Bar cutoff points

Face of support

Theoretical positive moment

$\mathbb{C}$ of span

Inflection point for $(+A_s)$

Moment capacity of bars O

Theoretical negative moment

Inflection point for $(-A_s)$

Moment capacity of bars M

Greatest of d, $12d_b$, $l_n/16$ for at least $^1/3$ of $(-A_s)$

d or $12d_b$

l_d

Bars M

l_d

Bars N

Bars L

d or $12d_b$

Bars O
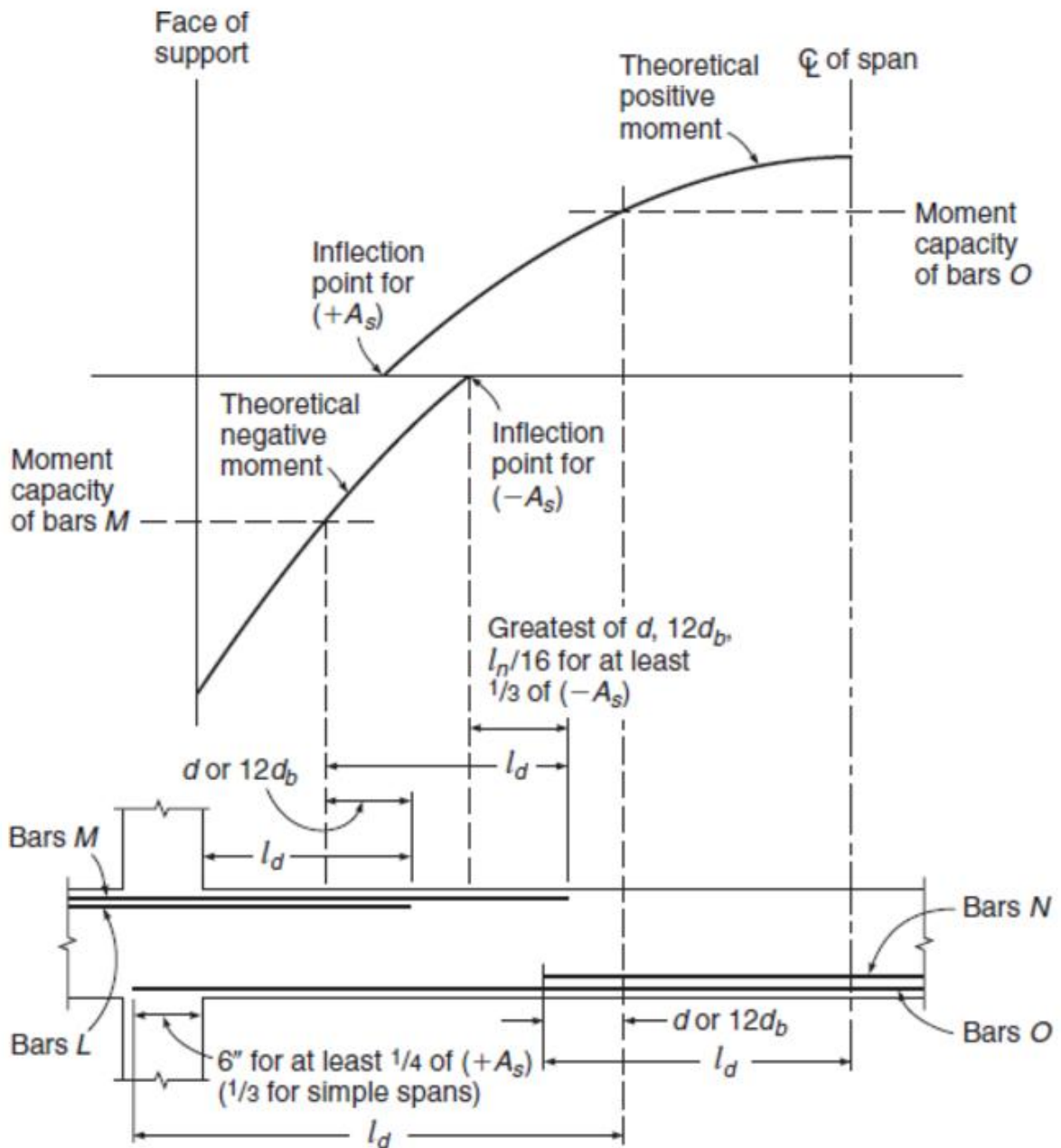
l_d

6" for at least $^1/4$ of $(+A_s)$ ($^1/3$ for simple spans)

l_d

ACI code requirements „ positive Moment reinforcement must be continued uninterrupted 6 in. into the support (at least 1/3 simple beam, ¼ continuous) ; negative„ Moment : 1/3 of reinforcement must be continued uninterrupted by the greater of (Ln/16 or d or 12 db)

