STUDY REPORT

PROPOSED DESIGN

OF

EXISTING SIMPLE SPAN STEEL GIRDERS MADE CONTINUOUS

Submitted to:
Maryland State Highway Administration

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Table of Contents

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Introduction

The objective of this study for the State of Maryland is to provide recommended details for making simple span steel girders continuous, according to allowable stress design (AASHTO Standards).

Four methods are proposed for making simple span steel beams continuous, depending on the type of existing beams.

The study started by sending letters to the Departments of Transportation in all 50 states requesting their standard detail drawings of diaphragms over piers. The limited replies by other states have been reviewed, and it was observed that New York State Department Of Transportation have provided with one detail that might be included with our proposed details. Also, Maryland Department of Transportation has provided details that have been used in several projects.

Four methods for making simple span steel girders continuous are being proposed for the state of Maryland. Each method proposes a procedure to represent the top and bottom components. In addition, the proposed method three discussed in the section titled:" Proposed methods" include a spreadsheet that calculates the required steel reinforcement along with the dimensions for the proposed concrete diaphragm, having different beam spacing. It should be noted that Merlin-Dash was used to extract the moments due to dead load, superimposed dead load and live load and impact, on continuous steel girders.

PROPOSED METHODS

Four methods are proposed for simple span steel girders to be made continuous. Each of the four methods presents a detail that shows the connection between adjacent girders to be made continuous, assessing for tension or compression at top and bottom respectively. In addition, procedures of installation of the mentioned methods are entailed in the related section. Method one, where top flanges of the adjacent steel girders are bolted to a single splice plate cast-in concrete and the lower ends of the two webs are connected to a stiffened plate assembly. Methods two is similar to method one for the top flanges detail, the difference is in the provided detail for the bottom compression section where web splice plates are bolted to the webs. It should be noted that for both method one and two, the steel girders top flanges are at the same level. Method one and two are suitable for equal and unequal height steel girders. Method Three is suitable for equal height adjacent steel girders. In the latter method, a concrete diaphragm is used to assess for continuity and live load over pier. Finally, proposed method four is provided by New York State Department of Transportation, and it is suitable for equally height adjacent steel girders. In this method top, bottom, and web steel plates are used to assess for continuity over pier.

Method One; Casted Top Steel Bolted Splice With Web Stiffened Plate Assembly

In proposed method one, that assess for moment continuity over pier only, the top flanges of the two adjacent steel girders are bolted to a single splice plate cast in concrete to resist tension component, along with shear studs. The lower end of the webs is connected to a stiffened plate assembly with four bolts to resist compression component of the flexural moment (see Appendix, Figures M1). For shear analysis, it is assumed that shear associated with each adjacent steel girder is directly transferred to their respective bearings, and discontinuous over continuity area. Designer is recommended to check the adequacy of the mentioned statement. It should be noted that method one is proposed for unequally and equally height adjacent steel girders.

The installation procedures for method one are:

a. Remove existing concrete deck.
b. Drill bolt holes in existing top flange, install top flange splice plate and bolts.
c. Install one side of the bottom connection assembly.
d. Pour concrete deck.
e. Choose shim plate thickness to make a tight fit of the remaining side of the bottom assembly. Weld the assembly to the existing stringer and fasten the connection bolts.

Method Two; Casted Top Steel Bolted Splice with Bolted Web Plates

The proposed method two can be considered as an alternative of method one. The top part detail of the connection is similar to method one. The difference is in the connection detail used in the lower end of the webs. The mentioned detail consists of a web splice plate bolted to the webs of the adjacent steel girders. Web splice plate serve two purposes; resist the compression component of the pier moment, and resist the shear associated with each steel girder. Also, method two is intended to serve both equal and unequal height adjacent steel girders.

The installation procedures for method two are:

1. Drill bolt holes in existing flanges. Install top flange plate and bolts.
2. Complete concrete deck placements in all spans.
3. Drill bolt holes in existing webs and cut slots in existing bearing stiffeners. Install web plates and bolts.

Method Three; Concrete Casted Diaphragm

The proposed method three is similar to the proposed method for assessing continuity over piers for prestressed concrete girders, included in the study report title: "Survey and Design of Simple Span Precast Concrete Girders Made Continuous ". The PCI bridge design manual was referred to for the design of the diaphragm. The AASHTO Standard Specifications for Highway Bridges (Sixteenth Edition) was used also. Based on the review, a spreadsheet that calculates the negative moment reinforcement at the pier was constructed. The design was based on a concrete rectangular block having a height equal to the adjacent beams including the slab thickness, and the width was taken equal to the adjacent beams bottom width. The spreadsheet accounts for five different heights of steel girders. Three different span spacing were used and reinforcement along with minimum required stirrups were calculated accordingly. The user has to input the negative dead load moment combination and live load. Figure 1 shows the dimensions and reinforcement details of the proposed diaphragm detail over pier for the State of Maryland. Referring to the spreadsheet, Bar A is to be found for all types of girders based on the inputted dead load and live load combinations. Bars B, and C are standard for the presented types. The user can still change the latter mentioned bars.

