

Chapter 4

Bridge Program Drawings

Section 4.19-Reinforcing Steel

Introduction

Because concrete has a low tensile strength, reinforcing steel is embedded in the concrete to resist the applied loads causing tension. Compressive reinforcing steel can be used in beams and columns to reduce the size of these members. In addition, reinforcing steel can control strain and subsequent concrete cracking from temperature and shrinkage and distribute applied loads to other reinforcing steel.

Reinforcing steel is in the form of bars or wires whose surface may be coated, smooth, or deformed. Deformed bars are generally used because they produce better bond with the concrete due to the raised patterns on the steel. Smooth bars are generally used in welded wire fabric.

Reinforcing Steel Types

DEFORMED BARS range in diameter from $\frac{3}{8}$ " to $2\frac{1}{4}$ ". Bar sizes are designated by a number, which is approximately eight times the bar diameter. The most commonly used bars are No. 4 through No. 11 bars, with No. 3 bars being limited to use as spiral reinforcing in columns. Straight reinforcing steel shall have yield strength of 60,000 psi (Grade 60). Ties and stirrups generally require minimum yield strength of 40,000 psi (Grade 40), although yield strength of 60,000 psi may be specified.

WELDED WIRE FABRIC consists of a rectangular grid of uniformly spaced smooth wires, welded at their intersections. Welded wire fabric offers fast and easy field placement.

General Design and Detail Information

REINFORCING STEEL COVER refers to the clear distance from the concrete surface to the face of the reinforcing steel. Minimum clearances must be maintained to protect the reinforcing steel from corrosion and to allow for proper concrete placement. Concrete cover to the face of reinforcing steel shall be 2" unless noted. It is not necessary to provide any cover from an internal construction joint. The end of the bar may be placed against or rest

on the joint. Other exceptions include the following.

Curb, sidewalk, and barrier rail contraction joint	1"
Drilled hole to face of reinforcing	1"
Bridge decks - top of deck - bottom of deck	2½" 1"
Curbs and sidewalks - top and sides Bridge barrier rail- sides	1½"
Any concrete surface resting on or placed against earth	
- bottom of spread footing	3"
- bottom of bottom slab of culvert	3"
- bottom of abutment wingwall	3"
- bottom of drilled shafts	0"
T-girder and box girder webs - bottom face and sides	
Bottom slab of box girder- top and bottom faces	
Column - diameter < 48"	
Bottom of approach slabs	
Bottom of slope paving	1½"
Drilled shaft foundation, side clearance	3" (Min)

Concrete cover on precast concrete sections shall conform to AASHTO requirements.

Reinforcing steel is identified on the Bridge Program drawings by **BAR MARKS**. Bar marks identify each bar by designating the bar size and length in the case of a straight bar and the bar size, structural unit, and unique number for a specific unit of the structure for bent bars. The unique number for each specific unit shall be numbered consecutively.

Straight bars are marked as follows.

Mark	ASTM Bar Size	Length
405-10	No. 4	5'-10"
817-3	No. 8	17'-3"
1025-6	No. 10	25'-6"

Bent bars (ties, stirrups, cranks, etc.) are marked as follows.

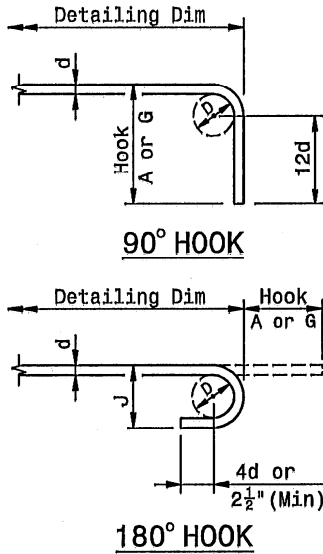
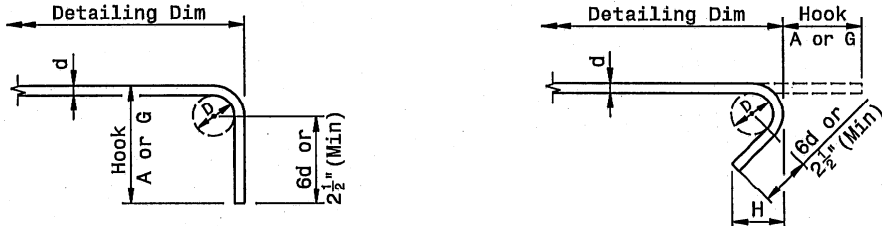
Mark	ASTM Bar Size	Designation
4B4 (Tie)	No. 4	B4
7A3 (Stirrup)	No. 7	A3
5S1	No. 5	SI
Spiral 3B3	No. 3	B3

The following letters shall be used as standard designators for each structural unit.

A:	Abutment
AS:	Approach Slab
B:	Bent/Pier
C:	Reinforced Concrete Box Culvert
G:	Concrete Girder
R:	Concrete Bridge Barrier Rail
S:	Slab
W:	Retaining Wall

When the word **TIE** or **STIRRUP** follows a bent bar designation, it refers to the type of bent bar. Closed bent bars should be designated as ties, while open bent bars should be designated as stirrups. The word tie or stirrup informs the fabricator that minimum bends are required. Although some fabricators will supply Grade 60 ties and stirrups when Grade 40 ties and stirrups are sufficient, Grade 60 ties and stirrups are used when required by the design. Lengths of bent bars are shown in the Bill of Reinforcement.

The following table shows the American Concrete Institute standards for hooks. Any hook shown on the plans and not otherwise dimensioned shall conform with the hooks shown in this table.

