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Problem
The beam shown is supported on pedestals 20-in. wide. The loads are service loads, and the
distributed load includes the beam weight. The clear span is 24′-4″. Use psi; the

reinforcing steel is A615 Grade 60. Design shear reinforcing for the beam: a. Between the point load and the left reaction b. Between the point load and the right reaction Show design sketches, including the stirrup pattern. PROBLEM 4–14

Step-by-step solution

Determine the ultimate load using the relation. Here, is dead load and is live load. Comment
Substitute 1.8 kips for and 3 kips for .
Comment

Determine the ultimate column load using the relation. Here, is concentrated dead load and is concentrated live load. Comment
Substitute 56 kips for and 56 kips for .
Comment
Determine the clear span for left side using the relation.
Substitute 20 ft for and 20 in. for b.

Comment
Determine the clear span for right side 2 using the relation.
Substitute 6 ft for and 20 in. for b.

Comment To find reaction .
Here, is clear span. Substitute for , 156.8 kips for , 19.17 ft for , and 24.4 ft for .

Comment To find reaction .
Substitute for , 156.8 kips for , 208 kips for , and 24.4 ft for .
Comment

a) Comment

Left side (positive shear): The positive design shear is 118 kips. Determine the critical design shear using the relation.
Substitute 118 kips for , 30 in. for d, and for .
Comment
Calculate shear resistance capacity using the formula.

Here, is modulus of rupture for normal weight concrete and is compressive stress of concrete. Substitute 0.75 for from section (4.2) of the text book, 1 for , 4,000 psi for , 20 in. for b, and 30 in. for d.

Comment
Determine the parameter .

Therefore, stirrups are required. Comment

Calculate distance x where stirrup may end from the end face using the formula.
Substitute 28.45 kips for and for .
Calculate distance up to which stirrups are required using the formula.
Substitute 25.59 ft for L and 4 ft for x.

Calculate distance up to which factored shear resistance is acting using the formula. Substitute 8.78 ft for stirrup distance and 4 ft for x.

Comment

Draw the shear force diagram as in Figure (1) Comment

Comment

Calculate required shear strength of stirrup for boundary condition Substitute 118 kips for , 56.9 kips for , and for .
Determine the required critical spacing using the relation.
Substitute for .
Comment

Assume #3 single loop stirrups having an area of Substitute 0.75 for , for , 60 ksi for , 30 in. for d, 100.6 kips for , and 56.9
kips for .

Use 6 in. spacing. Comment

Calculate maximum shear strength of stirrup using the relation.
Substitute for required .
Substitute 100.6 kips for , 56.9 kips for , 0.75 for , 4,000 psi for , 20 in. for b, and
30 in. for d.

Comment

The maximum spacing is or 30 in. whichever is smaller. Determine the maximum spacing using the relation.

Substitute 30 in. for d.
Comment

Check for maximum spacing: Determine the maximum spacing for span using the relation.

Substitute for , 60,000 psi for , and 20 in. for .

Therefore, use maximum spacing is 13 in. Comment

Determine the required spacing s based on shear strength .
Substitute 0.75 for , for , 60 ksi for , 30 in. for d, and for
required .

Comment
Draw the graph distance from FOS versus required spacing as in Figure (2).

Comment

b) Comment

Right side (Negative shear): Comment

The negative design shear is 208 kips. Comment

Determine the critical design shear using the relation.
Comment
Substitute 208 kips for , 30 in. for d, and for .
Comment
Calculate shear resistance capacity using the formula.

Here, is modulus of rupture for normal weight concrete and is compressive stress of concrete. Substitute 0.75 for from section (4.2) of the text book, 1 for , 4,000 psi for , 20 in. for b, and 30 in. for d.

Comment
Determine the parameter .

Therefore, stirrups are required. By inspection, stirrups required from the FOS to the location of the point load. Comment

Calculate required shear strength of stirrup for boundary condition Substitute 208 kips for , 56.9 kips for , and for .

Comment

Determine the required critical spacing using the relation.
Substitute for .

Assume #3 single loop stirrups having an area of Substitute 0.75 for , for , 60 ksi for , 30 in. for d, 190.6 kips for , and 56.9
kips for .

Required critical spacing is less than 4 in., therefore use double #3 stirrups having an area of . Comment

Determine the required critical spacing using the relation.
Substitute 0.75 for , for , 60 ksi for , 30 in. for d, 190.6 kips for , and 56.9
kips for .

Use 4 in. spacing. Comment

Calculate maximum shear strength of stirrup using the relation.
Substitute for required .
Substitute 190.6 kips for , 56.9 kips for , 0.75 for , 4,000 psi for , 20 in. for b, and
30 in. for d.

Therefore, the maximum spacing is or 30 in. whichever is smaller. Comment

Determine the maximum spacing using the relation.
Substitute 30 in. for d.
Comment

Check for maximum spacing: Determine the maximum spacing for span using the relation.

Substitute for , 60,000 psi for , and 20 in. for .

Therefore, use maximum spacing is 7.5 in. Comment

Determine the required spacing s based on shear strength .
Substitute 0.75 for , for , 60 ksi for , 30 in. for d, and for
required .

Comment
Draw the graph distance from FOS versus required spacing as in Figure (3).

Comment
Draw the stirrup layout arrangement as in Figure (4).

Comment

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Step 2 of 38

Step 3 of 38

Step 4 of 38

Step 5 of 38

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Step 30 of 38

Step 31 of 38

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Step 35 of 38

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Step 37 of 38

Step 38 of 38 0 1 Chapter 4, Problem 17P A rectangular reinforced concrete beam 14 in. × 20

in. deep is subject to a maximum factored torque of 24 ft-k. Calculate the cracking torque, Tcr, and
determine if torsion can be neglected in the design

of this beam. Assume... View this solution Chapter 4, Problem 11P For the beam shown, check moment and design

single-loop stirrups. The loads shown are factored
loads. Assume the supports to be 12-in. wide. Use
psi and fy = 60,000 psi. The uniformly distributed

load includes the beam weight.PROBLEM 4–11 View this solution Post a question Answers from our experts for your tough homework questions Enter question Continue to post Continue to edit and attach image(s). Chegg tutors who can help right now Anila Univeristy of Kerala… 339 Mansi Gujarat University 460 Mohit AIET 306 FIND ME A TUTOR ABOUT CHEGG Media Center College Marketing US Privacy Policy Your CA Privacy Rights International Privacy Policy Terms of Use General Policies Cookie Notice Intellectual Property Rights Investor Relations Corporate Development Enrollment Services RESOURCES Site Map Mobile Publishers Join Our Affiliate Program Advertising Choices TEXTBOOK LINKS Return Your Books Textbook Rental eTextbooks Used Textbooks Cheap Textbooks College Textbooks Sell Textbooks STUDENT SERVICES Chegg Play Study 101 Chegg Coupon Scholarships Career Search Internships College Search College Majors Scholarship Redemption COMPANY Jobs Customer Service Give Us Feedback Chegg For Good Become a Tutor LEARNING SERVICES Online Tutoring Chegg Study Help Solutions Manual Tutors by City GPA Calculator Test Prep © 2003-2018 Chegg Inc. All rights reserved.

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