In Figure 2, a transverse section of the diaphragm between girders is shown. It should be noted that horizontal reinforcements are temperature and shrinkage requirements of ACI and AASHTO. Stirrups calculations were based on minimum reinforcement as per ACI and AASHTO requirements. The spreadsheet includes a detailed design and analysis for the girders types listed

Method Four

The proposed method five is developed by New York State Department of Transportation. In the mentioned method, plates are bolted at top and bottom flanges of the steel girders to resist tension and compression components of flexural moments respectively. In addition, the Best center at the University of Maryland has developed a spreadsheet that calculates the required plates dimensions. This table covers most common cases for span lengths ranging from 40 ft to 120 ft and girders spacing of 6, 8, and 10 ft. Splice designs are provided for the mentioned ranges. A recommendation on the final design is provided.

Table 1

Length (ft)	Width (ft)	Girder Total Height (in)	Web plates 2 PLs				Top Flange Plates						Bottom Flange Plates					
			b (in)	t (in)	No. of bolt rows	Total No. of bolts	Ext.		Int. 2 PLs		No. of bolt rows	Total No. of bolts	Ext.		Int. 2 PLs		No. of bolt rows	Total No. of bolts
							b (in)	t (in)	b (in)	t (in)			b (in)	t (in)	b (in)	t (in)		
40	6	35.0	27.0	0.375	6	54	12.0	0.375	52.5	0.375	2	20	12.0	0.375	5.25	0.375	2	20
	8	35.0	27.0	0.375	6	54	12.0	0.375	5.25	0.375	2	20	12.0	0.375	5.25	0.375	2	20
	10	35.0	27.0	0.375	6	54	12.0	0.375	5.25	0.375	2	20	12.0	0.375	5.25	0.375	2	20
60	6	47.0	39.0	0.375	6	78	13.0	0.375	5.75	0.375	2	24	13.0	0.375	5.75	0.375	2	24
	8	47.0	39.0	0.375	6	78	13.0	0.375	5.75	0.375	2	24	13.0	0.375	5.75	0.375	2	24
	10	47.0	42.0	0.375	6	84	13.0	0.375	5.75	0.375	2	28	13.0	0.375	5.75	0.375	2	28
80	6	57.0	51.0	0.375	6	102	14.0	0.375	6.25	0.375	4	24	14.0	0.375	6.25	0.375	4	32
	8	57.0	51.0	0.375	6	102	14.0	0.375	6.25	0.375	4	32	14.0	0.375	6.25	0.375	4	32
	10	57.0	48.0	0.375	8	128	14.0	0.500	6.25	0.500	4	32	14.0	0.500	6.25	0.500	4	40
100	6	66.0	60.0	0.375	6	120	15.0	0.500	6.75	0.500	4	32	15.0	0.500	6.75	0.500	4	40
	8	66.0	57.0	0.375	8	152	15.0	0.500	6.75	0.500	4	32	15.0	0.500	6.75	0.500	4	40
	10	66.0	57.0	0.500	8	152	16.0	0.5	7.25	0.500	4	40	16.0	0.5	7.25	0.500	4	48
120	6	74.0	66.0	0.375	8	176	16.0	0.5	7.25	0.500	4	40	16.0	0.5	7.25	0.500	4	40
	8	74.0	66.0	0.500	8	176	16.0	0.5	7.25	0.500	4	40	16.0	0.5	7.25	0.500	4	48
	10	74.0	69.0	0.500	8	184	17.0	0.625	7.75	0.625	4	48	17.0	0.625	7.75	0.625	4	56

Design Of Diaphragm Over Pier Of steel Girders (Method Three) (Spreadsheet)

1. Dimensions of the diaphragm over pier are shown in figure 1.
2. Layout of reinforcement is shown in figures 1 & 2.
3. Design was based on a concrete block with a width equals the girder bottom flange width and the depth equals the beam height plus the thickness of the slab.
4. The user should enter the dead load combination and live load and impact load combination in the assigned cells. It should noted that Merlin-Dash was used in this study to obtain the negative moment due to the superimposed dead load and live load + impact load at the pier, using girder spacing of 6', 8', and 10', and HS-25 loading. The results for all five types are presented in the attached spreadsheet printout.
5. The user should choose the reinforcement to assess for negative moment over pier, for any type of girder.
6. The spreadsheet will check the adequacy of the chosen area of reinforcement.
7. Table 1 (Bar A): Spreadsheet user can input the chosen bar diameter and quantity (step 1 – 10).
8. Table 3 (Bar B): the table shows the recommended standard for stirrups. The user can change the standard, and the spreadsheet will check adequacy (step 12).
9. Table 4 (Bar C): the table shows the recommended standard for temperature and shrinkage reinforcement. The user can change the standard, and the spreadsheet will check its adequacy (step 13).

