

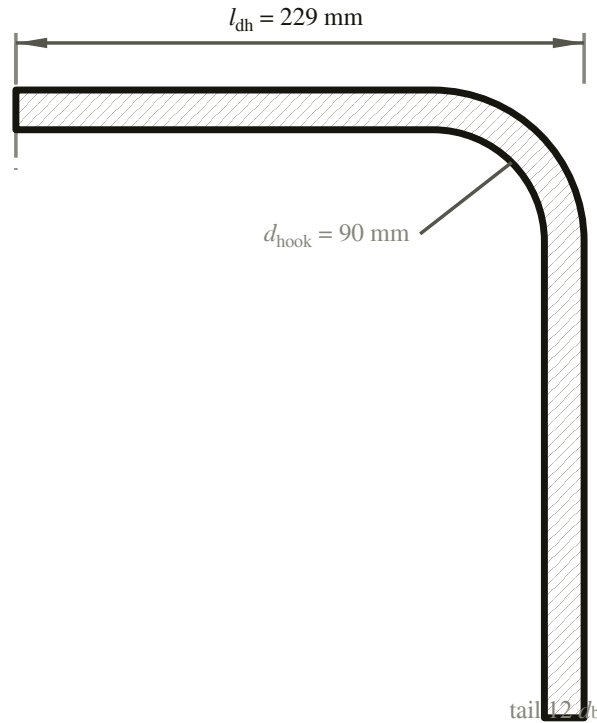
Standard hook development length

Development length of a standard hook in tension, to CSA A23.3-24 Cl. 12.5.

Inputs

Symbol	Value	Unit	Description
f_c	25	MPa	Concrete compressive strength
f_y	400	MPa	Specified yield strength, f_{yg}
c_{side}	50	mm	Side cover normal to the plane of the hook
A_{th}	0	mm ²	Ties or stirrups enclosing the hooks, all legs
n_h	2		Number of hooked bars at the section
s_h	150	mm	Centre-to-centre spacing of the hooked bars
$A_{s,\text{ratio}}$	1		A_s required over provided, Cl. 12.5.5
c_{tb}	50	mm	Top or bottom cover to the hook
s_t	45	mm	Spacing of ties enclosing the hook along l_{dh}
e_t	30	mm	First tie from the outside of the bend
rebar	15M		Bar size
hook _{type}	90 deg		Hook type
in _{core}	No		Hook ends inside a column core
coating	Uncoated reinforcement		Bar coating
conc _{density}	Normal-density concrete		Concrete density
end	Not at a discontinuous end		Member end, Cl. 12.5.6

Figures



Standard hook at its bend diameter, drawn from the values above.

Results

Quantity	Description	Value	Unit
l_{dh}	Hook development length required	229	mm
l_{hb}	Basic hooked bar development length, Cl. 12.5.2	229	mm

Derivation

$$d_b = 16 \text{ mm}$$

Bar diameter | 15M

$$A_b = 200 \text{ mm}^2$$

Bar area | 15M

$$d_{hook} = 90 \text{ mm}$$

Standard hook bend diameter | 15M

$$\theta_{\text{hook}} = 90$$

Hook bend angle, degrees | 90 deg

Branch: $c_{\text{side}} \geq 6 \cdot d_b$ did not hold

$$k_l = 1$$

Other bar location | Table 12.5

$$k_c = 1$$

Uncoated | Table 12.5

$$k_d = 1$$

Normal-density concrete | Table 12.5

$$\begin{aligned} A_{\text{hs}} &= n_h \cdot A_b \\ &= 2 \cdot 200 \text{ mm}^2 \\ &= 400 \text{ mm}^2 \end{aligned}$$

Cl. 3.2, A_hs

Branch: $A_{\text{th}} \geq 0.4 \cdot A_{\text{hs}}$ did not hold

Branch: $s_h \geq 6 \cdot d_b$ held

$$k_r = 0.6$$

Hooked bars at 6 d_b or more | Table 12.5

$$\begin{aligned} l_{\text{hb}} &= \frac{k_l \cdot k_c \cdot k_d \cdot k_r \cdot f_y \cdot \left(\frac{d_b}{1 \text{ mm}}\right)^{1.5} \cdot 1 \text{ mm}}{30 \cdot \left(\frac{\min(f_c, 64 \text{ MPa})}{1 \text{ MPa}}\right)^{0.25} \cdot 1 \text{ MPa}} && \text{Cl. 12.5.2, with the 8 MPa cap of Cl. 12.1.2} \\ &= \frac{1 \cdot 1 \cdot 1 \cdot 0.6 \cdot 400 \text{ MPa} \cdot \left(\frac{16 \text{ mm}}{1 \text{ mm}}\right)^{1.5} \cdot 1 \text{ mm}}{30 \cdot \left(\frac{\min(25 \text{ MPa}, 64 \text{ MPa})}{1 \text{ MPa}}\right)^{0.25} \cdot 1 \text{ MPa}} \\ &= 229 \text{ mm} \end{aligned}$$

$$\begin{aligned} l_{\text{dh}} &= \max(l_{\text{hb}} \cdot A_{s,\text{ratio}}, 8 \cdot d_b, 150 \text{ mm}) \\ &= \max(229 \text{ mm} \cdot 1, 8 \cdot 16 \text{ mm}, 150 \text{ mm}) \\ &= 229 \text{ mm} \end{aligned}$$

Cl. 12.5.1 and 12.5.5