Concrete Beam Design

Job:
Beam ID:
Date: 8/7/2020 9:17:17 AM

Designed By:
Checked By:
Program: Concrete Beam Design 4.1

Description:

Code	ACI (2011)	Design Method	Ultimate Strength
Member Type	Beam	Cross Section Shape	Rectangular

Span Data:

Main Span Length	25.000 Ft		
Left End Support	Fixed	Right End Support	Fixed
Left Support Width	0.000 In	Right Support Width	0.000 In
Left Haunch Start Location	Not Present	Right Haunch Start Location	Not Present

Cross Section Data:

Total Depth at Mid-Span	24.000 In	Top Width at Mid-Span	22.000 In

Material Data:

f'c	4.000 K/In^2	Flexural Reinforcing fy	60.000 K/In^2
Concrete Density	144.000 Lb/Ft^3	Shear Reinforcing fvy	60.000 K/In^2
Concrete Tensile Strength	0.420 K/In^2	Stress Block, Beta	0.850

Design Criteria:

Bottom Cover to Stirrup	1.500 In	Top Cover to Stirrup	1.500 In
Side Cover to Stirrup	1.500 In		
Total Load Deflection Limit	L/240.00	Live Load Deflection Limit	L/360.00
Allow Cuts in Tension Zone	N	Check Crack Control Provisions	Y

ECHO OF LOAD INPUT

		DEAD LOAD	LIVE LOAD	WIND LOAD	EARTHQUAKE LOAD	ROOF LOAD
	Check Deflection:		Yes			
Main Span						
# 1	Concentrated Load:	0.000 K	-1.500 K			
	Distance:	0.000 Ft	15.000 Ft			
# 1	Uniform Load:	-1.000 K /Ft	-4.000 K /Ft			
	Distance to Begin:	0.000 Ft	0.000 Ft			
	Distance to End:	25.000 Ft	25.000 Ft			

CRITICAL SHEARS & MOMENTS

Load Combination Dead Load:	**1.400 x Dead Load**
Load Combination # 1:	**1.200 x Dead Load + 1.600 x L + 0.500 x R**
Load Combination # 2:	**1.200 x Dead Load + 1.000 x L + 1.600 x R**
Load Combination # 3:	**1.200 x Dead Load + 0.800 x W + 1.600 x R**
Load Combination # 4:	**1.200 x Dead Load + 1.000 x L + 1.600 x W + 0.500 x R**

		DEAD LOAD	LOAD COMB 1	LOAD COMB 2	LOAD COMB 3	LOAD COMB 4
Shear	Left End:	17.500 K	95.845 K	65.528 K	15.000 K	65.528 K
Moment	Left End:	-72.917 K -Ft	-401.593 K -Ft	-274.433 K -Ft	-62.500 K -Ft	-274.433 K -Ft
Shear	Right End:	-17.500 K	-96.555 K	-65.972 K	-15.000 K	-65.972 K
Moment	Right End:	-72.917 K -Ft	-404.473 K -Ft	-276.233 K -Ft	-62.500 K -Ft	-276.233 K -Ft
Maximum Moment	:	36.458 K -Ft	202.764 K -Ft	138.443 K -Ft	31.250 K -Ft	138.443 K -Ft
	Located at:	12.500 Ft	12.611 Ft	12.602 Ft	12.500 Ft	12.602 Ft
Max Deflection	:	-0.019 In	-0.229 In	-0.229 In	-0.019 In	-0.229 In
	Located at:	12.500 Ft	12.528 Ft	12.528 Ft	12.500 Ft	12.528 Ft
	Dead Part:		-0.019 In	-0.019 In	-0.019 In	-0.019 In
	Inflection Points:	5.283 Ft	5.306 Ft	5.304 Ft	5.283 Ft	5.304 Ft

		19.717 Ft	19.709 Ft	19.710 Ft	19.717 Ft	19.710 Ft
Reaction	Left End:	17.500 K	95.845 K	65.528 K	15.000 K	65.528 K
Reaction	Right End:	17.500 K	96.555 K	65.972 K	15.000 K	65.972 K

Load Combination # 5:	**1.200 x Dead Load + 1.000 x L + 1.400 x E + 0.200 x R**
Load Combination # 6:	**0.900 x Dead Load + 1.600 x W**
Load Combination # 7:	**0.900 x Dead Load + 1.400 x E**
Load Combination # 8:	**1.200 x Dead Load - 0.800 x W + 1.600 x R**
Load Combination # 9:	**1.200 x Dead Load + 1.000 x L - 1.600 x W + 0.500 x R**