<u>Appendix</u>

Method Three: Concrete Casted Diaphragm (Spreadsheet)

Method One Details (A.M1.1 – 9)

Method Two Details (A.M2.1 – 3)

Method Three Details (A.M3.1 – 2)

Method Four Details (A.M4.1 – 2)

Negative Moment Analysis, For Method Three

PCI-8.2.3: Design of Negative Moment Regions For Members Made Continous for Live Load

Use the width of the bottom flange as the width of the concrete compressive block, b. Determine the required steel in the deck to resist the total factored negative Moment, assuming the compression block is uniform

Step 1 $M_u = 1.3*(M_{DL}+M_{SDL}+1.67*M_{LL+I})$, (7.3.1-3, PCI Bridge Design Manual)

Step 2 $R_n = M_u/(\phi bd^2)$, (8.2.3.1-1, PCI Bridge Design Manual)

Step 3 $\rho = (1/m)*(1-sqrt(1-2mR_n/f_y))$, (8.2.3.1-2, PCI Bridge Design Manual)

Step 4 $m = f_y/(0.85f'_c)$, (8.2.3.1-3, PCI Bridge Design Manual)

Step 5 $A_s = \rho bd$,b = width of Selected Girder

Step 6 $\phi Mn = \phi A_s f_y(d-a/2)$, (STD Eq. 8-16)

Step 7 $a = A_s f_y/0.85f'_c b$, (STD Eq. 8-17) ,b = width of Selected Girder

Reinforcment Limits (Standard Specifications)

Step 8 $\rho_b = (0.85\beta_1 f'_c/f_y)*(87{,}000/(87{,}000+f_y))$, (STD Art. 8.16.3.1)

Step 9 $\rho_{max} = 0.75\rho_b$, (STD Art. 8.16.3.1.1)

Minimum Reinforcement For Stirrups Calculations

Step 10 $A_{s\ (Min)}$, Stirrups, Bar C = $0.0316*sqrt(f'_c)*b_w*s/f_y$, s = spacing = 12 in, (AASHTO LRFD-5.8.2.5-1)
where f_y and f'_c in step 12 are in KSI
bw = width of Diaphragm over Pier, in inches

Temperature & Shrinkage Reinforcement Calculations

Step 11 $A_{s\ (Min,\ T\&S)}$, Bar D = $0.11*A_g/f_y$, (AASHTO LRFD-5.10.8.2-1)
b_w = width of diaphragm

Steel Continuity Using Method III
Girder Spacing 6 ft

Steel Beam Method III						
Span Length, ft	**40**	**60**	**80**	**100**	**120**	**120**
***Depth, in**	**44.5**	**56.5**	**66.5**	**75.5**	**83.5**	**83.5**
Girder Eff. width, in	**72**	**72**	**72**	**72**	**72**	**72**

120[a]: user's choice

Diaphragm Width	30	in
fy	60000	psi
f'c	7000	psi
Slab Thickness	8	in
Haunch	2	in
f	0.9	
Girders Spacing	**6.0**	ft
b_1	0.7	
m	10.08	

Load Input

M_{DL}^-, k-ft*	139.4	329.8	617.6	1034.3	1585.3	1585.3
M_{SDL}^-, k-ft*	26.8	62.1	113.1	181.6	266.1	266.1
M_{LL+I}^-, k-ft*	174.1	325.5	517.9	760.7	1045.2	1045.2

* No sign needed

Output: Negative Moment Analysis (Bar A)

M_U^-, k-ft	594.031	1216.13	2074.27	3232.15	4675.95	4675.95
R_n, psi	55.55	70.55	86.86	105.00	124.19	124.19
A_{est}^-, in^2	2.98043	4.81191	6.98291	9.59878	12.577	12.577
$A_{s(chosen)}^-$, in^{2*}	9.44	7.75	7.75	11.23	13.51	13.51
fMn, k-ft	1862.28	1951.51	2300.26	3775.65	5018.87	5018.87
r	0.000930	0.001183	0.001458	0.001766	0.002092	0.002092
0.75r$_b$	0.030813	0.030813	0.030813	0.030813	0.030813	0.030813

* $A_{s(chosen)}^-$ = Additional $A_{s(chosen)}^-$ + Standard Slab Reinf A_s

Negative Moment Checks

fM_n > M_u	OK	OK	OK	OK	OK	OK
r < 0.75r$_b$	OK	OK	OK	OK	OK	OK
A_{est}^->= $A_{s(chosen)}^-$	OK	OK	OK	OK	OK	OK

Table 1: Bar A*						
Span Length	Additional $A_{s(chosen)}^-$			Standard Slab Reinf. As		
40	12	#	5	13	#	6
60	12	#	5	13	#	5
80	12	#	5	13	#	5
100	12	#	7	13	#	5
120	12	#	8	13	#	5
120[a]	12	#	8	13	#	5

* Over the effective width

Table 2 : **Bar B						
Span Length	$A_{s(Stirrups)}$					
40	#	5	@	12	in c/c	closed strirrup
60	#	5	@	12	in c/c	closed strirrup
80	#	5	@	12	in c/c	closed strirrup
100	#	5	@	12	in c/c	closed strirrup
120	#	5	@	12	in c/c	closed strirrup
120[a]	#	5	@	12	in c/c	closed strirrup

