COLLEGE OF ENGINEERING PUNE
End Semester Exam 2011-2012 (II SEM.)
Theory of Thin Plates and Shells (SE 504)

Programme: M. Tech.(Structures)
Duration: 180 minutes
Time: 9-00 am to 12-00 noon

Date: 08-05-2012
Max. Marks: 50

Instructions :

1) **Answer all questions.**
2) **Figures to the right indicate full marks.**
3) **Use of non-programmable calculator is allowed.**
4) **Assume suitable data if required.**

Q.1 For a conical shell obtain the following: (10)
   i. Equilibrium equations
   ii. Strain displacements equations
   iii. Displacement field

Q.2 A cylindrical tank of diameter 3.5 m and height 5 m has a wall thickness of 250 mm. The tank is fixed at bottom and free at top. Determine the expressions for deflection, the bending moment and the shear force if the tank is completely filled with water. Modulus of elasticity for concrete is 5000 √fck MPa where fck = 30 MPa. (10)

Q.3 For a membrane shell of revolution for axisymmetric case, obtain the following: (10)
   i. Equilibrium equations
   ii. Strain displacements equations
   iii. Displacement field

Q.4 A solid circular plate of radius 0.25 m with its outer edge completely restrained is subjected to a pressure load of 7 MPa. If the allowable stress in the plate is limited to 90 MPa, determine (10)
   i. the thickness of the plate
   ii. the maximum deflection

   Take E = 200 GPa and υ =0.3

Q.5 A square plate of side 0.5 m is simply supported at two opposite edges and remaining two edges are completely restrained is subjected to a pressure load of 10 MPa over the entire plate. The thickness of the plate is 25 mm. Obtain the central deflection and normal stress at the centre of the plate. (10)
Take E = 200 GPa and υ =0.3

Following formulae may be used.

A] Equilibrium Equations for shell-

$$\frac{\partial N_1 A_2}{\partial \alpha_1} + \frac{\partial N_{21} A_1}{\partial \alpha_2} + N_{12}\frac{\partial A_1}{\partial \alpha_2} - N_2 \frac{\partial A_2}{\partial \alpha_1} + \frac{A_1 A_2}{R_1} Q_1 + q_1 A_1 A_2 = 0$$

$$\frac{\partial N_{12} A_2}{\partial \alpha_1} + \frac{\partial N_2 A_1}{\partial \alpha_2} + N_{21}\frac{\partial A_2}{\partial \alpha_1} - N_1 \frac{\partial A_1}{\partial \alpha_2} + \frac{A_1 A_2}{R_2} Q_2 + q_2 A_1 A_2 =$$

$$\frac{\partial Q_1 A_2}{\partial \alpha_1} + \frac{\partial Q_2 A_1}{\partial \alpha_2} - \left(\frac{N_1}{R_1} + \frac{N_2}{R_2}\right) A_1 A_2 + q_3 A_1 A_2 = 0$$

$$\frac{\partial M_1 A_2}{\partial \alpha_1} + \frac{\partial M_{21} A_1}{\partial \alpha_2} + \frac{M_{12}\partial A_1}{\partial \alpha_2} - M_2 \frac{\partial A_2}{\partial \alpha_1} - Q_1 A_1 A_2 = 0$$

$$\frac{\partial M_{12} A_2}{\partial \alpha_1} + \frac{\partial M_2 A_1}{\partial \alpha_2} + M_{21}\frac{\partial A_2}{\partial \alpha_1} - M_1 \frac{\partial A_1}{\partial \alpha_2} - Q_2 A_1 A_2 = 0.$$

