Design of

Helical spring

What is helical spring

Helical spring is a spiral wound wire with a constant coil diameter and uniform pitch.

Function of Helical spring

- Used to store energy and subsequently release it
- To absorb shock
- To maintain a force between contacting surfaces

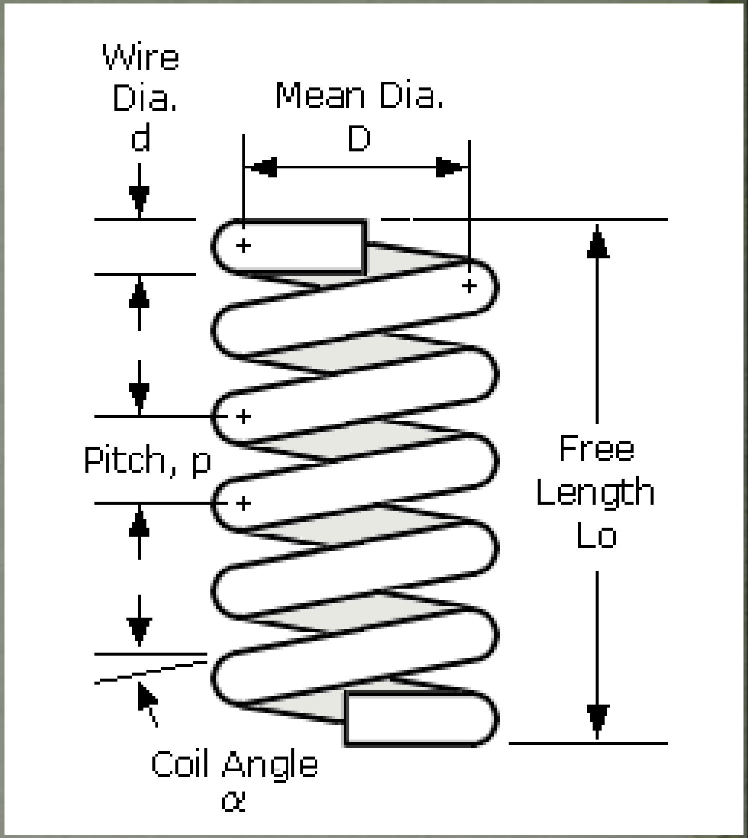
Design consideration of helical spring

The design of a new spring involves the following considerations:

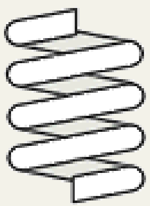
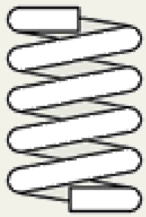
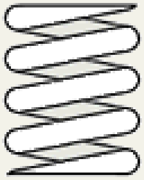
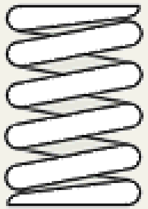
- Space into which the spring must fit and operate.
- Values of working forces and deflections.
- Accuracy and reliability needed.
- Tolerances and permissible variations in specifications.
- Environmental conditions such as temperature, presence of a corrosive atmosphere.
- Cost and qualities needed.

Nomenclature of Helical spring

C = Spring Index D/d
d = wire diameter (m)
D = Spring diameter (m)
Di = Spring inside diameter (m)
Dil = Spring inside diameter (loaded) (m)
E = Young's Modulus (N/m2)
F = Axial Force (N)
G = Modulus of Rigidity (N/m2)
K W = Wahl Factor = [(4C-1)/(4C+5)}]+ (0,615/C)
L 0 = Free Length (m)
L s = Solid Length (m)
n t = Total number of coils
n = Number of active coils
p = pitch (m)
y = distance from neutral axis to outer fibre of wire (m)
τ = shear stress (N/m2)
τ max = Max shear stress (N/m2)
θ = Deflection (radians)



Effect of End treatment.

	Plain Ends	Closed Ends	Plain Ends Ground	Closed Ends Ground*
				
Active Coils, N_a	N_t	N_t-2	N_t-1	N_t-2
Free Length, L_o	$N_a p+d$	$N_a p+3d$	$(N_a+1)p$	$N_a p+2d$
Solid Length, L_s	$(N_a+1)d$	$(N_a+1)d$	$(N_a+1)d$	$(N_a+2)d$
Pitch, p	$(L_o-d)/N_a$	$(L_o-3d)/N_a$	$L_o/(N_a+1)$	$(L_o-2d)/N_a$

The module calculates the following design parameters:

1. *Outer Diameter* (Do)

$$D_o = D + d$$

2. *Spring Index* (C)

$$D_i = D - d$$

index range is 4 to 12

3. *Slenderness ratio*

$$(L_o / D)$$

4. *Spring rate (k)*

$$k = \frac{Gd^4}{8D^3 N_a}$$

5. *Maximum load*

$$P_{max} = k \cdot \delta_{max}$$

6. *Corrected maximum stress*

$$\tau_{max}' = K_w \cdot \tau_{max}$$

7. *Uncorrect maximum stress*

$$\tau_{max} = \frac{8DP_{max}}{\pi d^3}$$

8. *Wahl correction factor*

$$K_w = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

9. Maximum deflection

$$\delta_{max} = L_o - L_s$$

10. Spring mass

$$M = \rho L_w \cdot \frac{\pi d^2}{4}$$

11. Wire length

$$L_w = \pi D\left(\frac{N_a}{\cos(\alpha)} + N_{ia}\right)$$

12. Shear stress

$$G = \frac{E}{2(1+\nu)}$$

13. uncorrected Shear stress

$$\tau_{max} = \frac{8DP_{max}}{\pi d^3}$$

14. Natural frequency

$$f_n = \frac{1}{2}\sqrt{\frac{k}{M}}$$

Spring testing machine

Thanks