Minimum Pier Diaphragm Reinfocement between Beams (Bars B & C)

$A_{s\ (Min)}$, Stirrups, **Bar B**	0.50	0.50	0.50	0.50	0.50	0.50
Bar B, chosen in^2/ft	0.62	0.62	0.62	0.62	0.62	0.62
Adequacy of **Bar B**	OK	OK	OK	OK	OK	OK
$A_{s(Min,\ T\&S)}$, **Bar C**	0.66	0.66	0.66	0.66	0.66	0.66
Bar C, chosen in^2/ft	0.88	0.88	0.88	0.88	0.88	0.88
Adequacy of **Bar C**	OK	OK	OK	OK	OK	OK

Table 3 :**Bar C						
Span Length	$A_{s(Temperature\&Shrinkage)}$					
40	#	6	@	12	in c/c	/back & Front
60	#	6	@	12	in c/c	/back & Front
80	#	6	@	12	in c/c	/back & Front
100	#	6	@	12	in c/c	/back & Front
120	#	6	@	12	in c/c	/back & Front
120[a]	#	6	@	12	in c/c	/back & Front

Note: Design of continuity was based on a concrete block having the width of the bottom flange and the height of the chosen beam and chosen slab thickness

Note: Loading is Based on HS-25

**Note: Tables for Bars B,C,and D are standards, user can change the recommended reinforcement by inputting in the related cells the desired reinforcement. The Spreadsheet wwill check the adequacy of the user's choice.

Steel Continuity Using Method III
Girder Spacing 8 ft

Steel Beam Method III						
Span Length, ft	40	60	80	100	120	120
***Depth, in**	44.5	56.5	66.5	75.5	83.5	83.5
Girder Eff. width, in	96	96	96	96	96	96

120[a]: user's choice

Diaphragm Width	30	in
fy	60000	psi
f'c	7000	psi
Slab Thickness	8	in
Haunch	2	in
f	0.9	
Girders Spacing	**8.0**	ft
b_1	0.7	
m	10.08	

Load Input

M_{DL}^-, k-ft*	180.2	419.8	786.9	1291.7	1956.5	1956.5
M_{SDL}^-, k-ft*	32	74.3	136.6	218.1	319.8	319.8
M_{LL+I}^-, k-ft*	227.9	426.1	683.9	995.8	1365.6	1365.6

* No sign needed

Output: Negative Moment Analysis (Bar A)

M_U^-, k-ft	770.631	1567.39	2685.3	4124.62	5923.91	5923.91
R_n, psi	54.05	68.19	84.34	100.50	118.01	118.01
A_{est}^-, in^2	3.86598	6.20051	9.03794	12.2445	15.9251	15.9251
$A_{s(chosen)}^-$, in^{2*}	9.44	7.75	9.31	13.51	16.03	16.03
fMn, k-ft	1869.30	1956.24	2765.53	4546.88	5962.54	5962.54
r	0.000905	0.001143	0.001416	0.001689	0.001987	0.001987
0.75r_b	0.030813	0.030813	0.030813	0.030813	0.030813	0.030813

* $A_{s(chosen)}^-$ = Additional $A_{s(chosen)}^-$ + Standard Slab Reinf A_s

Table 1: Bar A*						
Span Length	Additional $A_{s(chosen)}^-$			Standard Slab Reinf. As		
40	12	#	5	13	#	6
60	12	#	5	13	#	5
80	12	#	6	13	#	5
100	12	#	8	13	#	5
120	12	#	9	13	#	5
120[a]	12	#	9	13	#	5

* Over the effective width

Negative Moment Checks

fM_n > M_u	OK	OK	OK	OK	OK	OK
r < 0.75r_b	OK	OK	OK	OK	OK	OK
A_{est}^->= $A_{s(chosen)}^-$	OK	OK	OK	OK	OK	OK

Table 2 : **Bar B						
Span Length	$A_{s(Stirrups)}$					
40	#	5	@	12	in c/c	closed strirrup
60	#	5	@	12	in c/c	closed strirrup
80	#	5	@	12	in c/c	closed strirrup
100	#	5	@	12	in c/c	closed strirrup
120	#	5	@	12	in c/c	closed strirrup
120[a]	#	5	@	12	in c/c	closed strirrup

Minimum Pier Diaphragm Reinforcement between Beams (Bars B & C)

$A_{s\ (Min)}$, Stirrups, **Bar B**	0.50	0.50	0.50	0.50	0.50	0.50
Bar B, chosen in^2/ft	0.62	0.62	0.62	0.62	0.62	0.62
Adequacy of **Bar B**	OK	OK	OK	OK	OK	OK
$A_{s(Min,\ T\&S)}$, **Bar C**	0.66	0.66	0.66	0.66	0.66	0.66
Bar C, chosen in^2/ft	0.88	0.88	0.88	0.88	0.88	0.88
Adequacy of **Bar C**	OK	OK	OK	OK	OK	OK