B] Strain Displacement relations-

$$\epsilon_1 = (\epsilon_1^0 + \xi \chi_1), \text{ where } \epsilon_1^0 = \frac{1}{A_1}\frac{\partial u_{10}}{\partial \alpha_1} + \frac{u_{20}}{A_1 A_2}\frac{\partial A_1}{\partial \alpha_2} + \frac{w}{R_1}$$

$$\chi_1 = \frac{1}{A_1}\frac{\partial \psi_1}{\partial \alpha_1} + \frac{\psi_2}{A_1 A_2}\frac{\partial A_1}{\partial \alpha_2}$$

$$\epsilon_2 = (\epsilon_2^0 + \xi \chi_2), \text{ where } \epsilon_2^0 = \frac{1}{A_2}\frac{\partial u_{20}}{\partial \alpha_2} + \frac{u_{10}}{A_1 A_2}\frac{\partial A_2}{\partial \alpha_1} + \frac{w}{R_2}$$

$$\chi_2 = \frac{1}{A_2}\frac{\partial \psi_2}{\partial \alpha_2} + \frac{\psi_1}{A_1 A_2}\frac{\partial A_2}{\partial \alpha_1}$$

$$\gamma_{12} = (\gamma_{12}^0 + \xi \chi), \text{ where } \gamma_{12}^0 = \frac{A_1}{A_2}\frac{\partial}{\partial \alpha_2}\left(\frac{u_{10}}{A_1}\right) + \frac{A_2}{A_1}\frac{\partial}{\partial \alpha_1}\left(\frac{u_{20}}{A_2}\right)$$

$$\chi = \frac{A_1}{A_2}\frac{\partial}{\partial \alpha_2}\left(\frac{\psi_1}{A_1}\right) + \frac{A_2}{A_1}\frac{\partial}{\partial \alpha_1}\left(\frac{\psi_2}{A_2}\right)$$

C] Displacement field Approximation-

$$\left.\begin{aligned} u_1 &= u_{10} + \xi \psi_1 \\ u_2 &= u_{20} + \xi \psi_2 \\ w &= w_0 \end{aligned}\right\} \text{ where } \begin{aligned} \psi_1 &= \frac{u_{10}}{R_1} - \frac{1}{A_1}\frac{\partial w}{\partial \alpha_1} \\ \psi_2 &= \frac{u_{20}}{R_2} - \frac{1}{A_2}\frac{\partial w}{\partial \alpha_2} \end{aligned}$$

College of Engineering Pune
Civil Engineering Department
F.-Y. M. Tech. (Structures) Semester II

(SE 508) Design of Prestressed Concrete Structures

Year: 2011-12 — 14th May 2012
Time : 9 am to 12 noon. — End-Semester Examination — Max. Marks: 50

Instructions:

- All questions are compulsory.
- Make suitable assumptions wherever required and state them clearly.
- Use of IS 1343, IS 3370, IS 456, IRC 6, IRC 21 and IRC18 is permitted.
- Assume E_{steel} = 200 GPa wherever required.

Q.1 A commercial complex is to be provided with post-tensioned flat slab. For the following data, design a typical panel of flat slab. (10)

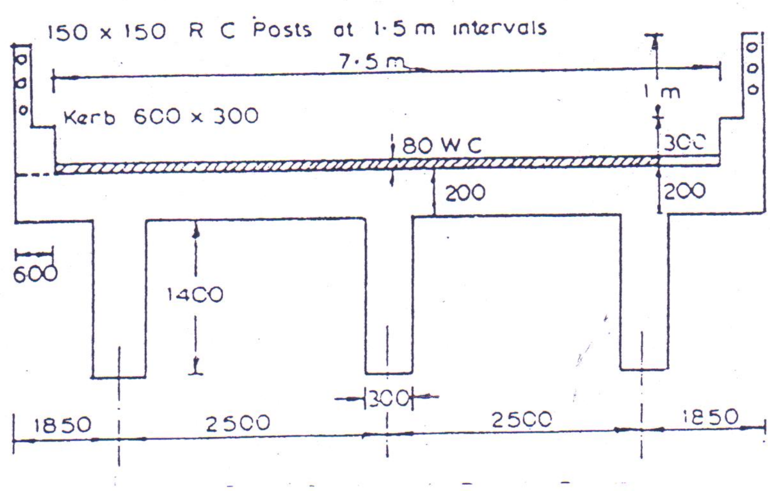
- Center to center spacing of columns = 7.5 m in both directions
- All columns of size = 600 mm × 600 mm
- Floor to floor height = 3.8 m
- Loading :
  - Superimposed DL = 1 kN/m^2
  - Floor finish = 1.5 kN/m^2
  - Live load = 2.5 kN/m^2
- M25 concrete for RCC columns and M40 concrete for PT flat slab
- Assume 18% losses due to prestress
- Permissible stress in 7 mm dia. wires = 1200 N/mm^2.
- Strand diameter = 15.748 mm
- Number of strands / cable = 5