Face of support
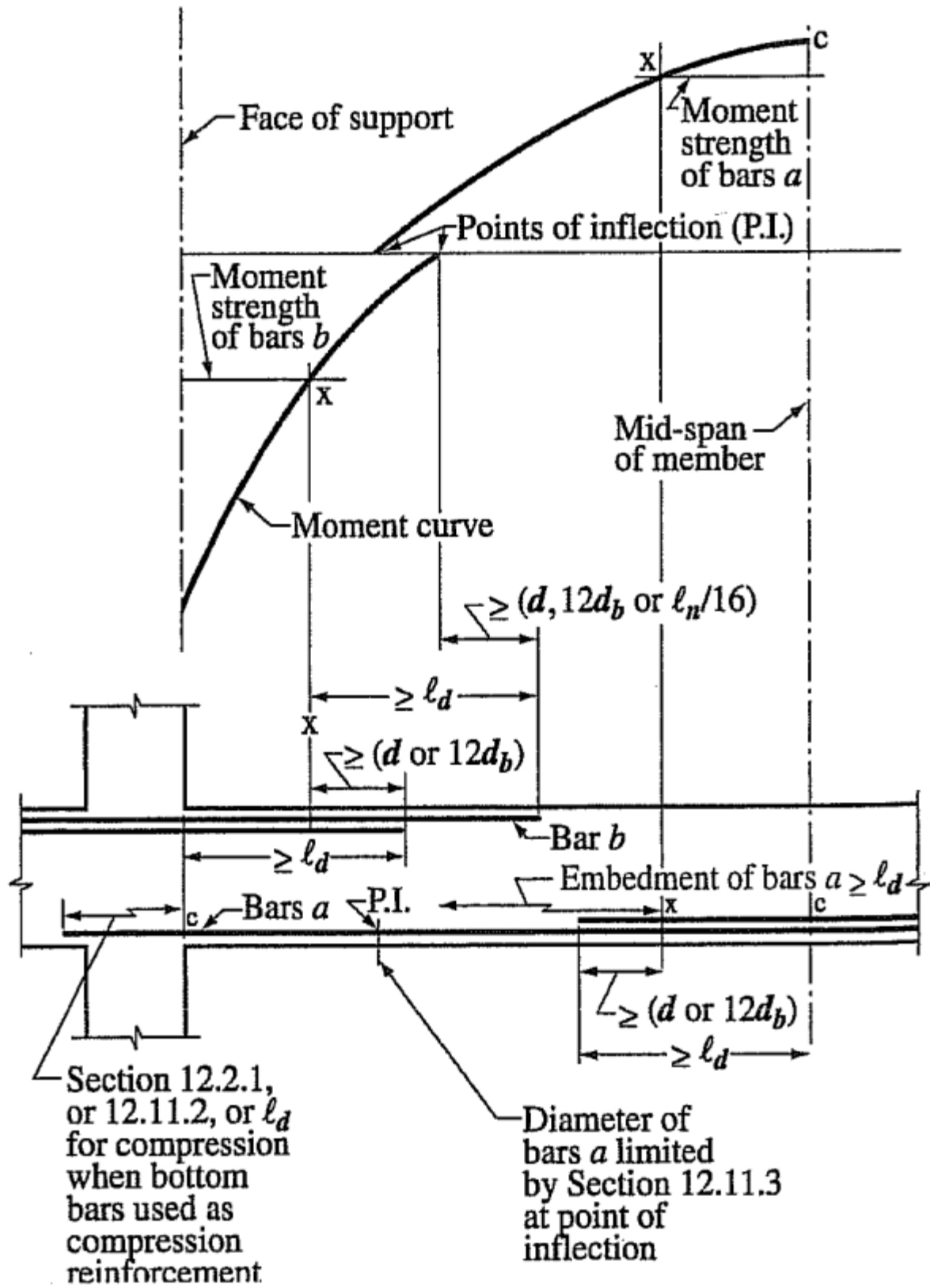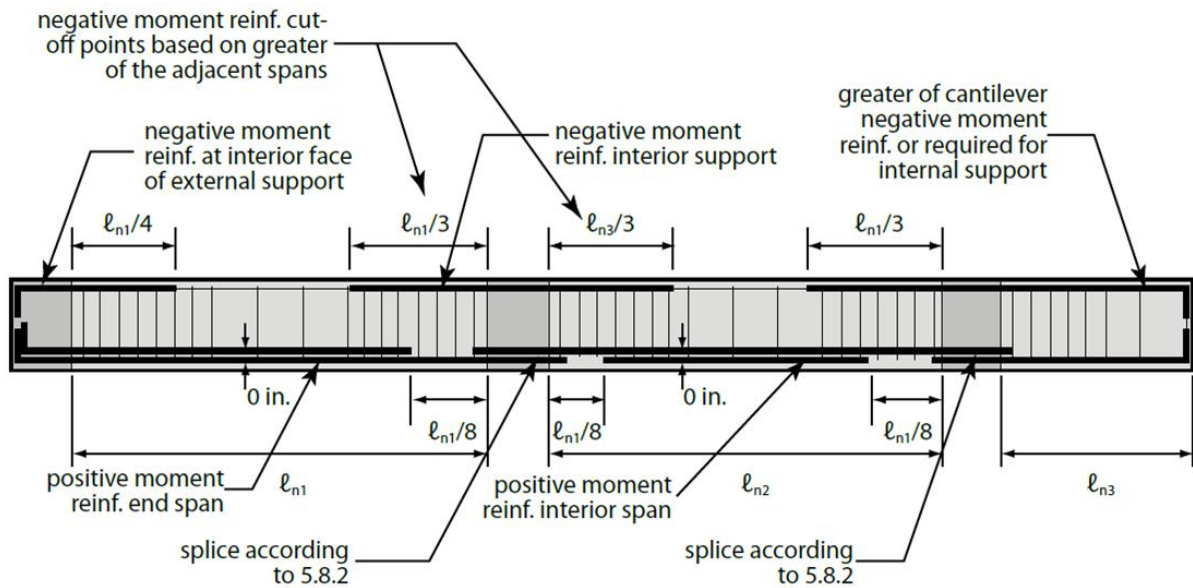