Table 3 :**Bar C						
Span Length	$A_{s(Temperature\&Shrinkage)}$					
40	#	6	@	12	in c/c	/back & Front
60	#	6	@	12	in c/c	/back & Front
80	#	6	@	12	in c/c	/back & Front
100	#	6	@	12	in c/c	/back & Front
120	#	6	@	12	in c/c	/back & Front
120[a]	#	6	@	12	in c/c	/back & Front

Note: Design of continuity was based on a concrete block having the width of the bottom flange and the height of the chosen beam and chosen slab thickness

Note: Loading is Based on HS-25

**Note: Tables for Bars B,C,and D are standards, user can change the recommended reinforcement by inputting in the related cells the desired reinforcement. The Spreadsheet wwill check the adequacy of the user's choice.

Steel Continuity Using Method III
Girder Spacing 10 ft

Steel Beam Method III						
Span Length, ft	40	60	80	100	120	120
*Depth, in	44.5	56.5	66.5	75.5	83.5	83.5
Girder Eff. width, in	96	96	96	96	96	96

120[a]: user's choice

Diaphragm Width	30	in
fy	60000	psi
f'c	7000	psi
Slab Thickness	8	in
Haunch	2	in
f	0.9	
Girders Spacing	10.0	ft
b_1	0.7	
m	10.08	

Load Input

M_{DL}^-, k-ft*	200	512.3	946.9	1560.3	2345.7	2345.7
M_{SDL}^-, k-ft*	40	88.6	161.8	260.9	381.9	381.9
M_{LL+I}^-, k-ft*	300	535.9	854.9	1257.8	1723.4	1723.4

* No sign needed

Output: Negative Moment Analysis (Bar A)

M_U^-, k-ft	963.3	1944.61	3297.3	5098.24	7287.38	7287.38
R_n, psi	67.56	84.61	103.56	124.22	145.17	145.17
A_{est}^-, in^2	4.83811	7.70358	11.1161	15.1659	19.6368	19.6368
$A_{s(chosen)}^-$, in^{2*}	10.68	8.99	13.63	16.67	20.03	20.03
fMn, k-ft	2111.71	2266.61	4034.87	5597.95	7431.45	7431.45
r	0.001133	0.001420	0.001741	0.002092	0.002450	0.002450
$0.75 r_b$	0.030813	0.030813	0.030813	0.030813	0.030813	0.030813

* $A_{s(chosen)}^-$ = Additional $A_{s(chosen)}^-$ + Standard Slab Reinf A_s

Table 1: Bar A*						
Span Length	Additional $A_{s(chosen)}^-$			Standard Slab Reinf. As		
40	16	#	5	13	#	6
60	16	#	5	13	#	5
80	16	#	7	13	#	5
100	16	#	8	13	#	5
120	16	#	9	13	#	5
120[a]	16	#	9	13	#	5

* Over the effective width

Negative Moment Checks

$fM_n > M_u$	OK	OK	OK	OK	OK	OK
$r < 0.75 r_b$	OK	OK	OK	OK	OK	OK
$A_{est}^- >= A_{s(chosen)}^-$	OK	OK	OK	OK	OK	OK

Table 2 : **Bar B						
Span Length	$A_{s(Stirrups)}$					
40	#	5	@	12	in c/c	closed strirrup
60	#	5	@	12	in c/c	closed strirrup
80	#	5	@	12	in c/c	closed strirrup
100	#	5	@	12	in c/c	closed strirrup
120	#	5	@	12	in c/c	closed strirrup
120[a]	#	5	@	12	in c/c	closed strirrup

Minimum Pier Diaphragm Reinfocement between Beams (Bars B & C)

$A_{s\ (Min)}$, Stirrups, **Bar B**	0.50	0.50	0.50	0.50	0.50	0.50
Bar B, chosen in^2/ft	0.62	0.62	0.62	0.62	0.62	0.62
Adequacy of **Bar B**	OK	OK	OK	OK	OK	OK
$A_{s(Min,\ T\&S)}$, **Bar C**	0.66	0.66	0.66	0.66	0.66	0.66
Bar C, chosen in^2/ft	0.88	0.88	0.88	0.88	0.88	0.88
Adequacy of **Bar C**	OK	OK	OK	OK	OK	OK

