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1531

Tema proiect Masini Electrice II

$m_1 := 3$

Conexiune Y

Clasa de izolatie: F (max 120°C)

$U_N := 415 \ V$

Grupa de proiectie: IP 44

$f_1 := 50 \ Hz$

Serviciul: S1 (continuu)

Conditii de functionare: normale

$P_N := 132 \ kW$

$n_N := 988 \ \frac{rot}{min}$ $n_1 := 1000 \ \frac{rot}{min}$

Determinarea marimii de calcul a masinii:

Determinarea numarului de poli:

$p := \frac{60 \cdot f_1}{n_1} = 3$ $2 \ p = 6$

Puterea aparenta absorbita nominala Sn si curentul nominal pe faza:

$\eta := 0.92$ $cos\varphi := 0.88$

$S_N := \frac{P_N}{\eta \cdot cos\varphi} = 163.043 \ kVA$ $S_N := 1.63 \cdot 10^5 \ VA$

$I_N := \frac{S_N}{\sqrt{3} \cdot U_N} = 226.766 \ A$

$\lambda := 1.3$ Raportul de forma al masinii

$\alpha_1 := 0.69$ Coeficientul de acoperire ideala al pasului

$k_B := 1.05$ Factorul de forma T.E.M

$k_{SD} := 1.3$ Coeficientul de saturatie magnetica partial al dintilor

$k_D := 1.37$

Tensiunea electromotoare de faza E si puterea aparenta interioara S:

$k_E := 0.97$

$U_1 := \frac{U_N}{\sqrt{3}} = 239.6\ V$ $E_1 := k_E \cdot U_1 = 232.412\ V$

$S_i := k_E \cdot S_N = 1.581 \cdot 10^5 VA$

Calculul dimensiunilor principale:

Coeficientul de utilizare:

$C := 218\ \frac{J}{dm^3}$

$D := \sqrt[3]{\frac{2 \cdot p}{\pi \cdot \lambda} \cdot \frac{60 \cdot S_i}{n_1 \cdot C}} = 3.999\ dm$

$D := 400\ mm$ Diametrul interior al statorului

Calculul diametrelor statorului:

$D_e := k_D \cdot D = 548\ mm$

$D_e := 550\ mm$ Diametrul exterior al statorului

$k_{w1} := 0.92$ Factorul infasurare pentru armonica necesara

$B_\delta := 0.76\ T$ (fig 1.11) Inductia maxima in intrefier

$A := 410\ \frac{A}{cm}$ (fig 1.11) Solicitari electromagnetice $A := 41000\ \frac{A}{m}$

$D := 0.4\ m$

Calculul marimilor masinii asincrone:

$l_i := \frac{60 \cdot S_i}{k_B \cdot k_{w1} \cdot \alpha_1 \cdot \pi^2 \cdot D^2 \cdot n_1 \cdot A \cdot B_\delta} = 0.289\ m$ Lungimea ideala

$a_{1max} := 2 \cdot p = 6$ $a_1 := 1 .. 6$ $a_1 := 3$

$\frac{2 \cdot p}{a_1} = 2$

$n_f := 1 .. 20$ $n_f := 6$ Numarul de fire in paralel

$\tau := \frac{\pi \cdot D}{2 \cdot p} = 0.209\ m$ $\tau := 20.944\ cm$ $l_i := 28.9\ cm$

$\lambda := \frac{l_i}{\tau} = 1.38$

$k_u := 0.75$

$k_{Fe} := 0.95$

$q_1 := 3 .. 5$ $q_1 := 4$ $\tau := 0.20944\ m$ $l_i := 0.289\ m$

$\phi := \alpha_1 \cdot \tau \cdot l_i \cdot B_\delta = 0.0317\ Wb$

$J_1 = (4.5 .. 5)$ $J_1 := 5\ \frac{A}{mm^2}$ Densitatea de curent in infasurarile statorului

$w_1 := \frac{k_E \cdot U_1}{4 \cdot k_B \cdot k_{w1} \cdot \phi \cdot f_1} = 37.8994$

$Z_1 := 2 \cdot p \cdot m_1 \cdot q_1 = 72$ Numarul de crestaturi statorice

$n_{c1} := \frac{2 \cdot m_1 \cdot a_1 \cdot w_1}{Z_1} = 9.475$ $n_{c1} := 10$ Numarul de conductoare efective

$B_{d1} = (1.5 .. 1.8)$ $B_{d1} := 1.7\ T$

$w_1 := \frac{k_E \cdot U_1}{4 \cdot k_B \cdot f_1 \cdot k_{w1} \cdot \phi} = 37.899$ Numarul de spire, pe faza

$w_1 := \frac{Z_1 \cdot n_{c1}}{2 \cdot m_1 \cdot a_1} = 40$ Numarul real de spire pe faza