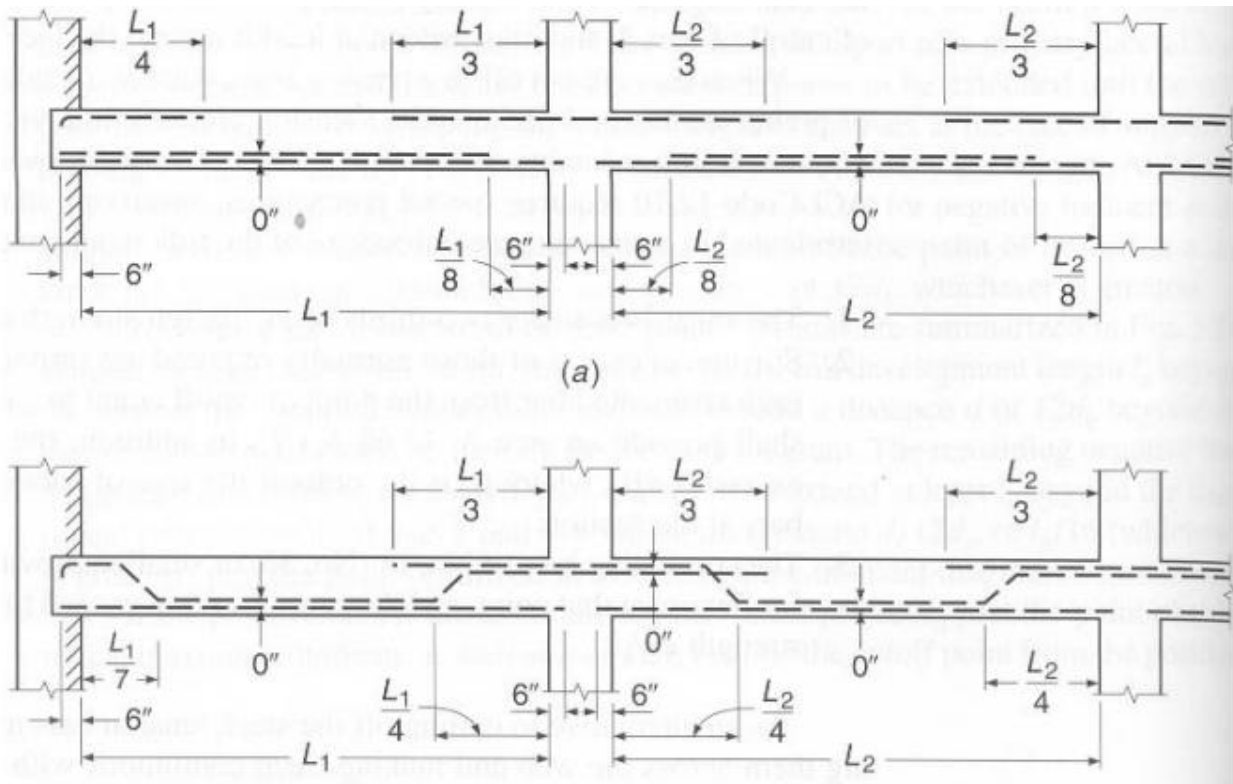
Moment
strength
of bars a