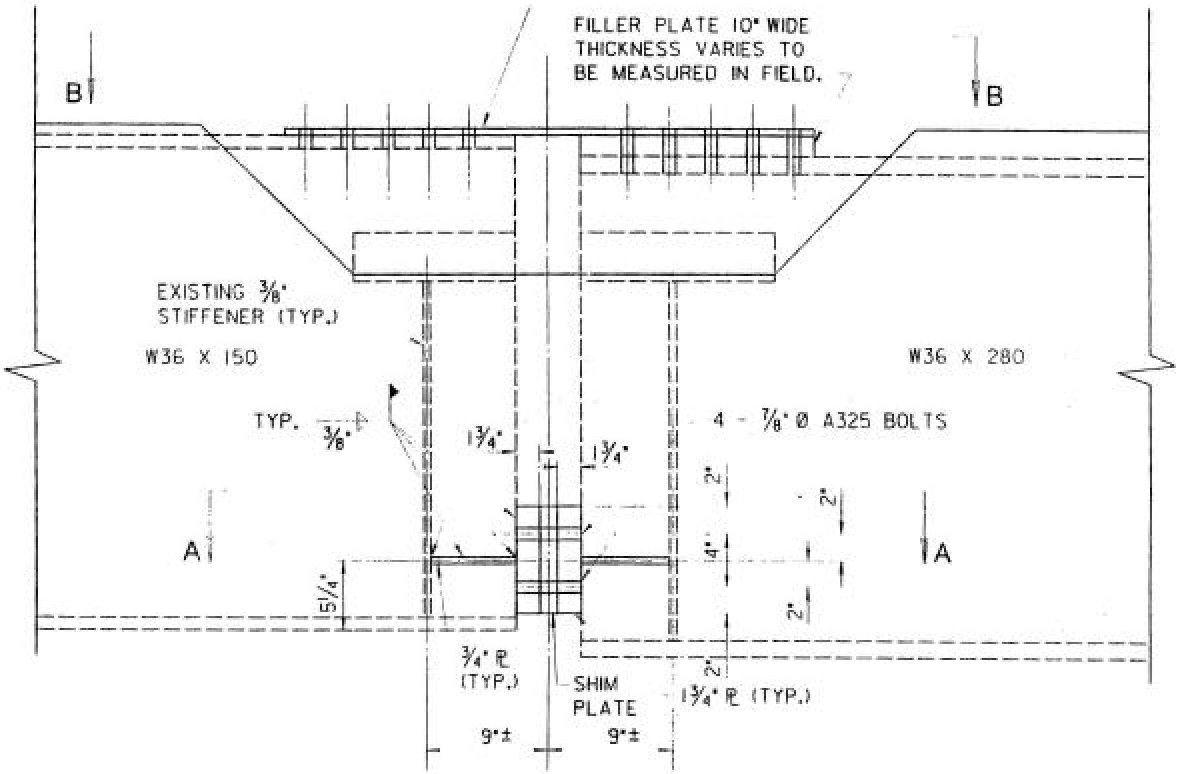
Table 3 :**Bar C						
Span Length	$A_{s(Temperature\&Shrinkage)}$					
40	#	6	@	12	in c/c	/back & Front
60	#	6	@	12	in c/c	/back & Front
80	#	6	@	12	in c/c	/back & Front
100	#	6	@	12	in c/c	/back & Front
120	#	6	@	12	in c/c	/back & Front
120[a]	#	6	@	12	in c/c	/back & Front

Note: Design of continuity was based on a concrete block having the width of the bottom flange and the height of the chosen beam and chosen slab thickness

Note: Loading is Based on HS-25

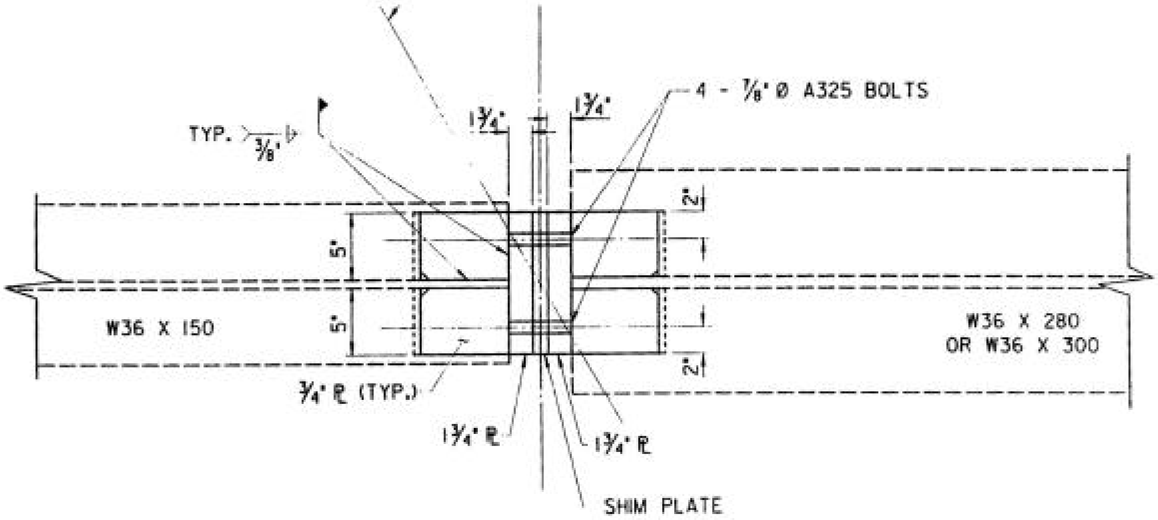
**Note: Tables for Bars B,C,and D are standards, user can change the recommended reinforcement by inputting in the related cells the desired reinforcement. The Spreadsheet wwill check the adequacy of the user's choice.

