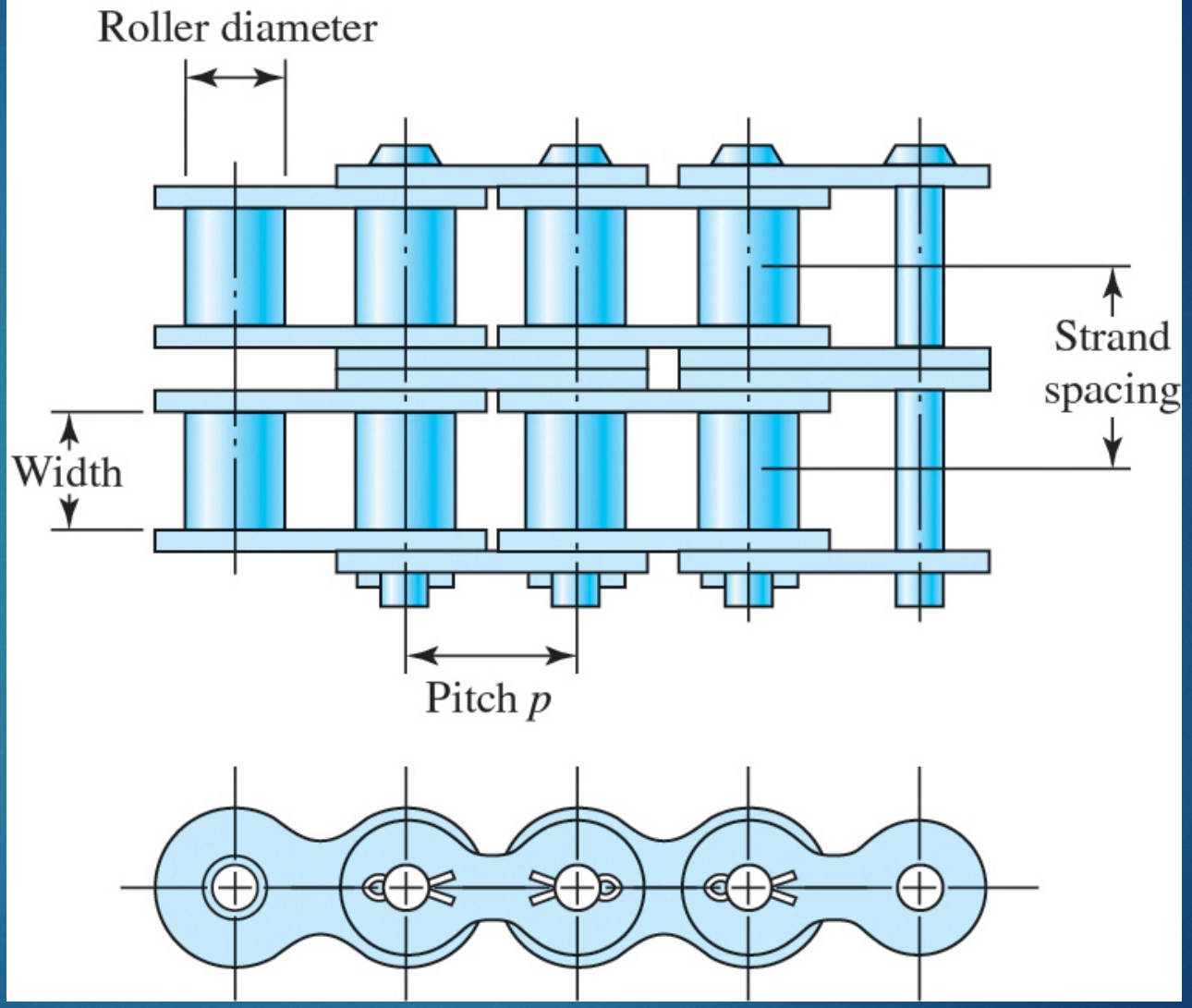
67.29 Proyecto de Máquinas

TRANSMISIÓN POR CADENAS

Cadena de rodillos



