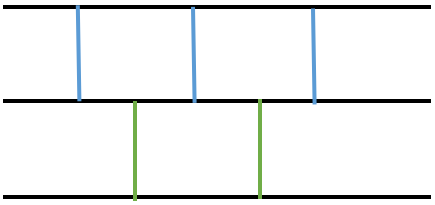
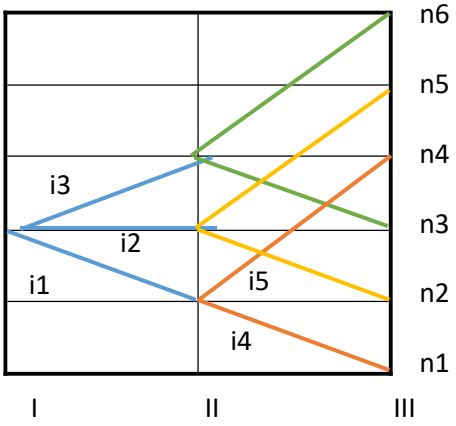
Proyecto Final de caja de velocidades

Diseñar por el método grafo analítico los esquemas estructurales y diagrama de velocidades de una caja de Z = 3*2 = 6 con una potencia de 2.5 kWatt, y 950 rpm, del motor eléctrico. La frecuencia de rotación para n1 = 200 rpm. El valor de φ = 1.26. El valor de x0 = 1, para el primer grupo principal.



$$Pa = P1 = 3; X_0 = 1$$

$$Pb = P2 = 2; X_1 = P1 = 3$$



$$n1 = 200\ rpm$$

$$n2 = n1 * \varphi = 200\ rpm * 1.26 = 252\ rpm$$

$$n3 = n2 * \varphi = 252\ rpm * 1.26 = 317.52\ rpm$$

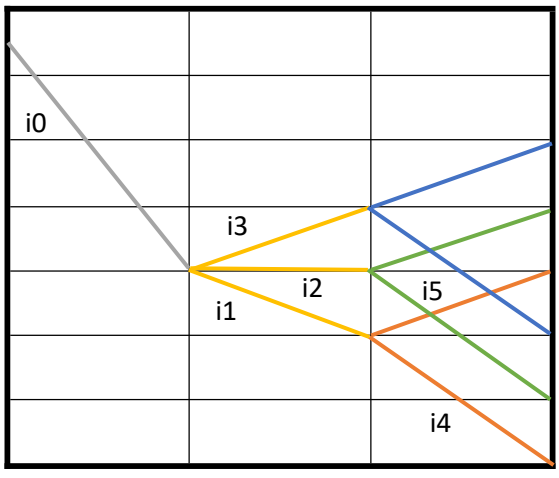
$$n4 = n3 * \varphi = 317.52\ rpm * 1.26 = 400.075\ rpm$$

