Shear and Moment Diagrams for a Continuous Beam

The slope-deflection method is used to determine the shear and moment diagram for the beam shown below. A comparison between results obtained from the hand solution and spSlab/spBeam software is provided to illustrate the features and capabilities of the spBeam and spSlab software programs.

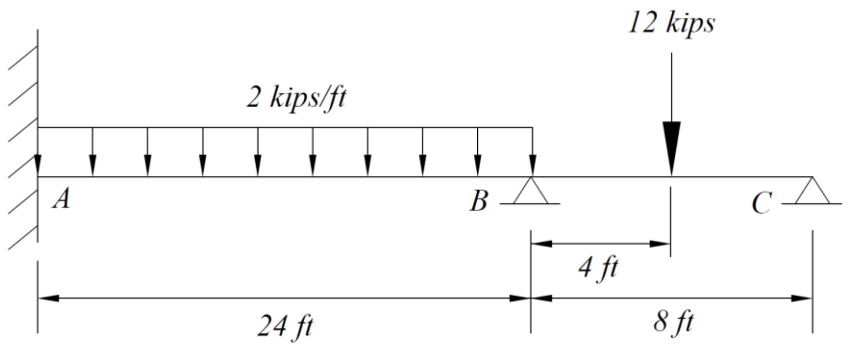


Figure 1 – Continuous Beam

Scope

1. Determine the Fixed-End Moments (FEM) 1
2. Slope-Deflection Equations 2
   2.1. Span AB (End Span with Far End Fixed) 2
   2.2. Span BC (End Span with Far End Pinned) 2
3. Equilibrium Equations 3
4. Shear and Moment Diagrams 3
5. spSlab/spBeam Software Program Model Solution 4
6. Summary and Comparison of Results 4
7. Conclusions & Observations 5

Reference

Structural Analysis. Eighth Edition, 2012 R. C. Hibbeler, Example 11.2

Analysis Data

EI is considered constant

L_{AB} = 24 ft

L_{BC} = 8 ft

Support *A* is fixed

Supports *B* and C are pined

w_u = 2 kips/ft between supports *A* and *B*

P_u = 12 kips at 4 ft away from support *B*

Solution

The slope-deflection technique is used to analyze indeterminate beams and framed structures along with the moment distribution technique, this method was originally developed in the 1915 by G. Manderla and O Mohr to investigate the secondary stresses in trusses. G. A. Maney developed this technique and applied it to the analysis of indeterminate beams and framed structures. The following shows a detailed analysis of two-span beam using slope-deflection technique. The results are compared with values obtained from spSlab software.

1. Determine the Fixed-End Moments (FEM)

$$FEM_{AB} = -\frac{wL^2}{12} = -\frac{2 \times 24^2}{12} = -96\,kips - ft$$

$$FEM_{BA} = \frac{wL^2}{12} = \frac{2 \times 24^2}{12} = 96\,kips - ft$$

$$FEM_{BC} = -\frac{3PL}{16} = -\frac{3 \times 12 \times 8}{16} = -18\,kips - ft$$

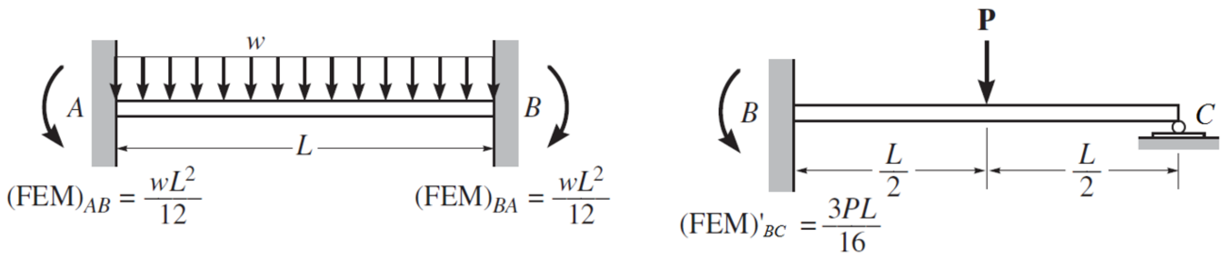


Figure 2 – Fixed-End Moments Equations

2. Slope-Deflection Equations

2.1. Span AB (End Span with Far End Fixed)

Span AB is end span with far end fixed, the general slope-deflection equation should be used:

$$M_N = 2Ek(2\theta_N + \theta_F - 3\Psi) + FEM_N$$

Where:

M_N = internal moment in the near end of the span; *kips-ft*

This moment is positive clockwise when acting on the span.

E = modulus of elasticity; *ksi*

k = span stiffness = I/L; in^3

θ_N = near-end slope or angular displacement of the span at the support; *rad positive clockwise*

θ_F = far-end slope or angular displacement of the span at the support; *rad positive clockwise*

Ψ = span rotation of its cord due to a linear displacement = Δ/L; *rad positive clockwise*

Since the supports do not settle, $\Psi_{AB} = \Psi_{BC} = 0$.

FEM_N = fixed-end moment at the near-end support; *kips-ft positive clockwise when acting on the span*

Note that by inspection, $\theta_A = 0$, for M_{AB}:

$$M_{AB} = 2E\left(\frac{I}{L}\right)(2\theta_A + \theta_B - 3(0)) + FEM_{AB} = 2E\left(\frac{I}{24}\right)(2(0) + \theta_B - 3(0)) - 96$$

$$M_{AB} = 0.08333EI\theta_B - 96 \qquad \text{Eq. (1)}$$

For M_{BA}:

$$M_{BA} = 2E\left(\frac{I}{L}\right)(2\theta_B + \theta_A - 3(0)) + FEM_{BA} = 2E\left(\frac{I}{24}\right)(2\theta_B + 0 - 3(0)) + 96$$

$$M_{BA} = 0.1667EI\theta_B + 96 \qquad \text{Eq. (2)}$$

2.2. Span BC (End Span with Far End Pinned)

Span BC is end span with far end pinned, the following slope-deflection equation can be used so that it has to be applied only once to the span rather than twice:

$$M_N = 3Ek(\theta_N - \Psi) + FEM_N$$

Applying this equation for span BC with B as the near end and C as the far end:

$$M_{BC} = 3E\left(\frac{I}{L}\right)(\theta_B - (0)) + FEM_{BC} = 3E\left(\frac{I}{8}\right)(\theta_B - (0)) - 18$$

$$M_{BC} = 0.375EI\theta_B - 18 \qquad \text{Eq. (3)}$$

3. Equilibrium Equations

The conditions of equilibrium at the support B is used to find the fourth equation that is necessary to calculate the four unknowns from the above three equations.