Points of inflection (P.I.)

Moment
strength
of bars b

Mid-span
of member

Moment curve

$\geq (d, 12d_b$ or $\ell_n/16)$

$\geq \ell_d$

$\geq (d$ or $12d_b)$

$\geq \ell_d$

Bar b

Embedment of bars $a \geq \ell_d$

Bars a — P.I.

$\geq (d$ or $12d_b)$

$\geq \ell_d$

Section 12.2.1,
or 12.11.2, or ℓ_d
for compression
when bottom
bars used as
compression
reinforcement

Diameter of
bars a limited
by Section 12.11.3
at point of
inflection

Fig. R12.10.2—Development of flexural reinforcement in typical continuous beam

For nearly-equal spans where < 50% of steel is cut

(a)

negative moment reinf. cut-off points based on greater of the adjacent spans

negative moment reinf. at interior face of external support

negative moment reinf. interior support

greater of cantilever negative moment reinf. or required for internal support

$\ell_{n1}/4$

$\ell_{n1}/3$

$\ell_{n3}/3$

$\ell_{n1}/3$

0 in.

$\ell_{n1}/8$

$\ell_{n1}/8$

0 in.

$\ell_{n1}/8$

positive moment reinf. end span

ℓ_{n1}

positive moment reinf. interior span

ℓ_{n2}

ℓ_{n3}

splice according to 5.8.2

splice according to 5.8.2

Reinforcement for beams and joists supported by beams or girders.

Lap Splices

Lap splices in tension „ Lap splice length „ Determined as a development length ld „ Lap splice categories „

1. Class A – requires a lap of 1.0 ld
2. Class B – requires a lap of 1.3 ld
3. Lap splice >= 12 in.

Class A splices are allowed when „ As provided is >= 2 As required over entire length of splice „ 50% or less of total As is spliced within lap length

	Maximum Percent of A_s Spliced within Required Lap Length	
$\dfrac{A_{s\ provided}}{A_{s\ required}}$	50	100
Equal to or greater than 2	Class A	Class B
Less than 2	Class B	Class B

Tension Splices

The code (12.15) divides tension lap splices into two classes, A and B. The class of splice used is dependent on the level of stress in the reinforcing and on the percentage of steel that is spliced at a particular location.

Class A splices are those where the reinforcing is lapped for a minimum distance of 1.0l_d (but not less than 12 in.) and where one-half or less of the reinforcing is spliced at any one location.

Class B splices are those where the reinforcing is lapped for a minimum distance of 1.3 l_d (but not less than 12 in.) and where all the reinforcing is spliced at the same location.

The code (12.15.2) states that lap splices for deformed bars and deformed wire in tension must be Class B unless (1) the area of reinforcing provided is equal to two or more times the area required by analysis over the entire length of the splice and (2) one-half or less of the reinforcing is spliced within the required lap length. A summary of this information is given in Table 7.3, which is Table R12.15.2 in the ACI Commentary.

Lap splices in compression

Bars in columns can be spliced by Lapping, direct end bearing, welding, and mechanical connection. Minimum length of lap for compression splice ; Bars with fy =< 60 ksi --- 0.0005 fy db. Bars with fy > 60 ksi --- (0.0009 fy −24) db. Compression lap length > 12 in. For f'c < 3000 psi increase lap by 1/3

Compression bars may be spliced by lapping, by end bearing, and by welding or mechanical devices. (Mechanical devices consist of bars or plates or other pieces welded or otherwise attached transversely to the flexural bars in locations where sufficient anchorage is not available.) The code (12.16.1) says that the minimum splice length of such bars should equal 0.0005$f_y d_b$ for bars with f_y of 60,000 psi or less, (0.0009f_y − 24)d_b for bars with higher f_y values, but not less than 12 in. Should the concrete strengths be less than 3000 psi, it is necessary to increase the computed laps by one-third. Reduced values are given in the code for cases where the bars are enclosed by ties or spirals (12.17.2.4 and 12.17.2.5).