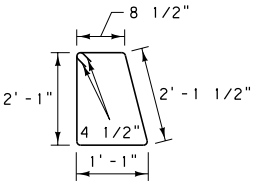
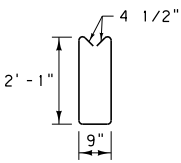
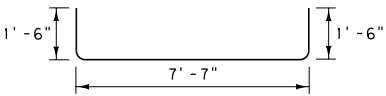
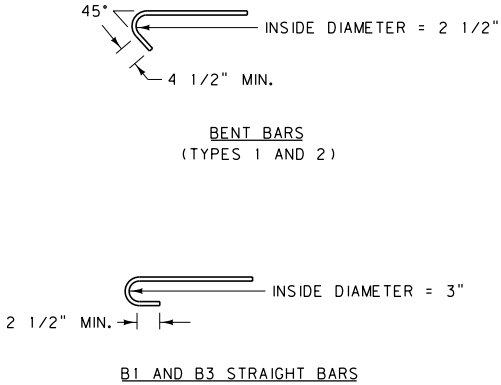


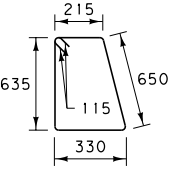
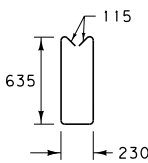
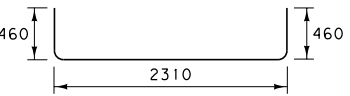
BILL OF REINFORCING STEEL									
BENT BARS (ALL DIMENSIONS ARE OUT TO OUT)									
<div><div><div>TYPE 1</div></div><div><div>TYPE 2</div></div><div><div>TYPE 3</div></div></div>									
16 FT. C. G.					30 FT. C. G.				
MARK	SIZE	NO.	TYPE	LENGTH	MARK	SIZE	NO.	TYPE	LENGTH
B1	#4	12	STR.	16'-9"	B1	#4	12	STR.	30'-9"
B2	#4	22	1	6'-9"	B2	#4	42	1	6'-9"
B3	#4	6	STR.	7'-7"	B3	#4	12	STR.	7'-7"
B4	#4	4	2	5'-8"	B4	#4	8	2	5'-8"
B5	#4	6	3	10'-7"	B5	#4	6	3	10'-7"
ESTIMATED WT. = 321 LB.					ESTIMATED WT. = 569 LB.				
20 FT. C. G.					32 FT. C. G.				
B1	#4	12	STR.	20'-9"	B1	#4	12	STR.	32'-9"
B2	#4	28	1	6'-9"	B2	#4	44	1	6'-9"
B3	#4	6	STR.	7'-7"	B3	#4	18	STR.	7'-7"
B4	#4	4	2	5'-8"	B4	#4	12	2	5'-8"
B5	#4	6	3	10'-7"	B5	#4	6	3	10'-7"
ESTIMATED WT. = 381 LB.					ESTIMATED WT. = 640 LB.				
24 FT. C. G.					36 FT. C. G.				
B1	#4	12	STR.	24'-9"	B1	#4	12	STR.	36'-9"
B2	#4	34	1	6'-9"	B2	#4	50	1	6'-9"
B3	#4	6	STR.	7'-7"	B3	#4	12	STR.	7'-7"
B4	#4	4	2	5'-8"	B4	#4	8	2	5'-8"
B5	#4	6	3	10'-7"	B5	#4	6	3	10'-7"
ESTIMATED WT. = 440 LB.					ESTIMATED WT. = 654 LB.				
					40 FT. C. G.				
B1	#4	12	STR.	40'-9"	B1	#4	12	STR.	40'-9"
B2	#4	54	1	6'-9"	B2	#4	54	1	6'-9"
B3	#4	18	STR.	7'-7"	B3	#4	18	STR.	7'-7"
B4	#4	12	2	5'-8"	B4	#4	12	2	5'-8"
B5	#4	6	3	10'-7"	B5	#4	6	3	10'-7"
ESTIMATED WT. = 749 LB.									

- NOTES:
- ① CONCRETE QUANTITIES WERE FIGURED WITHOUT A CROWN, INCREASE WHEN A CROWNED INSTALLATION IS USED.
- ② ALL REINFORCING STEEL IS OF THE DEFORMED TYPE, MEETING THE REQUIREMENTS OF AASHTO M31 (ASTM A615, GRADE 60).
- ③ SEE DTL. DWG. NO. 611-00 FOR CAST-IN-PLACE CATTLE GUARD DETAILS.

ESTIMATED CLASS GENERAL CONCRETE QUANTITIES	
16' C. G. =	4.76 C. Y.
20' C. G. =	5.69 C. Y.
24' C. G. =	6.61 C. Y.
30' C. G. =	8.51 C. Y.
32' C. G. =	9.48 C. Y.
36' C. G. =	9.90 C. Y.
40' C. G. =	11.33 C. Y.