From the free body diagram for support B shown in Figure 3:

$$M_{BA} + M_{BC} = 0 \qquad \text{Eq. (4)}$$

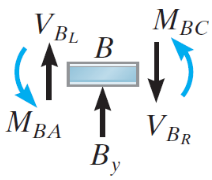


Figure 3 – Free Body Diagram for Support B

Where counterclockwise is positive.

By substituting Eq. (2) and Eq. (3) into Eq. (4)

$$(0.1667EI\theta_B + 96) + (0.375EI\theta_B - 18) = 0$$

$$\theta_B = -\frac{144}{EI}$$

By substituting θ_B into Eq. (1), Eq. (2), and Eq. (3):

$$M_{AB} = -108.0 \; kips - ft$$

$$M_{BA} = +72.0 \; kips - ft$$

$$M_{BC} = -72.0 \; kips - ft$$

4. Shear and Moment Diagrams

Using these moments, the shear reactions at the ends of the beam spans can be found as shown in Figure 4. The shear and moment diagrams are plotted in Figure 5.

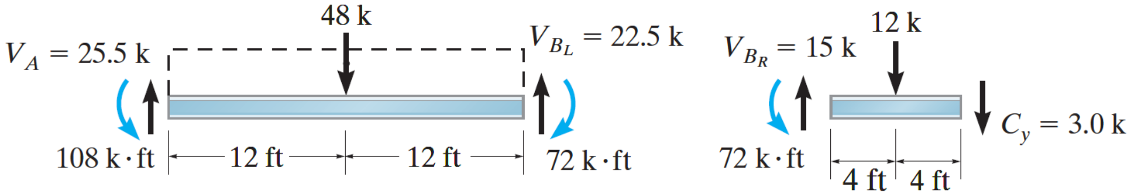


Figure 4 – Moments and Shear Reactions at the Ends of the Beam Spans

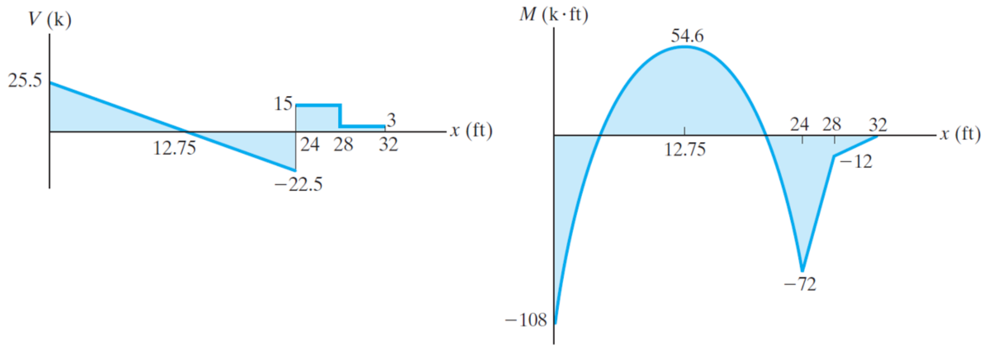


Figure 5 – Shear and Moment Diagrams

5. spSlab/spBeam Software Program Model Solution

spSlab/spBeam is utilized to analyze continuous beams and one-way slabs using the stiffness method. The software calculates the internal forces (shear forces and bending moments), moment and shear capacities, immediate and long-term deflection results, and required flexural and shear reinforcement. The goal of this example is to show how spSlab/spBeam software calculates moment and shear values that are used to complete the design of beams and slabs in concrete floor systems.

The graphical and text results are provided in Appendix A for both input and output of the spSlab/spBeam model.

6. Summary and Comparison of Results

The moment diagram from the hand calculation shows positive moments on the compression side. While the positive moments from spSlab/spBeam is drawn on the tension side.