$D := 40\ cm$

$N_1 := Z_1 \cdot n_{c1} = 720$ $I := \frac{I_N}{a_1} = 75.589\ A$

$A := \frac{N_1 \cdot I}{\pi \cdot D} = 433.092\ \frac{A}{cm}$

$t_1 := \frac{\pi \cdot D}{Z_1} = 1.745329\ cm$ Pasul dentar

$h_{istm1} = (1 .. 2)$ $h_{istm1} := 1.2\ mm$

$h_{pana} = (2..4)$ $h_{pana} := 2.2\ mm$

$g_{iz} < 0.44$ $g_{iz} := 0.4\ mm$

Infasurarea si crestaturile statorului:

$S_{Cu1} := \frac{I_N}{a_1 \cdot J_1} = 15.118\ mm^2$

$d_c := \sqrt{\frac{4 \cdot S_{Cu1}}{n_f \cdot \pi}} = 1.791\ mm$ Diametrul conductorului izolat al infasurarii statorice

$d_c := 1.7\ mm$ => $d_{ci} := 1.785\ mm$ Diametrul izolat al conductorului

$iz := \frac{d_{ci} - d_c}{2} = 0.043\ mm$

$n_{tot} := n_f \cdot n_{c1} = 60$

$S_{cond} := \frac{\pi \cdot d_c^{\ 2}}{4} = 2.27\ mm^2$

$S_{Cu1} := n_f \cdot S_{cond} = 13.619\ mm^2$

$d_{ci} := d_c + 2 \cdot iz = 1.785\ mm$

$b_{istm1} \le d_{ci} + 1.5$ $b_{istm1} := d_{ci} + 1.5 = 3.285 mm$

$b_{d1} := \frac{t_1 \cdot B_\delta}{k_{Fe} \cdot B_{d1}} = 0.821\ cm$ $b_{d1} := 8.21\ mm$

$S'_{cr} := \frac{n_{tot} \cdot d_{ci}^{\ 2}}{k_u} = 254.9 mm^2$ Sectiunea neta a crestaturii

$D := 400\ mm$

$b_{cr1v} := \frac{\pi}{Z_1} \cdot \left(D + 2 \cdot h_{istm1} + 2 \cdot h_{pana} + 4 \cdot g_{iz}\right) - b_{d1} = 9.61\ mm$

Inaltimea radiala a partii utile a crestaturii:

$$h_{util.cr1} := \frac{\sqrt{\left(b_{cr1v} - 2 \cdot g_{iz}\right)^2 + 4 \cdot S'_{cr} \cdot \tan\left(\frac{\pi}{Z_1}\right)} - \left(b_{cr1v} - 2 \cdot g_{iz}\right)}{2 \cdot \tan\left(\frac{\pi}{Z_1}\right)} = 25.668 mm$$

Inaltimea radiala a dintelui statoric:

$h_{d1} := h_{util.cr1} + h_{istm1} + h_{pana} + 4 \cdot g_{iz} = 30.668\ mm$

Latimea crestaturii statorice la baza partii trapezoidale:

$b_{cr1b} := \frac{\pi}{Z_1}\left(D + 2 \cdot h_{d1}\right) - b_{d1} = 11.92\ mm$

Latimea dintelui statoric in zona varfului crestaturii trapezoidale:

$b_{d1v} := \frac{\pi}{Z_1}\left(D + 2 \cdot h_{istm1} + 2 \cdot h_{pana}\right) - b_{cr1v} = 8.14\ mm$

Latimea dintelui statoric in zona medie a inaltimii crestaturiui trapezoidale:

$b_{d1b} := \frac{\pi}{Z_1}\left(D + 2 \cdot h_{d1}\right) - b_{cr1b} = 8.21\ mm$

Inaltimea de calcul a jugului statoric:

$h_{j1} := \frac{D_e - D}{2} - h_{d1} = 44.332\ mm \qquad h_{j1} := 0.044332 m$

Geometria miezului: $l_{Fe} := l_i = 0.289\ m \qquad l_g := l_i = 0.289\ m$

$B_{j1} := \frac{\phi}{2 \cdot k_{Fe} \cdot l_{Fe} \cdot h_{j1}} = 1.304\ T$ Inductia in jugul statoric

$J_1 := \frac{I_N}{a_1 \cdot S_{Cu1}} = 5.55 \quad \frac{A}{mm^2}$ Valoarea exacta a densitatii de curent

$k_i := \frac{\sin\left(\frac{\pi \cdot p}{Z_1}\right)}{\frac{\pi \cdot p}{Z_1}} = 0.997$ Factorul de infasurare datorita inclinarii

$J_{2b} = (3 .. 4.5)$ $J_{2b} := 4 \ \frac{A}{mm^2}$

$J_{2i} = (0.65 .. 0.8) \cdot J_{2b}$ $J_{2i} := 0.7 \cdot J_{2b} = 2.8 \ \frac{A}{mm^2}$

$l_g := 289 \ mm$

Determinarea latimii intrefierului: $\delta := 3 \cdot \left(4 + 0.7 \cdot \sqrt{D \cdot l_g}\right) \cdot 10^{-2} = 7.26 mm$

intrefierul este de 7.26 (prea mare), ceea ce a stricat calculele care-l contin

$b_v = (1 .. 1.5 \ cm)$ $b_v := 1.2 \ cm$

$Z_2 := 62$ $m_2 := Z_2 = 62$

$w_2 := \frac{1}{2}$

$D_r := D - 2 \cdot \delta = 385.48 \ mm$ Nu bun din cauza intrefieruui Diametrul exterior al rotorului