Q.2 Design a cylindrical PSC water tank of internal diameter 32 m and height 8 m. Compressive stress in concrete is not to exceed 12.5 N/mm^2 at transfer. Minimum compressive stress at working loads is to be 1 N/mm^2. The prestress is to be provided by a circumferential winding of 6 mm diameter wire. Vertical cables of 12, 5 mm diameter wires can be provided, in which the stress at transfer is 900 N/mm^2. Design the tank for hinged base condition. (10)

Q.3 (a) The end block of a post-tensioned beam is 100 mm wide and 200 mm deep. A 7 mm dia. prestressing wire, stressed to 1200 N/mm^2 has to be anchored against the end block at the center. The anchorage plate is 60 mm × 60 mm. The wire bears on the plate through a female cone of 20 mm dia. The permissible stress in concrete at transfer, f_{ci} is 20 N/mm^2 and the permissible shear stress in steel is 94.5 N/mm^2. Determine the thickness of the anchorage plate. (05)

(b) The end block of a post-tensioned bridge girder is 600 mm wide by 1200 mm deep. Two cables, each comprising of 97 HT wires of 7 mm dia. are anchored using two square anchor plates of side length 420 mm. Centers of the plates are located at 600 mm from the top and bottom edges of the girder. The jacking force in each cable is 4500 kN. Design suitable anchorage zone reinforcement using Fe415. (05)

Q.4 A prestressed concrete bridge has three T-girders, each of span 16 m. The cross section of the bridge deck is as shown in the figure below. For IRC **Class A** loading, compute the maximum design bending moment and maximum shear in the outer girder. Design the outer girder of the bridge. (13)



Q.5 The following table shows particulars of a cable group provided for the T- girder in Q.4. Find the slip and the stress at each section due to anchorage slip loss. Also find the total expected extension of the cable group. (07)

Title	0.0L	0.1L	0.2L	0.3L	0.4L	0.5L
Distance from beam end (m)	0.0	1.6	3.2	4.8	6.4	8.0
Jacking stress before slip loss (N/mm^2)	1400	1380.3	1363.7	1351.6	1339.4	1327.4
Slip (m)						
Stress after slip loss (N/mm^2)						

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COLLEGE OF ENGINEERING, PUNE
M. Tech. –I (Civil – Structural Engg.)
(CE5105) Finite Element Method
End- Semester Examination

Year : 2011-12 | **Semester : II**

[Max. Marks: 30 | Time: Three hour]

Instruction: 1. **ALL** questions are compulsory.
2. Make suitable assumptions if required any.

Q.1 Multiple Choice Questions [10]

1.1 For a second-order differential equation,the variable u is approximated as $u = a + bx + cx^2$ .If the boundary conditions are $u = 5$ at $x = 0$ and $du/dx = 0$ at $x = 1$,the appropriate approximation for using it in a Galerkin method is

(a) $b(2x - x^2)$ (b) $5 + bx + cx^2$ (c) $5 + x + cx^2$ (d) $5 + \frac{b}{2}(2x - x^2)$

1.2 For solving a fourth-order ordinary differential equation to obtain y as a function of x ,a beam element of length 1m is used.On solving the equation, y is obtained as 0 at the first node and $1/3$ m at the second node.The first derivative dy/dx is obtained as 0 at the first node and $1/2$ at the second node.The third derivative, d^3y/dx^3 ,in the element is

(a) $-1/2$ (b) -1 (c) $1/6$ (d) $-1/6$

1.3 Identify the wrong statement

(a)Finite element analysis is a method for the numerical solution of a differential equation.