- Fig. 17–16

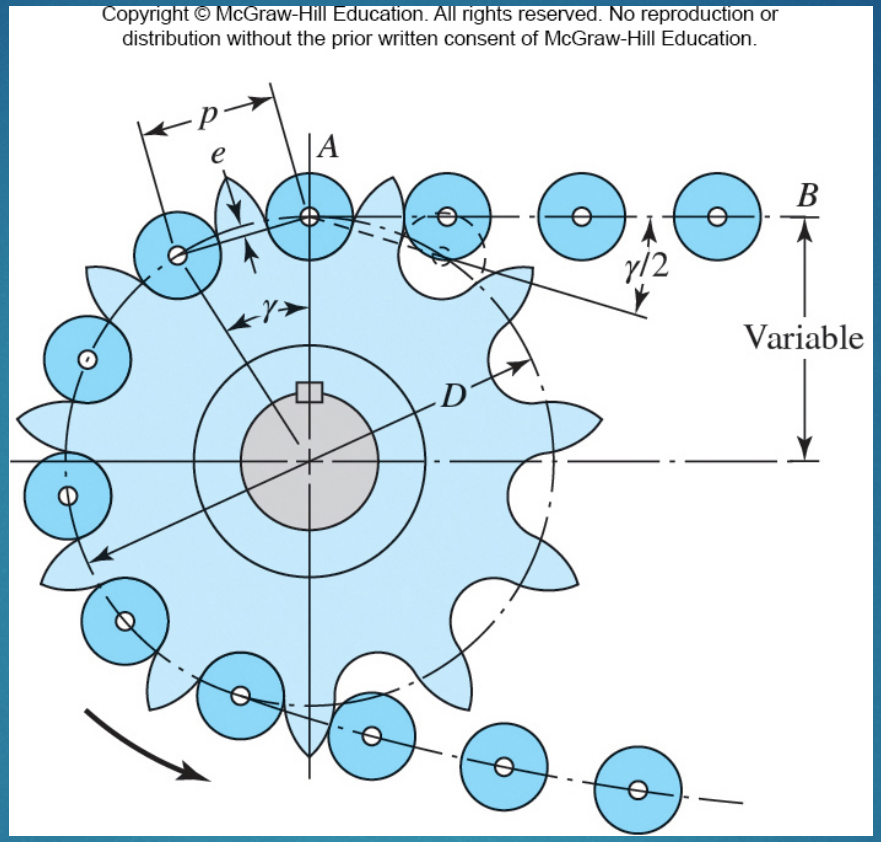
- Access the text alternative for slide images.