$$n5 = n4 * \varphi = 400.075\ rpm * 1.26 = 504.094\ rpm$$

$$n6 = n5 * \varphi = 504.094\ rpm * 1.26 = 635.158\ rpm$$

$$n7 = n6 * \varphi = 635.158\ rpm * 1.26 = 800.299\ rpm$$

$$n8 = n7 * \varphi = 800.299\ rpm * 1.26 = 1008.377\ rpm$$

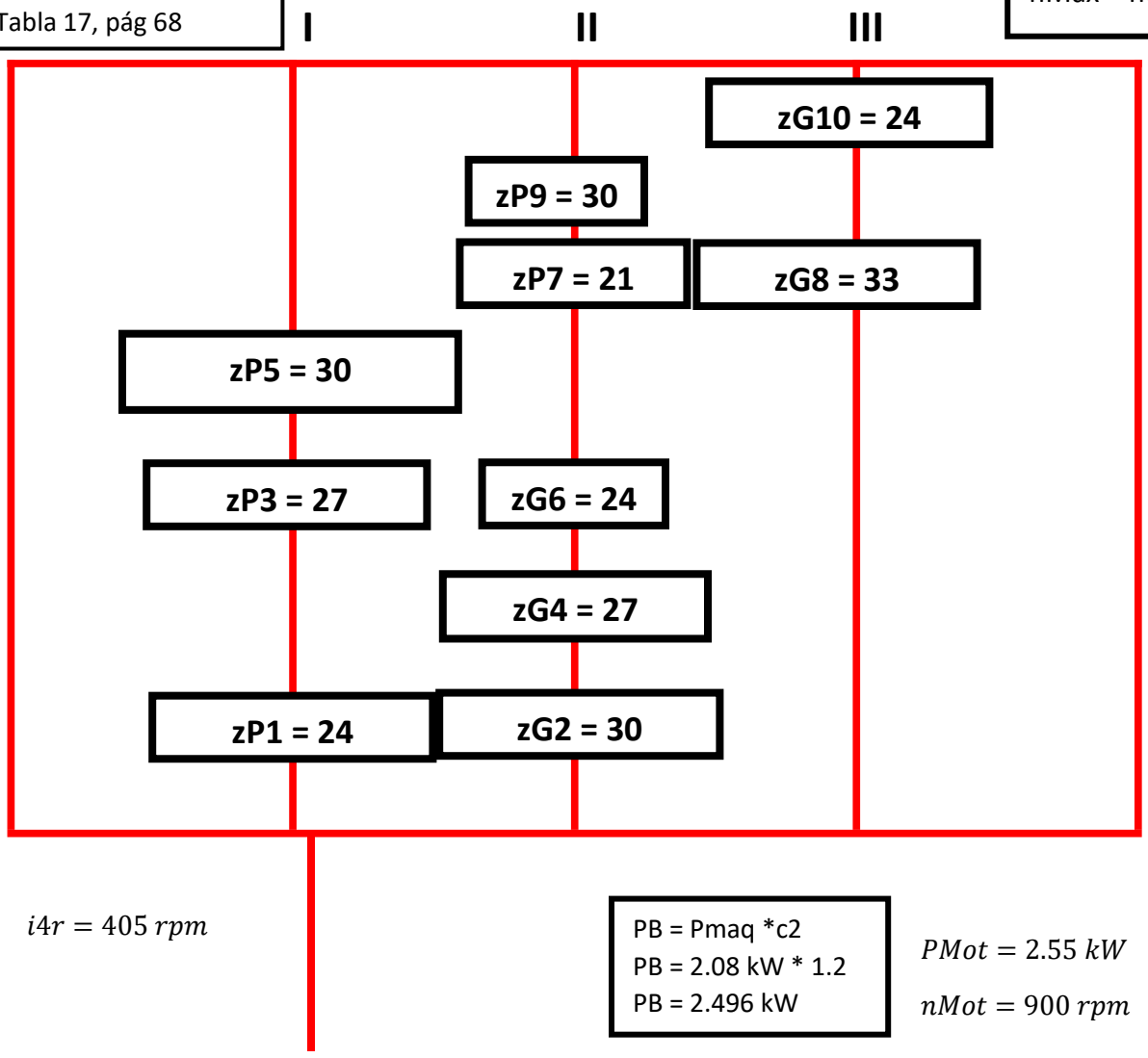


$$i_0 = \frac{n_m}{n_4} = \frac{950\ rpm}{400.1\ rpm} = 2.249 < 5$$

Relación de velocidad	i1	i2	i3	i4	i5
Valores	$\frac{1}{\varphi}$	φ^0	φ^1	$\frac{1}{\varphi^2}$	φ^1
φ = 1.26	$\frac{1}{1.26}$	1.26^0	1.26^1	$\frac{1}{1.26^2}$	1.26^1
Sustitución	0.793	1	1.26	0.630	1.26
Zp:ZG	24:30	27:27	30:24	21:33	30:24
Σz	54				
m	2.5				

C2 = 1.2
Motor 3F TA
Servicio hasta 10 horas
Tabla 17, pág 68

Pmaq = 2.083 kW
Nmin = n1 = 200 rpm
nMax = n6 = 635.2 rpm



$i4r = 405\ rpm$

PB = Pmaq *c2
PB = 2.08 kW * 1.2
PB = 2.496 kW

$PMot = 2.55\ kW$

$nMot = 900\ rpm$

M

Dd2 = 140 mm	i = 2.249	Dd1 = 63 mm

Polea

Tipo SPZ

Pmot = 2.55 kW Diagrama 4, página 54

Nmot = 900 rpm

ddk = dd1

ddg = dd2

$$i0 = \frac{nmot}{n4} = \frac{900\,rpm}{400.1\,rpm} = 2.249$$

$$i0 = 2.249$$

dd1 = 63 mm

SPZ; dd1 max 100 mm

Tabla 9 página 42

$$i0 = \frac{dd2}{dd1}$$

$$dd2 = dd1 * i0 = 63mm * 2.249 = 141.687\,mm$$

$$dd2 = 141.687\,mm$$

$$dd2 = 140\,mm$$

$$i_{vorh} = \frac{dd2}{dd1} = \frac{140\,mm}{63\,mm} = 2.222$$

$$n_{4vorh} = \frac{n_{mot}}{i_{vorh}} = \frac{900rpm}{2.222} = 405\,rpm$$

$$a > 0.7(dd_1 + dd_2) = (0.7)(63 + 140) = 142.1mm$$

$$a < 2(dd_1 + dd_2) = (2)(63 + 140) = 406mm$$

$$a = 274.05mm$$

$$L_{dth} = 2a + (1.57)(dd_1 + dd_2) + \frac{(dd_2 - dd_1)^2}{4a}$$

$$L_{dth} = (2)(274.05mm) + (1.57)(63 + 140) + \frac{(140 - 63)^2}{(4)(274.05)}$$