(b)Partial differential equations occur when both spatial and time coordinates are included in the same problem.

(c)Finite element method is not useful for solving coupled ordinary or partial differential equations.

(d)Analytical solutions for coupled partial differential equations are complicated.

1.4 Finite element analysis deals with (a)approximate numerical solutions

(b) boundary value problems (c)differential equations (d) all the above

1.10 The Galerkin method of approximate analysis is

(a)classified as a method of weighted residuals.

(b)based upon assuming an approximate solution for a differential equation.

(c)based on both conditions **(a)** and **(b)**.

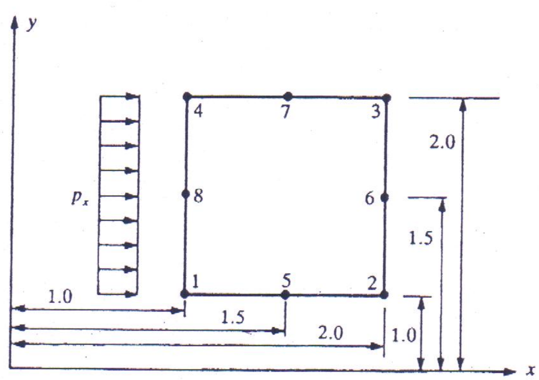
(d)error free.

Q.2 Using Principle of Virtual Work derive the general formulation for *Finite Element Method.* [6]

Q.3 A rectangular finite element with dimensions $a \times b$ is defined in an x,y co-ordinate system Assume a function of the form $\phi = A + Bx + Cy + Dxy$ and derive the shape functions for rectangular element. [4]

Q.4 A triangular element has node points located at $(x_1 = 1, y_1 = 1)$, $(x_2 = 6, y_2 = 1)$, and $(x_3 = 3, y_3 = 4)$ .A function has been computed to have nodal point values of $\phi_1 = 900$, $\phi_2 = 600$, and $\phi_3 = 1200$. Use the interpolation function for a three-node triangular element and compute the values of ϕ at $(x = 3, y = 4)$. [4]

Q.5 Assume the eight-node quadrilateral iso-parametric element shown in figure is loaded with a uniform pressure loading $p_x = 1.0$,acting in the $x-$direction along the side defined by nodes 1,8 and 4.Compute the distribution of the pressure loading to each node. Use a two-point Gaussian quadrature. [6]



Use shape functions

1.5 A shape function is usually

(a)the coefficient that appears in the interpolation polynomial.

(b)written for each individual node of finite element.

(c)interchanged with the terminology interpolation polynomial.

(d)All the above.

1.6 The one dimensional problem in elasticity is given by the balance of forces in an elastic rod, in terms of normal stress σ, area A and axial body force f ,as

(a) $\frac{d[\sigma(x)A(x)]}{dx}+f(x)A(x)=0$ (b) $\frac{d[f(x)A(x)]}{dx}+\sigma(x)A(x)=0$

(c) $\frac{d[\sigma(x)]}{dx}+f(x)A(x)=0$ (d) $\frac{d[\sigma(x)A(x)]}{dx}+f(x)=0$

1.7 Identify the wrong statement

(a)In finite element method, a continuous function can be approximated using a discrete model.

(b)A discrete model is compared of one or more interpolation polynomials.

(c)Continuous function is not divided into finite elements.

(d)The end points of the finite element are called nodes.

1.8 The commonly used two-dimensional elements are

(a)four-node quadrilateral and three-node triangular elements.

(b)three-node quadrilateral and four-node triangular elements.

(c)eight-node quadrilateral and six-node triangular elements.

(d)All the above.