Infasurarea si crestaturile rotorului:

$t_2 := \frac{\pi \cdot D_r}{Z_2} = 19.533 \ mm$ Pasul dentar al rotorului

Factorul care tine cont de infasurarea curentului: $k_{w2} := k_i = 0.997$ $k_I := 0.93$

$E_2 = U_{20}$

$B_{d2} = (1.5 .. 1.8)$ $B_{d2} := 1.6 \ T$

$E_2 := \frac{k_E \cdot U_1 \cdot k_i}{2 \cdot w_1 \cdot k_{w1}} = 3.149 \ V$

$b_{istm2} := 1 .. 2$ $b_{istm2} := 1.4 \ mm$ Latimea istmului crestaturii rotorului

$I_2 := k_I \cdot \frac{m_1 \cdot w_1 \cdot k_{w1}}{m_2 \cdot w_2 \cdot k_{w2}} \cdot I_N = 753.2 \ A$

$h_{istm2} := 0.8 .. 1.5$ $h_{istm2} := 1.3 \ mm$ Inaltimea istmului crestaturii rotorului

$I_b := k_I \cdot \frac{2 \cdot m_1 \cdot w_1 \cdot k_{w1}}{Z_2 \cdot k_i} \cdot I_N = 753.2 \ A$ Curentul pe faza

$B_{j2} := 1.2 .. 1.6$ $B_{j2} := 1.5\,T$

$p = 3$ $P_N = 132$ kW => $d_{cap\_ax} := 58\,mm$

$b_0 = 1.5 .. 2$ $b_0 := 1.7\ mm$

$I_i := \frac{I_b}{2 \cdot \sin\left(\frac{\pi \cdot p}{Z_2}\right)} = 2.487 \cdot 10^3 A$ Curentul in inelul de scurtcircuit al coliviei

$h_0 = (1 .. 2)$ $h_0 := 1.5\ mm$

$b = (3.5 .. 6)$ $b := 6\ mm$

$S_b := \frac{I_b}{J_{2b}} = 188.3\ mm^2$

$S_i := \frac{I_i}{J_{2i}} = 888.212\ mm^2$

$b_{d2} := \frac{t_2 \cdot B_\delta}{k_{Fe} \cdot B_{d2}} = 9.766\ mm$

Latimea barei colivie rotorice la varful crestaturii trapezoidale:

$b_{cr2v} := \frac{\pi}{Z_2}\left(D_r - 2 \cdot h_{istm2}\right) - b_{d2} = 9.635\ mm$

Latimea barei colivie rotorice la vaza crestaturii trapezoidale si inaltimea crestaturii rotorului:

$h_{cr2} := \frac{Z_2}{2 \cdot \pi}\left(b_{cr2v} - \sqrt{b_{cr2v}^2 - \frac{4 \cdot \pi}{Z_2} \cdot S_b}\right) + h_{istm2} = 23.417 mm$

$h_{d2} := h_{cr2} = 23.417\ mm$

$b_{cr2b} := b_{cr2v} - \frac{2 \cdot \pi}{Z_2}\left(h_{cr2} - h_{istm2}\right) = 7.393\ mm$

Latimea dintelui rotoric in zona varfului barei coliviei:

$b_{d2v} := \frac{\pi}{Z_2}\left(D_r - 2 \cdot h_{istm2}\right) - b_{cr2v} = 9.766\ mm$

Latimea dintelui rotoric in zona crestaturii trapezoidale:

$b_{d2b} := \frac{\pi}{Z_2}\left(D_r - 2 \cdot h_{d2}\right) - b_{cr2b} = 9.766\ mm$

Aria sectiunii trapezoidale a barei coliviei rotorice:

$$S_b := \frac{b_{cr2v} + b_{cr2b}}{2} \cdot \left(h_{cr2} - h_{istm2}\right) = 188.3 \quad mm^2$$

$$h'_{j2} := \frac{\phi}{2 \cdot k_{Fe} \cdot l_{Fe} \cdot B_{j2}} = 0.039\ m \qquad h'_{j2} := 39\ mm$$ Inaltimea de calcul a jugului rotoric

$$D_{ir} := D_r - 2 \cdot \left(h_{d2} + h'_{j2}\right) = 260.646 \quad mm$$

$$D_{ir} := 260 \quad mm$$ Diametrul interior al rotorului

$$d_{ax} := d_{cap\_ax} + 10 = 68 \quad mm$$

$$h_{j2} := \frac{D_r - D_{ir}}{2} - h_{d2} = 39.323\ mm \qquad h_{j2} := 0.037259 m$$ Inaltimea reala a jugului rotoric

$$t_1 := 17.45329\ mm \qquad \tau := 209.44\ mm$$

$$\beta := \frac{h_{d1}}{t_1} = 1.757 \qquad \beta_1 := \frac{h_{d1}}{\tau} = 0.146$$

$$B_{j2} := \frac{\phi}{2 \cdot k_{Fe} \cdot l_{Fe} \cdot h_{j2}} = 1.551\ T$$ Inductia in jugul rotoric

$$b_c := t_1 \cdot \beta = 30.668 \quad mm$$

$$\beta_2 := \frac{h_{d1}}{b_c} = 1$$

Tensiunea magnetomotoare pe o pereche de poli:

T.M a intrefierului:

$$\mu_0 := 4 \cdot \pi \cdot 10^{-7} \quad \frac{H}{m}$$

$$\gamma_1 := \frac{\left(\frac{b_{istm1}}{\delta}\right)^2}{5 + \frac{b_{istm1}}{\delta}} = 0.038 \qquad \gamma_2 := \frac{\left(\frac{b_{istm2}}{\delta}\right)^2}{5 + \frac{b_{istm2}}{\delta}} = 0.007$$ De astea doua a spus ca sunt prea mici

Coeficientul lui Carter:

$$k_{C1} := \frac{t_1}{t_1 - \gamma_1 \cdot \delta} = 1.016 \qquad k_{C2} := \frac{t_2}{t_2 - \gamma_2 \cdot \delta} = 1.003$$

Coeficientul intrefierului:

$k_C := k_{C1} \cdot k_{C2} = 1.019$

$\delta' := k_C \cdot \delta = 7.395\ mm$ $\delta' := 0.007395\ m$

$U_{m\delta} := 2 \cdot \frac{B_\delta}{\mu_0} \cdot \delta' = 8.945 \cdot 10^3\ A$ A spus ca este prea mare, fiindca da cu 10^3

T.M a dintilor:

$H_{d1} := 53\ \frac{A}{cm}$ $B_{d1} = 1.7\ T$

$h_{d1} := 3.0668\ cm$

$U_{md1} := 2 \cdot h_{d1} \cdot H_{d1} = 325.081\ A$

T.M a dintilor rotorului:

$H_{d2} := 25\ \frac{A}{cm}$ $B_{d2} = 1.6\ T$

$h_{d2} := 2.3417\ cm$

$U_{md2} := 2 \cdot h_{d2} \cdot H_{d2} = 117.085\ A$

$k_{sd} := \frac{U_{m\delta} + U_{md1} + U_{md2}}{U_{m\delta}} = 1.049$

T.M a jugului statoric:

$B_{j1} = 1.304\ T$

$\zeta_1 := 0.5$

$H_{j1} := 5\ \frac{A}{cm}$

$D_e := 55\ cm$ $h_{j1} := 4.4332\ cm$

$L_{j1} := \frac{\pi \cdot (D_e - h_{j1})}{2 \cdot p} = 26.477\ cm$

$U_{mj1} := \zeta_1 \cdot H_{j1} \cdot L_{j1} = 66.192\ A$

T.M a jugului rotoric:

$B_{j2} = 1.551\ T$

$\zeta_2 := 0.35$

$H_{j2} := 12 \quad \frac{A}{cm}$

$D_{ir} := 26\ cm$ $\qquad$ $h_{j2} := 3.7259 \quad cm$

$L_{j2} := \frac{\pi \cdot (D_{ir} + h_{j2})}{2 \cdot p} = 15.564\ cm$

$U_{mj2} := \zeta_2 \cdot H_{j2} \cdot L_{j2} = 65.371 \quad A$

$U_{mcirc} := U_{m\delta} + U_{md1} + U_{md2} + U_{mj1} + U_{mj2} = 9.519 \cdot 10^3 \quad A$ Din cauza lui Umdelta nu d bine calculul

Curentul de magnetizare:

$I_\mu := \frac{p \cdot U_{mcirc}}{0.9 \cdot m_1 \cdot w_1 \cdot k_{w1}} = 287.396\ A$ $\qquad$ $I_N = 226.766 \quad A$

Iu este mai mare decat IN, curentul cu care am inceput, ceea ce nu e bine aparent din ce a spus profu

$I_{\mu procent} := \frac{I_\mu}{I_N} \cdot 100 = 126.737$ [%]

$k_s := \frac{U_{mcirc}}{U_{m\delta}} = 1.064$

Inaltimea inelului de scurtcircuitare a coliviei rotorice:

$h_{i.sc} = h_{d2} + 5 \ldots 10$ $\qquad$ $h_{i.sc} := h_{d2} + 6 = 8.342 \quad cm$ $\qquad$ $h_{i.sc} := 83.42 mm$

Latimea inelului de scurtcircuitare:

$b_{i.sc} := \frac{S_i}{h_{i.sc}} = 10.647\ mm$

Diametrul mediu al inelului de scurtcircuitare a coliviei rotorice:

$D_{i.sc} := D_r - h_{i.sc} = 302.06 \quad mm$

$b_{cr1m} := \sqrt{\frac{1}{2} \cdot \left(b_{cr1v}^{\ 2} + b_{cr1b}^{\ 2}\right)} = 10.826\ mm$