Dimensiones de las cadenas de rodillos estándar estadounidenses

ANSI Chain Number	Pitch, in (mm)	Width, in (mm)	Minimum Tensile Strength, lbf (N)	Average Weight, lbf/ft (N/m)	Roller Diameter, in (mm)	Multiple-Strand Spacing, in (mm)
25	0.250 (6.35)	0.125 (3.18)	780 (3 470)	0.09 (1.31)	0.130 (3.30)	0.252 (6.40)
35	0.375 (9.52)	0.188 (4.76)	1 760 (7 830)	0.21 (3.06)	0.200 (5.08)	0.399 (10.13)
41	0.500 (12.70)	0.25 (6.35)	1 500 (6 670)	0.25 (3.65)	0.306 (7.77)	— —
40	0.500 (12.70)	0.312 (7.94)	3 130 (13 920)	0.42 (6.13)	0.312 (7.92)	0.566 (14.38)
50	0.625 (15.88)	0.375 (9.52)	4 880 (21 700)	0.69 (10.1)	0.400 (10.16)	0.713 (18.11)
60	0.750 (19.05)	0.500 (12.7)	7 030 (31 300)	1.00 (14.6)	0.469 (11.91)	0.897 (22.78)
80	1.000 (25.40)	0.625 (15.88)	12 500 (55 600)	1.71 (25.0)	0.625 (15.87)	1.153 (29.29)
100	1.250 (31.75)	0.750 (19.05)	19 500 (86 700)	2.58 (37.7)	0.750 (19.05)	1.409 (35.76)
120	1.500 (38.10)	1.000 (25.40)	28 000 (124 500)	3.87 (56.5)	0.875 (22.22)	1.789 (45.44)
140	1.750 (44.45)	1.000 (25.40)	38 000 (169 000)	4.95 (72.2)	1.000 (25.40)	1.924 (48.87)
160	2.000 (50.80)	1.250 (31.75)	50 000 (222 000)	6.61 (96.5)	1.125 (28.57)	2.305 (58.55)
180	2.250 (57.15)	1.406 (35.71)	63 000 (280 000)	9.06 (132.2)	1.406 (35.71)	2.592 (65.84)
200	2.500 (63.50)	1.500 (38.10)	78 000 (347 000)	10.96 (159.9)	1.562 (39.67)	2.817 (71.55)
240	3.00 (76.70)	1.875 (47.63)	112 000 (498 000)	16.4 (239)	1.875 (47.62)	3.458 (87.83)

- Table 17–19

Cadena y piñón



- Fig. 17–16 **(a)**

$$\sin\frac{\gamma}{2}\frac{p/2}{D/2} \qquad \text{or} \qquad D = \frac{p}{\sin(\gamma/2)}$$

$$D = \frac{p}{\sin(180°/N)} \qquad \textbf{(17 - 29)}$$

- Access the text alternative for slide images.

Velocidad de cadena

$$V = \frac{Npn}{12} \text{ feet per minute} \qquad \textbf{(17-30)}$$

- donde N = número de dientes de piñón
- p = paso de cadena, en mm
- n = velocidad de piñón, rev/min

$$v_{\max} = \frac{\pi Dn}{2} = \frac{\pi np}{12\sin(\gamma/2)} \qquad \textbf{(b)}$$

$$d = D\cos\frac{\gamma}{2} \qquad \textbf{(c)}$$

$$v_{\min} = \frac{\pi dn}{12} = \frac{\pi np\cos(\gamma/2)}{12\sin(\gamma/2)} \qquad \textbf{(d)}$$

Variación de velocidad Cordal

$$\frac{\Delta V}{V} = \frac{v_{max} - v_{min}}{V} = \frac{\pi}{N}\left[\frac{1}{\sin(180°/N)} - \frac{1}{\tan(180°/N)}\right] \quad \textbf{(17 - 31)}$$