STANDARD HOOKS - GRADE 40 & 60						
END HOOK						
 <p>90° HOOK</p> <p>180° HOOK</p>	Bar Size	d	D	90° HOOK	180° HOOK	
				Hook A or G	Hook A or G	J
	# 3	$\frac{1}{8}$ "	$2\frac{1}{4}$ "	6"	5"	3"
	# 4	$\frac{1}{2}$ "	3"	8"	6"	4"
	# 5	$\frac{5}{8}$ "	$3\frac{3}{4}$ "	10"	7"	5"
	# 6	$\frac{3}{4}$ "	$4\frac{1}{2}$ "	1' - 0"	8"	6"
	# 7	$\frac{7}{8}$ "	$5\frac{1}{4}$ "	1' - 2"	10"	7"
	# 8	1"	6"	1' - 4"	11"	8"
	# 9	$1\frac{1}{8}$ "	9"	1' - 7"	1' - 3"	$11\frac{1}{4}$ "
	# 10	$1\frac{1}{4}$ "	$10\frac{1}{4}$ "	1' - 10"	1' - 5"	$1' - 0\frac{3}{4}$ "
	# 11	$1\frac{3}{8}$ "	$11\frac{1}{4}$ "	2' - 0"	1' - 7"	$1' - 2\frac{1}{4}$ "
	# 14	$1\frac{3}{4}$ "	1' - 5"	2' - 7"	2' - 2"	$1' - 8\frac{1}{2}$ "
	# 18	$2\frac{1}{4}$ "	$1' - 10\frac{3}{4}$ "	3' - 5"	2' - 11"	2' - 3"
STIRRUP & TIE HOOK						
 <p>90° STIRRUP HOOK (Ties similar)</p> <p>135° STIRRUP HOOK (Ties similar)</p>	Bar Size	d	D	90° HOOK	135° HOOK	
				Hook A or G	Hook A or G	H
	# 3	$\frac{3}{8}$ "	$1\frac{1}{2}$ "	4"	4"	$2\frac{1}{2}$ "
	# 4	$\frac{1}{2}$ "	2"	$4\frac{1}{2}$ "	$4\frac{1}{2}$ "	3"
	# 5	$\frac{5}{8}$ "	$2\frac{1}{2}$ "	6"	$5\frac{1}{2}$ "	$3\frac{3}{4}$ "
	# 6	$\frac{3}{4}$ "	$4\frac{1}{2}$ "	1' - 0"	8"	$4\frac{1}{2}$ "
	# 7	$\frac{7}{8}$ "	$5\frac{1}{4}$ "	1' - 2"	9"	$5\frac{1}{4}$ "
	# 8	1"	6"	1' - 4"	$10\frac{1}{2}$ "	6"

Reinforcing steel shall be **BILLED** in either the plan or elevation and called out in the section. When circumstances dictate, it may be necessary to bill the bar in the section. Billing is the method by which the required number, or count, of any bar is determined. Each bar shall be billed only once, but may be called out more than once elsewhere on the plans. The billing of bars is determined from the spacing for a particular group of bars.

Billing	Number Required
747-2 @ 3 Spa	4 Bars
405-10 @ 12"=22'-0"	23 Bars
7A3 @ 6"=15'-6" (T&B)	64 Bars (32 top face and 32 bottom face)
817-3 @ 12"=9'-0" (EF)	20 Bars (10 each face)
609-8 @ 10 Eq Spa=9'-6"	11 Bars
4B4 @ 24"=12'-0" (4 per line)	28 Bars
5B3 @ 6"=4'-6" (Pairs)	20 Bars

The maximum bar length is 60'-0".

BAR SPACING shall be shown in inches, with the distance between the two end bars for any mark totaled and shown in feet and inches. When the first bar of any mark is referenced from a concrete edge and the distance is greater than 1'-0", that distance may be shown in feet and inches.

SPIRALS are lateral reinforcement used in columns and drilled shafts and are generally a No. 3 or No. 4 bar bent at a specific spacing or pitch. Vertical bars, or channel spacers, are furnished with each spiral to hold the spiral in place during placing of concrete. The core dimension for a spiral is the outside diameter of the reinforcement. Spirals require additional information for fabrication. The following data is generally shown in the Bill of Reinforcement.

Spiral 3B2: Pitch 3", Core 33", Turns 103

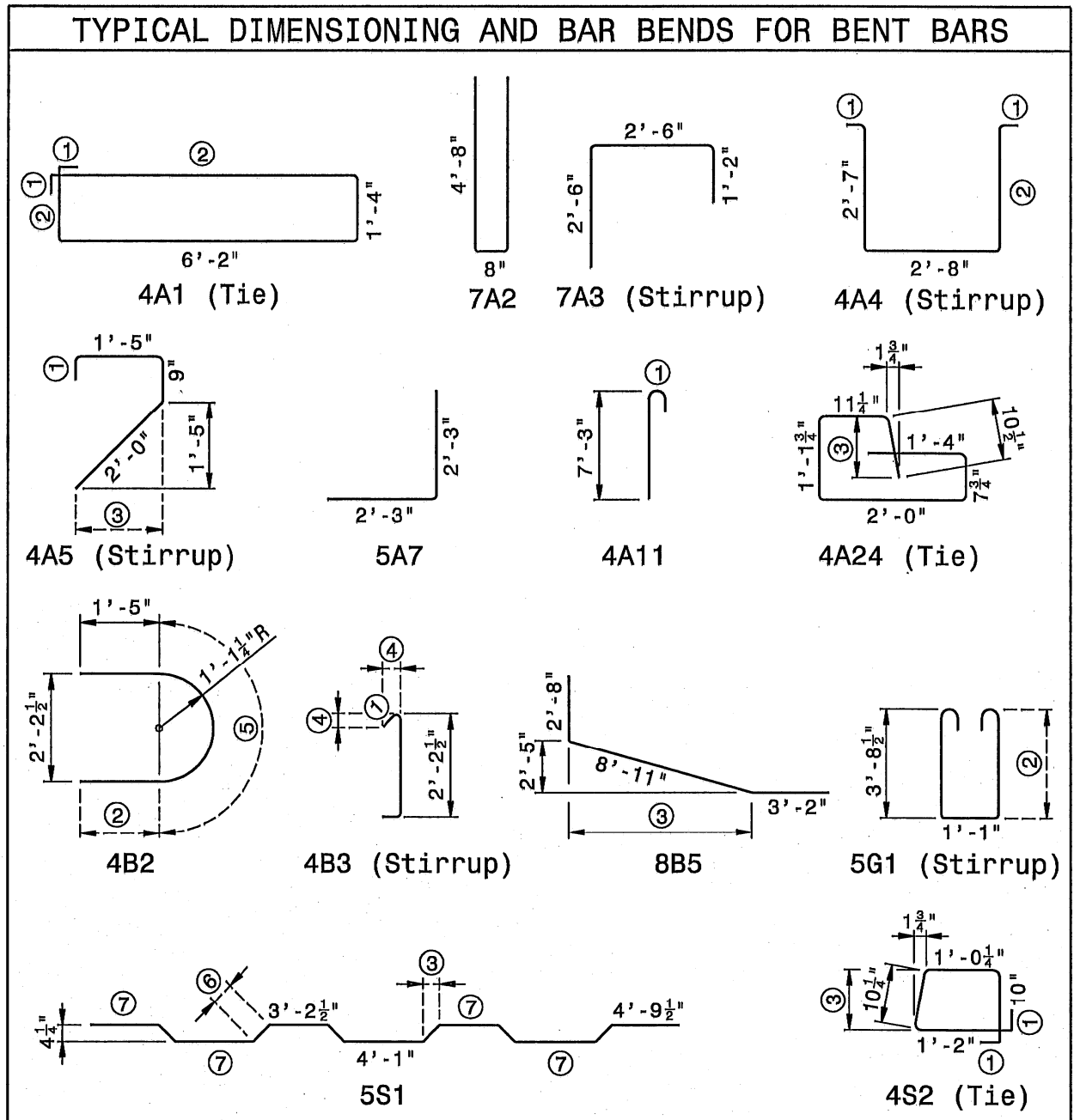
For columns, the number of turns is equal to the length of the column plus the distance from the top of the column to the bottom steel in the cap, divided by the pitch, plus one and one-half turns (top and bottom) required for development. For drilled shaft foundations, the number of turns is equal to the length of the drilled shaft foundation divided by the pitch, plus one and one-half turns (top only) for development. The number of turns shall be rounded up to the nearest one-half turn. A note shall be included on the sheet with the Bill of Reinforcement stating the number of