1.9 The shape functions for a triangular element in a two-dimensional problem is often expressed in terms of (a)surface co-ordinates

(b) area co-ordinates (c) volume co-ordinates (d) all the above

$$N_1 = (1-\xi)(1-\eta)(-\xi-\eta-1)/4 \qquad N_2 = (1+\xi)(1-\eta)(\xi-\eta-1)/4$$

$$N_3 = (1+\xi)(1+\eta)(\xi+\eta-1)/4 \qquad N_4 = (1-\xi)(1+\eta)(-\xi+\eta-1)/4$$

$$N_5 = (1-\xi^2)(1-\eta)/2 \qquad N_6 = (1+\xi)(1-\eta^2)/2$$

$$N_7 = (1-\xi^2)(1+\eta)/2 \qquad N_8 = (1-\xi)(1-\eta^2)/2$$

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COLLEGE OF ENGINEERING, PUNE (COEP)

END SEMESTER EXAMINATION

Earthquake Analysis and Design of Structures (SE506)

M.Tech. Civil (Structural Engg.)

Year: 2011-12, Semester II **Date: 11/05/2012**
Duration: 3 hours Max. Marks: 100

Instructions:

1. Solve All questions
2. Figures to right indicate full marks
3. Make necessary assumptions and suitable data wherever required.
4. Use of non-programmable calculators is allowed.
5. Use of OWN copy of IS 456. IS 1893, IS 13920 is permitted.

Q.1 Design a shear wall for a 12 story building with two window openings of size 1500 x 1200 for the following data: Show the reinforcement details. (20)

- Storey shear at different levels are as follows:-

Storey No.	1	2	3	4	5	6	7	8	9	10	11	12
Storey Shear (kN)	5	10	30	80	140	200	360	500	700	850	950	900

- Storey height - 3.2 m
- Length of shear wall - 15 m
- Axial load on shear wall - 9000 kN
- Seismic weight of the building 60000 kN
- Building is situated in Mumbai
- M-25 & Fe-415

Q.2a Explain the working of the Base isolation system with a proper sketch indicate where it is useful? (10)

Q.2b How the dampers are useful in the earthquake resistant system? Explain with neat sketch. In which cases dampers are useful? (10)

Q.3 Find the total design base shear, and its distribution along the height of the Gr + 3 building. Building is proposed in Zone V with special moment resisting frame structure with an importance factor of 1.5. (20)

L_X - 16m, L_Y - 16m. Fl. Ht. - 3.5 m.

DL - 10 KN/m^2 and LL - 3 KN/m^2,

Column spacing - 4 m in X- and Y-direction.

Natural period (s)	Mode 1 0.0647	Mode 2 0.023	Mode 3 0.016
i^{th} floor	Mode Shapes		
3^{rd} floor	1.000	1.000	1.000
2^{nd} floor	0.802	-0.555	-2.247
1^{st} floor	0.445	-1.246	1.802

Q.4a Distinguish between response spectra and design spectra; also explain how to develop them. (10)

Q.4b What are the causes of torsion in the building? How it is countered? Explain the precautions taken in the IS code to prevent use of such buildings? (10)

Q.5a Design the reinforcement for a column of size 450 mm X 450 mm, subjected to the following forces. The column has an unsupported length of 4.0 m and is braced against side sway in both directions. Use M-25 grade concrete and Fe 415 steel. (15)

	Dead Load	Live Load	Seismic load
Axial load (kN)	1000	800	550
Moment (kNm)	50	40	100

Q.5b A vertical cantilever parapet wall of 1.2 m is to be designed for zone V. Design as per IS 456 and IS 1893 and compare. Show the details. (05)

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Chart - 6 Interaction Chart for Combined Bending and Compression
Rectangular Section - Reinforcement Distributed Equally on Four Sides