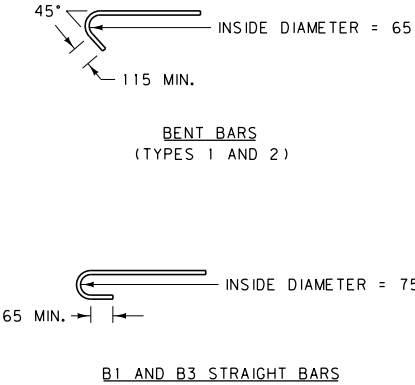


REBAR DETAILS

METRIC BILL OF REINFORCING STEEL									
BENT BARS (ALL DIMENSIONS ARE OUT TO OUT)									
<div><div><div>TYPE 1</div></div><div><div>TYPE 2</div></div><div><div>TYPE 3</div></div></div>									
4.8 m C. G.					9.0 m C. G.				
MARK	SIZE	NO.	TYPE	LENGTH	MARK	SIZE	NO.	TYPE	LENGTH
B1	#13	12	STR.	5105	B1	#13	12	STR.	9375
B2	#13	22	1	2060	B2	#13	42	1	2060
B3	#13	6	STR.	2310	B3	#13	12	STR.	2310
B4	#13	4	2	1730	B4	#13	8	2	1730
B5	#13	6	3	3230	B5	#13	6	3	3230
ESTIMATED WT. = 145.6 kg					ESTIMATED WT. = 258.1 kg				
6.0 m C. G.					9.6 m C. G.				
B1	#13	12	STR.	6325	B1	#13	12	STR.	9980
B2	#13	28	1	2060	B2	#13	44	1	2060
B3	#13	6	STR.	2310	B3	#13	18	STR.	2310
B4	#13	4	2	1730	B4	#13	12	2	1730
B5	#13	6	3	3230	B5	#13	6	3	3230
ESTIMATED WT. = 172.8 kg					ESTIMATED WT. = 290.3 kg				
7.2 m C. G.					10.8 m C. G.				
B1	#13	12	STR.	7545	B1	#13	12	STR.	11200
B2	#13	34	1	2060	B2	#13	50	1	2060
B3	#13	6	STR.	2310	B3	#13	12	STR.	2310
B4	#13	4	2	1730	B4	#13	8	2	1730
B5	#13	6	3	3230	B5	#13	6	3	3230
ESTIMATED WT. = 199.6 kg					ESTIMATED WT. = 296.6 kg				
					12.0 m C. G.				
B1	#13	12	STR.	12420	B1	#13	12	STR.	12420
B2	#13	54	1	2060	B2	#13	54	1	2060
B3	#13	18	STR.	2310	B3	#13	18	STR.	2310
B4	#13	12	2	1730	B4	#13	12	2	1730
B5	#13	6	3	3230	B5	#13	6	3	3230
ESTIMATED WT. = 339.7 kg									


- NOTES:
- ① METRIC CATTLE GUARD SIZES ARE NOMINAL.
- ② CONCRETE QUANTITIES WERE FIGURED WITHOUT A CROWN, INCREASE WHEN A CROWNED INSTALLATION IS USED.
- ③ ALL REINFORCING STEEL IS OF THE DEFORMED TYPE, MEETING THE REQUIREMENTS OF AASHTO M31 (ASTM A615, GRADE 60).
- ④ SEE DTL. DWG. NO. 611-00 FOR CAST-IN-PLACE CATTLE GUARD DETAILS.

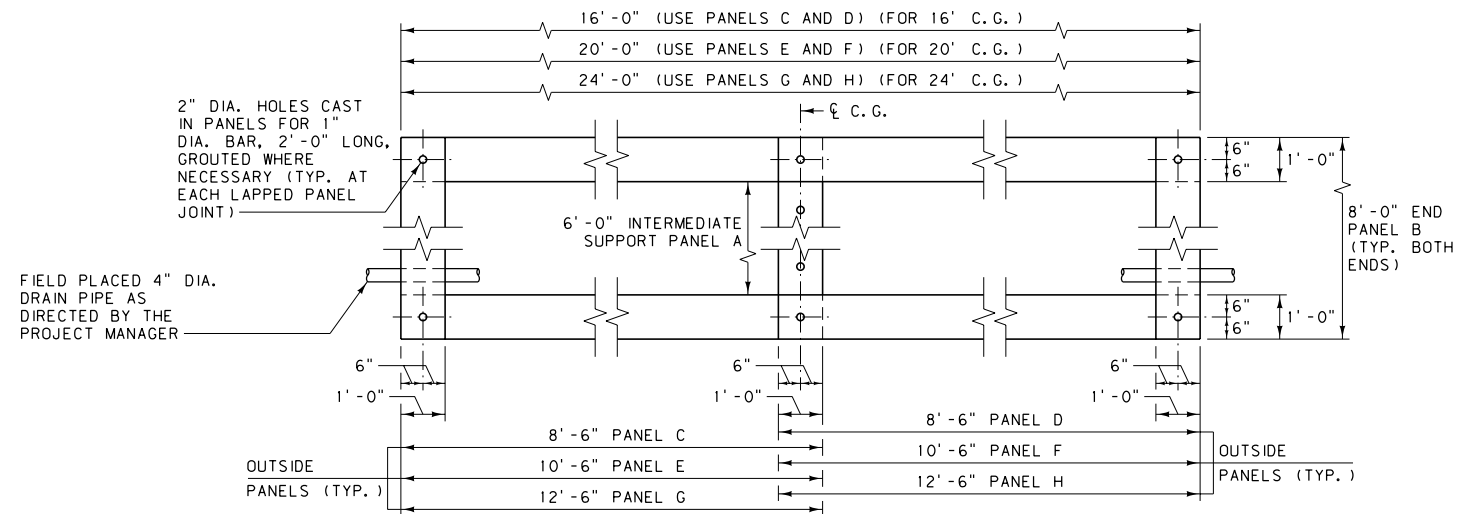
ESTIMATED CLASS GENERAL CONCRETE QUANTITIES	
4.8 m C. G. =	3.64 m³
6.0 m C. G. =	4.35 m³
7.2 m C. G. =	5.05 m³
9.0 m C. G. =	6.51 m³
9.6 m C. G. =	7.25 m³
10.8 m C. G. =	7.57 m³
12.0 m C. G. =	8.66 m³



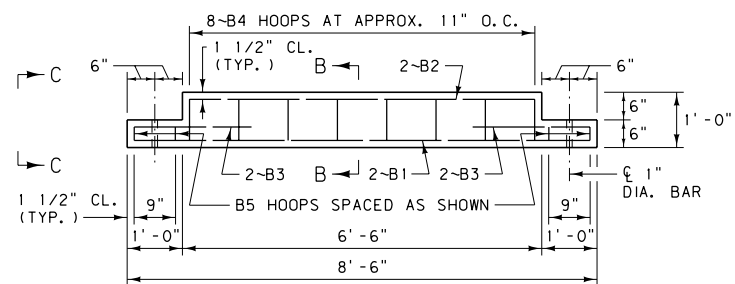
REBAR DETAILS

ALL DIMENSIONS ARE MILLIMETERS (mm) UNLESS OTHERWISE NOTED.