turns required top and/or bottom. The table shown in Chapter 5 - Quantities can be used to calculate the weight of spiral reinforcement per vertical foot of column or drilled shaft.

Often, with sloping surfaces and uniformly spaced bars, each bar length will be different. Rather than calling out each individual bar, a **SET** may be employed. Each group of bars will require a unique number identifying the set, with the first and last bars being called out. A set will be billed in the following manner.

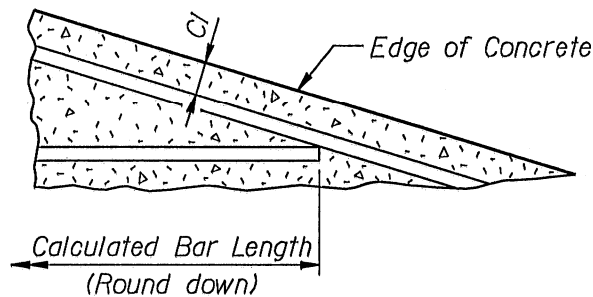
Set 1 Bars @ 6" =12'-6"

Bent bars are detailed to the nearest $\frac{1}{4}$ " out to out with the total length rounded up to the whole inch. Straight bars are detailed to the nearest whole inch. The average length of set bars shall be to the nearest $\frac{1}{2}$ ". Because reinforcing steel is stocked in standard lengths, bars shall not be detailed greater than 60'-0". In bar runs longer than 60'-0", utilize 60'-0" long bars where possible. When a required bar length is longer than 60'-0", a lap is required. Bars shall be detailed using the maximum bar lengths, and one bar of lesser length placed within the run. The following table shows the dimensions and information required for commonly used bent bars.



- ① Omit A or G dimensions for hooks (See Standard Hooks table).
- ② Omit dimension on opposite side of symmetrical bars.
- ③ Omit run (longest) dimension of bevel only if bevel is 1:1.
- ④ Omit bevel dimensions on 135° stirrup hooks.
- ⑤ Omit curved length of bars where radius is shown.
- ⑥ Omit length of bend on crank bars.
- ⑦ Omit all repetitive dimensions on symmetrical crank bars.

When calculating bar lengths, consideration should be given to other bars lying in the same plane as the bar whose length is being calculated.



When bar lengths in a group or run require various lengths, rather than using a set, a uniform bar length may be employed to allow the lap between bars to be greater than the required minimum in order to facilitate fabrication and construction.

Reinforcing steel must be **DEVELOPED** for a sufficient length before it can achieve its design strength. This can be accomplished by either **LAPPING** it with other reinforcing steel, or **EXTENDING** it in each direction beyond the critical section. Lap and extension lengths vary depending on the bar size, cover, spacing, location, and concrete strength. A Class C lap is used for most cases. Laps other than Class C shall be designated in the design.

Top bar laps are used for horizontal reinforcing steel when a minimum of 12" of new concrete is placed below the bars.

Class A laps are used in regions of low tensile stress (where tensile reinforcement provided is more than twice that required for strength), if no more than three-quarters of the bars are lapped within a required lap length.

Class B laps are used in regions of low tensile stress (where tensile reinforcement provided is more than twice that required for strength) in regions where more than three-quarters of the bars are lapped within a required lap length; or in regions of high tensile stress (where tensile reinforcement provided is equal to or less than twice that required for strength), if no more than one-half of the bars are lapped within a required lap length.

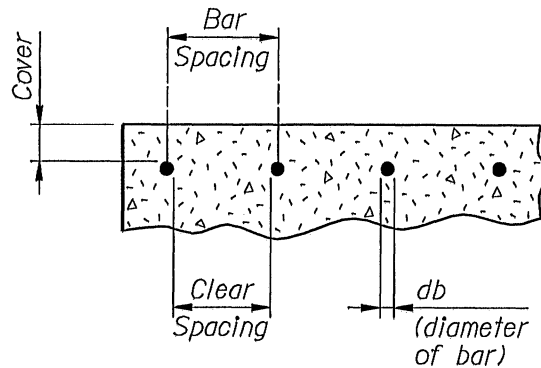
Class C laps are used in regions of high tensile stress (where tensile reinforcement provided is equal to or less than twice that required for strength), if more than one-half of the bars are lapped

within a required lap length.

Tabular values shall not be used in cases of bundled bars, welded splices, positive connections, or for reinforcement in lightweight concrete.

Lap lengths for bars enclosed and lapped inside of a spiral ("lap enclosed in spiral" in the following table) are based on Class C tension lap requirements. The maximum pitch for spirals shall be 3" for Load Factor Designs and 4" for Load and Resistance Factor Designs.

The following detail may be used as a guide to determine the correct lap length found in the reinforcing steel tables.



The following tables list the reinforcing steel properties, laps, and development length to be used for **UNCOATED REINFORCING STEEL**.