$h_{cr1v} := \frac{b_{cr1m} - b_{cr1v}}{b_{cr1b} - b_{cr1v}} \cdot \left(h_{util.cr1} - h_{istm1} - h_{pana} - 4 \cdot g_{iz}\right) = 10.887\ mm$

$$h_{cr1b} := \frac{b_{cr1b} - b_{cr1m}}{b_{cr1b} - b_{cr1v}} \cdot \left(h_{util.cr1} - h_{istm1} - h_{pana} - 4 \cdot g_{iz}\right) = 9.781 \quad mm$$

$$y_\tau := \frac{Z_1}{2 \cdot p} = 12 \qquad y_1 := y_\tau = 12$$

$$K_{cu} := 6 \cdot \frac{p \cdot y_1}{Z_1} + 1.67 = 4.67$$

$$K_h := 6 \cdot \frac{p \cdot y_1}{Z_1} + 1 = 4$$

$h_{cr1b} := 0.9781\ cm$ $b_{cr1b} := 1.192\ cm$ $g_{iz} := 0.04\ cm$ $b_{cr1m} := 1.0826\ cm$

$h_{cr1v} := 1.0887\ cm$ $b_{cr1v} := 0.961\ cm$ $h_{pana} := 0.22\ cm$ $h_{istm1} := 0.12\ cm$

$b_{istm1} := 0.3285 cm$

$$\lambda_{cr1} := \frac{1}{4} \cdot \left(\frac{2}{3} \cdot \frac{h_{cr1b}}{b_{cr1b} + b_{cr1m}} + \frac{g_{iz}}{b_{cr1m}} + K_{cu} \cdot \frac{h_{cr1v}}{b_{cr1m} + b_{cr1v}}\right) + \frac{1}{4} \cdot K_h \cdot \left(\frac{h_{pana} + 2 \cdot g_{iz}}{b_{cr1v}} + \frac{2 \cdot h_{pana}}{b_{cr1v} + b_{istm1}} + \frac{h_{istm1}}{b_{istm1}}\right)$$

$$\lambda_{cr1} = 1.722$$

$$\gamma_1 = 0.038 \qquad \gamma_2 = 0.007$$

$$k_{c1} := \frac{t_1}{t_1 - \gamma_1 \cdot \delta} = 1.016 \qquad k_{c2} := \frac{t_2}{t_2 - \gamma_2 \cdot \delta} = 1.003$$

$$K_c := k_{c1} \cdot k_{c2} = 1.019 \qquad \delta' := K_c \cdot \delta = 7.395\ mm \qquad \delta' := 0.7395\ cm$$

$$t_1 := 1.74532 \quad cm$$

$$\lambda_{d1} := \frac{t_1}{11.9} \cdot \frac{{k_{w1}}^2}{K_c \cdot \delta'} = 0.165$$

$$2 \cdot p = 6 \qquad => A := 0\ cm$$

$D := 40 \quad cm \quad h_{d1} = 3.067\ cm$

$$t_{med} := \frac{\pi \cdot \left(D + h_{d1}\right)}{Z_1} = 1.879 \quad cm \qquad R_m := y_1 \cdot \frac{t_{med}}{2} = 11.275 \quad cm$$

$l_{f1} := \pi \cdot R_m = 35.421\ cm$ $\tau := 20.944\ cm$ $l_i := 28.9\ cm$

$$\lambda_{f1} := 0.34 \cdot \frac{q_1}{l_i} \cdot \left(l_{f1} - 0.64 \cdot \frac{y_1}{y_\tau} \cdot \tau \right) = 1.036$$

$$X_{\sigma 1} := 0.158 \cdot f_1 \cdot l_i \cdot \frac{{w_1}^2}{p \cdot q_1} \cdot 10^{-6} \cdot \left(\lambda_{cr1} + \lambda_{d1} + \lambda_{f1} \right) = 0.089\ \Omega$$

Este mult mai mic decat R1, ceea ce nu e bine, fiindca trebuie sa fie mai mare

$$b_{cr2} := \frac{b_{cr2b} + b_{cr2v}}{2} = 8.514\ mm$$

$$\lambda_{cr2} := \left(\frac{h_{cr2} - h_{istm2}}{3 \cdot b_{cr2}} + \frac{h_{istm2}}{b_{istm2}} \right) = 1.794$$

$t_2 := 19.533\ mm$ $\delta := 7.26\ mm$

$$\lambda_{d2} := \frac{10}{119} \cdot \frac{t_2}{K_c \cdot \delta} = 0.222$$

$l_i := 28.9\ cm$ $D_{i.sc} := 30.206\ cm$ $h_{i.sc} := 8.342 cm$ $b_{i.sc} := 1.0647\ cm$

$$\lambda_{f2} := \frac{2.3 \cdot D_{i.sc}}{4 \cdot Z_2 \cdot l_i \cdot \sin\left(\frac{\pi \cdot p}{Z_2} \right)^2} \cdot \log\left(\frac{4.7 \cdot D_{i.sc}}{h_{i.sc} + 2 \cdot b_{i.sc}} \right) = 0.479$$

$$X_{\sigma 2} := 7.9 \cdot f_1 \cdot l_i \cdot 10^{-8} \cdot \left(\lambda_{cr2} + \lambda_{d2} + \lambda_{f2} \right) = 2.848 \cdot 10^{-4}\ \Omega$$