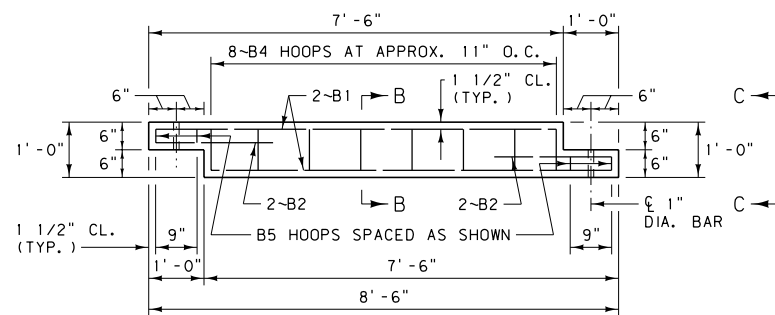
DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 611	DWG. NO. 611-05
CAST-IN-PLACE CATTLE GUARD REBAR DETAILS	
EFFECTIVE: SEPTEMBER 2014	
	



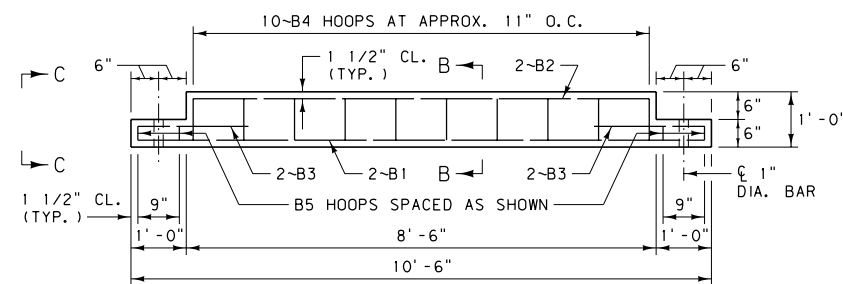
TYPICAL PLAN VIEW



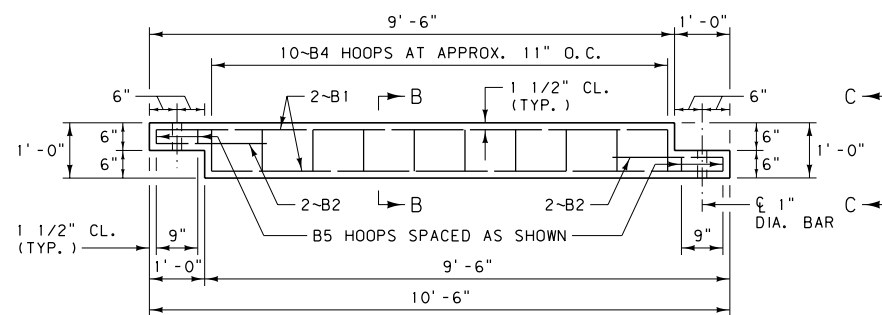
PANEL C ELEVATION



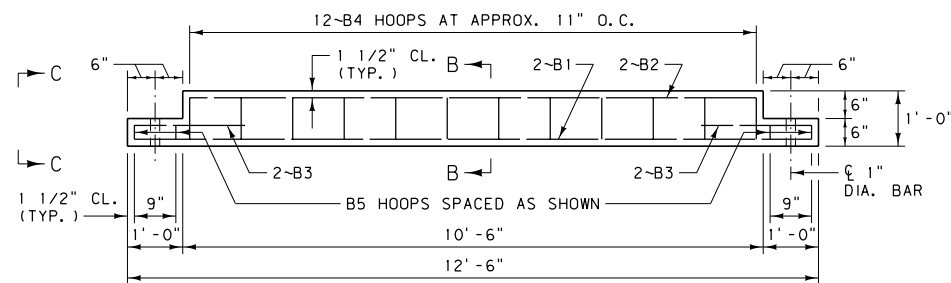
PANEL D ELEVATION



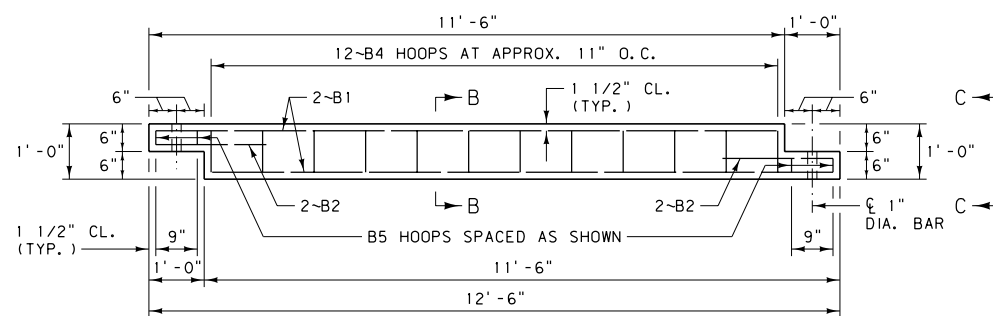
PANEL E ELEVATION



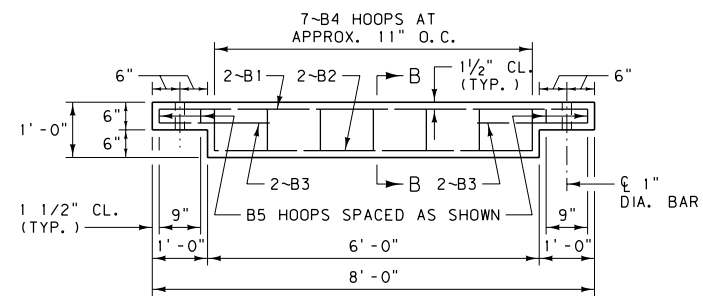
PANEL F ELEVATION



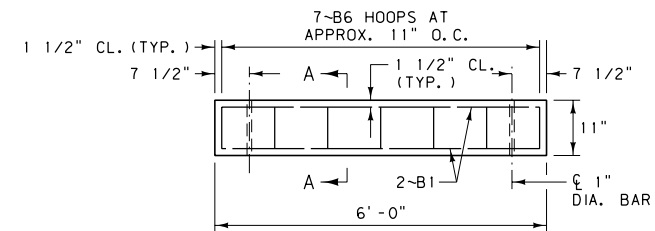
PANEL G ELEVATION



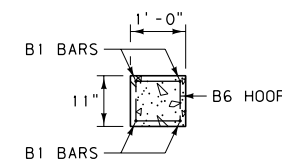
PANEL H ELEVATION



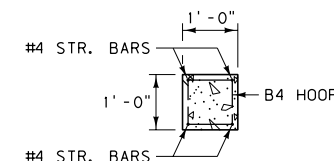
END PANEL B ELEVATION



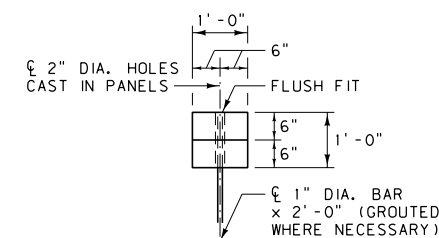
INTERMEDIATE SUPPORT PANEL A ELEVATION



SECTION A-A



SECTION B-B



VIEW C-C (TYP. LAPPED PANEL JOINT)

NOTES:

- USE ONLY ON FIELD OR PRIVATE APPROACHES.
- PROVIDE CAST-IN ANCHOR BOLTS AS SHOWN IN DTL. DWG. NO. 611-00 AT THE APPROPRIATE LOCATIONS. CAST-IN LAG PLATES, SIMILAR TO THOSE SHOWN IN DTL. DWG. NO. 611-15, MAY ALSO BE USED.
- ALL REINFORCING STEEL IS OF THE DEFORMED TYPE, MEETING THE REQUIREMENTS OF AASHTO M31 (ASTM A615, GRADE 60).
- FOR DETAILS OF STEEL GRATES AND STEEL WINGS SEE DTL. DWG. NO. 611-00.