		LOAD COMB 5	LOAD COMB 6	LOAD COMB 7	LOAD COMB 8	LOAD COMB 9
Shear	Left End:	65.528 K	11.250 K	11.250 K	15.000 K	65.528 K
Moment	Left End:	-274.433 K -Ft	-46.875 K -Ft	-46.875 K -Ft	-62.500 K -Ft	-274.433 K -Ft
Shear	Right End:	-65.972 K	-11.250 K	-11.250 K	-15.000 K	-65.972 K
Moment	Right End:	-276.233 K -Ft	-46.875 K -Ft	-46.875 K -Ft	-62.500 K -Ft	-276.233 K -Ft
Maximum Moment	:	138.443 K -Ft	23.438 K -Ft	23.438 K -Ft	31.250 K -Ft	138.443 K -Ft
	Located at:	12.602 Ft	12.500 Ft	12.500 Ft	12.500 Ft	12.602 Ft
Max Deflection	:	-0.229 In	-0.019 In	-0.019 In	-0.019 In	-0.229 In
	Located at:	12.528 Ft	12.500 Ft	12.500 Ft	12.500 Ft	12.528 Ft
	Dead Part:	-0.019 In	-0.019 In	-0.019 In	-0.019 In	-0.019 In
	Inflection Points:	5.304 Ft	5.283 Ft	5.283 Ft	5.283 Ft	5.304 Ft
		19.710 Ft	19.717 Ft	19.717 Ft	19.717 Ft	19.710 Ft
Reaction	Left End:	65.528 K	11.250 K	11.250 K	15.000 K	65.528 K
Reaction	Right End:	65.972 K	11.250 K	11.250 K	15.000 K	65.972 K

Load Combination # 10:	**1.200 x Dead Load + 1.000 x L - 1.400 x E + 0.200 x R**
Load Combination # 11:	**0.900 x Dead Load - 1.600 x W**
Load Combination # 12:	**0.900 x Dead Load - 1.400 x E**

		LOAD COMB 10	LOAD COMB 11	LOAD COMB 12	LOAD COMB 13	LOAD COMB 14
Shear	Left End:	65.528 K	11.250 K	11.250 K		
Moment	Left End:	-274.433 K -Ft	-46.875 K -Ft	-46.875 K -Ft		
Shear	Right End:	-65.972 K	-11.250 K	-11.250 K		
Moment	Right End:	-276.233 K -Ft	-46.875 K -Ft	-46.875 K -Ft		
Maximum Moment	:	138.443 K -Ft	23.438 K -Ft	23.438 K -Ft		
	Located at:	12.602 Ft	12.500 Ft	12.500 Ft		
Max Deflection	:	-0.229 In	-0.019 In	-0.019 In		
	Located at:	12.528 Ft	12.500 Ft	12.500 Ft		
	Dead Part:	-0.019 In	-0.019 In	-0.019 In		
	Inflection Points:	5.304 Ft	5.283 Ft	5.283 Ft		
		19.710 Ft	19.717 Ft	19.717 Ft		
Reaction	Left End:	65.528 K	11.250 K	11.250 K		
Reaction	Right End:	65.972 K	11.250 K	11.250 K		

SECTION DESIGN INFORMATION
SECTION FLEXURAL DESIGN

Mid-Span Region:

Cross-Section Information:

Total Depth :	24.000 In	Distance to Centroid As :	21.63 In
Top Width :	22.000 In	Distance to Centroid A's :	2.38 In
For Design Moment, Mu :	202.764 K -Ft		
Required As :	2.171 In^2 (p : 0.005)		
Required A's :	0.000 In^2 (p : 0.000)		
Provided As :	2.370 In^2 (p : 0.005)		
Provided A's :	0.000 In^2 (p : 0.000)		
Reduction Factor, Phi :	0.90		
Moment Capacity, *Mn :	220.493 K -Ft		
Gross Area :	528.000 In^2		
Gross Moment of Inertia :	25,344.000 In^2	Neutral Axis Location :	12.00 In
N (Es/Ec) :	8.04	Modulus, Ec :	3,606.51 K /In^2
Cracked Moment of Inertia :	6,170.578 In^2	Neutral Axis Location :	18.68 In

Cracking Moment :	83.484 K -Ft		

At Left Support:

Cross-Section Information:

Total Depth :	24.000 In	Distance to Centroid As :	21.49 In
Top Width :	22.000 In	Distance to Centroid A's :	2.19 In
For Design Moment, Mu :	-401.593 K -Ft		
Required As :	4.538 In^2 (p : 0.010)		
Required A's :	0.000 In^2 (p : 0.000)		
Provided As :	4.650 In^2 (p : 0.010)		
Provided A's :	0.000 In^2 (p : 0.000)		
Reduction Factor, Phi :	0.90		
Moment Capacity, *Mn :	-410.601 K -Ft		
Gross Area :	528.000 In^2		
Gross Moment of Inertia :	25,344.000 In^2	Neutral Axis Location :	12.00 In
N (Es/Ec) :	8.04	Modulus, Ec :	3,606.51 K /In^2
Cracked Moment of Inertia :	10,363.136 In^2	Neutral Axis Location :	16.99 In
Cracking Moment :	83.484 K -Ft		