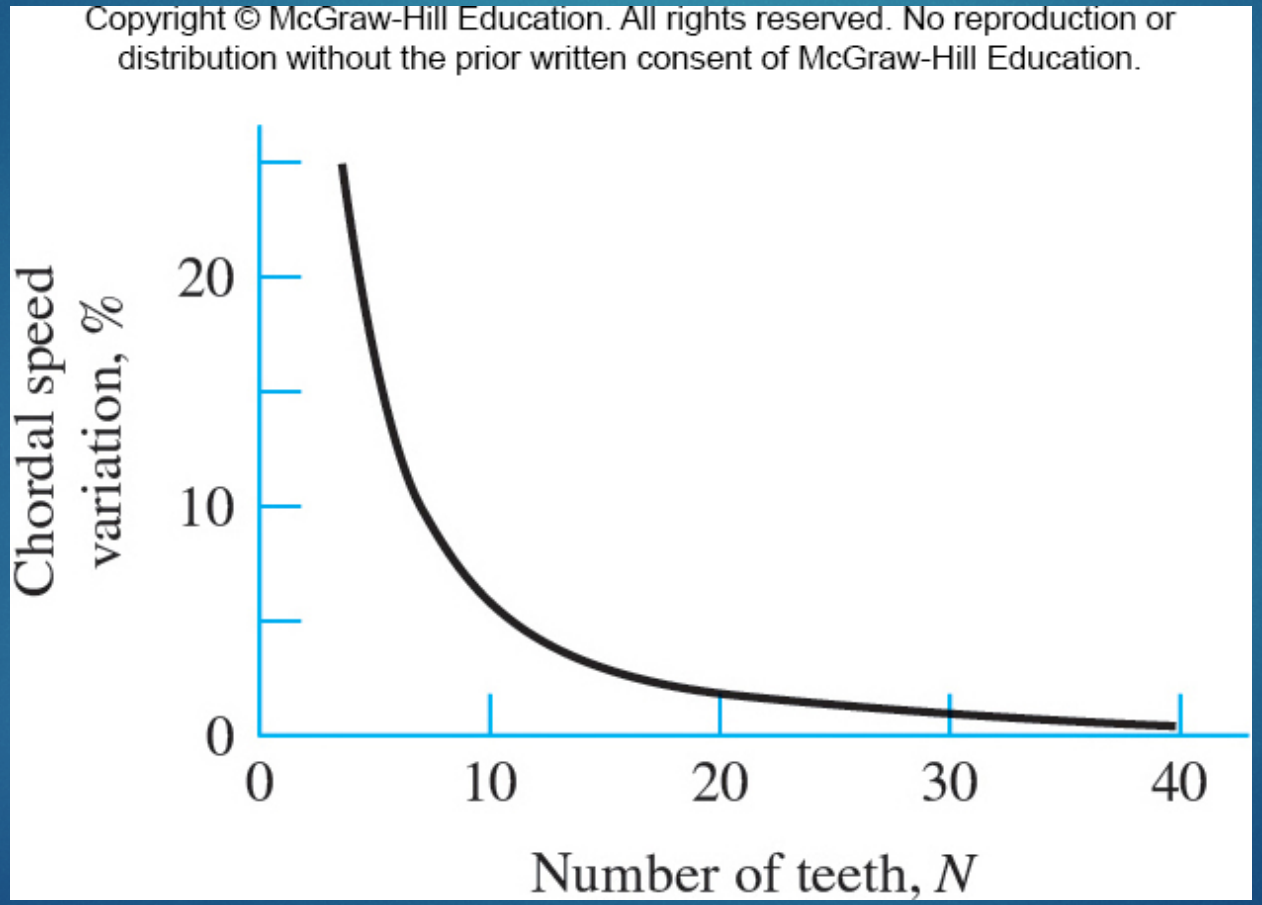


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Fig. 17–18

Available Sprocket Tooth Counts

- **Table 17–21** Single-Strand Sprocket Tooth Counts Available from One Supplier*

No.	Available Sprocket Tooth Counts
25	8-30, 32, 34, 35, 36, 40, 42, 45, 48, 54, 60, 64, 65, 70, 72, 76, 80, 84, 90, 95, 96, 102, 112, 120
35	4-45, 48, 52, 54, 60, 64, 65, 68, 70, 72, 76, 80, 84, 90, 95, 96, 102, 112, 120
41	6-60, 64, 65, 68, 70, 72, 76, 80, 84, 90, 95, 96, 102, 112, 120
40	8-60, 64, 65, 68, 70, 72, 76, 80, 84, 90, 95, 96, 102, 112, 120
50	8-60, 64, 65, 68, 70, 72, 76, 80, 84, 90, 95, 96, 102, 112, 120
60	8-60, 62, 63, 64, 65, 66, 67, 68, 70, 72, 76, 80, 84, 90, 95, 96, 102, 112, 120
80	8-60, 64, 65, 68, 70, 72, 76, 78, 80, 84, 90, 95, 96, 102, 112, 120
100	8-60, 64, 65, 67, 68, 70, 72, 74, 76, 80, 84, 90, 95, 96, 102, 112, 120
120	9-45, 46, 48, 50, 52, 54, 55, 57, 60, 64, 65, 67, 68, 70, 72, 76, 80, 84, 90, 96, 102, 112, 120
140	9-28, 30, 31, 32, 33, 34, 35, 36, 37, 39, 40, 42, 43, 45, 48, 54, 60, 64, 65, 68, 70, 72, 76, 80, 84, 96
160	8-30, 32–36, 38, 40, 45, 46, 50, 52, 53, 54, 56, 57, 60, 62, 63, 64, 65, 66, 68, 70, 72, 73, 80, 84, 96
180	13-25, 28, 35, 39, 40, 45, 54, 60
200	8-30, 32, 35, 38, 40, 42, 44, 45, 48, 52, 53, 54, 56, 58, 59, 60, 63, 64, 65, 68, 70, 72
240	9-30, 32, 35, 36, 40, 44, 45, 48, 52, 54, 60