X1 si X2 trebuie sa fie apropiate, insa nu este cazul aici, si a spus ca este problema legat de faptul asta, ca nu sunt apropiate

$U_1 = 239.6\ V$

$I_\mu = 287.396\ A$

$$X_m := \frac{U_1 - I_\mu \cdot X_{\sigma 1}}{I_\mu} = 0.745\ \Omega$$

$$K := \frac{12 \cdot \left(w_1 \cdot k_{w1}\right)^2}{Z_2} = 262.111$$

$$\rho_{20} := \frac{1}{32} = 0.031 \ \Omega \frac{mm^2}{m}$$

$$\rho_{115g} := 1.35 \cdot \rho_{20} = 0.042 \ \Omega \frac{mm^2}{m}$$

$$\rho_b := \rho_{115g} = 0.042 \ \Omega \frac{mm^2}{m}$$

$$\rho_i := \rho_{115g} = 0.042 \ \Omega \frac{mm^2}{m}$$

$$L_b := l_g = 289 \ mm$$

$$L_i := \frac{\pi \cdot D_{ir}}{Z_2} = 13.174 mm$$

$$R_b := \rho_b \cdot \frac{L_b}{S_b} = 0.065 \ \Omega$$

$$R_i := \rho_i \cdot \frac{L_i}{S_i} = 6.257 \cdot 10^{-4} \ \Omega$$

$$R_2 := R_b + \frac{R_i}{2 \cdot \sin\left(\frac{\pi \cdot p}{Z_2}\right)^2} = 0.078 \ \Omega$$

$$R'_2 := K \cdot R_2 = 20.548 \Omega$$

$$X'_{\sigma 2} := K \cdot X_{\sigma 2} = 0.075 \ \Omega$$

$$D_{ir} := 260 \ mm$$

$$S_b := 188.3 \ mm^2$$

$$S_i := 888.212 \ mm^2$$

Calculul pierderilor și randamentului mașinii de inducție

1.Pierderi principale in fier

a)Pierderi principale in jugul statoric

$k_j := 1.3$

$p_{10\_50} := 2.4 \frac{W}{kg}$

$p_{j1} := p_{10\_50} \cdot 1^{1.3} \cdot B_{j1}{}^2 = 4.081 \frac{W}{kg}$

$\gamma_{Fe} := 7800 \frac{kg}{m^3}$ $l_{Fe} = 0.289\ m$

$D_{ej1} := D_e = 55\ cm$ $D_{ej1} := 0.55\ m$

$D_{ij1} := D + 2 \cdot h_{d1} = 46.134\ cm$ $D_{ij1} := 0.04674 m$

$G_{Fej1} := \gamma_{Fe} \cdot \frac{\pi}{4} \left(D_{ej1}{}^2 - D_{ij1}{}^2 \right) \cdot k_{Fe} \cdot l_{Fe} = 505.107\ kg$ Este prea mare

$P_{j1} := k_j \cdot p_{j1} \cdot G_{Fej1} = 2.679 \cdot 10^3\ W$ $P_{j1} := 2.679\ kW$

b)Pierderile principale in pierderile statorului

$B'_{d1} := 1.75\ T$

$B_{d1med} := B'_{d1} = 1.75\ T$

$b_{d1m} := \frac{b_{d1b} + b_{d1v}}{2} = 8.175\ mm$

$b_{d1med} := b_{d1m} = 8.175\ mm$ $b_{d1med} := 0.008175\ m$

$k_d := 1.8$

$p_{d1} := 7.5 \quad \frac{W}{kg}$ $h_{d1} := 0.030668 \quad m$

$l_{Fe} := 0.289 \ m$

$G_{d1} := h_{d1} \cdot b_{d1med} \cdot l_{Fe} \cdot k_{Fe} \cdot Z_1 \cdot \gamma_{Fe} = 38.656 \ kg$

$P_{d1} := k_d \cdot p_{d1} \cdot G_{d1} = 521.862 \ W$ $P_{d1} := 0.521862 \ kW$

c)pierderile principale totale in fier

$P_{Fepr} := P_{j1} + P_{d1} = 3.201 \ kW$

2.Pierderile suplimentare in fier la functionarea in gol

a)pierderile suplimentare ale statorului

$b_{istm2} := 1.4 \ mm$ $\delta := 7.26 \ mm$

$k_0 := 1.6$ $\frac{b_{istm2}}{\delta} = 0.193$

$\beta_{01} := 0.21$

$B_{01} := \beta_{01} \cdot k_C \cdot B_\delta = 0.163 \ T$ $t_2 := 0.019533 \ m$

$p_{supr1} := 0.5 \cdot k_0 \cdot \left(\frac{Z_2 \cdot n_1}{10000}\right)^{1.5} \cdot \left(10 \cdot B_{01} \cdot t_2\right) = 0.392 \ \frac{W}{m^2}$