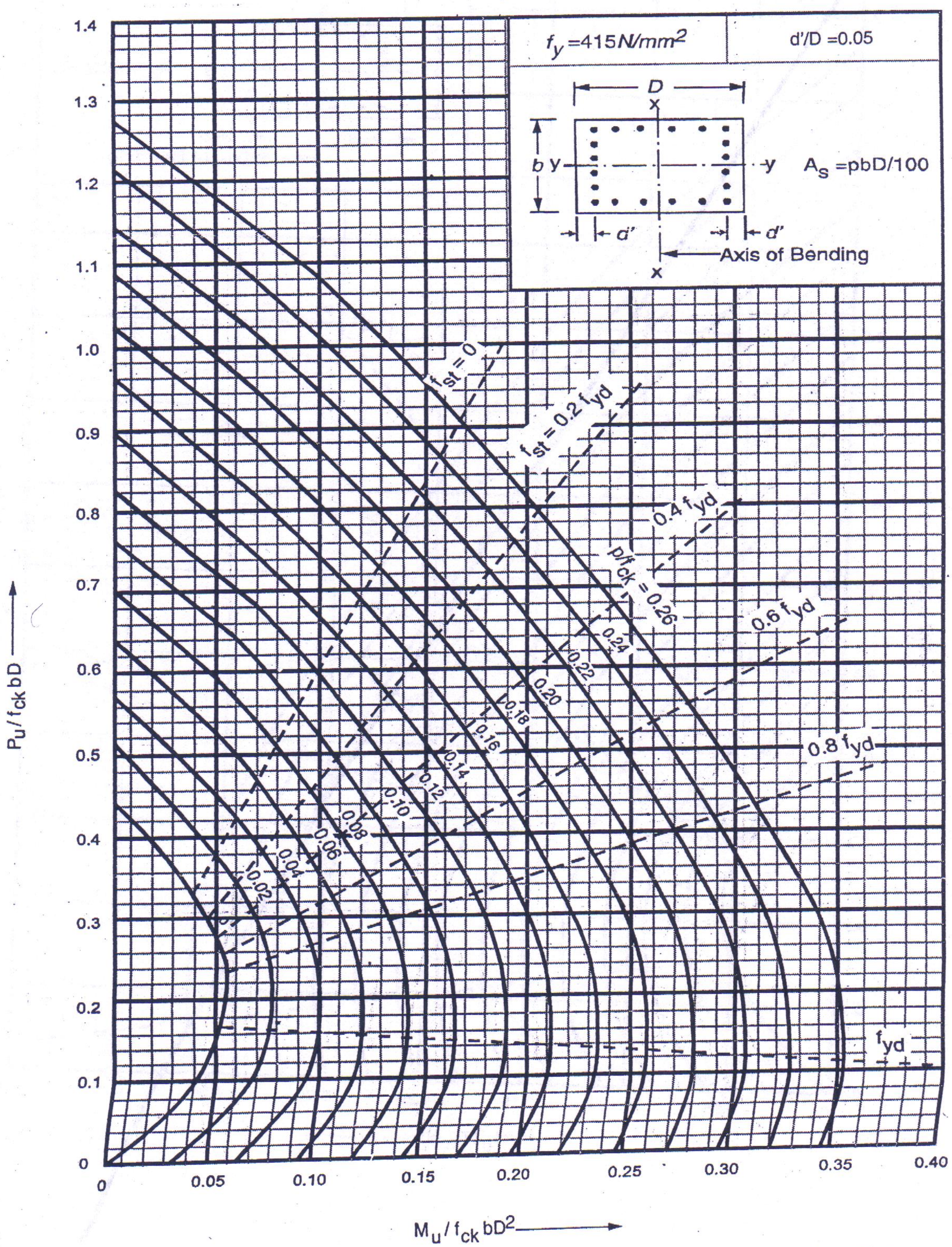

Chart - 7 Interaction Chart for Combined Bending and Compression
Rectangular Section - Reinforcement Distributed Equally on Four Sides