AASHTO Standard Specifications for Highway Bridges 17th Edition - 2002

UNCOATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60												
Bar Size				#4	#5	#6	#7	#8	#9	#10	#11	
Weight				0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter				0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area				0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²	
f'c = 3250 psi	Bar Spacing ≥ 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-10"	2'-0"	2'-3"	2'-6"
				Tens	1'-0"	1'-0"	1'-3"	1'-9"	2'-3"	2'-10"	3'-7"	4'-5"
			Tens Lap - Class C *		1'-5"	1'-9"	2'-2"	2'-11"	3'-10"	4'-10"	6'-1"	7'-6"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
		Top Bar	Lap Enclosed in Spiral		1'-1"	1'-4"	1'-7"	2'-2"	2'-10"	3'-7"	4'-7"	5'-7"
			Extension	Comp	1'-2"	1'-5"	1'-9"	2'-5"	3'-2"	4'-0"	5'-0"	6'-2"
				Tens	1'-11"	2'-5"	3'-0"	4'-1"	5'-4"	6'-9"	8'-6"	10'-6"
			Bar Spacing < 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-10"	2'-0"
	Tens	1'-0"				1'-3"	1'-7"	2'-2"	2'-10"	3'-7"	4'-6"	5'-6"
	Tens Lap - Class C *				1'-9"	2'-2"	2'-8"	3'-7"	4'-9"	6'-0"	7'-7"	9'-4"
	Comp Lap *				1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
	Top Bar	Lap Enclosed in Spiral		1'-4"	1'-8"	2'-0"	2'-9"	3'-7"	4'-6"	5'-9"	7'-0"	
		Extension		Comp	1'-5"	1'-9"	2'-2"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"
				Tens	2'-5"	3'-0"	3'-9"	5'-1"	6'-8"	8'-5"	10'-8"	13'-1"

* Not for bars enclosed in a spiral
Class A Lap = 59% of Class C Lap
Class B Lap = 77% of Class C Lap

UNCOATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60												
Bar Size				#4	#5	#6	#7	#8	#9	#10	#11	
Weight				0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 pif	5.313 plf	
Diameter				0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area				0.20 in²	0.31 in²	0.44 in²	0.60 in²	0.79 in²	1.00 in²	1.27 in²	1.56 in²	
f'c = 3750 psi	Bar Spacing ≥ 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
				Tens	1'-0"	1'-3"	1'-6"	1'-9"	2'-1"	2'-8"	3'-4"	4'-1"
			Tens Lap - Class C *		1'-5"	1'-9"	2'-1"	2'-8"	3'-7"	4'-6"	5'-8"	7'-0"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
		Top Bar	Lap Enclosed in Spiral		1'-1"	1'-4"	1'-7"	2'-0"	2'-8"	3'-4"	4'-8"	5'-3"
			Extension	Comp	1'-2"	1'-5"	1'-9"	2'-3"	2'-11"	3'-8"	4'-8"	5'-9"
				Tens	1'-11"	2'-5"	2'-11"	3'-9"	4'-11"	6'-3"	7'-11"	9'-9"
			Tens Lap - Class C		1'-11"	2'-5"	2'-11"	3'-9"	4'-11"	6'-3"	7'-11"	9'-9"
	Bar Spacing < 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
				Tens	1'-0"	1'-3"	1'-6"	2'-0"	2'-7"	3'-4"	4'-2"	5'-2"
			Tens Lap - Class C *		1'-9"	2'-2"	2'-7"	3'-4"	4'-5"	5'-7"	7'-1"	8'-8"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
		Top Bar	Lap Enclosed in Spiral		1'-4"	1'-8"	1'-11"	2'-6"	3'-4"	4'-2"	5'-4"	6'-6"
			Extension	Comp	1'-5"	1'-9"	2'-2"	2'-9"	3'-8"	4'-7"	5'-10"	7'-2"
				Tens	2'-5"	3'-0"	3'-7"	4'-8"	6'-2"	7'-10"	9'-11"	12'-2"
			Tens Lap - Class C		2'-5"	3'-0"	3'-7"	4'-8"	6'-2"	7'-10"	9'-11"	12'-2"

* Not for bars enclosed in a spiral
Class A Lap = 59% of Class C Lap
Class B Lap = 77% of Class C Lap

AASHTO LRFD Bridge Design Specifications 3rd Edition - 2004

UNCOATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60											
Bar Size				#4	#5	#6	#7	#8	#9	#10	#11
Weight				0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf
Diameter				0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in
Area				0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²
f _c = 3250 psi	Bar Spacing ≥ 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-9"	2'-0"	2'-3"
				Tens	1'-0"	1'-0"	1'-3"	1'-8"	2'-3"	2'-10"	3'-7"
			Tens Lap - Class C *		1'-5"	1'-9"	2'-1"	2'-10"	3'-9"	4'-9"	6'-0"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"
			Lap Enclosed in Spiral		1'-1"	1'-4"	1'-7"	2'-2"	2'-10"	3'-7"	4'-6"
		Top Bar	Extension	Comp	1'-2"	1'-5"	1'-9"	2'-4"	3'-1"	3'-11"	5'-0"
				Tens	1'-11"	2'-5"	2'-11"	4'-0"	5'-3"	6'-8"	8'-5"
			Tens Lap - Class C		1'-11"	2'-5"	2'-11"	4'-0"	5'-3"	6'-8"	8'-5"
	Bar Spacing < 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-9"	2'-0"	2'-3"
				Tens	1'-0"	1'-3"	1'-7"	2'-1"	2'-9"	3'-6"	4'-5"
			Tens Lap - Class C *		1'-9"	2'-2"	2'-8"	3'-7"	4'-8"	5'-11"	7'-6"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"
			Lap Enclosed in Spiral		1'-4"	1'-8"	2'-0"	2'-8"	3'-6"	4'-6"	5'-8"
		Top Bar	Extension	Comp	1'-5"	1'-9"	2'-2"	2'-11"	3'-11"	4'-11"	6'-2"
				Tens	2'-5"	3'-0"	3'-8"	5'-0"	6'-7"	8'-4"	10'-6"
			Tens Lap - Class C		2'-5"	3'-0"	3'-8"	5'-0"	6'-7"	8'-4"	10'-6"

* Not for bars enclosed in a spiral
 Class A Lap = 59% of Class C Lap
 Class B Lap = 77% of Class C Lap

UNCOATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60											
Bar Size				#4	#5	#6	#7	#8	#9	#10	#11
Weight				0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf
Diameter				0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in
Area				0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²
f _c = 3750 psi	Bar Spacing ≥ 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"
				Tens	1'-0"	1'-0"	1'-3"	1'-7"	2'-1"	2'-7"	3'-4"
			Tens Lap - Class C *		1'-5"	1'-9"	2'-1"	2'-8"	3'-6"	4'-5"	5'-7"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"
			Lap Enclosed in Spiral		1'-1"	1'-4"	1'-7"	2'-0"	2'-8"	3'-4"	4'-3"
		Top Bar	Extension	Comp	1'-2"	1'-5"	1'-9"	2'-3"	2'-11"	3'-8"	4'-8"
				Tens	1'-11"	2'-5"	2'-11"	3'-9"	4'-11"	6'-2"	7'-10"
			Tens Lap - Class C		1'-11"	2'-5"	2'-11"	3'-9"	4'-11"	6'-2"	7'-10"
	Bar Spacing < 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"
				Tens	1'-0"	1'-3"	1'-6"	2'-0"	2'-7"	3'-3"	4'-2"
			Tens Lap - Class C *		1'-9"	2'-2"	2'-7"	3'-4"	4'-5"	5'-6"	7'-0"
			Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"
			Lap Enclosed in Spiral		1'-4"	1'-8"	1'-11"	2'-6"	3'-4"	4'-2"	5'-3"
		Top Bar	Extension	Comp	1'-5"	1'-9"	2'-2"	2'-9"	3'-7"	4'-7"	5'-9"
				Tens	2'-5"	3'-0"	3'-7"	4'-8"	6'-1"	7'-9"	9'-10"
			Tens Lap - Class C		2'-5"	3'-0"	3'-7"	4'-8"	6'-1"	7'-9"	9'-10"

* Not for bars enclosed in a spiral
 Class A Lap = 59% of Class C Lap
 Class B Lap = 77% of Class C Lap

An **EPOXY COATING** is used to protect the reinforcing steel from corrosive actions. Epoxy coating shall be used on all bars billed with the bridge deck and curbs, sidewalks, raised medians, barrier rails, and approach slabs. Because the bond and development lengths are different when reinforcing steel is epoxy

coated, the following tables shall be used to determine the required lap or development length for **EPOXY COATED REINFORCING STEEL**.

AASHTO Standard Specifications for Highway Bridges
17th Edition - 2002

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS													
GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in²	0.31 in²	0.44 in²	0.60 in²	0.79 in²	1.00 in²	1.27 in²	1.56 in²	
f'c = 3250 psi	Cover ≥ 3db and Clear Spacing ≥ 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-10"	2'-0"	2'-3"	2'-6"
					Tens	1'-0"	1'-2"	1'-6"	2'-0"	2'-7"	3'-3"	4'-2"	5'-1"
				Tens Lap - Class C *		1'-7"	2'-0"	2'-5"	3'-4"	4'-5"	5'-6"	7'-0"	8'-7"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed in Spiral		1'-3"	1'-6"	1'-10"	2'-6"	3'-4"	4'-2"	5'-3"	6'-6"
				Extension	1'-4"	1'-8"	2'-0"	2'-9"	3'-7"	4'-7"	5'-9"	7'-1"	
					Tens Lap - Class C	2'-3"	2'-9"	3'-5"	4'-8"	6'-1"	7'-9"	9'-10"	12'-0"
				Bar Spacing < 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-10"	2'-0"
	Tens	1'-2"	1'-6"				1'-10"	2'-6"	3'-3"	4'-1"	5'-2"	6'-4"	
	Tens Lap - Class C *		2'-0"			2'-6"	3'-1"	4'-2"	5'-6"	6'-11"	8'-9"	10'-9"	
	Comp Lap *		1'-3"			1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"	
	Top Bar	Lap Enclosed in Spiral			1'-6"	1'-10"	2'-4"	3'-2"	4'-1"	5'-2"	6'-7"	8'-1"	
		Extension	1'-8"		2'-1"	2'-6"	3'-5"	4'-6"	5'-8"	7'-3"	8'-10"		
			Tens Lap - Class C		2'-9"	3'-6"	4'-3"	5'-10"	7'-8"	9'-8"	12'-3"	15'-0"	

* Not for bars enclosed in a spiral
 Class A Lap = 59% of Class C Lap
 Class B Lap = 77% of Class C Lap

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS															
GRADE 60															
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11			
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf			
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in			
Area					0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²			
f'c = 3250 psi	Cover < 3db or Clear Spacing < 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-10"	2'-0"	2'-3"	2'-6"		
					Tens	1'-3"	1'-6"	1'-11"	2'-7"	3'-4"	4'-3"	5'-5"	6'-7"		
				Tens Lap - Class C *		2'-1"	2'-7"	3'-2"	4'-4"	5'-8"	7'-2"	9'-2"	11'-2"		
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"		
				Lap Enclosed in Spiral		1'-7"	1'-11"	2'-5"	3'-3"	4'-3"	5'-5"	6'-10"	8'-5"		
			Top Bar	Extension		1'-5"	1'-9"	2'-2"	2'-11"	3'-10"	4'-10"	6'-1"	7'-6"		
				Tens Lap - Class C		2'-4"	2'-11"	3'-7"	4'-11"	6'-5"	8'-2"	10'-4"	12'-8"		
				Bar Spacing < 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-10"	2'-0"	2'-3"	2'-6"
							Tens	1'-6"	1'-11"	2'-4"	3'-2"	4'-2"	5'-4"	6'-9"	8'-3"
						Tens Lap - Class C *		2'-7"	3'-3"	4'-0"	5'-5"	7'-1"	9'-0"	11'-5"	14'-0"
		Comp Lap *				1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"		
		Lap Enclosed in Spiral				1'-11"	2'-5"	3'-0"	4'-1"	5'-4"	6'-9"	8'-7"	10'-6"		
		Top Bar	Extension		1'-9"	2'-2"	2'-8"	3'-7"	4'-9"	6'-0"	7'-7"	9'-4"			
			Tens Lap - Class C		2'-11"	3'-8"	4'-6"	6'-1"	8'-1"	10'-2"	12'-11"	15'-10"			

* Not for bars enclosed in a spiral
 Class A Lap = 59% of Class C Lap
 Class B Lap = 77% of Class C Lap

AASHTO Standard Specifications for Highway Bridges
17th Edition - 2002

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2,670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²	
f'c = 3750 psi	Cover ≥ 3db and Clear Spacing ≥ 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
					Tens	1'-0"	1'-2"	1'-5"	1'-10"	2'-5"	3'-1"	3'-10"	4'-9"
				Tens Lap - Class C *	1'-7"	2'-0"	2'-5"	3'-1"	4'-1"	5'-2"	6'-6"	8'-0"	
					Comp Lap *	1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Lap Enclosed in Spiral	1'-3"	1'-6"	1'-10"	2'-4"	3'-1"	3'-10"	4'-11"	6'-0"		
				Top Bar	Extension	1'-4"	1'-8"	2'-0"	2'-7"	3'-4"	4'-3"	5'-5"	6'-7"
			Tens Lap - Class C			2'-3"	2'-9"	3'-4"	4'-4"	5'-8"	7'-2"	9'-1"	11'-2"
			General		Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
		Tens				1'-2"	1'-6"	1'-9"	2'-4"	3'-0"	3'-10"	4'-10"	5'-11"
		Tens Lap - Class C *		2'-0"	2'-6"	3'-0"	3'-10"	5'-1"	6'-5"	8'-2"	10'-0"		
				Comp Lap *	1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"	
		Bar Spacing < 6"	Top Bar	Lap Enclosed in Spiral	1'-6"	1'-10"	2'-3"	2'-11"	3'-10"	4'-10"	6'-1"	7'-6"	
					Extension	1'-8"	2'-1"	2'-5"	3'-2"	4'-2"	5'-4"	6'-9"	8'-3"
				Tens Lap - Class C		2'-9"	3'-6"	4'-2"	5'-5"	7'-1"	9'-0"	11'-5"	14'-0"