At Right Support:

Cross-Section Information:

Total Depth :	24.000 In	Distance to Centroid As :	21.49 In
Top Width :	22.000 In	Distance to Centroid A's :	2.19 In
For Design Moment, Mu :	-404.473 K -Ft		
Required As :	4.573 In^2 (p : 0.010)		
Required A's :	0.000 In^2 (p : 0.000)		
Provided As :	4.650 In^2 (p : 0.010)		
Provided A's :	0.000 In^2 (p : 0.000)		
Reduction Factor, Phi :	0.90		
Moment Capacity, *Mn :	-410.601 K -Ft		
Gross Area :	528.000 In^2		
Gross Moment of Inertia :	25,344.000 In^2	Neutral Axis Location :	12.00 In
N (Es/Ec) :	8.04	Modulus, Ec :	3,606.51 K /In^2
Cracked Moment of Inertia :	10,363.136 In^2	Neutral Axis Location :	16.99 In
Cracking Moment :	83.484 K -Ft		

* Indicates That Nominal Resistance Includes Appropriate Phi Factor

BOTTOM BARS

Mid-Span Region:

Design Moment, Mu	202.76 K-Ft	As Required	2.171 In^2	As Provided	2.370 In^2	d	21.625 In

Bar Size	#8	Number of Layers	1	Layer Spacing	0.00 In
Number of Bars	3	Bars in Lower Layer	3	Ld	29.96 In

At Left Support:

Percent of Bars Continuing into Support	100	Suggested Bar Cutoff (from Centerline of Support)	0.00 In

At Right Support:

Percent of Bars Continuing into Support	100	Suggested Bar Cutoff (from Centerline of Support)	0.00 In

TOP BARS - LEFT SUPPORT

Design Moment, Mu	-401.59 K-Ft	As Required	4.538 In^2	As Provided	4.650 In^2	d	21.488 In

Bar Size	#5	Number of Layers	2	Layer Spacing	1.63 In
Number of Bars	15	Bars in Lower Layer	12	Ld	18.50 In

Suggested Bar Cutoff	85.25 In		

TOP BARS - RIGHT SUPPORT

Design Moment, Mu	-404.47 K-Ft	As Required	4.573 In^2	As Provided	4.650 In^2	d	21.488 In

Bar Size	#5	Number of Layers	2	Layer Spacing	1.63 In
Number of Bars	15	Bars in Lower Layer	12	Ld	18.50 In

Suggested Bar Cutoff	85.00 In		

MAXIMUM DEFLECTIONS

Span	Load Comb	Short Total	Long Total	Max Allow	Short Live Load	Max Allow	Ieffective
		In	In	In	In	In	In^4
MAIN	Dead	-0.019		1.250 OK			25,344.00
	1	-0.229	-0.354	1.250 OK	-0.210	0.833 OK	10,859.68
	2	-0.229	-0.354	1.250 OK	-0.210	0.833 OK	10,859.68
	3	-0.019	-0.038	1.250 OK	0.000	0.833 OK	25,344.00
	4	-0.229	-0.354	1.250 OK	-0.210	0.833 OK	10,859.68
	5	-0.229	-0.354	1.250 OK	-0.210	0.833 OK	10,859.68
	6	-0.019	-0.038	1.250 OK	0.000	0.833 OK	25,344.00
	7	-0.019	-0.038	1.250 OK	0.000	0.833 OK	25,344.00
	8	-0.019	-0.038	1.250 OK	0.000	0.833 OK	25,344.00
	9	-0.229	-0.354	1.250 OK	-0.210	0.833 OK	10,859.68
	10	-0.229	-0.354	1.250 OK	-0.210	0.833 OK	10,859.68
	11	-0.019	-0.038	1.250 OK	0.000	0.833 OK	25,344.00
	12	-0.019	-0.038	1.250 OK	0.000	0.833 OK	25,344.00

SHEAR DESIGN - MAIN SPAN

---------- Left Side ----------		---------- Right Side ----------	
Number @ Spacing	**Al In^2**	**Number @ Spacing**	**Al In^2**
Spacing starts from face of support			
@ 3.250 In		@ 3.250 In	
4 @ 6.000 In		5 @ 6.000 In	
1 @ 7.000 In		1 @ 8.000 In	
1 @ 8.000 In		8 @ 10.000 In	
8 @ 10.000 In		Beyond 10.104 Ft From Face None Required	
Beyond 10.188 Ft From Face None Required			

Use #3 Stirrups - 2 Vertical Legs