$t_1 := 0.01745329 \ m$ $b_{istm1} := 0.003285 \ m$

$P_{supr1} := 2 \cdot p \cdot \left(\frac{t_1 - b_{istm1}}{t_1}\right)^{1.5} \cdot \tau \cdot l_{Fe} \cdot k_{Fe} \cdot p_{supr1} = 9.896 \ W$ $P_{supr1} := 0.009896 kW$

b)pierderile de suprafara ale motorului $\delta := 0.00726 m$

$k_0 := 1.9$ $\frac{b_{istm1}}{\delta} = 0.452$

$\beta_{02} := 0.35$

$B_{02} := \beta_{02} \cdot k_C \cdot B_\delta = 0.271 \ T$

$p_{supr2} := 0.5 \cdot k_0 \cdot \left(\frac{Z_1 \cdot n_1}{10000}\right)^{1.5} \cdot \left(10 \cdot B_{02} \cdot t_1\right) = 0.868 \ \frac{W}{m^2}$

$t_2 := 0.019533\ m$ $b_{istm2} := 0.0014\ m$

$P_{supr2} := 2 \cdot p \cdot \left(\frac{t_2 - b_{istm2}}{t_2} \right)^{1.5} \cdot \tau \cdot l_{Fe} \cdot k_{Fe} \cdot p_{supr2} = 26.783\ W$ $P_{supr2} := 0.026783\ kW$

c)pierderile de pulsatie in dintii statorului

$k'_0 := 0.1$

$B_{puls1} := \frac{\gamma_2 \cdot \delta}{2 \cdot t_1} \cdot B_{d1med} = 0.003\ T$

$P_{puls1} := k'_0 \cdot \left(\frac{Z_2 \cdot n_1}{10000} \cdot 10 \cdot B_{puls1} \right)^2 \cdot G_{d1} = 0.101\ kW$

d)piederile de pulsatie in dintii rotorului

$B'_{d2} := 1.6\ T$ $B_{d2med} := B'_{d2} = 1.6\ T$

$b_{d2m} := \frac{b_{d2b} + b_{d2v}}{2} = 9.766\ mm$

$b_{d2med} := b_{d2m} = 9.766\ mm$

$B_{puls2} := \frac{\gamma_2 \cdot \delta}{2 \cdot t_2} \cdot B_{d2med} = 0.002\ T$

$h_{c2} := h_{d2} = 2.342\ mm$ $h_{c2} := 0.002342\ m$ $b_{d2med} := 0.009766\ m$

$G_{d2} := h_{c2} \cdot b_{d2med} \cdot l_{Fe} \cdot k_{Fe} \cdot Z_2 \cdot \gamma_{Fe} = 3.037\ kg$

$P_{puls2} := k'_0 \cdot \left(\frac{Z_1 \cdot n_1}{10000} \cdot 10 \cdot B_{puls2} \right) \cdot G_{d2} = 0.047\ kW$

e)pierderile totale in fier la functionarea in gol

$P_{Fe} := P_{Fepr} + P_{supr1} + P_{supr2} + P_{puls1} + P_{puls2} = 3.385\ kW$

3.Pierderile electrice principale

a)pierderile in infasurarea statorului

$k_r := 1$ $\rho_{115} := 1.38 \cdot \rho_{20} = 0.043\ \Omega \cdot \frac{mm^2}{m}$

$l_g := 289\ mm$ $l_{f1} := 354.21 mm$

$l_{wmed} := l_g + l_{f1} = 643.21\ mm$

$L_1 := 2 \cdot w_1 \cdot l_{wmed} = 5.146 \cdot 10^4 mm$ $L_1 := 51.46\ m$

$R_1 := k_r \cdot \rho_{115} \cdot \frac{L_1}{S_{Cu1} \cdot a_1} = 0.054\ \Omega$

$P_{el1} := m_1 \cdot R_1 \cdot I_N{}^2 = 8.379 \cdot 10^3\ W$ $P_{el1} := 8.379 kW$

b)pierderile in infasurarea rotorului

$P_{el2} := m_2 \cdot R_b \cdot I_2{}^2 = 2.277 \cdot 10^6\ W$ $P_{el2} := 2277\ kW$

Pierderea este prea mare, de 10^6

$P_{el} := P_{el1} + P_{el2} = 2.285 \cdot 10^3\ kW$

c)pierderile electrice in contactul intre peri si inelele colectoare

$P_{ct} := 0\ kW$

4.Pierderile mecanice pentru frecare si de ventilatie

$n_v := 0.2$

$P_{frv} := 1.2 \cdot 2 \cdot p \cdot \left(\frac{\tau}{10}\right)^2 \cdot (n_v + 11) = 353.728\ W$ $P_{frv} := 0.353728\ kW$