Appendix A.M1.1
Elevation of connection of unequal height for Method 1



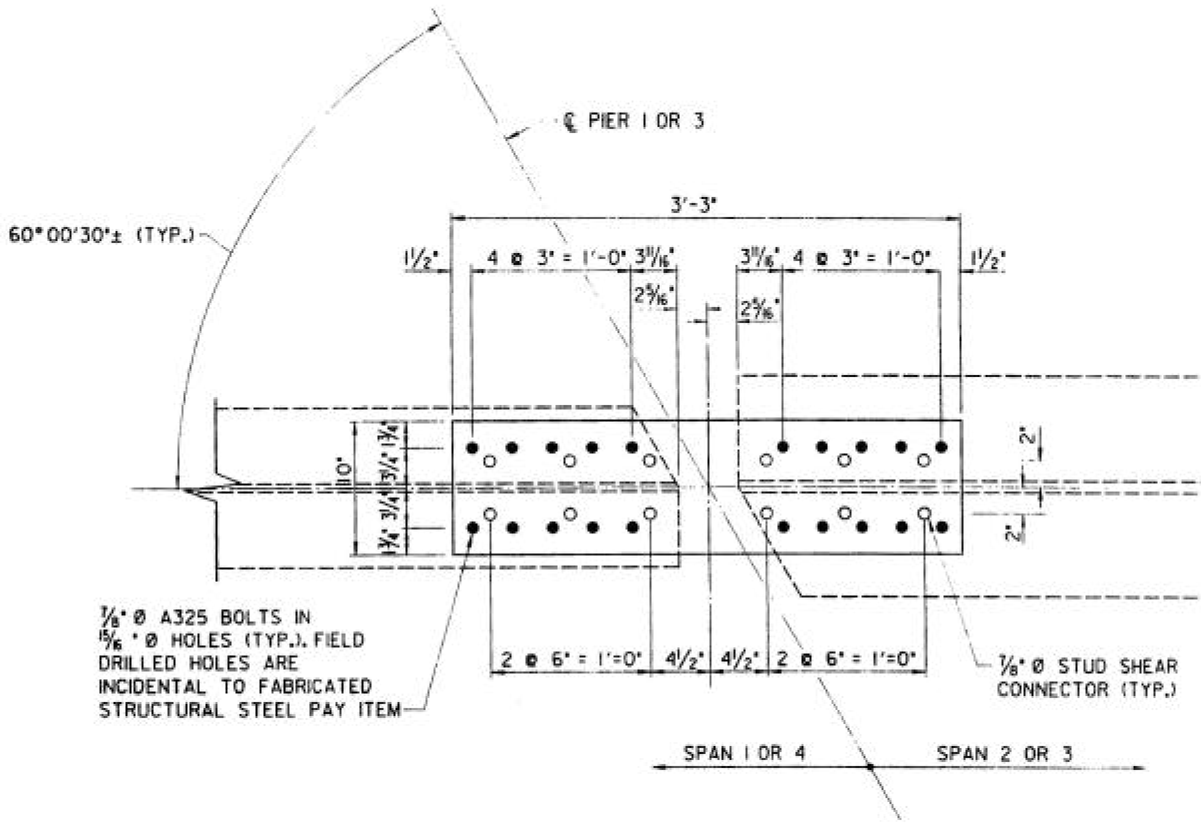
ELEVATION

Appendix A.M1.2
Section A-A for Method 1



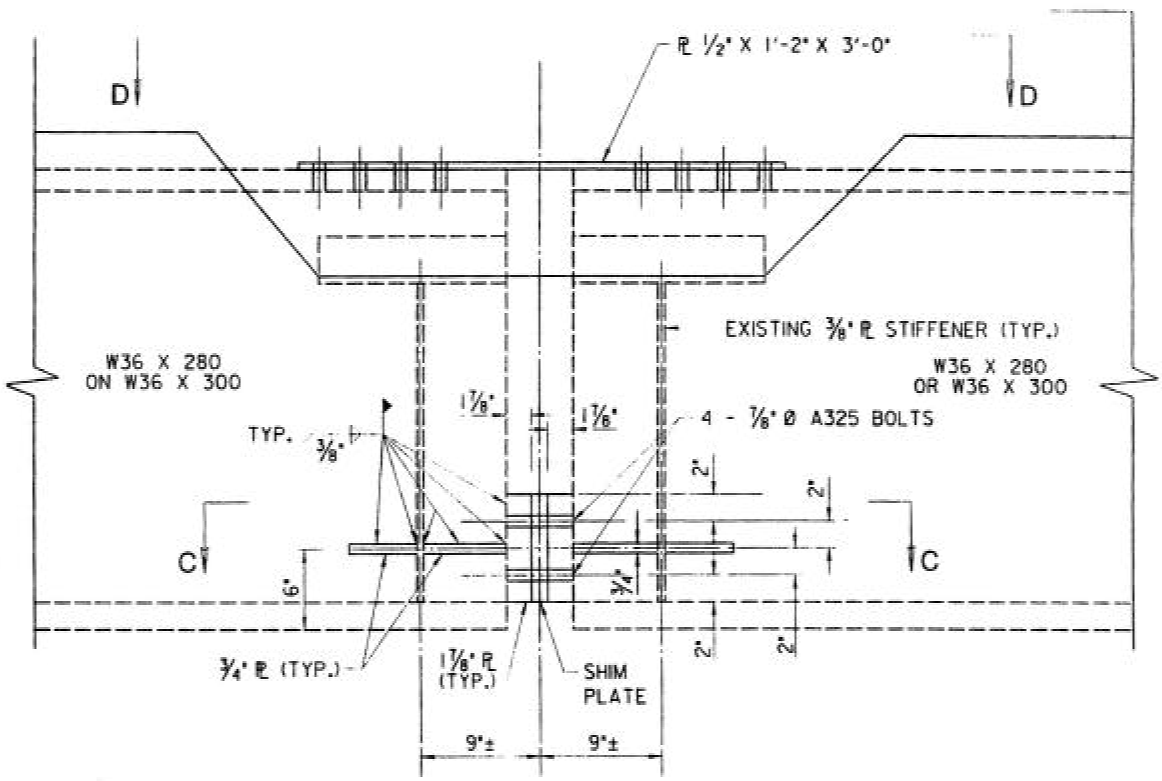
SECTION A-A

Appendix A.M1.3
Section B-B for Method 1