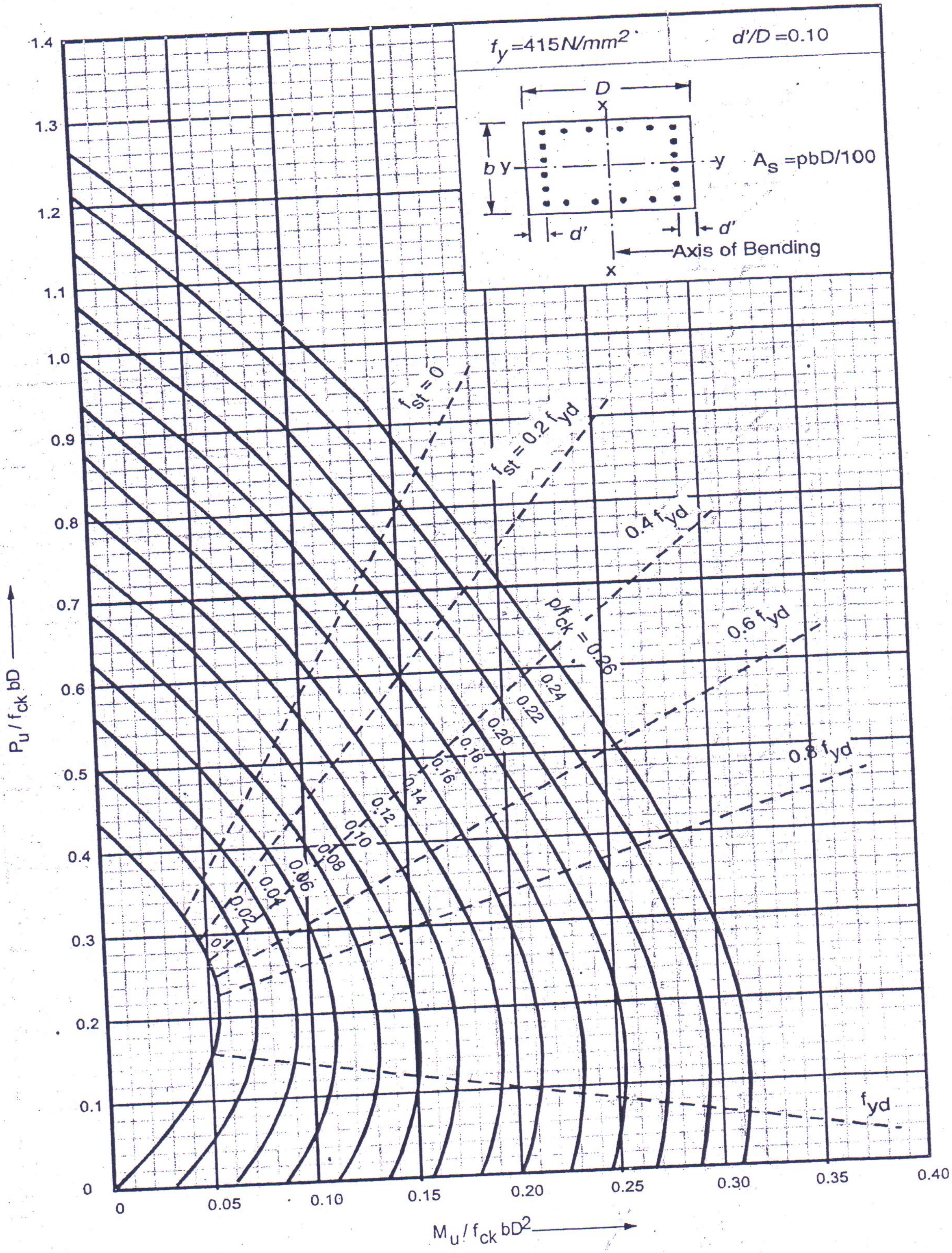

Chart - 8 Interaction Chart for Combined Bending and Compression Rectangular Section - Reinforcement Distributed Equally on Four Sides