$P_{fpe} := 0\ kW$

$P_{mec} := P_{frv} + P_{Fe} = 3.739\ kW$

5.Pierderi in ventilatie

$\eta_v := 0.2$

$P_N = 132 kW$

$$Q := \frac{(1-\eta)\cdot 110}{1.1\cdot 30} = 0.267 \quad \frac{m^3}{s}$$

$\eta_p := 0.4$ $\quad D_e := 0.55 \quad m$ $\quad D := 0.4 \quad m$

$$u_1 := \pi \cdot \frac{(D_e - 0.03)\cdot n_N}{60} = 26.9 \quad \frac{m}{s}$$

$$u_2 := \frac{\pi \cdot D \cdot n_N}{60} = 20.693 \quad \frac{m}{s}$$

$$H := 1.1 \cdot \eta_p \cdot \left(u_1^{\,2} - u_2^{\,2}\right) = 129.997 \quad Pa$$

$$P_v := \frac{Q \cdot H}{\eta_v} = 173.329 \quad W \qquad P_v := 0.173329 \, kW$$

6.Pierderile suplimentare in fier la functionarea in sarcina

$$P_{sFe} := 0.005 \cdot P_N = 0.66 \quad kW$$

7.Pierderile totale si randamentul masinii

a)pierderi totale

$$P := P_{Fe} + P_{el} + P_{mec} + P_v + P_{sFe} = 2.293 \cdot 10^3 \quad kW$$

b)randamentul masinii in functionare nominala

$$\eta_N := \frac{P_N}{P_N + P} = 0.054$$ Randamentul este prea mic

Calculul caracteristicilor mașinii de inducție cu parametrii constanți

Curentul de funcționare în gol:

$$I_{0r} := I_\mu = 287.396 A$$

$$I_0 := I_{0r} = 287.396 A \qquad P_{e10} := m_1 \cdot R_1 \cdot I_0^{\,2} = 1.346 \cdot 10^4 \quad W$$

$P_{Fe} := 3385 \ W$ $\quad P_{mec} := 3739 \quad W$ $\quad P_v := 173.329 \quad W$

$$I_{0a} := \frac{P_{Fe} + P_{mec} + P_v + P_{e10}}{m_1 \cdot U_1} = 28.877 \quad A$$

$$I_0 := \sqrt{{I_{0a}}^2 + {I_{0r}}^2} = 288.843 \quad A$$

Factorul de putere la funcționarea în gol:

$$cos\varphi_0 := \frac{I_{0a}}{I_0} = 0.1$$

Curentul absorbit:

$$s := \frac{n_1 - n_N}{n_1} = 0.012 \qquad X'_{\sigma 2} = 0.075 \quad \Omega$$

$$X_{\sigma 1} = 0.089 \quad \Omega$$

$$c_1 := 1 + \frac{X_{\sigma 1}}{X_m} = 1.119$$

$$I'_{2a} := \frac{U_1 \cdot \left(R_1 + c_1 \cdot \frac{R'_2}{s}\right)}{\left(R_1 + c_1 \cdot \frac{R'_2}{s}\right)^2 + \left(X_{\sigma 1} + c_1 \cdot X'_{\sigma 2}\right)^2} = 0.125 \quad A$$

$$I'_{2r} := \frac{U_1 \cdot \left(X_{\sigma 1} + c_1 \cdot X'_{\sigma 2}\right)}{\left(R_1 + c_1 \cdot \frac{R'_2}{s}\right)^2 + \left(X_{\sigma 1} + c_1 \cdot X'_{\sigma 2}\right)^2} = 1.125 \cdot 10^{-5} \quad A$$

$$I_\mu = 287.396 \quad A$$

$$I_1(s) := \sqrt{\left(I_{0a} + I'_{2a}\right)^2 + \left(I_\mu + I'_{2r}\right)^2} = 288.856 \quad A$$

Alunecarea nominala $\qquad I_{2N} := I_2 = 753.2 \quad A$

$$I'_{2N} := I_{2N} \cdot \frac{m_2 \cdot w_2 \cdot k_{w2}}{m_1 \cdot w_1 \cdot k_{w1}} = 210.893 \quad A$$

$$s_N := \frac{m_1 \cdot R'_2 \cdot {I'_{2N}}^2}{m_1 \cdot E_1 \cdot I'_{2N}} = 18.645$$

Factorul de putere nominala:

$I_{1N} := I_1(s) = 288.856 \quad A$

$I'_{2aN} := I'_{2a} = 0.125 \quad A$

$cos\varphi_N := \frac{I_{0a} + I'_{2aN}}{I_{1N}} = 0.1$

A spus ca noi am inceput cu cos(fi) la valoarea 0.88, iar in calculul acesta ne da de 0.1. Trebuiau sa fie apropiate

Cuplul nominal

$M_N := \frac{60 \cdot P_N}{2 \cdot \pi \cdot n_N} = 1.276 \quad N \cdot m$

$$M_{N1} := \frac{m_1 \cdot p \cdot U_1^{\,2} \cdot \frac{R'_2}{s_N}}{w_1 \cdot \left(\left(R_1 + c_1 \cdot \frac{R'_2}{s_N} \right)^2 + \left(X_{\sigma 1} + c_1 \cdot X'_{\sigma 2} \right)^2 \right)} = 8.429 \cdot 10^3 \quad N \cdot m$$

MN si MN1 dau valori complet diferite, a spus ca trebuia ca acestea sa dea valori macar apropiate