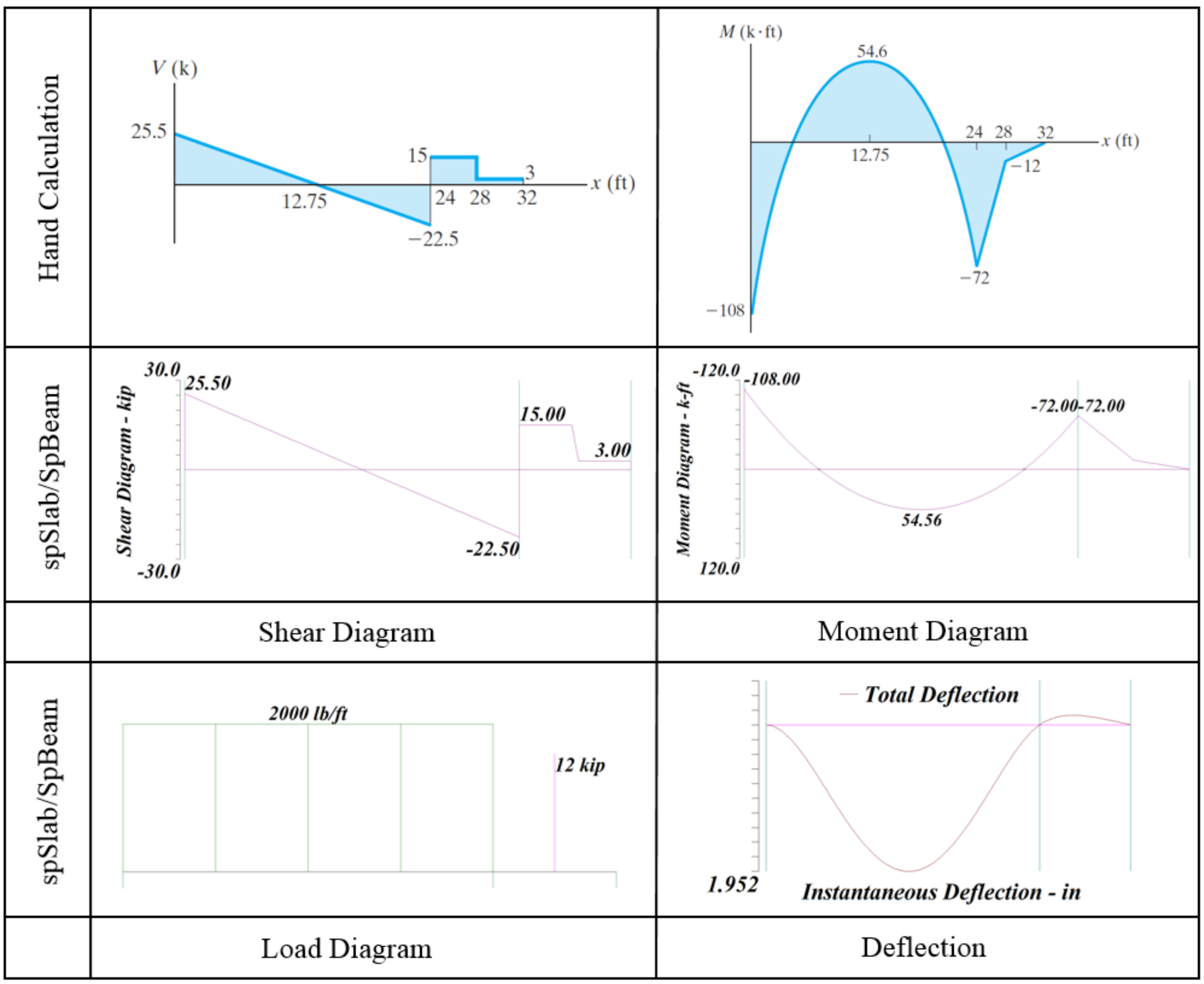


Figure 6 – Shear and Moment Diagrams

7. Conclusions & Observations

The results from hand solution using slope-deflection and spSlab/spBeam software using the stiffness method are exactly identical. spBeam/spSlab output provides a host of other detailed output such as deflections and reactions. The output is also used to determine required flexural, shear, and torsion reinforcement for concrete floor systems. The software can be used for up to 20 spans including various load type and conditions and considers live load patterning and moment redistribution for up to 255 load combinations.

spSlab v5.00. Licensed to: StructurePoint. License ID: 66184-1055152-4-2C6B6-2C6B6

