77)

Reinforced Concrete Bridge

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following data :

* Clear span of the bridge is 15m and width of support is 60cm.
* Clear width of the bridge is 10.5m.
* Wearing surface of the bridge slab is 1.20 kN/m^2 .
* Concrete compressive strength, fc` = 24MPa and fc = 0.4fc`.
* Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

1- Design the slab of the bridge and draw the detail of reinforcement.
2- Design an interior girder for the maximum shear.

See Fig (56)

78)

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following data :

* Clear span of the bridge is 15m and width of support is 60cm.
* Clear width of the bridge is 7m.
* Wearing surface of the bridge slab is 0.72 kN/m^2 .
* Concrete compressive strength, fc` = 21 MPa and fc = 0.4fc`.
* Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

1- Design the slab of the bridge.
2- Design an interior girder for the maximum moment.

See Fig (57)

79)

Reinforced Concrete Bridge

A reinforced concrete Deck slab bridge, its plan and sections shown in Fig. the bridge has the following data:

- Center to center of supports = 9.15m, width of support(Pad) = 30cm and width of Abutment = 70cm.
- Clear distance between supports 8.65m.
- Clear width of the bridge = 9.60m.
- Edge beam width = 55cm and overall height of 80cm(50cm slab and 30cm curb).
- Wearing surface of the bridge = 1.4 kN/m^2 .
- Concrete compressive strength, fc` = 30MPa, and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy, n=8.
- Design according to AASHTO, Hs20-44 loading.

Design the slab of the bridge.

See Fig (58)

80)

Reinforced Concrete Bridge

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following design data :

- Clear span of the bridge is 12m and width of support is 50cm.
- Wearing surface of the bridge slab is 1.40 kN/m^2 .
- Concrete compressive strength, fc` = 28MPa and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.
- Live loading Hs 20-44 Loading.

1- Design the slab of the bridge (the slab continuous above four beams).
2- Design an interior girder for the maximum bending moment only.
3- Re – design the slab of the bridge as deck slab bridge (i. e. slab without beams).
4- Compare the design of the above two options and comment.

See Fig (59)

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81)

Reinforced Concrete Bridge

A reinforced concrete bridge, its plan and cross section shown in Fig. The bridge has the following given data:

- Clear span of the bridge is 8.0m and width of support is 50cm.
- Wearing surface of the bridge slab is 1.20 kN/m^2 .
- Concrete compressive strength, fc` = 21MPa and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.
- Live loading Hs 20-44 Loading.

1- Design the slab of the bridge (the slab continuous above four beams).
2- Re – design the slab of the bridge as a deck slab bridge (i. e. slab without beams).
3- Compare the design of the above two options and write your comments.
4- Calculate the maximum live load moment for an interior girder only.

See Fig (60)

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82) Reinforced Concrete Bridge

A reinforced concrete bridge, its plan and cross section shown in Fig. The bridge has the following given data:

- Clear span of the bridge is 8.0m and width of support is 50cm.
- Wearing surface of the bridge slab is 1.20 kN/m^2 .
- Concrete compressive strength, fc` = 21MPa and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.
- Live loading Hs 20-44 Loading.

Design an interior beam for bending.

See Fig (61)

83)

Reinforced Concrete Bridge

A reinforced concrete bridge, its plan and cross section shown in Fig. the bridge has the following design data:

- Span of the girder = 12m c/c (simply supported), width of supports = 60cm .
- Clear width of the bridge = 11m.
- Wearing surface of the bridge = 1.2 kN/m^2 .
- Concrete compressive strength, fc` = 21MPa, and fc = 0.4fc`.
- Steel yield strength, fy = 414MPa for all types of reinforcement and fs = 0.5fy.
- Design according to AASHTO 1996, Hs20-44 loading.

1- Design slab of the bridge.
2- Design an interior girder for bending.

