Input Summary

Input	Description	Value
fy	**f_y**	60000psi
fc	**f'_c** *Concrete strength, f'_c*	4000psi
$lambda$	**Modification Factor for Concrete, λ**	1.0
psi_e	**Modification Factor for Epoxy Coating, Ψ_e** *For development length of straight and hooked deformed bars in tension*	1
$condition$	**Spacing/cover condition of rebar**	case_a
psi_r	**Modification Factor for Confining Reinforcement, Ψ_r** *For development length of hooked deformed bars in tension*	1
psi_o	**Modification Factor for Location, Ψ_o** *For development length of hooked deformed bars in tension*	1
db	**Selected Rebar d_b**	#6

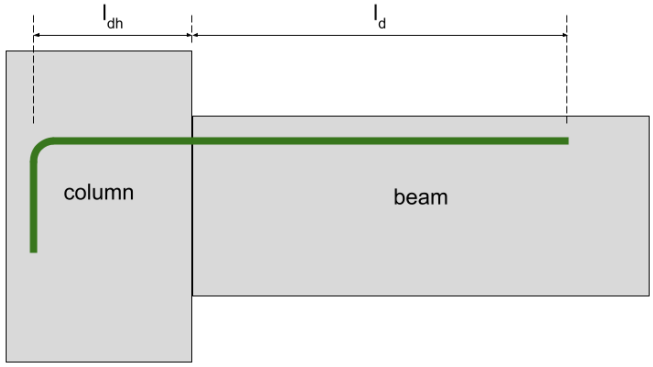
Development and Splice Length of Deformed Bars (ACI 318-19)

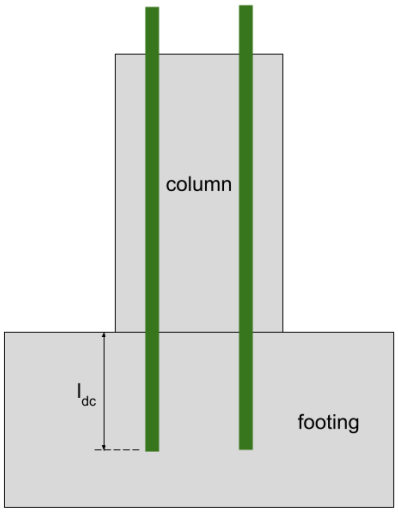
Development Length for fy = 60000 psi and f'c = 4000 psi

Rebar	Bar Dia. in.	Top Bars Tension l_d in.	Bottom Bars Tension l_d in.	Compression l_{dc} in.
#3	0.375	19	15	8
#4	0.5	25	19	10
#5	0.625	32	24	12
#6	0.75	38	29	15
#7	0.875	55	42	17
#8	1	62	48	19
#9	1.128	70	55	22
#10	1.27	79	61	25
#11	1.41	88	68	27

Note:

1. Top bars are horizontal bars with more than 12 in. depth of concrete cast below reinforcement.

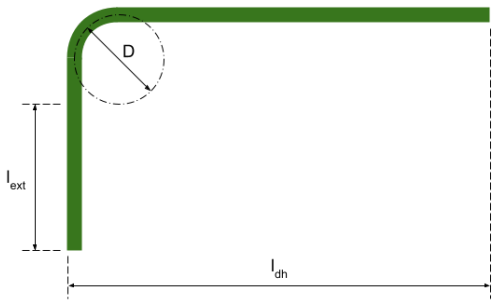




90° Hook Development Length and Geometry for deformed bars in tension

fy = 60000 psi and f'c = 4000 psi

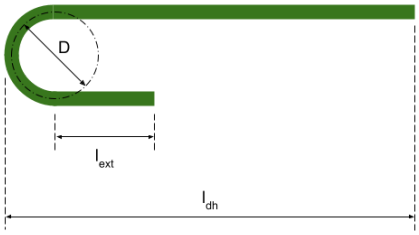
Rebar	Bar Dia. in.	Hook l_{dh} in.	90° Hook l_{ext} in.	90° Inside Dia. D in.
#3	0.375	6	4.5	2.25
#4	0.5	6	6	3
#5	0.625	8	7.5	3.75
#6	0.75	10	9	4.5
#7	0.875	13	10.5	5.25
#8	1	15	12	6
#9	1.128	18	13.54	9.02
#10	1.27	22	15.24	10.16
#11	1.41	26	16.92	11.28



