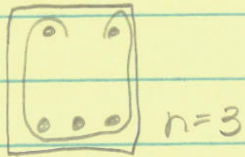


$$K_{tr} = \frac{A_v}{A_{tr} f_{yt}} \cdot 1500 s_n k$$

center to center spacing of stirrups

of bars developed in one plane of splitting



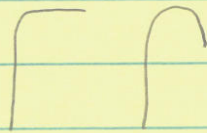
Hooks
l_{dn}
Cutoff Points
Splices
#W#8
7.6, 7.10, 7.18, 7.24

What if l_d cannot be achieved

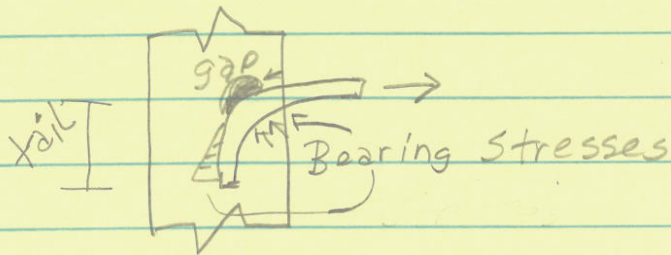
Options

- more smaller bars
(sufficient width)
(labor cost to install)
- Mechanical Anchorage
plates, threaded lugs
- not in ENCE 4359
- hooks

many kinds

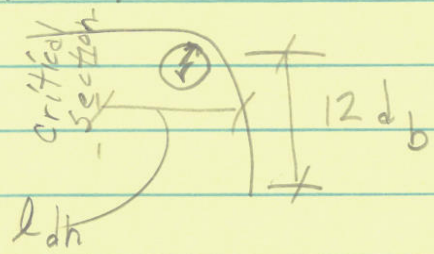


Behavior of Hooks



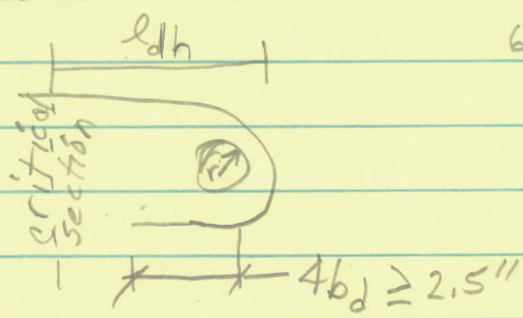
Standard Hooks
 l_{dh} [12.5.3]

90° Hook



- minimum r
- 4 d_b for #3-#8
 - 5 d_b for #9-#11
 - 6 d_b for #14-#18

180° Hook

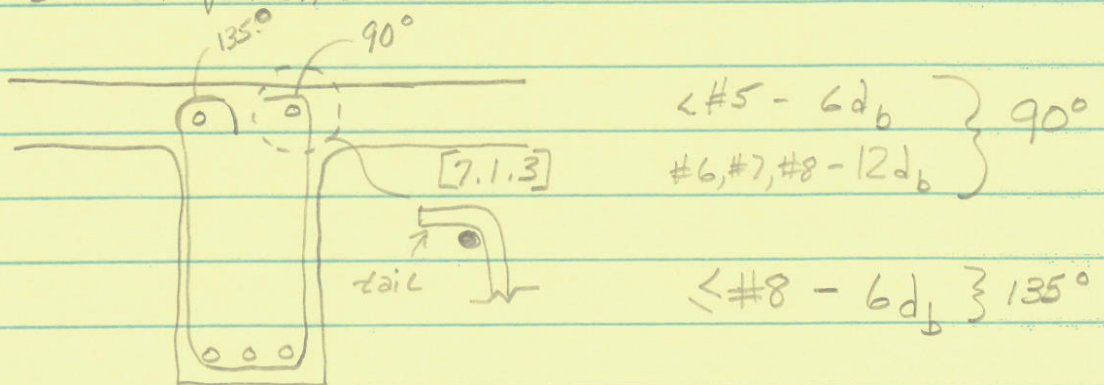


$$l_{dh} = \max \left\{ \begin{array}{l} \frac{0.2 \Psi_e f_y d_b}{\lambda \sqrt{f_c}} \\ 8 d_b \\ 6 \text{ in} \end{array} \right.$$