See Fig (62)

84)

Reinforced Concrete Bridge

A reinforced concrete bridge, its cross section shown in Figure The bridge has the following design data:

* Clear span of the bridge is 16m and width of support is 60cm, Live loading Hs 20-44 Loading.
* Wearing surface of the bridge slab is 1.20 kN/m^2.
* Concrete compressive strength, fc` = 28MPa and fc = 0.4fc`.
* Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.

1- Design an interior girder for the maximum applied bending moment.
2- Design an interior girder for the maximum shear force.

See Fig (63)

85)

Reinforced Concrete Bridge

A reinforced concrete bridge its cross section and plan shown in Fig. The bridge has the following data :

* Clear span of the bridge is 17.5m and width of support is 60cm.
* Clear width of the bridge is 9m.
* Wearing surface of the bridge slab is 1.4 kN/m^2 .
* Concrete compressive strength, fc` = 21 MPa and fc = 0.4fc`.
* Steel yeild strength, fy = 350MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

1- Design the slab of the bridge (i.e. calculate thickness and amount of steel reinforcement).
2- Design an interior girder for the maximum moment.
3- Design the same interior girder in 2 above for the maximum shear force.

See Fig (64)

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86)

A reinforced concrete bridge, its plan and cross section shown in Fig. the bridge has the following given data:

- Clear span of the girder = 15m, width of support = 50cm.
- Clear width of the bridge = 11.25m.
- Wearing surface of the bridge = 1.4 kN/m^2 .
- Concrete compressive strength, fc` = 30MPa.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.
- Kg = 12.24 $x10^{10} mm^4$.
- Design based on HL-93 or IL-120 Standard Truck..

Design an interior girder for bending.

See Fig (65)

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87)

Reinforced Concrete Bridge

A reinforced concrete bridge, its plan and cross section shown in Fig. the bridge has the following data:

- Clear span of the girder = 15m, width of support = 50cm.
- Clear width of the bridge = 14m.
- Wearing surface of the bridge = 1.4 kN/m^2 .
- Concrete compressive strength, fc` = 21MPa, and fc = 0.4fc`.
- Steel yield strength, fy = 414MPa for all types of reinforcement and fs = 0.5fy.
- Design according AASHTO 1996, Hs20-44 loading.

1- Design the slab of the bridge and sketch details.
2- Design an interior girder for bending and shear.

See Fig (66)

88)

Reinforced Concrete Bridge

A reinforced concrete bridge, its cross section and plan shown in Fig. The bridge has the following given data :

* Clear span of the bridge is 15m and width of support is 60cm.
* Clear width of the bridge is 10.5m.
* Wearing surface of the bridge slab is 1.2 kN/m^2 .
* Concrete compressive strength, fc` = 20.7 MPa and fc = 0.4fc`.
* Steel yeild strength, fy = 414MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

Design an interior girder for :
1- Maximum bending moment.
2- Maximum shear force.

See Fig (67)

89)

Reinforced Concrete Bridge

A reinforced concrete Deck slab bridge, its plan and sections shown in Fig. the bridge has the following data:

- Center to center of supports = 9.15m, width of support(Pad) = 30cm and width of Abutment = 70cm.
- Clear distance between supports 8.65m.
- Clear width of the bridge = 9.60m.
- Edge beam width = 55cm and overall height of 80cm(50cm slab and 30cm curb).
- Wearing surface of the bridge = 1.4 kN/m^2 .
- Concrete compressive strength, fc` = 30MPa, and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy, n=8.
- Design according to AASHTO, Hs20-44 loading.

Design the slab of the bridge.

See Fig (68)

90)

A reinforced concrete bridge, its plan and cross section shown in Fig. the bridge has the following given data:

- Clear span of the girder = 18m, width of support = 50cm.
- Clear width of the bridge = 11.25m.
- Wearing surface of the bridge = 1.2 kN/m^2 .
- Concrete compressive strength, fc` = 30MPa.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.
- Design based on HL-93 or IL-120 Standard Truck..

Design an interior girder for shear (find amount and spacing of shear reinforcement).

See Fig (69)

91)

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following design data :

- Clear span of the bridge is 15m and width of support is 50cm, Live loading Hs 20-44 Loading.
- Wearing surface of the bridge slab is 1.40 kN/m^2 .
- Concrete compressive strength, fc` = 25MPa and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.