*Morse Chain Company, Ithaca, NY, Type B hub sprockets.

Tooth Correction Factors K_1

Number of Teeth on Driving Sprocket	K_1 Pre-extreme Horsepower	K_1 Post-extreme Horsepower
11	0.62	0.52
12	0.69	0.59
13	0.75	0.67
14	0.81	0.75
15	0.87	0.83
16	0.94	0.91
17	1.00	1.00
18	1.06	1.09
19	1.13	1.18
20	1.19	1.28
N	$(N_1/17)^{1.08}$	$(N_1/17)^{1.5}$

- Table 17–22

Multiple-Strand Factors K_2

Number of Strands	K_2
1	1.0
2	1.7
3	2.5
4	3.3
5	3.9
6	4.6
8	6.0

- Table 17–23

Clasificaciones nominales de potencia para cadena

- De la publicación de la Asociación Americana de Cadenas Cadenas Cadenas cadenas para la transmisión de energía y el manejo de materiales
- Para cadena de una sola hebra
- Potencia nominal, placa de enlace limitada
- $$H_1 = 0.004 N_1^{1.08} n_1^{0.9} p^{(3-0.07p)} \quad \text{hp} \qquad \textbf{(17-32)}$$
- Potencia nominal, limitada por rodillos
- $$H_2 = \frac{1000 K_r N_1^{1.5} p^{0.8}}{n_1^{1.5}} \quad \text{hp} \qquad \textbf{(17-33)}$$
- where N_1 = number of teeth in the smaller sprocket
  - n_1 = sprocket speed, rev/min
  - p = pitch of the chain, in
  - K_r = 29 for chain numbers 25, 35; 3.4 for chain 41; and 17 for chains 40–240

Chain Dimensions

- Chain length in pitches

$$\frac{L}{p} \approx \frac{\sim 2C}{p} + \frac{N_1 + N_2}{2} + \frac{(N_2 + N_1)^2}{4\pi^2 C/p} \qquad \textbf{(17-34)}$$

- Center-to-center distance

$$C = \frac{P}{4}\left[-A + \sqrt{A^2 - 8\left(\frac{N_2 - N_1}{2\pi}\right)^2}\right] \qquad \textbf{(17-35)}$$

$$A = \frac{N_1 + N_2}{2} - \frac{L}{P} \qquad \textbf{(17-36)}$$

Chain Drive Power

- Allowable power

$$H_a = K_1 K_2 H_{\text{tab}} \qquad \textbf{(17 - 37)}$$

- where K_1 = correction factor for tooth number other than 17 (Table 17–22)
  - K_2 = strand correction (Table 17–23)
- Power that must be transmitted

$$H_d = H_{\text{nom}} K_s n_d \qquad \textbf{(17 - 38)}$$

Variations in Tabulated Power Conditions

- Power ratings in Table 17–20 are for chains of 100 pitch length and 17-tooth sprocket.
- For deviations from this,

$$H_2 = 1000\left[K_r\left(\frac{N_1}{n_1}\right)^{1.5} P^{0.8}\left(\frac{L_p}{100}\right)^{0.4}\left(\frac{15\,000}{h}\right)^{0.4}\right] \qquad \textbf{(17-39)}$$