180° Hook Development Length and Geometry deformed bars in tension

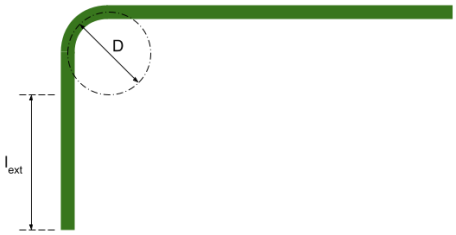
fy = 60000 psi and f'c = 4000 psi

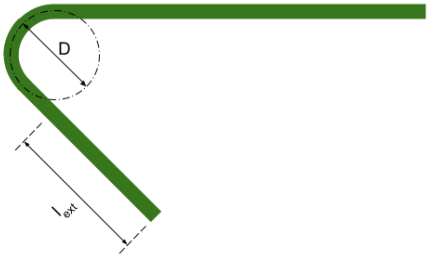
Rebar	Bar Dia. in.	Hook l_{dh} in.	180° Hook l_{ext} in.	180° Inside Dia. D in.
#3	0.375	6	2.5	2.25
#4	0.5	6	2.5	3
#5	0.625	8	2.5	3.75
#6	0.75	10	3	4.5
#7	0.875	13	3.5	5.25
#8	1	15	4	6
#9	1.128	18	4.51	9.02
#10	1.27	22	5.08	10.16
#11	1.41	26	5.64	11.28



Standard hook geometry for stirrups, ties, and hoops
fy = 60000 psi and f'c = 4000 psi

Rebar	Bar Dia. in.	90° Hook l_{ext} in.	90° Inside Dia. D in.	135° Hook l_{ext} in.	135° Inside Dia. D in.	180° Hook l_{ext} in.	180° Inside Dia. D in.
#3	0.375	3	1.5	3	1.5	2.5	1.5
#4	0.5	3	2	3	2	2.5	2
#5	0.625	3.75	2.5	3.75	2.5	2.5	2.5
#6	0.75	9	4.5	4.5	4.5	3	4.5
#7	0.875	10.5	5.25	5.25	5.25	3.5	5.25
#8	1	12	6	6	6	4	6



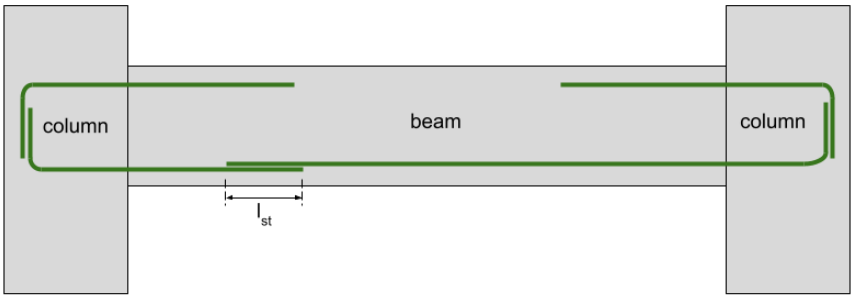


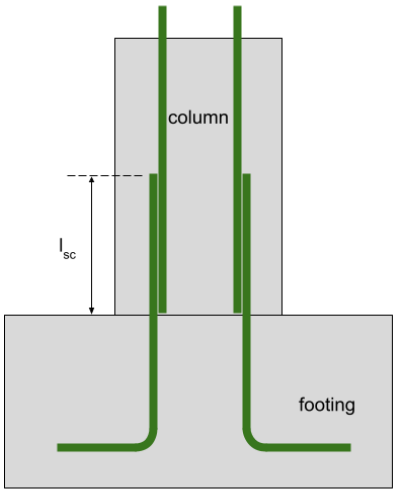
Splice Length for fy = 60000 psi and f'c = 4000 psi