$$L_{dth} = 872.419\ mm$$

Ajuste mínimo = 15mm

Página 75

$L_{dst} = 875mm$ $C_3 = 0.885$

Tabla de la Página 18 Tabla18 página 69 por interpolación

$$a_{nom} = a + \frac{L_{dst} - L_{dth}}{2}$$

$$a_{nom} = 274.05mm + \frac{875mm - 872.419mm}{2}$$

$$a_{nom} = 275.34\ mm$$

Ajuste mínimo x/y de la distancia entre ejes anom

Ajuste mínimo x para tensado = 15mm

Ajuste mínimo para montaje = 15 mm

Tala 20 página 75, para valor de Ldst = 875 mm

Velocidad y frecuencia de flexión de la correa

$$v = \frac{\pi * dd_1 * nm}{60000} = \frac{\pi * 63mm * 900\ rpm}{60000}$$

$$v = 2.967\ m/s$$

$$f_b = \frac{2 * 1000 * v}{L_{dst}} = \frac{2 * 1000 * 2.967}{875mm}$$

$$f_b = 6.782\ 1/s$$

Factor de desarrollo

$C_3 = 0.885$ *Tabla 18, página 69 por interpolación

Potencia Nominal de correa

$P_N = 0.61 + 0.155 = 0.79\ kW$ *Tabla 26, página 82

Número de correas

$$z = \frac{P_m * C_2}{P_N * C_1 * C_3} = \frac{(2.55kW)(1.2)}{(0.79kW)(0.99)(0.885)} = 4.421$$

$z = 4.421\ \therefore z = 5\ correas$

Rpm reales

$$n_{4r} = \frac{n_{mot} * dd1}{dd2}$$

$$n_{4r} = \frac{900 * 63}{140}$$

$$n_{4r} = 405\ rpm$$

$$n_{3r} = \frac{n_{4r} * zP1}{zG2}$$

$$n_{3r} = \frac{405 * 24}{30}$$

$$n_{3r} = 324\ rpm$$

$$n_{1r} = \frac{n_{3r} * zP7}{zG8}$$

$$n_{1r} = \frac{324 * 21}{33}$$

$$n_{1r} = 206.2\ rpm$$

$$n_{4r} = \frac{n_{3r} * zP9}{zG10}$$

$$n_{4r} = \frac{324 * 30}{24}$$

$$n_{4r} = 405\ rpm$$

$$n_{4r} = \frac{n_{4r} * zP3}{zG4}$$

$$n_{4r} = \frac{405 * 27}{27}$$

$$n_{4r} = 405\ rpm$$

$$n_{2r} = \frac{n_{4r} * zP7}{zG8}$$

$$n_{2r} = \frac{405 * 21}{33}$$

$$n_{2r} = 257.7\ rpm$$

$$n_{5r} = \frac{n_{4r} * zP9}{zG10}$$

$$n_{5r} = \frac{405 * 30}{24}$$

$$n_{5r} = 506.3\ rpm$$

$$n_{5r} = \frac{n_{4r} * zP5}{zG6}$$

$$n_{5r} = \frac{405 * 30}{24}$$

$$n_{5r} = 506.3\ rpm$$

$$n_{3r} = \frac{n_{5r} * zP7}{zG8}$$

$$n_{3r} = \frac{506.3 * 21}{33}$$

$$n_{3r} = 322.2\ rpm$$

$$n_{6r} = \frac{n_{5r} * zP7}{zG8}$$

$$n_{6r} = \frac{506.3 * 30}{24}$$

$$n_{6r} = 632.9\ rpm$$

Piñón 1

$$DP1 = zP1 * m$$

$$DP1 = 24 * 2.5$$

$$DP1 = 60\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$MTI = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTI = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTI = 60.130\ N * m$$

Engrane 2,4,6

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{3r}}$$

$$MTII = \frac{(9.55 * 10^3 * 2.55)}{324}$$

$$MTII = 75.162\ N * m$$

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTII = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTII = 60.130\ N * m$$