1- Design the slab of the bridge.
2- Re – design the slab of the bridge as a deck slab bridge (i. e. slab without beams).

See Fig (70)

92)

Reinforced Concrete Bridge

A reinforced concrete bridge, its plan and cross section shown in Fig. the bridge has the following design data:

- Span of the girder = 12m c/c (simply supported), width of supports = 60cm .
- Clear width of the bridge = 11m.
- Wearing surface of the bridge = 1.2 kN/m^2 .
- Concrete compressive strength, fc` = 32MPa, and fc = 0.4fc`.
- Steel yield strength, fy = 414MPa for all types of reinforcement and fs = 0.5fy.
- Design according to AASHTO 1996, Hs20-44 loading.

- **Design an interior girder for shear and show the stirrups in longitudinal and cross sections.**

See Fig (71)

93)

Reinforced Concrete Bridge

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following data :

* Clear span of the bridge is 18m and width of support is 60cm.
* Clear width of the bridge is 9.0m.
* Wearing surface of the bridge slab is 1.40 kN/m^2 .
* Concrete compressive strength, fc` = 25MPa and fc = 0.4fc`.
* Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

1- Design the slab of the bridge and draw the detail of reinforcement.
2- Design an exterior girder for the maximum bending moment.

See Fig (72)

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94)

Reinforced Concrete Bridge

A reinforced concrete bridge, its cross section shown in Fig. The bridge has the following data:

* Clear span of the bridge is 16.0m and width of support is 60cm.
* Clear width of the bridge is 10.5m.
* Wearing surface of the bridge slab is 1.4 kN/m^2 .
* Concrete compressive strength, fc` = 28 MPa.
* Steel yeild strength, fy = 420MPa for all types of reinforcement.
* Live loading as per AASHTO 2012 or IL-120 Design Truck.

Design the slab of the bridge (i.e. calculate thickness and amount of steel reinforcement required).

See Fig (73)

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95)

Reinforced Concrete Bridge

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following data :

* Clear span of the bridge is 15m and width of support is 60cm.
* Clear width of the bridge is 10.50m.
* Wearing surface of the bridge slab is 1.40 kN/m^2 .
* Concrete compressive strength, fc` = 28MPa and fc = 0.4fc`.
* Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

1- Design an interior girder for the maximum positive moment.
2- Design an interior girder for the maximum shear force.

See Fig (74)

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96) Reinforced Concrete Bridge

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following data :

* Clear span of the bridge is 15.0m and width of support is 50cm.
* Clear width of the bridge is 9.75m(3-lanes).
* Wearing surface of the bridge slab is 1.4 kN/m^2 .
* Concrete compressive strength, fc` = 21 MPa and fc = 0.4fc`.
* Steel yeild strength, fy = 420MPa for all types of reinforcement and fs = 0.5fy.
* Live loading Hs 20-44 Loading.

1- Design an interior girder for the maximum bending moment only.
2- Design an interior girder for the maximum shear force only.

See Fig (75)

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96)

Reinforced Concrete Bridge

A reinforced concrete bridge its cross section shown in Fig. The bridge has the following design data :

- Clear span of the bridge is 15m and width of support is 50cm, Live loading Hs 20-44 Loading.
- Wearing surface of the bridge slab is 1.40 kN/m^2 .
- Concrete compressive strength, fc` = 25MPa and fc = 0.4fc`.
- Steel yield strength, fy = 420MPa for all types of reinforcement and fs = 0.6fy.

1- Design the slab of the bridge.
2- Re – design the slab of the bridge as a deck slab bridge (i. e. slab without beams).