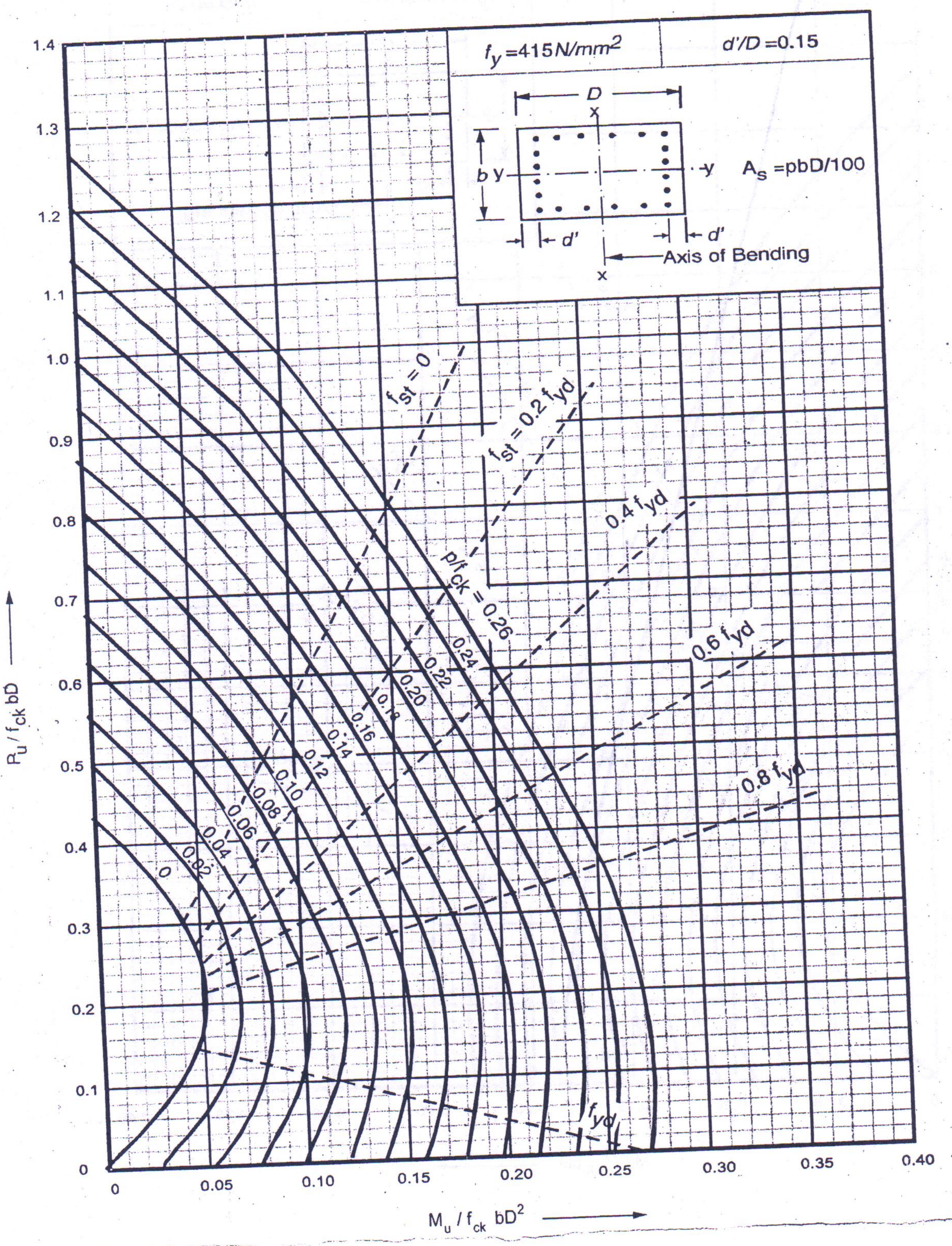

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Chart - 9 Interaction Chart for Combined Bending and Compression
Rectangular Section - Reinforcement Distributed Equally on Four Sides