File: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb

Project: Continuous Beam

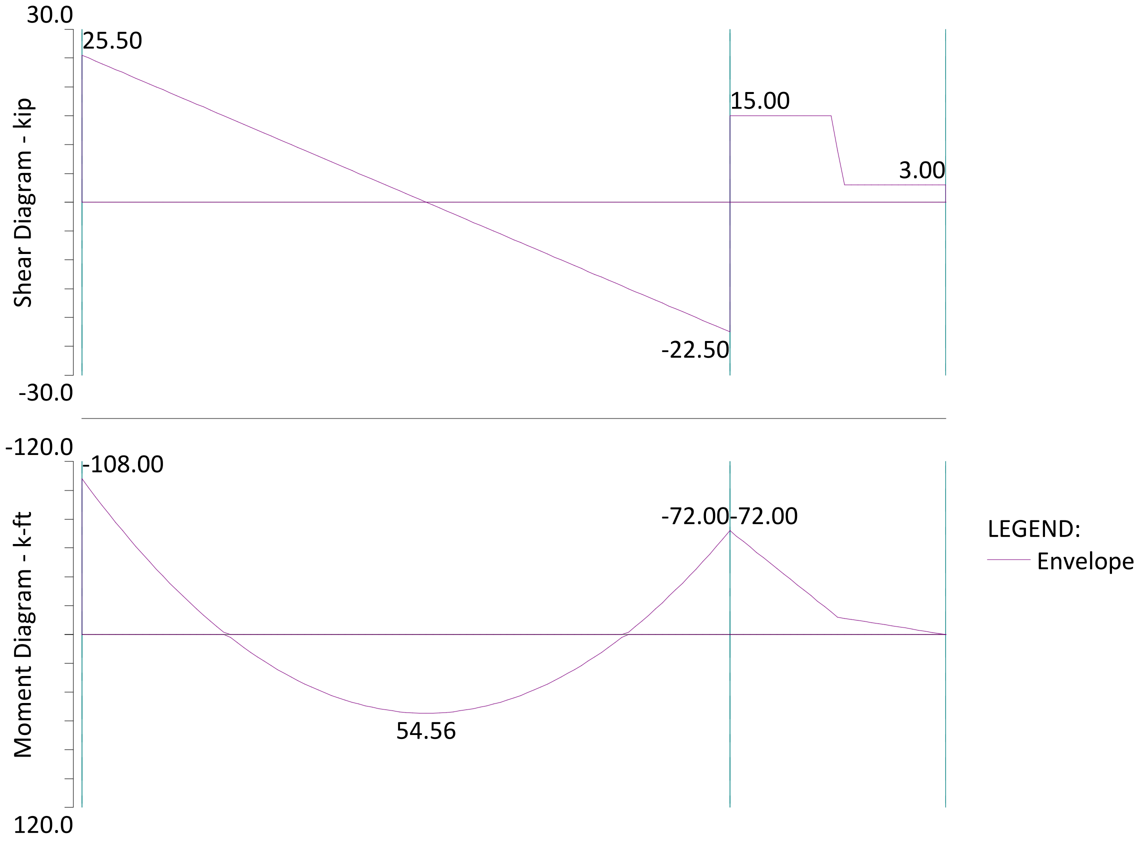
Frame: Continuous Beam

Engineer: SP

Code: ACI 318-14

Date: 12/19/16

Time: 15:09:14



File: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb

Project: Continuous Beam

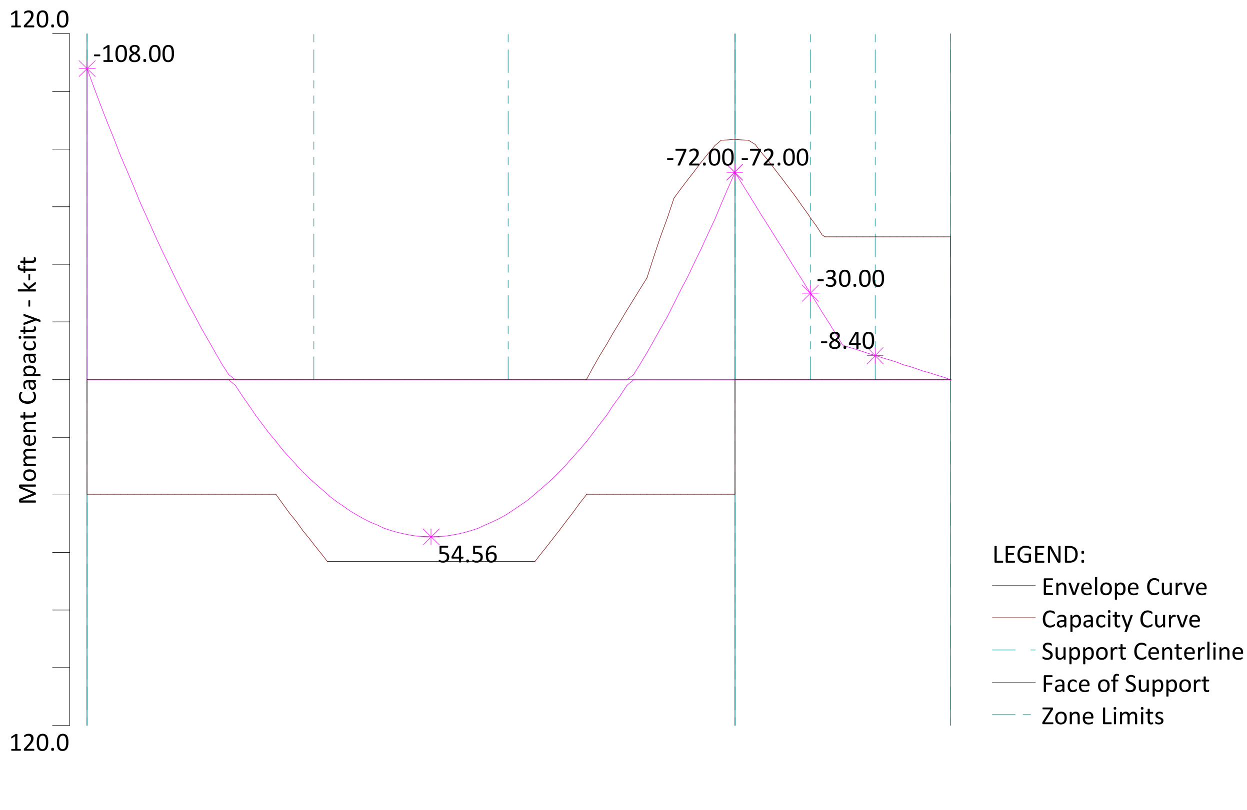
Frame: Continuous Beam

Engineer: SP

Code: ACI 318-14

Date: 12/19/16

Time: 15:10:01



File: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb

Project: Continuous Beam

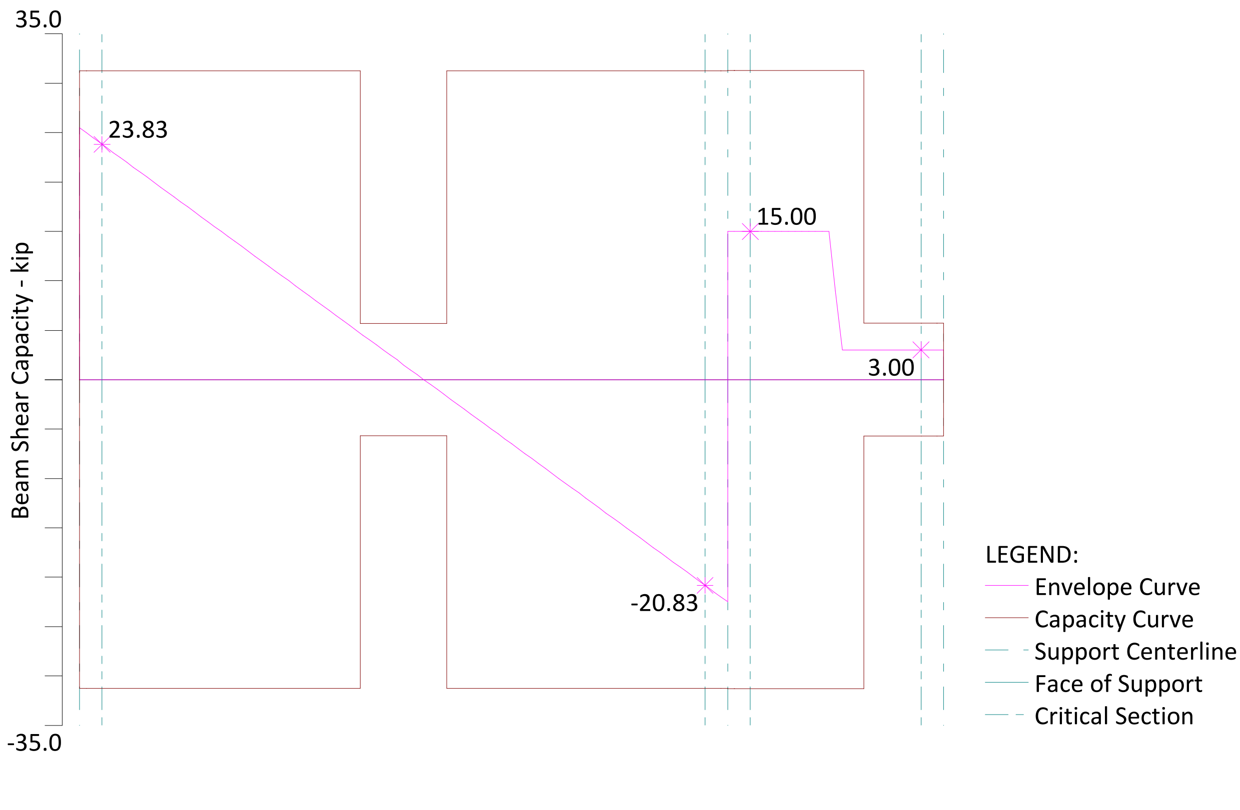
Frame: Continuous Beam

Engineer: SP

Code: ACI 318-14

Date: 12/19/16

Time: 15:10:38



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File: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb

Project: Continuous Beam

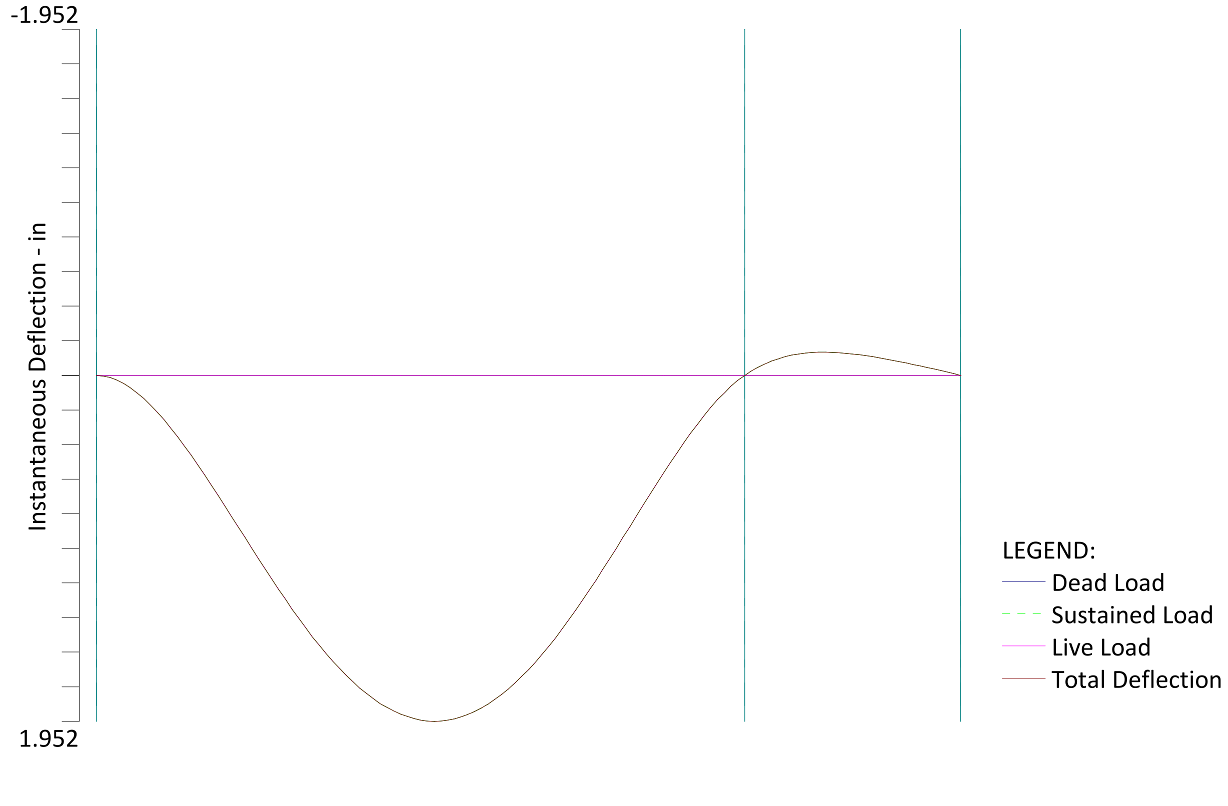
Frame: Continuous Beam

Engineer: SP

Code: ACI 318-14

Date: 12/19/16

Time: 15:11:11



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File: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb

Project: Continuous Beam

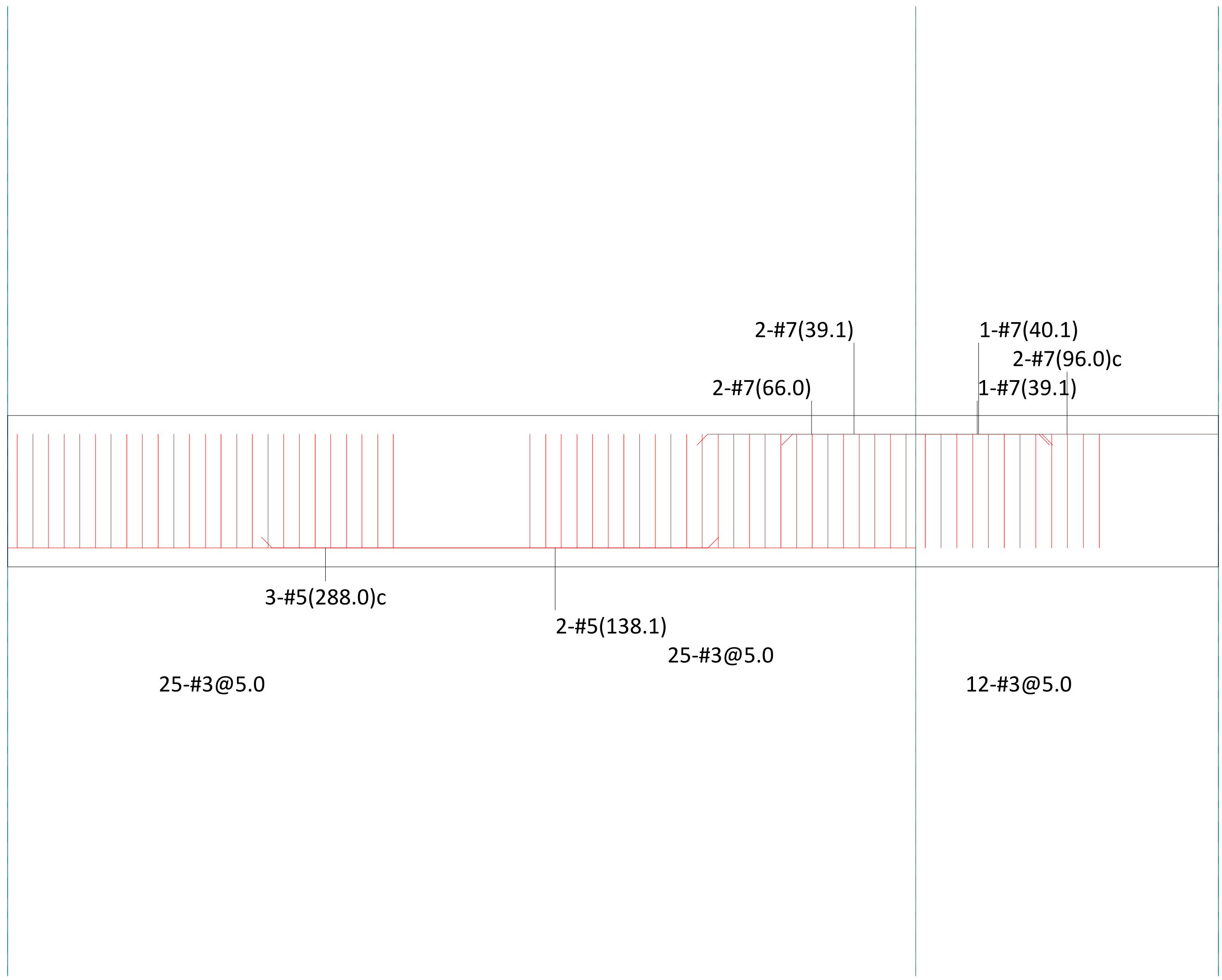
Frame: Continuous Beam

Engineer: SP

Code: ACI 318-14

Date: 12/19/16

Time: 15:11:27



Flexural and Transverse Reinforcement

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File: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb

Project: Continuous Beam

Frame: Continuous Beam

Engineer: SP

Code: ACI 318-14

Date: 12/19/16

Time: 15:13:22

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A Computer Program for Analysis, Design, and Investigation of
Reinforced Concrete Beams, One-way and Two-way Slab Systems

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[1] INPUT ECHO

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General Information

File name: C:\Continuous Beam\Continuous_Beam_Slope_Deflection.slb
Project: Continuous Beam
Frame: Continuous Beam
Engineer: SP
Code: ACI 318-14
Reinforcement Database: ASTM A615
Mode: Design
Number of supports = 3
Floor System: One-Way/Beam

Live load pattern ratio = 100%
Deflections are based on cracked section properties.
In negative moment regions, Ig and Mcr DO NOT include flange/slab contribution (if available)
Long-term deflections are calculated for load duration of 60 months.
0% of live load is sustained.
Compression reinforcement calculations NOT selected.
Default incremental rebar design selected.
Moment redistribution NOT selected.
Effective flange width calculations NOT selected.
Rigid beam-column joint NOT selected.
Torsion analysis and design NOT selected.

Material Properties

		Slabs|Beams	Columns	
wc	=	150	150	lb/ft3
f'c	=	4	4	ksi
Ec	=	3834.3	3834.3	ksi
fr	=	0.47434	0.47434	ksi

fy = 60 ksi, Bars are not epoxy-coated
fyt = 60 ksi
Es = 29000 ksi

Reinforcement Database

Units: Db (in), Ab (in^2), Wb (lb/ft)

Size	Db	Ab	Wb	Size	Db	Ab	Wb
#3	0.38	0.11	0.38	#4	0.50	0.20	0.67
#5	0.63	0.31	1.04	#6	0.75	0.44	1.50
#7	0.88	0.60	2.04	#8	1.00	0.79	2.67
#9	1.13	1.00	3.40	#10	1.27	1.27	4.30
#11	1.41	1.56	5.31	#14	1.69	2.25	7.65
#18	2.26	4.00	13.60				

Span Data

Slabs

Units: L1, wL, wR (ft); t, Hmin (in)

Span	Loc	L1	t	wL	wR	Hmin
1	Int	24.000	0.00	0.500	0.500	0.00
2	Int	8.000	0.00	0.500	0.500	0.00

Ribs and Longitudinal Beams

Units: b, h, Sp (in)

	Ribs			Beams		Span	
Span	b	h	Sp	b	h	Hmin	
1	0.00	0.00	0.00	12.00	12.00	15.57	*b
2	0.00	0.00	0.00	12.00	12.00	5.19	

NOTES:
*b - Span depth is less than minimum. Deflection check required.

Support Data

Columns

Units: c1a, c2a, c1b, c2b (in); Ha, Hb (ft)

Supp	c1a	c2a	Ha	c1b	c2b	Hb	Red%
1	0.00	0.00	0.000	0.00	0.00	0.000	999
2	0.00	0.00	0.000	0.00	0.00	0.000	0
3	0.00	0.00	0.000	0.00	0.00	0.000	0

Boundary Conditions

Units: Kz (kip/in); Kry (kip-in/rad)

Supp	Spring Kz	Spring Kry	Far End A	Far End B
1	0	0	Fixed	Fixed
2	0	0	Fixed	Fixed
3	0	0	Fixed	Fixed

Load Data

Load Cases and Combinations

Case	Dead
Type	DEAD
U1	1.000

Line Loads

Units: Wa, Wb (lb/ft), La, Lb (ft)

Case/Patt	Span	Wa	La	Wb	Lb
Dead	1	2000.00	0.000	2000.00	24.000

Point Forces

Units: Wa (kip), La (ft)

Case/Patt	Span	Wa	La
Dead	2	12.00	4.000

Reinforcement Criteria

Slabs and Ribs

	Top bars		Bottom bars		
	Min	Max	Min	Max	
Bar Size	#4	#4	#4	#4	
Bar spacing	1.00	18.00	1.00	18.00	in
Reinf ratio	0.18	2.00	0.18	2.00	%
Cover	1.00		1.00		in

There is NOT more than 12 in of concrete below top bars.

Beams

	Top bars		Bottom bars			Stirrups		
	Min	Max	Min	Max		Min	Max	
Bar Size	#5	#8	#5	#8		#3	#5	
Bar spacing	1.00	18.00	1.00	18.00		6.00	18.00	in
Reinf ratio	0.14	5.00	0.14	5.00	%			
Cover	1.50		1.50		in			
Layer dist.	1.00		1.00		in			
No. of legs						2	6	
Side cover						1.50		in

1st Stirrup	3.00	in

There is NOT more than 12 in of concrete below top bars.