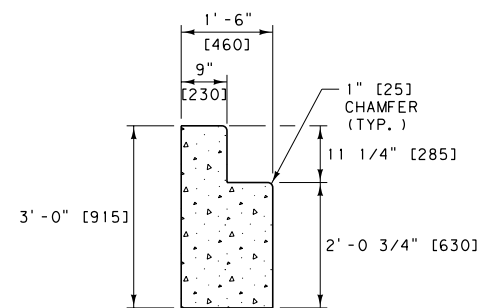
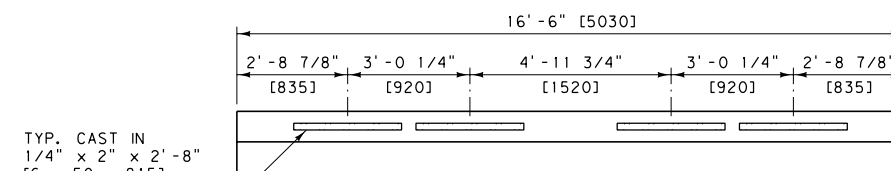
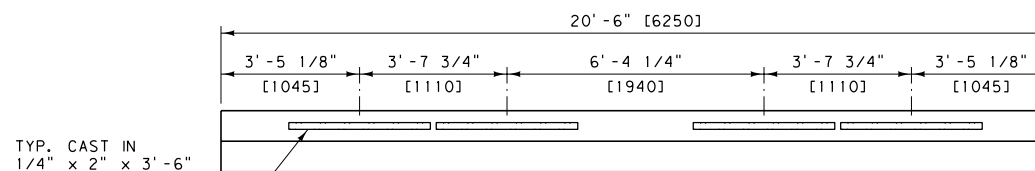
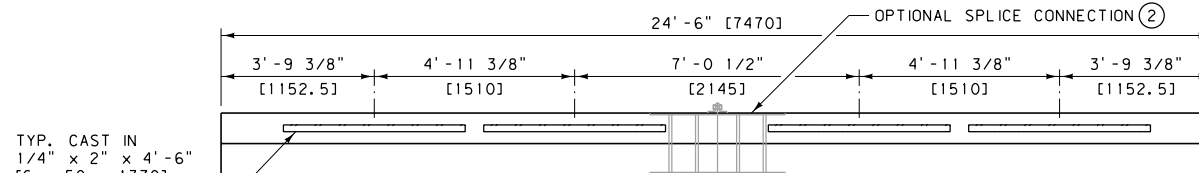
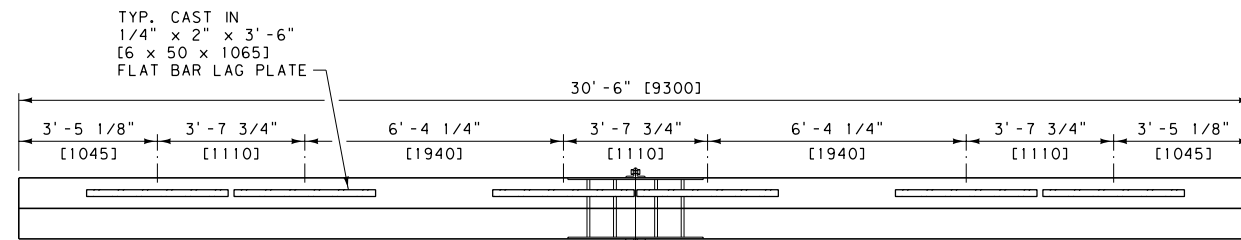
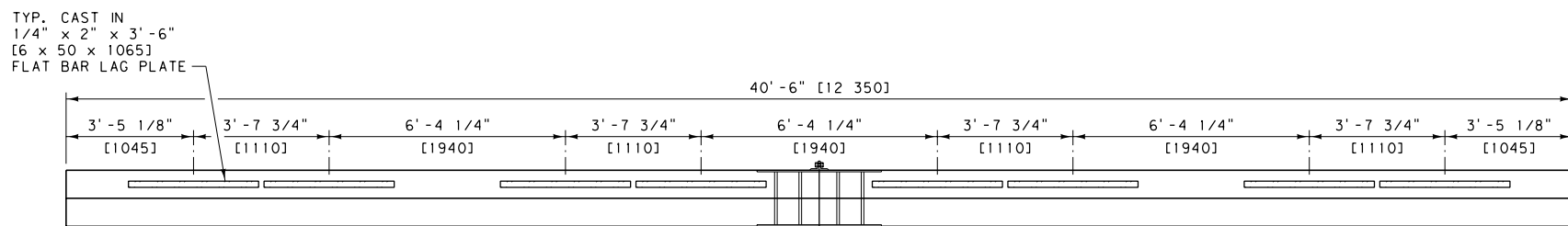
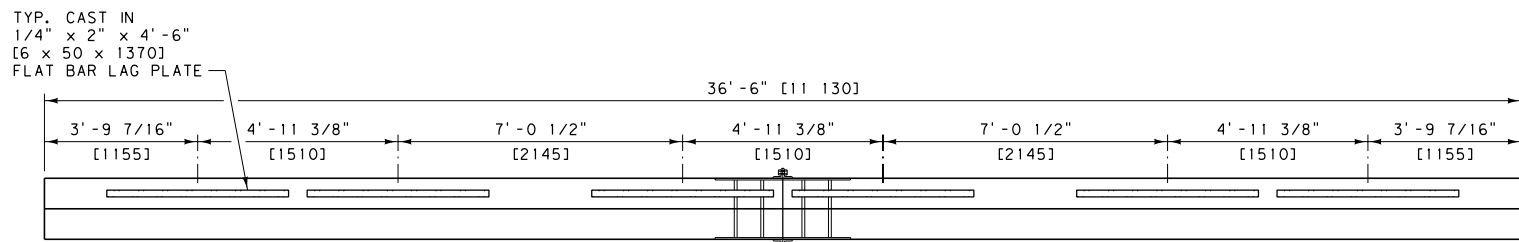
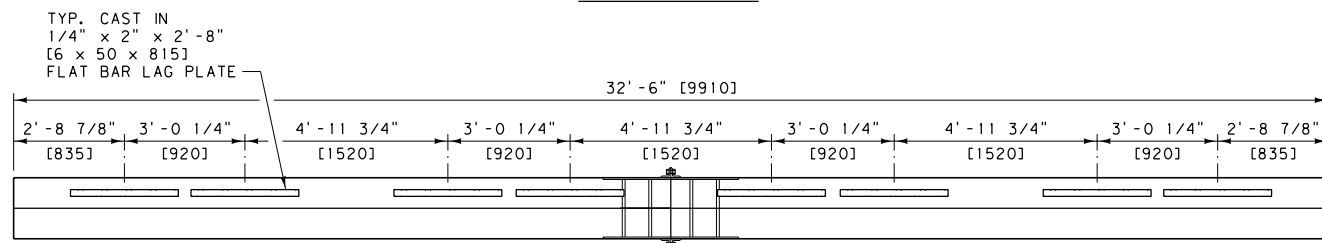
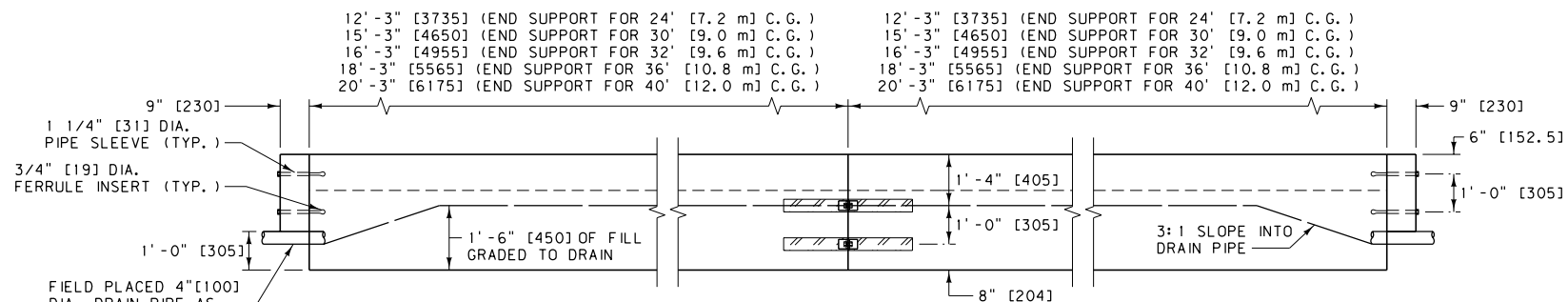
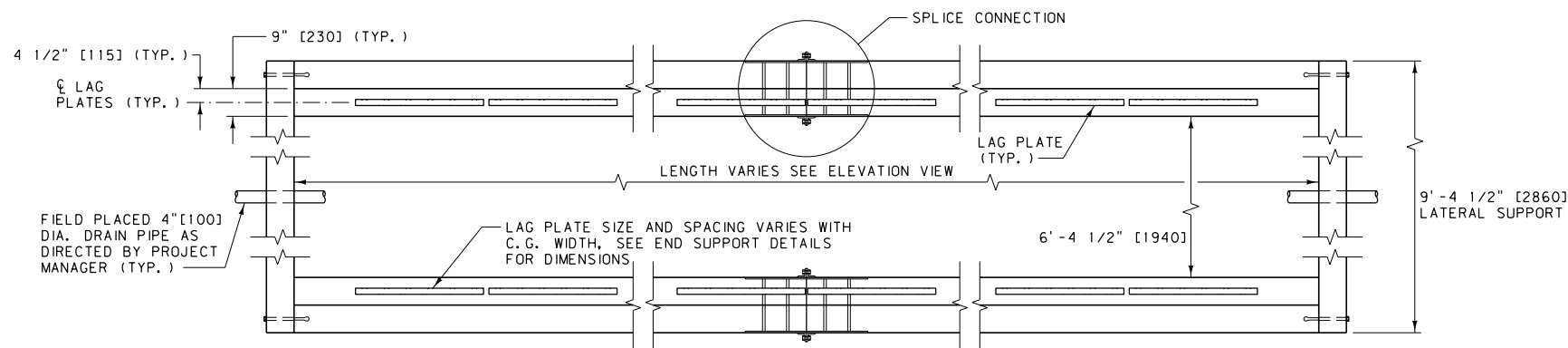
BILL OF REINFORCING STEEL *				
MARK	SIZE	NO.	TYPE	LENGTH
6'-0" SECTION - PANEL A				
B1	#4	4	STRAIGHT	5'-9"
B6	#3	7	2	3'-5"
ESTIMATED WT. = 24 LB.				
8'-0" SECTION - PANEL B				
B1	#4	2	STRAIGHT	7'-9"
B2	#4	2	STRAIGHT	5'-9"
B3	#4	4	STRAIGHT	2'-2"
B4	#3	7	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 37 LB.				
8'-6" SECTION - PANEL C				
B1	#4	2	STRAIGHT	8'-3"
B2	#4	2	STRAIGHT	6'-3"
B3	#4	4	STRAIGHT	2'-2"
B4	#3	8	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 40 LB.				
8'-6" SECTION - PANEL D				
B1	#4	4	STRAIGHT	7'-3"
B2	#4	4	STRAIGHT	2'-2"
B4	#3	8	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 40 LB.				
10'-6" SECTION - PANEL E				
B1	#4	2	STRAIGHT	10'-3"
B2	#4	2	STRAIGHT	8'-3"
B3	#4	4	STRAIGHT	2'-2"
B4	#3	10	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 48 LB.				
10'-6" SECTION - PANEL F				
B1	#4	4	STRAIGHT	9'-3"
B2	#4	4	STRAIGHT	2'-2"
B4	#3	10	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 48 LB.				
12'-6" SECTION - PANEL G				
B1	#4	2	STRAIGHT	12'-3"
B2	#4	2	STRAIGHT	10'-3"
B3	#4	4	STRAIGHT	2'-2"
B4	#3	12	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 56 LB.				
12'-6" SECTION - PANEL H				
B1	#4	4	STRAIGHT	11'-3"
B2	#4	4	STRAIGHT	2'-2"
B4	#3	12	1	3'-7"
B5	#3	4	3	2'-7"
ESTIMATED WT. = 56 LB.				