See Fig (76)

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97)

prestressed pretension

The bonded prestressed pretensioned beam shown in Fig. is simply supported and has a span length of 20m c/c. The beam carries a superimposed live load of 20kN/m and the service dead load of 10kN/m in addition to its own weight. Total losses of about 18%will be assumed, fsi = 1200 MPa, fc` = 40 MPa is specified, fc`i = 28 MPa, Aps = 1764mm^2 , fpu = 1860MPa and fpy = 1600MPa. Calculate:

1. **Find stresses in top and bottom fiber immediately after transfer.**
2. **Calculate temporary stresses in top and bottom fiber.**
3. **Find stresses in top and bottom fiber under full service loads.**

See Fig (77)

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98)

prestressed pretension

The bonded prestressed pretensioned T- beam shown in Fig. is simply supported and has a span length of 15m c/c. The beam carries a superimposed live load of 15kN/m and the service dead load of 7.0kN/m in addition to its own weight. Total losses of about 18%will be assumed, fsi = 1225 MPa, fse = 1180MPa, fc` = 45 MPa, fc = 20 MPa, fc`i = 28 MPa, fpu = 1860MPa and fpy = 1600MPa.,

1. **Select suitable section from the table and find the safety factor against failure for the selected section?**
2. **Find stresses in top and bottom fiber under full service loads for the selected section?**

See Fig (78)

99)

prestressed pretension

The bonded prestressed pretensioned beam shown in Fig. is simply supported and has a span length of 20m c/c. The beam carries a superimposed live load of 15kN/m, the only service dead load is the weight of the beam. Total losses of about 18%will be assumed, fsi = 1250 MPa, fc` = 45 MPa is specified, fc`i = 28 MPa, Aps = 2660mm^2 , fpu = 1895MPa and fpy = 1612MPa. Calculate:

- **The resisting moment carried by the section.**
- **Factor of safety against failure.**

See Fig (79)

100)

prestressed pretension

The bonded prestressed pretensioned beam shown in Fig. is simply supported and has a span length of 18m c/c. The beam carries a superimposed live load of 15kN/m and the service dead load of 20kN/m including its own weight. Total losses of about 18%will be assumed, fsi = 1225 MPa, fc` = 50 MPa is specified, fc`i = 30 MPa, Aps = 2002mm^2 , fpu = 1860MPa and fpy = 1600MPa. Calculate:

1. **Find stresses in top and bottom fiber under full service loads.**
2. **Determine the resisting moment carried by the section.**
3. **Calculate the safety factor against failure.**

See Fig (80)

101)

prestressed pretension

The bonded prestressed pretensioned beam shown in Fig. is simply supported and has a span length of 20m c/c. The beam carries a superimposed live load of 20kN/m and the service dead load of 10kN/m in addition to its own weight. Total losses of about 18%will be assumed, fsi = 1200 MPa, fc` = 40 MPa

is specified, fc`i = 28 MPa, Aps = 1764mm^2 , fpu = 1860MPa and fpy = 1600MPa. Calculate:

1. **Find stresses in top and bottom fiber immediately after transfer.**
2. **Calculate temporary stresses in top and bottom fiber.**
3. **Find stresses in top and bottom fiber under full service loads.**

See Fig (81)

102)

AASHTO Type III Standard section properties shown in Fig. it is simply supported and has a span length of 17m c/c. The girder is post tensioned and designed to carries a superimposed dead load of 3.8 kN/m and service live load of 9.60kN/m. Use f`c=42MPa, f`ci=30MPa, Aps=985mm^2, fpu=1862MPa and fsi=1303MPa. Total losses of 20% will be assumed.

1. **Check flexural stresses at mid span at service.**
2. **Determine the resisting moment of the section.**
3. **Calculate the safety factor of the section.**

See Fig (82)

103)

Prestressed Concrete Beam

- The rectangular section shown in Fig is prestressed pretensioned beam. Total losses of about 18%will be assumed, fc` = 45 MPa is specified, fc`i = 28 MPa, Aps = (18 x 98)mm2 , fpu = 1865MPa and fpy = 1585 MPa. Calculate:
- **The resisting moment carried by the section (Fig.4b) for the final stage.**
- **The resisting moment carried by the section (Fig.4c) for the final stage.**
- **Compare the results in 1 and 2 above and comment.**

See Fig (83)

104)