SECTION B-B

Appendix A.M1.4
Elevation of connection for equal height for Method 1

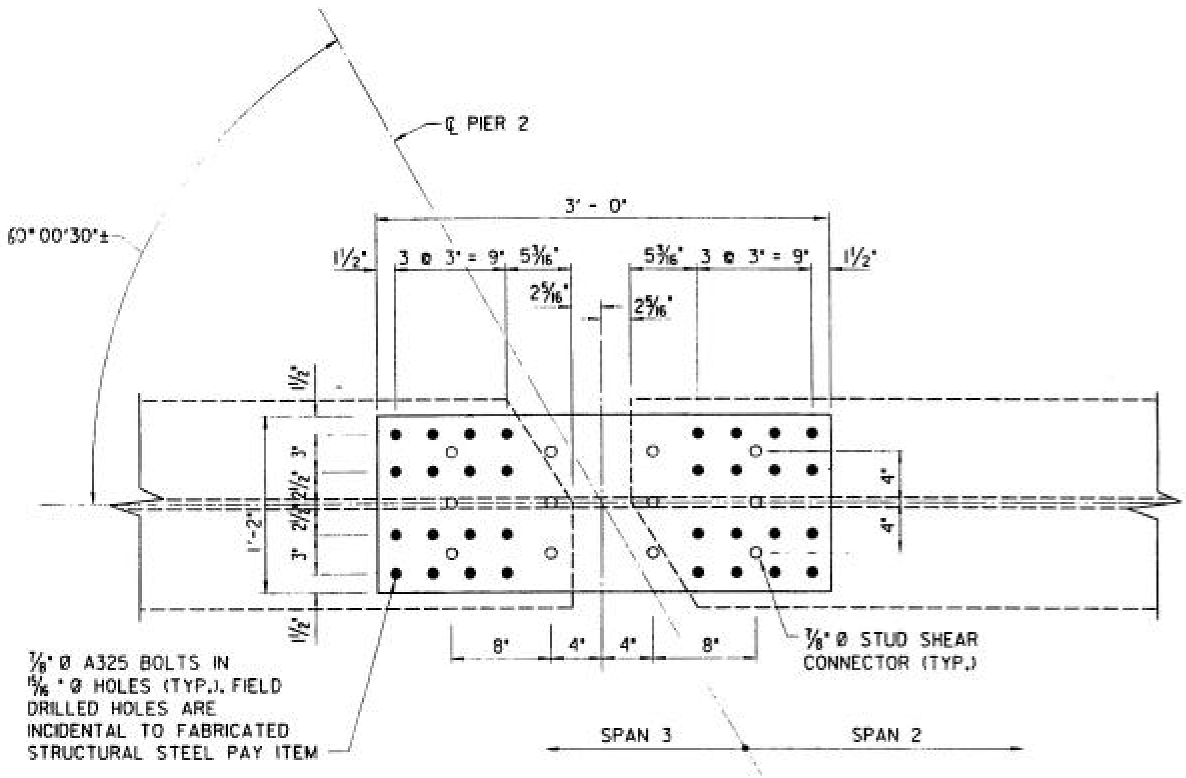


ELEVATION

Appendix A.M1.5
Section C-C for Method 1

SECTION C-C

Appendix A.M1.6
Section D-D for Method 1



SECTION D-D