\* FOR ONE PANEL ONLY

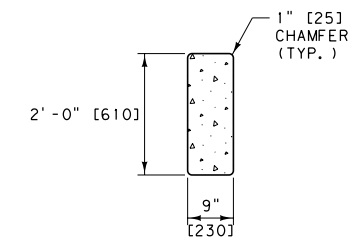
ESTIMATED CLASS GENERAL CONCRETE QUANTITIES	
6'-0" SECTION - PANEL A	= 0.20 C.Y.
8'-0" SECTION - PANEL B	= 0.26 C.Y.
8'-6" SECTION - PANEL C	= 0.28 C.Y.
8'-6" SECTION - PANEL D	= 0.28 C.Y.
10'-6" SECTION - PANEL E	= 0.35 C.Y.
10'-6" SECTION - PANEL F	= 0.35 C.Y.
12'-6" SECTION - PANEL G	= 0.43 C.Y.
12'-6" SECTION - PANEL H	= 0.43 C.Y.

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 611	DWG. NO. 611-10
LIGHT DUTY CATTLE GUARD - PRECAST	
EFFECTIVE: SEPTEMBER 2014	
MONTANA DEPARTMENT OF TRANSPORTATION	

**MDT** ★ MONTANA DEPARTMENT  
OF TRANSPORTATION



END SUPPORT SECTION VIEW



LATERAL SUPPORT SECTION VIEW

NOTES:

- METRIC CATTLE GUARD SIZES ARE NOMINAL. STANDARD HS20 LIVE LOADING IS REQUIRED FOR HEAVY DUTY CATTLE GUARDS.
- USE SPLICE CONNECTIONS WHEN A CROWNED INSTALLATION IS REQUIRED.
- SEE DTL. DWG. NO. 611-20 FOR ADDITIONAL PRE-CAST CONCRETE CATTLE GUARD BASE AND MATERIAL QUANTITY DETAILS.
- SEE DTL. DWG. NO. 611-00 FOR DETAILS OF STEEL GRATES AND STEEL WINGS.