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{5r}}$$

$$MTII = \frac{(9.55 * 10^3 * 2.55)}{506.3}$$

$$MTII = 48.099\ N * m$$

Engrane 2

$$DG2 = zG2 * m$$

$$DG2 = 30 * 2.5$$

$$DG2 = 75\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$FtzG2 - zP1 = \frac{(2 * MTII)}{DG2}$$

$$FtzG2 - zP1 = \frac{(2 * 75.162\ N * m)}{0.075\ m}$$

$$FtzG2 - zP1 = 2004.32\ N$$

Fuerza tangencial

$$FrzG2 - zp1 = FtzG2 - zP1 * tang\phi$$

$$FrzG2 - zp1 = 2004.32 * tang(20°)$$

$$FrzG2 - zp1 = 729.513\ N$$

Piñón 3

$$DP3 = zP3 * m$$

$$DP3 = 27 * 2.5$$

$$DP3 = 67.5\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$MTI = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTI = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTI = 60.130\ N * m$$

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTII = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTII = 60.130\ N * m$$

Engrane 4

$$DG4 = zG4 * m$$

$$DG2 = 27 * 2.5$$

$$DG2 = 67.5\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$FtzG4 - zP3 = \frac{(2 * MTII)}{DG4}$$

$$FtzG4 - zP3 = \frac{(2 * 60.130\ N * m)}{0.0675\ m}$$

$$FtzG4 - zP3 = 1781.630\ N$$

Fuerza tangencial

$$FrzG4 - zp3 = FtzG4 - zP3 * tang\phi$$

$$FrzG4 - zp3 = 1781.630 * tang(20°)$$

$$FrzG4 - zp3 = 648.460\ N$$

Piñón 5

$$DP5 = zP5 * m$$

$$DP5 = 30 * 2.5$$

$$DP5 = 75\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$MTI = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTI = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTI = 60.130\ N * m$$

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{5r}}$$

$$MTII = \frac{\left(9.55 * 10^3 * 2.55\right)}{506.3}$$

$$MTII = 48.099\ N * m$$

Engrane 6

$$DG6 = zG6 * m$$

$$DG6 = 24 * 2.5$$

$$DG6 = 60\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$FtzG6 - zP5 = \frac{(2 * MTII)}{DG6}$$

$$FtzG6 - zP5 = \frac{(2 * 48.099\ N * m)}{0.060\ m}$$

$$FtzG6 - zP5 = 1603.3\ N$$

Fuerza tangencial

$$FrzG6 - zp5 = FtzG6 - zP5 * tang\phi$$

$$FrzG6 - zp5 = 1603.3 * tang(20°)$$

$$FrzG6 - zp5 = 583.553\ N$$

Piñón 7

$$DP7 = zP7 * m$$

$$DP7 = 21 * 2.5$$

$$DP7 = 52.5\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$MTI = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTI = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTI = 60.130\ N * m$$

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{1r}}$$

$$MTII = \frac{\left(9.55 * 10^3 * 2.55\right)}{206.2}$$

$$MTII = 118.101\ N * m$$

Engrane 8

$$DG8 = zG8 * m$$

$$DG8 = 33 * 2.5$$

$$DG8 = 82.5\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$FtzG8 - zP7 = \frac{(2 * MTII)}{DG8}$$

$$FtzG8 - zP7 = \frac{(2 * 118.101\ N * m)}{0.0825\ m}$$

$$FtzG8 - zP7 = 2863.054\ N$$

Fuerza tangencial

$$FrzG8 - zp7 = FtzG8 - zP7 * tang\phi$$

$$FrzG8 - zp7 = 2863.054 * tang(20°)$$

$$FrzG8 - zp7 = 1042.066\ N$$

Piñón 9

$$DP9 = zP9 * m$$

$$DP9 = 30 * 2.5$$

$$DP9 = 75\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$MTI = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTI = \frac{(9.55 * 10^3 * 2.55)}{405}$$

$$MTI = 60.130\ N * m$$

$$MTII = \frac{(9.55 * 10^3 * P)}{n_{4r}}$$

$$MTII = \frac{\left(9.55 * 10^3 * 2.55\right)}{405}$$

$$MTII = 60.130\ N * m$$

Engrane 10

$$DG10 = zG10 * m$$

$$DG10 = 24 * 2.5$$

$$DG10 = 60\ mm$$

$$F = 10 * m$$

$$F = 10 * 2.5$$

$$F = 25\ mm$$

$$FtzG10 - zP9 = \frac{(2 * MTII)}{DG10}$$

$$FtzG10 - zP9 = \frac{(2 * 60.130\ N * m)}{0.060\ m}$$

$$FtzG10 - zP9 = 2004.333\ N$$

Fuerza tangencial

$$FrzG10 - zp9 = FtzG10 - zP9 * tang\phi$$

$$FrzG10 - zp9 = 2004.333 * tang(20°)$$

$$FrzG10 - zp9 = 729.517\ N$$