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           ooooo    oo          oooooo     ooo     ooooo o   ooooo    (TM)
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[2] DESIGN RESULTS

Top Reinforcement

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Zone	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	Left	1.00	108.00	0.000	0.408	2.208	3.010	0.000	> MAX *2
	Midspan	1.00	0.00	12.000	0.000	2.208	0.000	0.000	---
	Right	1.00	72.00	24.000	0.403	2.181	1.837	2.133	4-#7
2	Left	1.00	72.00	0.000	0.403	2.181	1.837	2.133	4-#7
	Midspan	1.00	30.00	2.800	0.403	2.181	0.698	6.399	2-#7
	Right	1.00	8.40	5.200	0.250	2.181	0.188	6.399	2-#7 *3

NOTES:
*2 - Reinforcement exceeds maximum allowable value.
*3 - Design governed by minimum reinforcement.

Top Bar Details

Units: Length (ft)

	Left				Continuous		Right			
Span	Bars	Length	Bars	Length	Bars	Length	Bars	Length	Bars	Length
1	------------ ERROR ------------				---		2-#7	5.50	2-#7	3.26
2	1-#7	3.34	1-#7	3.26	2-#7	8.00	---		---	

Top Bar Development Lengths

Units: Length (in)

	Left				Continuous		Right			
Span	Bars	Length	Bars	DevLen	Bars	DevLen	Bars	DevLen	Bars	DevLen
1	---		---		---		2-#7	39.09	2-#7	39.09
2	1-#7	39.09	1-#7	39.09	2-#7	16.36	---		---	

Bottom Reinforcement

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	1.00	54.56	12.750	0.408	2.208	1.315	1.644	5-#5
2	1.00	0.00	4.000	0.000	2.208	0.000	0.000	---

Bottom Bar Details

Units: Start (ft), Length (ft)

	Long Bars			Short Bars		
Span	Bars	Start	Length	Bars	Start	Length

1	3-#5	0.00	24.00	2-#5	6.99	11.51
2	---			---		

Bottom Bar Development Lengths

Units: DevLen (in)

	Long Bars		Short Bars	
Span	Bars	DevLen	Bars	DevLen
1	3-#5	22.95	2-#5	22.95
2	---		---	

Flexural Capacity

Units: x (ft), As (in^2), PhiMn, Mu (k-ft)

		Top						Bottom					
Span	x	AsTop	PhiMn-	Mu-	Comb	Pat	Status	AsBot	PhiMn+	Mu+	Comb	Pat	Status
1	0.000	0.00	0.00	-108.00	U1	All	*EXCEEDED	0.93	39.77	0.00	U1	All	OK
	5.250	0.00	0.00	-1.69	U1	All	*EXCEEDED	0.93	39.77	0.00	U1	All	OK
	6.994	0.00	0.00	0.00	U1	All	OK	0.93	39.77	21.43	U1	All	OK
	8.400	0.00	0.00	0.00	U1	All	OK	1.39	57.18	35.63	U1	All	OK
	8.906	0.00	0.00	0.00	U1	All	OK	1.55	63.11	39.77	U1	All	OK
	12.000	0.00	0.00	0.00	U1	All	OK	1.55	63.11	54.00	U1	All	OK
	12.750	0.00	0.00	0.00	U1	All	OK	1.55	63.11	54.56	U1	All	OK
	15.600	0.00	0.00	0.00	U1	All	OK	1.55	63.11	46.43	U1	All	OK
	16.594	0.00	0.00	0.00	U1	All	OK	1.55	63.11	39.77	U1	All	OK
	18.500	0.00	0.00	0.00	U1	All	OK	0.93	39.85	21.50	U1	All	OK
	18.506	0.00	-0.10	0.00	U1	All	OK	0.93	39.77	21.43	U1	All	OK
	20.743	0.83	-35.16	-9.32	U1	All	OK	0.93	39.77	0.00	U1	All	OK
	21.757	1.57	-63.06	-26.57	U1	All	OK	0.93	39.77	0.00	U1	All	OK
	24.000	2.40	-83.42	-72.00	U1	All	OK	0.93	39.77	0.00	U1	All	OK
2	0.000	2.40	-83.42	-72.00	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	0.081	2.39	-83.39	-70.79	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	2.800	1.38	-56.31	-30.00	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	3.257	1.21	-50.13	-23.14	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	3.338	1.20	-49.57	-21.93	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	4.000	1.20	-49.57	-12.00	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	5.200	1.20	-49.57	-8.40	U1	All	OK	0.00	0.00	0.00	U1	All	OK
	8.000	1.20	-49.57	0.00	U1	All	OK	0.00	0.00	0.00	U1	All	OK

Longitudinal Beam Transverse Reinforcement Demand and Capacity

Section Properties

Units: d (in), Av/s (in^2/in), PhiVc (kip)

Span	d	(Av/s)min	PhiVc
1	10.00	0.0100	11.38
2	10.06	0.0100	11.46

Beam Transverse Reinforcement Demand

Units: Start, End, Xu (in), Vu (ft), Av/s (kip/in^2)

			Required				Demand	
Span	Start	End	Xu	Vu	Comb/Patt	Av/s	Av/s	
1	0.250	4.024	0.833	23.83	U1/All	0.0277	0.0277	
	4.024	7.214	4.024	17.45	U1/All	0.0135	0.0135	
	7.214	10.405	7.214	11.07	U1/All	0.0000	0.0100	*8
	10.405	13.595	10.405	4.69	U1/All	0.0000	0.0000	
	13.595	16.786	16.786	8.07	U1/All	0.0000	0.0100	*8
	16.786	19.976	19.976	14.45	U1/All	0.0068	0.0100	*8
	19.976	23.750	23.167	20.83	U1/All	0.0210	0.0210	
2	0.250	1.892	0.839	15.00	U1/All	0.0078	0.0100	*8
	1.892	2.946	1.892	15.00	U1/All	0.0078	0.0100	*8
	2.946	4.000	2.946	15.00	U1/All	0.0078	0.0100	*8
	4.000	5.054	4.000	9.00	U1/All	0.0000	0.0100	*8
	5.054	6.108	5.054	3.00	U1/All	0.0000	0.0000	
	6.108	7.750	6.108	3.00	U1/All	0.0000	0.0000	

NOTES:
*8 - Minimum transverse (stirrup) reinforcement governs.

Beam Transverse Reinforcement Details

Units: spacing & distance (in).