* Not for bars enclosed in a spiral
 Class A Lap = 59% of Class C Lap
 Class B Lap = 77% of Class C Lap

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²	
f'c = 3750 psi	Cover < 3db or Clear Spacing < 6db	Bar Spacing ≥ 5"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
					Tens	1'-3"	1'-6"	1'-10"	2'-5"	3'-2"	4'-0"	5'-0"	6'-2"
				Tens Lap - Class C *	2'-1"	2'-7"	3'-1"	4'-0"	5'-4"	6'-8"	8'-6"	10'-5"	
					Comp Lap *	1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Lap Enclosed in Spiral	1'-7"	1'-11"	2'-4"	3'-0"	4'-0"	5'-0"	6'-5"	7'-10"		
				Top Bar	Extension	1'-5"	1'-9"	2'-1"	2'-8"	3'-7"	4'-6"	5'-8"	7'-0"
			Tens Lap - Class C		2'-4"	2'-11"	3'-6"	4'-7"	6'-0"	7'-7"	9'-8"	11'-10"	
			Bar Spacing < 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"
		Tens				1'-6"	1'-11"	2'-3"	3'-0"	3'-11"	4'-11"	6'-3"	7'-8"
		Tens Lap - Class C *			2'-7"	3'-3"	3'-10"	5'-0"	6'-7"	8'-4"	10'-7"	13'-0"	
					Comp Lap *	1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
		Lap Enclosed in Spiral			1'-11"	2'-5"	2'-11"	3'-9"	5'-0"	6'-3"	8'-0"	9'-9"	
					Top Bar	Extension	1'-9"	2'-2"	2'-7"	3'-4"	4'-5"	5'-7"	7'-1"
		Tens Lap - Class C	2'-11"	3'-8"		4'-5"	5'-8"	7'-6"	9'-6"	12'-0"	14'-9"		

* Not for bars enclosed in a spiral
 Class A Lap = 59% of Class C Lap
 Class B Lap = 77% of Class C Lap

AASHTO LRFD Bridge Design Specifications 3rd Edition - 2004

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in²	0.31 in²	0.44 in²	0.60 in²	0.79 in²	1.00 in²	1.27 in²	1.56 in²	
f _c = 3250 psi	Cover ≥ 3db and Clear Spacing ≥ 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-9"	2'-0"	2'-3"	2'-6"
					Tens	1'-0"	1'-3"	1'-6"	2'-0"	2'-8"	3'-4"	4'-3"	5'-3"
				Tens Lap - Class C *		1'-8"	2'-1"	2'-6"	3'-5"	4'-6"	5'-8"	7'-3"	8'-10"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed in Spiral		1'-3"	1'-7"	1'-11"	2'-7"	3'-5"	4'-3"	5'-5"	6'-8"
				Extension		1'-5"	1'-9"	2'-1"	2'-10"	3'-9"	4'-8"	6'-0"	7'-4"
				Tens Lap - Class C		2'-4"	2'-11"	3'-6"	4'-10"	6'-4"	8'-0"	10'-1"	12'-5"
		Bar Spacing < 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-9"	2'-0"	2'-3"	2'-6"
					Tens	1'-3"	1'-6"	1'-10"	2'-6"	3'-4"	4'-2"	5'-4"	6'-6"
				Tens Lap - Class C *		2'-1"	2'-7"	3'-2"	4'-3"	5'-8"	7'-1"	9'-0"	11'-1"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed in Spiral		1'-7"	1'-11"	2'-5"	3'-3"	4'-3"	5'-4"	6'-9"	8'-4"
				Extension		1'-9"	2'-2"	2'-7"	3'-6"	4'-8"	5'-10"	7'-5"	9'-2"
				Tens Lap - Class C		2'-11"	3'-7"	4'-5"	6'-0"	7'-10"	9'-11"	12'-7"	15'-6"

* Not for bars enclosed in a spiral
Class A Lap = 59% of Class C Lap
Class B Lap = 77% of Class C Lap

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in ²	0.31 in ²	0.44 in ²	0.60 in ²	0.79 in ²	1.00 in ²	1.27 in ²	1.56 in ²	
f'c = 3250 psi	Cover < 3db or Clear Spacing < 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-9"	2'-0"	2'-3"	2'-6"
					Tens	1'-3"	1'-6"	1'-10"	2'-6"	3'-4"	4'-2"	5'-4"	6'-6"
				Tens Lap - Class C *		2'-1"	2'-7"	3'-2"	4'-3"	5'-8"	7'-1"	9'-0"	11'-1"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed in Spiral		1'-7"	1'-11"	2'-5"	3'-3"	4'-3"	5'-4"	6'-9"	8'-4"
				Extension	1'-5"	1'-9"	2'-1"	2'-10"	3'-9"	4'-9"	6'-0"	7'-5"	
				Tens Lap - Class C		2'-4"	2'-11"	3'-7"	4'-10"	6'-4"	8'-1"	10'-3"	12'-7"
		Bar Spacing < 6"	General	Extension	Comp	0'-11"	1'-2"	1'-4"	1'-7"	1'-9"	2'-0"	2'-3"	2'-6"
					Tens	1'-6"	1'-11"	2'-4"	3'-2"	4'-2"	5'-3"	6'-8"	8'-2"
				Tens Lap - Class C *		2'-7"	3'-3"	3'-11"	5'-4"	7'-0"	8'-11"	11'-3"	13'-10"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed in Spiral		1'-11"	2'-5"	3'-0"	4'-0"	5'-3"	6'-8"	8'-6"	10'-5"
				Extension	1'-9"	2'-2"	2'-8"	3'-7"	4'-8"	5'-11"	7'-6"	9'-3"	
				Tens Lap - Class C		2'-11"	3'-8"	4'-5"	6'-1"	7'-11"	10'-1"	12'-9"	15'-8"