⑤ INSTALLATION PROCEDURE:

EXCAVATE 2' -0" [600] BELOW THE ELEVATION OF THE BOTTOM OF THE CATTLE GUARD BASE. EXTEND THE EXCAVATION HORIZONTALLY AT LEAST 1' -0" [300] IN ALL DIRECTIONS BEYOND THE CATTLE GUARD BASE'S EXTERIOR DIMENSION.

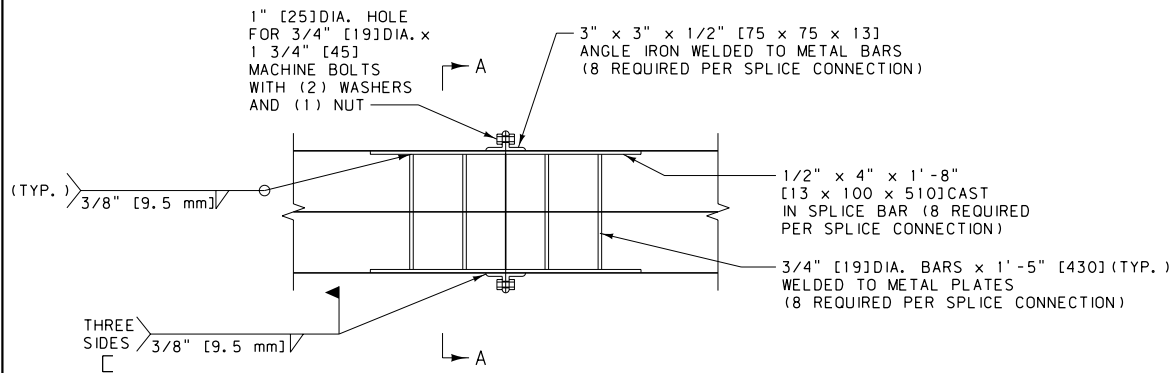
FILL THE EXCAVATION TO THE LEVEL OF THE BOTTOM OF THE CATTLE GUARD BASE WITH FILL MATERIAL OF AASHTO GRADE A-1-a OR BETTER, COMPACT TO MEET REQUIREMENTS OF SECTION 203.

AFTER PLACING THE CATTLE GUARD, FILL THE EXTERIOR PORTION OF THE EXCAVATION TO GRADE WITH THE SAME MATERIAL.

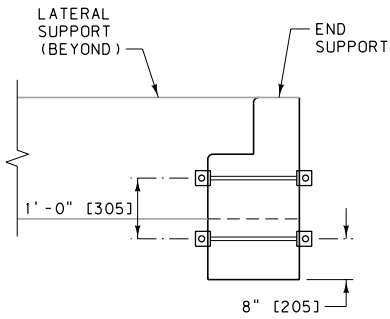
FILL THE INTERIOR OF THE CATTLE GUARD BASE TO A DEPTH OF 1' -6" [450] WITH THE SIMILARLY COMPACTED MATERIAL.

UNITS SHOWN IN BRACKETS [ ] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.

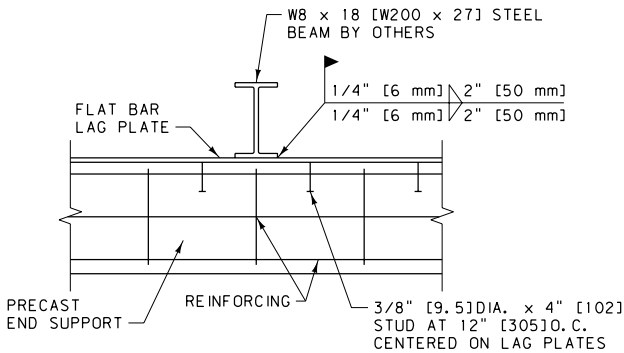
DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 611	DWG. NO. 611-15
HEAVY DUTY CATTLE GUARD - PRECAST	
EFFECTIVE: SEPTEMBER 2014	
MONTANA DEPARTMENT OF TRANSPORTATION	



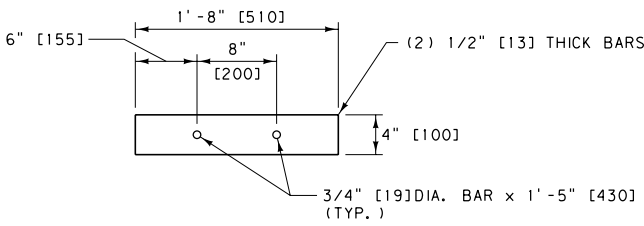
SPlice CONNECTION DETAIL



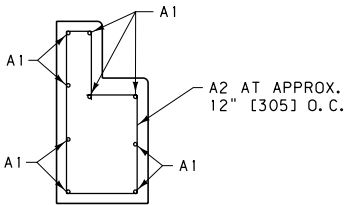
END SUPPORT SECTION A-A



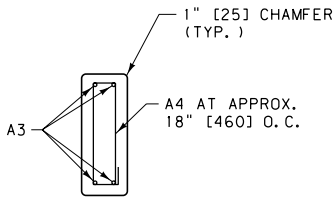
LAG PLATE CONNECTION DETAIL



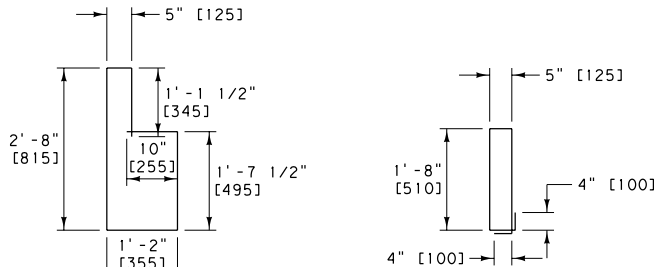
SPlice BAR DETAIL



END SUPPORT REBAR DETAIL



LATERAL SUPPORT REBAR DETAIL



REINFORCING STEEL

NOTE: ALL REBAR DIMENSIONS ARE OUT TO OUT.