Rebar	Bar Dia. in.	Splice length (compression) l_{sc} in.	Class A splice length (tension) l_{st} in.	Class B splice length (tension) l_{st} in.
#3	0.375	12	15	20
#4	0.5	15	19	25
#5	0.625	19	24	32
#6	0.75	23	29	38
#7	0.875	27	42	55
#8	1	30	48	63
#9	1.128	34	55	72
#10	1.27	39	61	80
#11	1.41	43	68	89

Note:

1. Class A tension lap splice: half or fewer of the bars spliced at any location and 0 ≤ fs ≤ 0.5fy in tension (ACI 318-19 Table 10.7.5.2.2)
2. Class B tension lap splices: more than half of the bars spliced at any section and/or fs > 0.5fy in tension (ACI 318-19 Table 10.7.5.2.2)





For Rebar #6 - 0.75 in.:

Development length in tension l_d:

Table 25.4.2.5
Table 25.4.2.3
Table 25.4.3.2
Section 25.4.3.1
Section 25.4.9
Table 25.5.2.1
Section 25.5.5

Clear spacing of bars or wires being developed or lap spliced not less than d_b, clear cover at least l_d, and stirrups or ties throughout l_d not less than the Code minimum
or
Clear spacing of bars or wires being developed or lap spliced at least $2d_b$ and clear cover at least d_b

Modification factor for concrete	$\lambda =$	1.0
Modification factor for reinforcement grade	$\psi_g =$	1
Modification factor for epoxy coating	$\psi_e =$	1
Modification factor for casting position	$\psi_t =$	1
Product of $\psi_t \psi_e$ need not exceed 1.7	$\psi_t \psi_e =$	1

$$l_d = \frac{f_y \psi_t \psi_e \psi_g}{25\lambda\sqrt{f'_c}} d_b$$

$$l_d = \frac{(60000)(1)(1)}{25(1.0)\sqrt{4000}} d_b = 38 d_b = 29 in.$$

Other Cases:

$$l_d = \frac{f_y \psi_t \psi_e \psi_g}{\frac{50}{3}\lambda\sqrt{f_c'}} d_b$$

$$l_d = \frac{(60000)(1)(1)}{\frac{50}{3}(1.0)\sqrt{4000}} d_b = 57 d_b = 43 in.$$

Development length of standard hooks in tension l_{dh}:

Modification factor for concrete	$\lambda =$	1.0
Modification factor for confining reinforcement	$\psi_r =$	1
Modification factor for epoxy coating	$\psi_e =$	1
Modification factor for location	$\psi_o =$	1
Modification factor for concrete strength	$\psi_c =$	0.867

l_{dh} shall be greater of:

$$\frac{f_y \psi_e \psi_r \psi_o \psi_c}{55\lambda\sqrt{f_c'}} {d_b}^{1.5}$$

$$8 d_b$$

$$6 in.$$

$$l_{dh} = \frac{(60000)(1)(1)(1)(0.867)}{55(1.0)\sqrt{4000}} {d_b}^{1.5} = 15 {d_b}^{1.5} > 8 d_b, 6 = 10 in.$$

Development length of hooks in tension (for seismic conditions - from Table 18.8.5.1)	$l_{dh} =$	12 in.

Development length of deformed bars in compression l_{dc}:

Modification factor for concrete	$\lambda =$	1.0
Modification factor for confining reinforcement	$\psi_r =$	1

l_{dc} shall be greater of:

$$\frac{f_y \psi_r}{50\lambda\sqrt{f_c'}} d_b$$

$$0.0003 f_y \psi_r d_b$$

$$8 in.$$

$$\frac{f_y \psi_r}{50\lambda\sqrt{f_c'}} d_b = \frac{(60000)(1)}{50(1.0)\sqrt{4000}} d_b = 19 d_b = 14.25 in.$$

$$0.0003(60000)(1) d_b = 18 d_b = 13.5 in.$$

$$l_{dc} = 15 in.$$

Lap Splice lengths of deformed bars in tension l_{st}:

Development length in tension	$l_d =$	29 in.

Class A:

$$l_{st,A} = 1.0 l_d > 12 = 29 in.$$

Class B:

$$l_{st,A} = 1.3 l_d > 12 = 38 in.$$

Lap Splice lengths of deformed bars in compression l_{sc}:

For f_y:

$$l_{sc} = 0.0005 f_y d_b > 12 = 23 in.$$