* Not for bars enclosed in a spiral
Class A Lap = 59% of Class C Lap
Class B Lap = 77% of Class C Lap

AASHTO LRFD Bridge Design Specifications
3rd Edition - 2004

EPOXY COATED BAR PROPERTIES, LAPS; AND DEVELOPMENT LENGTHS GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in²	0.31 in²	0.44 in²	0.60 in²	0.79 in²	1.00 in²	1.27 in²	1.56 in²	
f'c = 3750 psi	Cover ≥ 3db and Clear Spacing ≥ 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
					Tens	1'-0"	1'-3"	1'-6"	1'-11"	2'-6"	3'-2"	4'-0"	4'-11"
				Tens Lap - Class C *		1'-8"	2'-1"	2'-6"	3'-2"	4'-2"	5'-4"	6'-9"	8'-3"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed In Spiral		1'-3"	1'-7"	1'-11"	2'-5"	3'-2"	4'-0"	5'-1"	6'-2"
				Extension	Comp	1'-5"	1'-9"	2'-1"	2'-8"	3'-6"	4'-5"	5'-7"	6'-10"
					Tens Lap - Class C	2'-4"	2'-11"	3'-6"	4'-6"	5'-10"	7'-5"	9'-5"	11'-7"
				Bar Spacing < 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"
		Tens	1'-3"				1'-6"	1'-10"	2'-4"	3'-1"	3'-11"	5'-0"	6'-1"
		Tens Lap - Class C *				2'-1"	2'-7"	3'-1"	4'-0"	5'-3"	6'-8"	8'-5"	10'-4"
		Comp Lap *				1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
		Top Bar	Lap Enclosed In Spiral		1'-7"	1'-11"	2'-4"	3'-0"	3'-11"	5'-0"	6'-4"	7'-9"	
			Extension		Comp	1'-9"	2'-2"	2'-7"	3'-4"	4'-4"	5'-6"	6'-11"	8'-6"
					Tens Lap - Class C	2'-11"	3'-7"	4'-4"	5'-7"	7'-4"	9'-3"	11'-9"	14'-5"

* Not for bars enclosed in a spiral
Class A Lap = 59% of Class C Lap
Class B Lap = 77% of Class C Lap

EPOXY COATED BAR PROPERTIES, LAPS, AND DEVELOPMENT LENGTHS GRADE 60													
Bar Size					#4	#5	#6	#7	#8	#9	#10	#11	
Weight					0.668 plf	1.043 plf	1.502 plf	2.044 plf	2.670 plf	3.400 plf	4.303 plf	5.313 plf	
Diameter					0.5 in	0.625 in	0.75 in	0.875 in	1.00 in	1.128 in	1.27 in	1.41 in	
Area					0.20 in²	0.31 in²	0.44 in²	0.60 in²	0.79 in²	1.00 in²	1.27 in²	1.56 in²	
f _c = 3750 psi	Cover < 3db or Clear Spacing < 6db	Bar Spacing ≥ 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"	2'-1"	2'-4"
					Tens	1'-3"	1'-6"	1'-10"	2'-4"	3'-1"	3'-11"	5'-0"	6'-1"
				Tens Lap - Class C *		2'-1"	2'-7"	3'-1"	4'-0"	5'-3"	6'-8"	8'-5"	10'-4"
				Comp Lap *		1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
			Top Bar	Lap Enclosed in Spiral		1'-7"	1'-11"	2'-4"	3'-0"	3'-11"	5'-0"	6'-4"	7'-9"
				Extension	Tens	1'-5"	1'-9"	2'-1"	2'-8"	3'-6"	4'-5"	5'-7"	6'-11"
					Tens Lap - Class C	2'-4"	2'-11"	3'-6"	4'-6"	5'-11"	7'-6"	9'-6"	11'-8"
				Bar Spacing < 6"	General	Extension	Comp	0'-10"	1'-1"	1'-3"	1'-6"	1'-8"	1'-11"
		Tens	1'-6"				1'-11"	2'-3"	2'-11"	3'-10"	4'-11"	6'-2"	7'-7"
		Tens Lap - Class C *				2'-7"	3'-3"	3'-10"	5'-0"	6'-7"	8'-3"	10'-6"	12'-11"
		Comp Lap *				1'-3"	1'-7"	1'-11"	2'-3"	2'-6"	2'-10"	3'-3"	3'-7"
		Top Bar	Lap Enclosed in Spiral		1'-11"	2'-5"	2'-11"	3'-9"	4'-11"	6'-3"	7'-11"	9'-8"	
			Extension		Tens	1'-9"	2'-2"	2'-7"	3'-4"	4'-5"	5'-6"	7'-0"	8'-7"
					Tens Lap - Class C	2'-11"	3'-8"	4'-5"	5'-8"	7'-5"	9'-4"	11'-11"	14'-7"

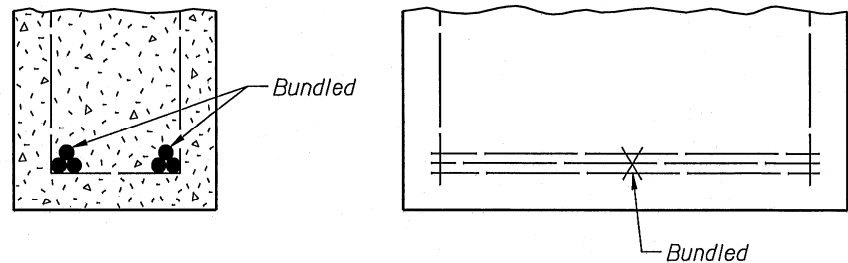
* Not for bars enclosed in a spiral
Class A Lap = 59% of Class C Lap
Class B Lap = 77% of Class C Lap

Welded wire fabric shall be selected from the following table.

