4-2

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2023
Program: B.Sc. Engineering (Civil)

Course Title: Project Planning and Management | Course Code: CE 401
Time: 3 Hours | Credit Hours: 3.00 | Full Marks: 150

Answer all the questions.

1. (i) "PERT system is preferred for those projects which are of non-repetitive nature". Provide sufficient justification to validate the above quoted statement. **[08]**

   (ii) Ascertain the scope of application of the Public Procurement Act (PPA) 2006. **[07]**

2. The network of a construction project is shown in **Figure 1**, along with the duration of each activity. Apply network analysis technique to determine the Earliest and Latest Event Time of each activity. **[20]**

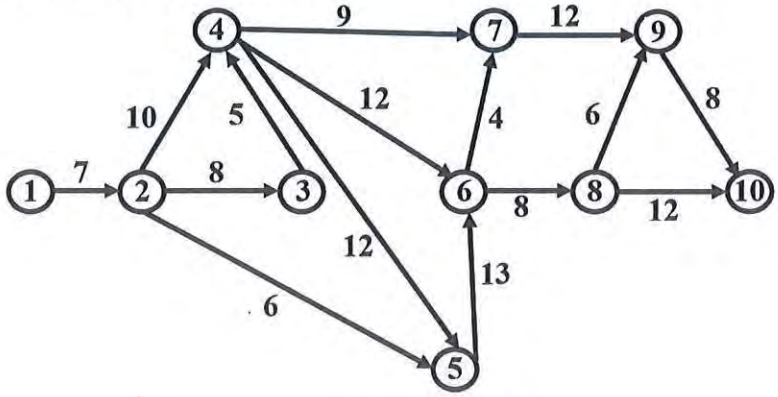

Figure 1

3. Apply CPM technique to the network shown in **Figure 1** to determine the followings:

   (i) Activity Time (EST, EFT, LST, LFT) of each activity. **[15]**
   (ii) Total Float of each activity. **[05]**
   (iii) The Critical Path. **Show the Critical Path on the Network.** **[05]**

4. The XYZ Company has been a producer of picture tubes for television sets and certain printed circuits for radios. The company has just expanded into full scale production and marketing of AM and AM-FM radios. It has built a new plant that can operate 48 hours per week. Production of an AM radio in the new plant will require 2 hours and production of an AM-FM radio will require 3 hours. Each AM radio will contribute Tk. 40 to profits while an AM-FM radio will contribute Tk. 80 to profits. The marketing department, after extensive research, has determined that a maximum of 15 AM radios and 10 AM-FM radios can be sold each week.

   (i) Figure out the objective function and constraint equations as a linear programming problem for the above-mentioned case. **[10]**

(ii) Investigate using **Graphical method** to find out the number of radios of each type that should be produced by the company to achieve the maximum profit. **[20]**

5. (i) ABC Company Ltd. is planning to invest in a new Project. Cash inflows and outflows of the project for 5 years is shown in the table below.

Years	Cash Inflows (USD)	Cash Outflows (USD)
Initial Investment		50,000
1	20,000	5,000
2	14,000	2,000
3	12,000	2,000
4	12,000	2,000
5	15,000	1,000

The discount rate is 5%. Calculate Net Present Value (NPV). Should ABC Company Ltd. invest in the Project? Explain why. **[20]**

(ii) Villa Homes wants to initiate a new project in which it builds a community center inside a growing neighborhood. For this project the company will need to lease the equipment which will cost $100,000. The company expects to see a $200,000 annual profit increase over the next 3 years. The inflation rate is 4%.

Apply the Benefit-Cost method to assess the profitability of this new project. **[10]**

6. The particulars relating to 950 kg of a certain raw material purchased by a particular company during September 2023 are as below:

Lot prices quoted by suppliers and accepted by the company for placing the purchase order are:

Lot up to 1000 kg	Tk. 25 per kg
Between 1000 - 1500 kg	Tk. 20 per kg
More than 1500 kg	Tk. 15 per kg

For Supplies to Factory, Trade Discount is 15%.
Price of a 25 kg container is Tk. 15 per container.
Credit allowed on return of containers is Tk. 10 per container.
Sales Tax is 10% on raw material and 5% on containers.
Transportation cost paid by the purchaser is Tk. 1500.
Insurance is 2% (on net invoice value) paid by the purchaser.
Stores Overheads applied at 5% on total purchase cost of material.
The entire quantity has been received and issued to production.
The containers are returned in due course.

Analyze the above data/information to calculate the followings:
(i) Total cost of material purchased. **[25]**
(ii) Unit cost of material issued to production. **[05]**

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University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2023
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering VII — Credit Hours: 2.0
Course Code: CE 419 (Introduction to Finite Element Method)
Time: 2 hours — Full Marks: 70 (= 7 × 10)

[Answer **any 7 (Seven)** of the following 10 questions]

[Given: $E_{conc} = (400 + 2R_0)$ ksf, Poisson's ratio $\nu = 0.30$, where R_0 = Last two digits of Registration #]

1. Fig. 1(a) shows a beam ABC at the UAP campus, while Fig. 1(b) shows the beam modeled schematically.

   Given: $L_1 = (15 + 0.05R_0)$ ft $\mu = (0.2 + 0.001R_0)$ k-s^2/ft^2 $I_{AB} = I_{BC} = (1 + 0.01R_0)$ ft^4

   For the beam AB, assume shape function

   $\psi(x) = [x/L_1 - Cos(\lambda L_1 - \lambda x) + (1/\lambda L_1)\, Sin(\lambda L_1 - \lambda x)]/1.40$, where $x = 0$ at A, $x = L_1$ at B, $\lambda L_1 = 4.493$

   and perform Gauss Integration (with $n = 1$) to calculate its

   (i) Flexural Stiffness (k^*), (ii) Effective mass (m^*), (iii) Natural frequency (ω_n).