- From a deviation viewpoint,

$$\frac{H_2^{2.5} h}{N_1^{3.75} L_p} = \text{constant} \qquad \textbf{(17-40)}$$

Recommended Maximum Chain Speed

$$n_1 \le 1000\left[\frac{82.5}{7.95^{p}(1.0278)^{N_1}(1.323)^{F/1000}}\right]^{1/(1.59\log p+1.873)} \quad \text{rev/min}$$

- where *F* is the chain tension in pounds

Chain Dimensions

- Chain length in pitches

$$\frac{L}{p} \approx \frac{\sim 2C}{p} + \frac{N_1 + N_2}{2} + \frac{(N_2 + N_1)^2}{4\pi^2 C/p} \qquad \textbf{(17-34)}$$

- Center-to-center distance

$$C = \frac{P}{4}\left[-A + \sqrt{A^2 - 8\left(\frac{N_2 - N_1}{2\pi}\right)^2}\right] \qquad \textbf{(17-35)}$$

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- Allowable power

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Example 17–5 (1)

- Select drive components for a 2:1 reduction, 90-hp input at 300 rev/min, moderate shock, an abnormally long 18-hour day, poor lubrication, cold temperatures, dirty surroundings, short drive *C/p* = 25.
- **Solution**
- *Function:* H_{nom} = 90 hp, n_1 = 300 rev/min, *C/p* = 25
- *Design factor:* Choose n_d = 1.5
- *Service factor:* Choose K_s = 1.3 for moderate shock
- *Sprocket teeth:* N_1 = 17 teeth, N_2 = 34 teeth, K_1 = 1, K_2 = 1, 1.7, 2.5, 3.3
- *Chain number of strands:* From Equations (17–37) and (17–38), with $H_a = H_d$,

$$H_{tab} = \frac{n_d K_s H_{nom}}{K_1 K_2} = \frac{1.5(1.3)90}{(1)K_2} = \frac{176}{K_2}$$

Example 17–5 (2)

- Form a table:

Número de Eslabones	176/K2 (Table 17–23)	Chain Number (Table 17–20)	Lubrication Type
1	176/1 = 176	200	C′
2	176/1.7 = 104	160	C
3	176/2.5 = 70.4	140	B
4	176/3.3 = 53.3	140	B

- **Decision**
- 3 strands of number 140 chain (from Table 17–20, H_{tab} is 72.4 hp).
- *Number of pitches in the chain* $\frac{L}{p} = \frac{2C}{p} + \frac{N_1 + N_2}{2} + \frac{(N_2 - N_1)^2}{4\pi^2 C/p}$

$$= 2(25) + \frac{17+34}{2} + \frac{(34-17)^2}{4\pi^2(25)} = 75.79 \text{ pitches}$$

- **Decision**
- Use 76 pitches. Then $L/p = 76$.

Example 17–5 (3)

- *Identify the center-to-center distance:* From Equations (17–35) and (17–36),

$$A = \frac{N_1 + N_2}{2} - \frac{L}{p} = \frac{17 + 34}{2} - 76 = -50.5$$

$$C = \frac{p}{4}\left[-A + \sqrt{A^2 - 8\left(\frac{N_2 - N_1}{2\pi}\right)^2}\right]$$

$$= \frac{p}{4}\left[50.5 + \sqrt{50.5^2 - 8\left(\frac{34 - 17}{2\pi}\right)^2}\right] = 25.104\,p$$

- For a 140 chain, $p = 1.75$ in. Thus,

$$C = 25.104\,p = 25.104(1.75) = 43.93 \text{ in}$$

- *Lubrication:* Type B
- *Comment:* This is operating on the pre-extreme portion of the power, so durability estimates other than 15 000 h are not available. Given the poor operating conditions, life will be much shorter.