[12.5]

* Factors - trying to further reduce l_{dh} - factors in [12.5.3 (a)-(c)]

Development of Web Reinforcement



Bar Splices

- Why necessary? bars are normally available in 20ft lengths

- Types

mechanical



must develop $125\% f_y$

- Welded



- lap splice



Lap Splices in Tension [12.15]

Class A $1.0 l_d$ } $> 12 \text{ in}$ [12.15.1]

Class B $1.3 l_d$ }

* All splices are class B

unless: $A_s > 2A_s$, required

less than $\frac{1}{2}$ of the total reinforcement is spliced in the lap length



Lap Splices in Compression

[12.16]

- Splice length ($f_y \leq 60 \text{ksi}$)
 $= 0.0005 f_y d_b > 12 \text{in}$

* IF $f'_c < 3,000 \text{ psi}$, increase splice length by $\frac{1}{3}$

[12.17.2] Column lap splices

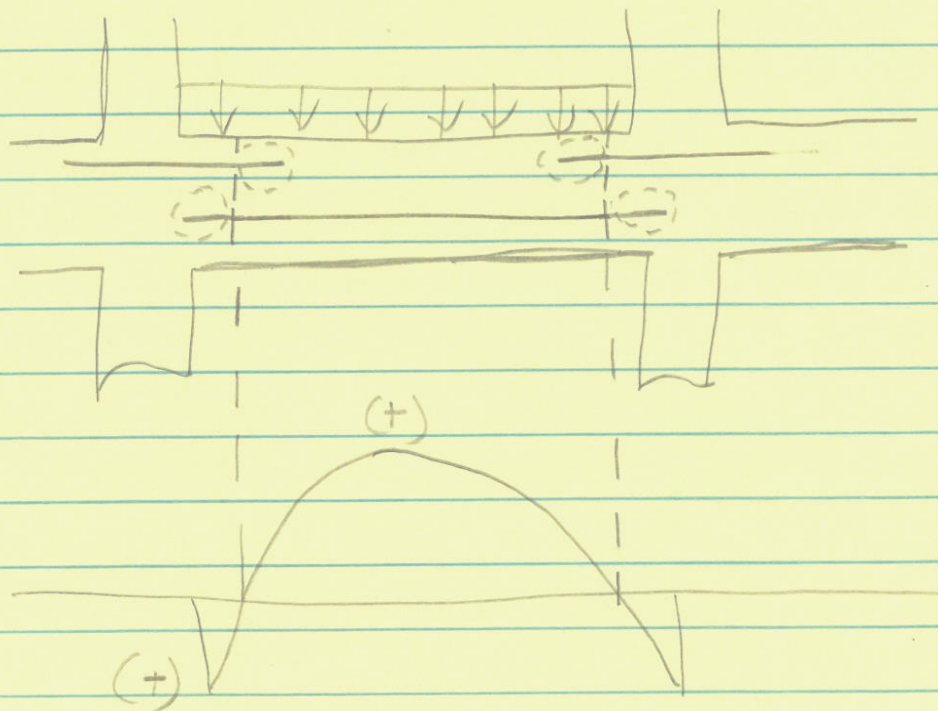
- more later during columns

Bar Cut-Off Points

[12.10, 12.11, 12.13]

- cutoff reinforcement if not needed to save \$

- beware of loading that can change the
 V & M diagrams



Bar Cutoffs (conservative Approach)

- Extend flexural steel to satisfy critical section past Inflection point a distance of $\max(d, 12d_b, l_n/16)$ Ensure minimum A_s available to hang stirrups

- $1/4 (+)$ moment steel into support [12.11.1]