QUANTITIES AND DIMENSIONS ARE APPROXIMATE ONLY BASED ON ONE COMPLETE CATTLE GUARD.													
NOMINAL C. G. SIZE	REINFORCING STEEL (NO. 4 BARS / GRADE 60)									MISC. STEEL			
	A1		A2		A3		A4		ESTIMATED WT.	LAG PLATES		SPLICE CONNECTION	ESTIMATED WT.
	REQUIRED	LENGTH	REQUIRED	LENGTH	REQUIRED	LENGTH	REQUIRED	LENGTH	LB.	REQUIRED	LENGTH		LB.
16' - 0"	18	16' - 2"	36	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	477	8	2' - 8"	NO	39
20' - 0"	18	20' - 2"	44	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	567	8	3' - 6"	NO	52
24' - 0"	18	24' - 2"	52	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	657	8	4' - 6"	NO	66
* 24' - 0"	36	11' - 11"	52	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	653	8	4' - 6"	YES	323
30' - 0"	36	14' - 11"	64	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	788	12	3' - 6"	YES	334
32' - 0"	36	15' - 11"	68	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	833	16	2' - 8"	YES	335
36' - 0"	36	17' - 11"	76	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	923	12	4' - 6"	YES	356
40' - 0"	36	19' - 11"	84	7' - 10"	8	9' - 1 1/2"	14	4' - 10"	1013	16	3' - 6"	YES	360

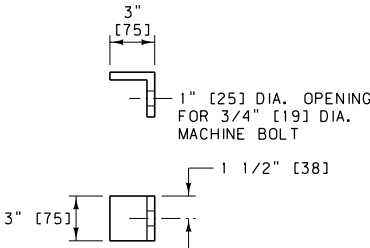
\* 24' - 0" CATTLE GUARD WITH OPTIONAL SPLICE

ESTIMATED CLASS GENERAL CONCRETE QUANTITIES	
16' - 0" C.G.	= 5.68 C.Y.
20' - 0" C.G.	= 6.81 C.Y.
24' - 0" C.G.	= 7.93 C.Y.
* 24' - 0" C.G.	= 7.93 C.Y.
30' - 0" C.G.	= 9.62 C.Y.
32' - 0" C.G.	= 10.18 C.Y.
36' - 0" C.G.	= 11.31 C.Y.
40' - 0" C.G.	= 12.43 C.Y.

QUANTITIES AND DIMENSIONS ARE APPROXIMATE ONLY BASED ON ONE COMPLETE CATTLE GUARD.													
NOMINAL C. G. SIZE	REINFORCING STEEL (NO. 13 BARS / GRADE 420)									MISC. STEEL			
	A1		A2		A3		A4		ESTIMATED WT.	LAG PLATES		SPlice CONNECTION	ESTIMATED WT.
	REQUIRED	LENGTH	REQUIRED	LENGTH	REQUIRED	LENGTH	REQUIRED	LENGTH	kg.	REQUIRED	LENGTH		kg.
4.8 m	18	4930 mm	36	2390 mm	8	2780 mm	14	1470 mm	216.3	8	815 mm	NO	16.7
6.0 m	18	6150 mm	44	2390 mm	8	2780 mm	14	1470 mm	257.1	8	1065 mm	NO	21.4
7.2 m	18	7370 mm	52	2390 mm	8	2780 mm	14	1470 mm	298.0	8	1370 mm	NO	27.1
* 7.2 m	36	3635 mm	52	2390 mm	8	2780 mm	14	1470 mm	296.2	8	1370 mm	YES	144.2
9.0 m	36	4550 mm	64	2390 mm	8	2780 mm	14	1470 mm	357.4	12	1065 mm	YES	149.1
9.6 m	36	4855 mm	68	2390 mm	8	2780 mm	14	1470 mm	377.8	16	815 mm	YES	150.4
10.8 m	36	5465 mm	76	2390 mm	8	2780 mm	14	1470 mm	418.7	12	1370 mm	YES	157.8
12.0 m	36	6075 mm	84	2390 mm	8	2780 mm	14	1470 mm	459.5	16	1065 mm	YES	159.8

\* 7.2 m CATTLE GUARD WITH OPTIONAL SPLICE

ESTIMATED CLASS GENERAL CONCRETE QUANTITIES (METRIC)	
4.8 m C.G.	= 3.72 m³
6.0 m C.G.	= 4.43 m³
7.2 m C.G.	= 5.13 m³
* 7.2 m C.G.	= 5.13 m³
9.0 m C.G.	= 6.19 m³
9.6 m C.G.	= 6.55 m³
10.8 m C.G.	= 7.25 m³
12.0 m C.G.	= 7.96 m³




ANGLE IRON DETAIL

NOTES:

- ① C.G. = CATTLE GUARD.
- ② ALL HARDWARE IS TO BE PRIMER PAINTED.
- ③ ALL STEEL HARDWARE IS TO CONFORM TO AASHTO M270 [270M] GRADE 36 [250].
- ④ ALL NUTS, BOLTS, AND WASHERS ARE TO CONFORM TO ASTM A307 [307M] AND BE GALVANIZED PER AASHTO M232 [M232M].
- ⑤ SEE DTL. DWG. NO 611-15 FOR PRECAST CONCRETE CATTLE GUARD BASE

UNITS SHOWN IN BRACKETS [ ] ARE METRIC AND ARE IN MILLIMETERS (mm) UNLESS OTHER UNITS ARE SHOWN.

DETAILED DRAWING	
REFERENCE STANDARD SPEC. SECTION 611	DWG. NO. 611-20
PRECAST CONCRETE CATTLE GUARD BASE DETAILS	
EFFECTIVE: SEPTEMBER 2014	
 MONTANA DEPARTMENT OF TRANSPORTATION	