Span	Size	Stirrups (2 legs each unless otherwise noted)
1	#3	25 @ 5.0 + <-- 38.3 --> + 25 @ 5.0
2	#3	12 @ 5.0 + <-- 32.4 -->

Beam Transverse Reinforcement Capacity

Units: Start, End, Xu (ft), Vu, PhiVn (kip), Av/s (in^2/in), Av (in^2), Sp (in)

			Required				Provided				
Span	Start	End	Xu	Vu	Comb/Patt	Av/s	Av	Sp	Av/s	PhiVn	
1	0.000	0.250	0.833	23.83	U1/All	-----	-----	-----	-----	-----	
	0.250	10.405	0.833	23.83	U1/All	0.0277	0.22	5.0	0.0442	31.29	
	10.405	13.595	10.405	4.69	U1/All	0.0000	-----	-----	-----	5.69	
	13.595	23.750	23.167	20.83	U1/All	0.0210	0.22	5.0	0.0442	31.29	
	23.750	24.000	23.167	20.83	U1/All	-----	-----	-----	-----	-----	
2	0.000	0.250	0.839	15.00	U1/All	-----	-----	-----	-----	-----	
	0.250	5.054	0.839	15.00	U1/All	0.0078	0.22	5.0	0.0439	31.33	*8
	5.054	7.161	5.054	3.00	U1/All	0.0000	-----	-----	-----	5.73	
	7.161	7.750	7.161	3.00	U1/All	0.0000	-----	-----	-----	5.73	
	7.750	8.000	7.161	3.00	U1/All	-----	-----	-----	-----	-----	

NOTES:
*8 - Minimum transverse (stirrup) reinforcement governs.

Slab Shear Capacity

Units: b, d (in), Xu (ft), PhiVc, Vu(kip)

Span	b	d	Vratio	PhiVc	Vu	Xu
1	--- Not checked ---					
2	--- Not checked ---					

Material Takeoff

Reinforcement in the Direction of Analysis

Top Bars:	82.0 lb	<=>	2.56 lb/ft	<=>	2.562 lb/ft^2
Bottom Bars:	99.1 lb	<=>	3.10 lb/ft	<=>	3.097 lb/ft^2
Stirrups:	73.8 lb	<=>	2.31 lb/ft	<=>	2.307 lb/ft^2
Total Steel:	254.9 lb	<=>	7.97 lb/ft	<=>	7.966 lb/ft^2
Concrete:	32.0 ft^3	<=>	1.00 ft^3/ft	<=>	1.000 ft^3/ft^2

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spSlab v5.00 (TM)
A Computer Program for Analysis, Design, and Investigation of
Reinforced Concrete Beams, One-way and Two-way Slab Systems

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[3] DEFLECTION RESULTS

Section Properties

Frame Section Properties

Units: Ig, Icr (in^4), Mcr (k-ft)

		M+ve			M-ve		
Span	Zone	Ig	Icr	Mcr	Ig	Icr	Mcr
1	Left	1728	471	11.38	1728	0	-11.38
	Midspan	1728	471	11.38	1728	0	-11.38
	Right	1728	471	11.38	1728	920	-11.38
2	Left	1728	0	11.38	1728	920	-11.38
	Midspan	1728	0	11.38	1728	558	-11.38
	Right	1728	0	11.38	1728	558	-11.38

NOTES: M+ve values are for positive moments (tension at bottom face).
M-ve values are for negative moments (tension at top face).

Frame Effective Section Properties

Units: Ie, Ie,avg (in^4), Mmax (k-ft)

			Load Level					
			Dead		Sustained		Dead+Live	
Span	Zone	Weight	Mmax	Ie	Mmax	Ie	Mmax	Ie
1	Left	0.150	-108.00	2	-108.00	2	-108.00	2
	Middle	0.700	54.56	483	54.56	483	54.56	483
	Right	0.150	-72.00	923	-72.00	923	-72.00	923
	Span Avg	----	----	477	----	477	----	477
2	Left	0.150	-72.00	923	-72.00	923	-72.00	923
	Middle	0.850	-27.00	646	-27.00	646	-27.00	646
	Span Avg	----	----	688	----	688	----	688

Instantaneous Deflections

Extreme Instantaneous Frame Deflections and Corresponding Locations

Units: Def (in), Loc (ft)

				Live			Total	
Span	Direction	Value	Dead	Sustained	Unsustained	Total	Sustained	Dead+Live
1	Down	Def	1.952	---	---	---	1.952	1.952
		Loc	12.500	---	---	---	12.500	12.500
	Up	Def	---	---	---	---	---	---
		Loc	---	---	---	---	---	---
2	Down	Def	---	---	---	---	---	---
		Loc	---	---	---	---	---	---
	Up	Def	-0.130	---	---	---	-0.130	-0.130
		Loc	3.000	---	---	---	3.000	3.000

Long-term Deflections

Long-term Deflection Factors

Time dependant factor for sustained loads = 2.000
Units: Astop, Asbot (in^2), b, d (in), Rho' (%), Lambda (-)

		M+ve					M-ve				
Span	Zone	Astop	b	d	Rho'	Lambda	Asbot	b	d	Rho'	Lambda
1	Midspan	----	----	----	0.000	2.000	----	----	----	0.000	2.000
2	Midspan	----	----	----	0.000	2.000	----	----	----	0.000	2.000

NOTES: Deflection multiplier, Lambda, depends on moment sign at sustained load level and Rho' in given zone.
Rho' is assumed zero because Compression Reinforcement option is NOT selected in Solve Options.

Extreme Long-term Frame Deflections and Corresponding Locations

Units: Def (in), Loc (ft)

Span	Direction	Value	cs	cs+lu	cs+l	Total
1	Down	Def	3.904	3.904	3.904	5.856
		Loc	12.500	12.500	12.500	12.500
	Up	Def	---	---	---	---
		Loc	---	---	---	---
2	Down	Def	---	---	---	---
		Loc	---	---	---	---
	Up	Def	-0.260	-0.260	-0.260	-0.390
		Loc	3.000	3.000	3.000	3.000

NOTES: Incremental deflections due to creep and shrinkage (cs) based on sustained load level values.
Incremental deflections after partitions are installed can be estimated by deflections due to:
- creep and shrinkage plus unsustained live load (cs+lu), if live load applied before partitions,
- creep and shrinkage plus live load (cs+l), if live load applied after partitions.
Total deflections consist of dead, live, and creep and shrinkage deflections.