The bonded prestressed pretensioned beam shown in Fig. it is simply supported and has a span length of 13m c/c. The beam carries a superimposed live load of 10kN/m, service dead load is 5 kN/m (in addition to its own weight). Total losses of about 18%will be assumed, fsi=1200 MPa, fc` = 40 MPa is specified, fc`i = 30 MPa, Aps = 1390mm^2 , fpu = 1890MPa and fpy = 1610 MPa. Calculate:

- **The flexural stresses at mid span at transfer.**
- **The flexural stresses at mid span when the member under full service loads.**

See Fig (84)

105)

The bonded prestressed pretension T- beam shown in Figure is simply supported and has a span length of 16m c/c. The beam carries a superimposed live load of 12kN/m and the service dead load of 17kN/m including its own weight. Total losses of about 18%will be assumed, fps = 1550MPa, fsi = 1280 MPa, fse = 1190MPa, fc` = 50 MPa, fc`i = 30 MPa, fpu = 1850MPa and fpy = 1620MPa.,

1. **Select suitable section from the table and find the safety factor against failure for the selected section?**
2. **Find stresses in top and bottom fiber under full service loads for the selected section?**

See Fig (85)

106)

The bonded prestressed pretension beam shown in Figure, is simply supported and has a span length of 20.0m c/c. The beam carries a superimposed live load of 16kN/m and the service dead load of 22kN/m including its own weight. Total losses of about 20%will be assumed, fsi = 1250 MPa, fc` = 50 MPa is specified, fc`i = 30MPa, Aps = 2352mm^2 , fpu = 1850MPa and fpy = 1620MPa. Calculate:

1. **Stresses in top and bottom fiber immediately after transfer.**
2. **Stresses in top and bottom fiber under full service loads.**

See Fig (86)

107)

The bonded prestressed pretensioned beam shown in Fig. is simply supported and has a span length of 15m c/c. The beam carries a superimposed live load of 22kN/m and service dead load of 12kN/m in addition to its own weight. Total losses of about 18% will be assumed, fsi=1250MPa, fc` = 50 MPa is specified, fc`i = 30 MPa, fps=1560Mpa, fpy = 1680MPa and fpu= 1860 MPa.

1-Calculate Stresses in top and bottom fiber under full service loads.
2-Determine the resisting moment carried by the section.
3-Calculate the safety factor against failure.

See Fig (87)

108)

The bonded prestressed pretensioned T- beam shown in Fig. is simply supported and has a span length of 15m c/c. The beam carries a superimposed live load of 15kN/m and the service dead load of 7.0kN/m in addition to its own weight. Total losses of about 20%will be assumed, fsi = 1225 MPa, fse = 1180MPa, fc` = 45 MPa, fc = 20 MPa, fc`i = 28 MPa, fpu = 1860MPa and fpy = 1600MPa.,

Select suitable section from the table and find the safety factor against failure.

See Fig (88)

The rectangular bonded prestressed pretensioned beam shown in Fig. is simply supported and has a span length of 12m c/c. The beam carries a superimposed live load of 20kN/m, the only service dead load is the weight of the beam. Total losses of about 16%will be assumed, fsi = 1200 MPa, fc` = 40 MPa is specified, fc`i = 28 MPa, Aps = 1390mm^2 , fpu = 1890MPa and fpy = 1610 MPa. Calculate:

- **The flexural stresses at mid span when the member under full service load conditions.**
- **The resisting moment carried by the section.**

See Fig (89)

110)

The bonded prestressed pretensioned T- beam shown in Fig. is simply supported and has a span length of 15m c/c. The beam carries a superimposed live load of 12kN/m and the service dead load of 5.0kN/m in addition to its own weight. Total losses of about 18%will be assumed, fsi = 1220 MPa, fse = 1200MPa, fc` = 45MPa,
fc`i = 28 MPa, fpu = 18500MPa and fpy = 1620MPa.

1. **Check stress at top and bottom fiber of the beam at final stage.**
2. **Calculate the ultimate moment capacity of the section.**

See Fig (90)