the second	196 (0	#1 5:16 *** ···			w III	459.03 watt
	ROTOR DI	MENSION (Salient Rotor) onal Area of Pole Body : 0,03341	nv (till) m²	Width of Pole	e (bp) : Rotar (Dr) :	0.210 0.206 1.291	n a	459.03 watt
	ROTOR DI Cross Section	MENSION (Salient Rotor) onal Area of Pole Body : 0,03341 ole (Lp) : 0,210	196 0000 m²	**: 516 Mm Length of Pole Writh of Pole Diameter of 1 Height of 1 Le	e (bp) : Rotor (Di) : Id Winding (m) :	0.210 0.206 1.291 0.184	ne m m	459.03 watt
	ROTOR DJ Cross Section Longth of Po Width of Po Diameter of	MENSION (Salient Rotor) onal Area of Pole Body :0,03341 ele (LB) : 0,210 fe (bp) : 0,206 (Rotor (Dr) : 1,201	196 (M) 197 19	tength of Po Length of Po Writh of Pole Diamieter of J Height of Lie Radial Length	e (bp) : Rotar (bt) : Id Winding (ht) : h at Pole (hpl) : san Tum	0.210 0.206 1.291 0.184 0.224	n n m m m m	459.03 watt
	ROTOR DI Cross Section Longth of Po Width of Po Diameter of Height of Fi	MENSION (Salient Rotor) onal Area of Pole Body 10,03841 oller Lius : 0,210 eler Lius : 0,200 Rotor (D) : 0,200 Rotor (D) : 1,201 elet Winding (H) : 0,184	no em	teggth of Dameeter of Po Weath of Po Dameeter of 1 Height of Lie Radiel Lengt Longth of Me	e (Up) : Katar (Ur) Kat Winding (m) n of Pole (npl) : an Turn ductor (Unrt) :	0.210 0.206 1.291 0.184 0.224 1.020	n at an	459.03 watt
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Fig. 3. Output Page

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V. CONCLUSION

Hence, we have designed the project to determine the dimensions and electrical parameters of Synchronous machine efficiently. To analyse the Synchronous machine parameter coding is done in software. This Software is reliable and efficient for Designing Synchronous Machine all parameters will be calculated easily if all the necessary data is available. This method provides faster results and minimizes the errors that are likely to occur when calculated manually therefore providing us with accurate results. This will also reduce physical work and mental strains occurs while calculating required parameters. Using Designing Software will save the time. The mere purpose of the project is to use it as an educational tool.

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