

CONCRETE DESIGN CALCULATOR: Quiz-4 Solution Section (3)



Select Strength:	$f_y = 60000 \text{ psi}; f_c = 4000 \text{ psi}$	Select design $\rho$ :	$\rho_{max}$	Select Load Case:	$1.2D + 1.4L$
$f_y = 60000$	$F_y = 4000$	Design $\rho = 0.0069$		Est $w_s$ [k/ft] = 1.78	
$\rho_{max} = 0.0033$	$\rho_{max} = 0.0181$	Design $R_n = 388.79$		$M_u$ [ft-k] = 227.8	
$R_n$ of $\rho_{max}$ [psi] = 192.2	$R_n$ of $\rho_{max}$ [psi] = 952.0	$b_w d^3 = 7813.549$		$M_u$ [ft-k] = 253.2	
		$d = 22.10$		Density [pcf] 150	

Enter Givens & Estimates:

$w_s$ [k/ft]	0.55	$b_w$ [in]	14	$b_{web}$ [in]	80
$w_s$ [k/ft]	0.4	$h$ [in]	27	$t$ [in]	3
Length [ft]	32	$d$ [in]	24	$a$ [in]	0.49
Clear Cover [in]	3	$A_g$ [in <sup>2</sup> ]	2.65	$\beta_1$	0.85
Est Self Wt [pcf]	400	$A_{g,max}$ [in <sup>2</sup> ]	1.214	$c$ [in]	0.57
Actual Self Wt [pcf]	450.00	$A_{g,max}$ [in <sup>2</sup> ]	1.280	$e_t$	0.1227
		$\phi M_u$ [ft-k]	253.36		

Neutral Axis Calculations:

T [kips]	142.2	$z$ [in] =	21.60
$A_g$ [in <sup>2</sup> ]	41.8	$z$ [in] =	22.50
$A_{g,req}$ [in <sup>2</sup> ]	240	Governing $z$	22.50

N.A. is in the flange

Select  $A_s$  in Tension:

BAR	Qty	$A_s$ [in <sup>2</sup> ]
#8	3	2.37

If  $a < ht$

$A_s$ [in <sup>2</sup> ]	2.6496
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If $a > t$	
$A_{s,req}$ [in <sup>2</sup> ]	10.88
$M_{u,max}$ [k-ft]	1224.00
$M_{u,req}$ [k-ft]	996.16
$R_n$	1441.20
$\rho_s = 0.03$	
$a$ [in]	14.64
$c$ [in]	17.22
$e_t$	0.00
$A_{s,req}$ [in <sup>2</sup> ]	13.27
$A_s$ [in <sup>2</sup> ]	24.15

Bar Selection:

BAR	Number of Bars in a Single Layer of Reinforcing													
	2		3		4		5		6		7		8	
	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width
#4	0.39	6.80	0.58	8.30	0.78	9.80	0.98	11.30	1.18	12.80	1.37	14.30	1.57	15.80
#5	0.61	6.90	0.91	8.50	1.23	10.20	1.55	11.80	1.84	13.4	2.15	15.00	2.45	16.70
#6	0.88	7.00	1.32	8.80	1.77	10.50	2.21	12.30	2.65	14.00	3.09	15.80	3.53	17.50
#7	1.20	7.20	1.80	9.00	2.41	10.90	3.01	12.80	3.61	14.70	4.21	16.50	4.81	18.40
#8	1.57	7.30	2.35	9.30	3.14	11.30	3.93	13.30	4.71	15.30	5.50	17.30	6.28	19.30
#9	2.00	7.60	3.00	9.80	4.00	12.10	5.00	14.30	6.00	16.60	7.00	18.80	8.00	21.10
#10	2.53	7.80	3.79	10.40	5.06	12.90	6.33	15.50	7.59	18.00	8.86	20.50	10.12	23.10
#11	3.12	8.10	4.68	10.90	6.25	13.80	7.81	16.60	9.37	19.40	10.94	22.20	12.50	25.00
#14	4.50	8.90	6.75	12.30	9.00	15.70	11.25	19.00	13.50	22.40	15.75	25.80	18.00	29.20
#18	8.00	10.60	12.00	14.10	16.00	19.60	20.00	24.50	24.00	28.80	28.00	35.10	32.00	37.70

# Civil Engineering Material Calculation

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## **Table of Contents Civil Engineering Material Calculation**

1. Understanding the eBook Civil Engineering Material Calculation
  - The Rise of Digital Reading Civil Engineering Material Calculation
  - Advantages of eBooks Over Traditional Books
2. Identifying Civil Engineering Material Calculation
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Civil Engineering Material Calculation
  - User-Friendly Interface
4. Exploring eBook Recommendations from Civil Engineering Material Calculation
  - Personalized Recommendations
  - Civil Engineering Material Calculation User Reviews and Ratings
  - Civil Engineering Material Calculation and Bestseller Lists
5. Accessing Civil Engineering Material Calculation Free and Paid eBooks

- Civil Engineering Material Calculation Public Domain eBooks
  - Civil Engineering Material Calculation eBook Subscription Services
  - Civil Engineering Material Calculation Budget-Friendly Options
6. Navigating Civil Engineering Material Calculation eBook Formats
    - ePub, PDF, MOBI, and More
    - Civil Engineering Material Calculation Compatibility with Devices
    - Civil Engineering Material Calculation Enhanced eBook Features
  7. Enhancing Your Reading Experience
    - Adjustable Fonts and Text Sizes of Civil Engineering Material Calculation
    - Highlighting and Note-Taking Civil Engineering Material Calculation
    - Interactive Elements Civil Engineering Material Calculation
  8. Staying Engaged with Civil Engineering Material Calculation
    - Joining Online Reading Communities
    - Participating in Virtual Book Clubs
    - Following Authors and Publishers Civil Engineering Material Calculation
  9. Balancing eBooks and Physical Books Civil Engineering Material Calculation
    - Benefits of a Digital Library
    - Creating a Diverse Reading Collection Civil Engineering Material Calculation
  10. Overcoming Reading Challenges
    - Dealing with Digital Eye Strain
    - Minimizing Distractions
    - Managing Screen Time
  11. Cultivating a Reading Routine Civil Engineering Material Calculation
    - Setting Reading Goals Civil Engineering Material Calculation
    - Carving Out Dedicated Reading Time
  12. Sourcing Reliable Information of Civil Engineering Material Calculation
    - Fact-Checking eBook Content of Civil Engineering Material Calculation
    - Distinguishing Credible Sources
  13. Promoting Lifelong Learning
    - Utilizing eBooks for Skill Development

- Exploring Educational eBooks

### 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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