Common Stock Styles Of Welded Wire Fabric							
Style Designation	Spacing of Wires (in.)		Diameter of Wires (in.)		Sectional Area (in ² / ft)		Weight (Lbs / 100 ft ²)
	Long.	Trans	Long.	Trans	Long.	Trans	
6 X 6-W1.4 X W1.4	6	6	0.134	0.134	0.028	0.028	21
6 X 6-W2 X W2	6	6	0.160	0.160	0.040	0.040	29
6 X 6-W2.9 X W2.9	6	6	0.192	0.192	0.058	0.058	42
6 X 6-W4 X W4	6	6	0.226	0.226	0.080	0.080	58
4 X 4-W1.4 X W1.4	4	4	0.134	0.134	0.042	0.042	31
4 X 4-W2 X W2	4	4	0.160	0.160	0.060	0.060	43
4 X 4-W2.9 X W2.9	4	4	0.192	0.192	0.087	0.087	62
4 X 4-W4 X W4	4	4	0.226	0.226	0.120	0.120	86

Each structural unit (i.e., abutment, bent, deck, approach slab) uses a numerical **PREFIX** to separate bars in one unit from another. A note is placed on each sheet containing a Bill of Reinforcement identifying the bar prefix. The reinforcing steel fabricator shall prefix each bar in that unit to allow for easy identification of the bars at the job site. Generally, bars are prefixed in the following order: abutments, bents/piers, concrete girders, slab, and approach slabs.

Bundled bars may be used to provide the design steel requirements and should be detailed as follows.



The bar marks, number of bars required, and the bending diagrams for every bar in each structural unit are shown in a **BILL OF REINFORCEMENT** for each structural unit. Example bills are shown towards the end of this section.

Bars for each location shall be grouped numerically by bar size. Within each bar size, bars shall be listed with bent bars first,

Section 4.19 – Reinforcing Steel

straight bars second, and set bars third. Bent bars and set bars shall be listed in ascending numerical order and straight bars shall be listed in ascending lengths. Plain bars, coated bars, and bars not included in the estimated quantity of reinforcing steel shall not be listed separately, but shall be combined within each bar size.

The weight shall be listed either under the location name or at the end of the list at each location. Weight is not required for approach slab bars or any other bars not included in the estimated quantity of reinforcing steel.

BILL OF REINFORCEMENT			
Location	Mark	Number Required	
		Bent No. 1	Bent No. 2
Cap	5B2	27	27
	5B3	24	24
	536-6	10	10
	8B1	8	8
	818-6	4	4
	836-6	8	8
	Weight	3152 LB	3152 LB
Columns	4B4	2	2
	813-3	36	36
	Weight	2385 LB	2385 LB
Drilled Shafts	4B5	2	—
	4B6	—	2
	824-10	18	—
	827-10	—	18
Bending Diagrams			
Spirals			
Mark	Core	Pitch	Turns
4B4	36"	2 1/2"	# 81
4B5	36"	2 1/2"	# 107
4B6	36"	2 1/2"	# 122

BILL OF REINFORCEMENT		
Location	Mark	Number Required
End Diaphragms	4S5	140
	4S6	70
	*4S7	64
	5S2	138
	535-0	16
	*6S3	104
	*Weight	*3051 LB
	Weight	3437 LB
Slab and Curbs	*4S1	130
	*406-4	4
	*437-6	52
	*460-0	4
	*5S4	59
	*507-3	50
	*535-0	120
	*560-0	50
	*635-0	8
	*Weight	*12504 LB
Bending Diagrams		

Section 4.19 – Reinforcing Steel

BILL OF REINFORCEMENT		
Location (Weight)	Mark	Number Required
End Diaphragms	*4S1	46
	4S2	62
	504-5	13
	*525-6	13
	560-0	13
	*6S3	41
	*4S1	42
	4S2	57
	*525-6	13
	557-8	13
	*6S3	41
	4S6	56
Intermediate Diaphragms (1195 LB)	504-3	10
	508-4	80
	*4S4	112
	*4S5	115
Slab (*38614 LB)	*411-2	41
	*460-0	41
	*542-5	173
	*558-5	59
	*560-0	59
	*Set 2 Bars	1
	*Set 4 Bars	1
	*604-10	4
	*642-5	173
	*657-8	4
	*660-0	4
	*Set 1 Bars	1
	*Set 3 Bars	1
	*454-6	2
	*457-11	2
	*460-0	4
Curbs (*311 LB)		
Bending Diagrams		
<p>*4S1 (Stirrup) (16'-0")</p> <p>4S2 (Stirrup) (4'-2")</p> <p>*6S3 (27'-0")</p> <p>*4S4 (Tie) (4'-10")</p> <p>*4S5 (Tie) (15'-0")</p> <p>4S6 (Stirrup) (12'-2")</p>		
Set Diagrams		
<p>*Set 1 Bars (No. 6 Bars) (Avg length = 21'-11")</p> <p>*Set 2 Bars (No. 5 Bars) (Avg length = 21'-10 1/2")</p> <p>*Set 3 Bars (No. 6 Bars) (Avg length = 22'-0")</p> <p>*Set 4 Bars (No. 5 Bars) (Avg length = 22'-0 1/2")</p>		

BILL OF REINFORCEMENT		
Location (Weight per Pier)	Mark	Number Required Per Pier
Cap (2332 LB)	4B13	10
	525-8	12
	Set 1 Bars	2
	Set 2 Bars	2
	8B14	16
	812-0	4
	925-8	12
Shaft (4031 LB)	4B15	240
	4B16	40
	410-0	40
	813-0	92
Footing (4410 LB)	706-8	96
	717-8	36
	8B17	92
Bending Diagrams		
<p>4B13 (5'-8")</p> <p>8B14 (12'-8")</p> <p>4B15 (Stirrup) (2'-6")</p> <p>4B16 (Stirrup) (6'-4")</p> <p>8B17 (7'-4")</p>		
Set Diagrams		
<p>5B1 (Tie) (8'-11")</p> <p>5B7 (Tie) (10'-2")</p> <p>5B8 (Tie) (10'-4")</p> <p>5B12 (Tie) (11'-8")</p> <p>Set 1 Bars (Avg length = 9'-6 1/2")</p> <p>Set 2 Bars (Avg length = 11'-0")</p>		

Cells**Name**

REBAR
REBARC
REBARL
REBARR
REBARU
REBENT
REBEV
REBILL
RECANE
RECRK4
RECRK5
RECRK6
REHOOK
REPAT
RESETB
RESETS
RESTPR
RESTPU
RETYBT
RETYBV
RETYSQ

Description

Section View of Rebar
C Shaped Rebar
L Shaped Rebar
Barrier Rail Rebar
U Shaped Rebar
Bent Rebar
Bevel Rebar
Bill of Reinforcement
Hook Rebar
Crank Rebar for 4 Girders
Crank Rebar for 5 Girders
Crank Rebar for 6 Girders
Hook Rebar with Foot
Reinforcing Steel Pattern
Set Bent Rebar
Straight Rebar Cut Set
R Shaped Stirrup
U Shaped Stirrup
Bent Tie Rebar for Curb
Bevel Tie Rebar for Curb
Square Tie Rebar