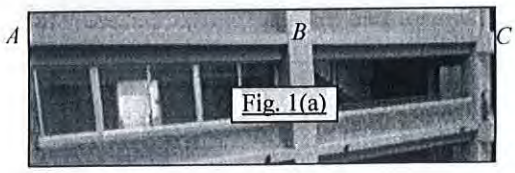

Fig. 1(a)

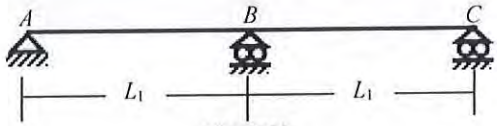

Fig. 1(b)

Fig. 2(a)

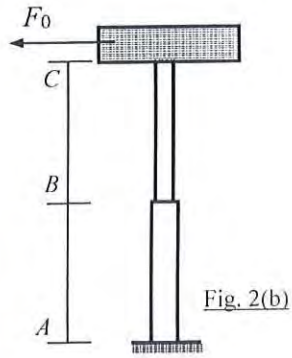

Fig. 2(b)

2. Fig. 2(a) shows a tree deformed in cyclone Remal, while Fig. 2(b) shows the tree modeled as carrying uniformly distributed load w_0, in addition to concentrated force $F_0 = (1000 + 10R_0)$ lb at C.

   Given: $L_2 = (5 + 0.02R_0)$ ft $w_0 = (100 + R_0)$ lb/ft $EI_{AB} = 2EI_{BC} = (1000 + 5R_0) \times 10^3$ lb-ft^2

   Assume shape function $\psi(x) = (0.5x/L_2)^{1.8}$ for the beam ABC [$x = 0$ at A, $x = L_2$ at B and $x = 2L_2$ at C] to calculate [using Gauss Integration with ($n = 1$)] its

   (i) Flexural Stiffness (k^*), (ii) Effective force (f^*), (iii) Deflection at point C.

3. Fig. 3(a) shows finite element Plane Strain modeling of Karnaphuli Tunnel surrounded by soil, using 2-dimensional triangular elements. One element abc is colored black and shown enlarged in Fig. 3(b). Nodal coordinates of the element are $a(0, 0)$, $b(15, 0)$ and $c(0, 10)$.

   (i) Form the matrices **B** and **D** for the triangular element abc.

   (ii) Given $\sigma_{xx} = (2 + 0.01R_0)$ ksf, $\sigma_{yy} = \sigma_{xx}/2$, $\tau_{xy} = 2\sigma_{xx}$, calculate the strains ε_{xx}, ε_{yy} and γ_{xy}, if $E_{soil} = (40 + 0.2R_0)$ ksf.

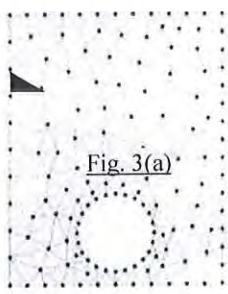
Fig. 3(a)

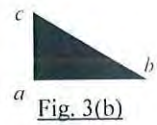

Fig. 3(b)

4. Fig. 4 shows finite-element modeling of the 0.5-ft thick deck of Dhaka Elevated Expressway using Q4 Mindlin Plate Elements. Evaluate first three rows and columns (3 × 3) of integrals

$$\iint \mathbf{B}_1^T \mathbf{B}_1 \, d\xi \, d\eta \quad \text{and} \quad \iint \mathbf{B}_2^T \mathbf{B}_2 \, d\xi \, d\eta$$

for one such element [size (5′ × 2′) each (colored black).

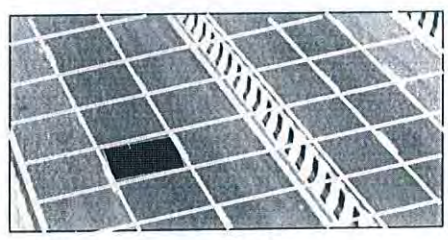
Fig. 4

5. Fig. 5 shows a simply supported beam AC (of span $(80 + R_0)'$) with rectangular cross-section (section $2' \times 5'$) at *Jatiya Sangsad Bhaban*.

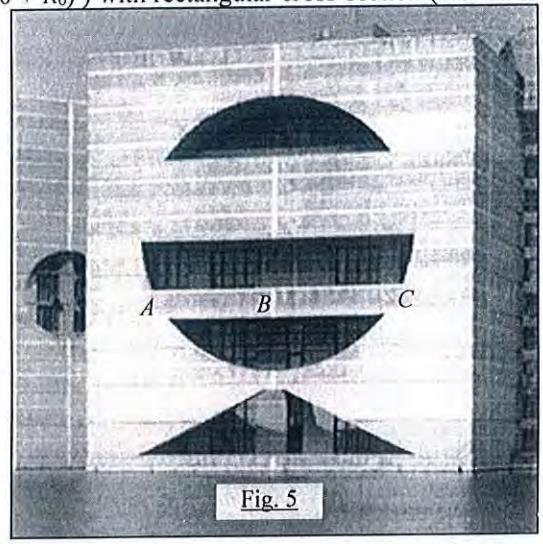

Fig. 5

It is modeled as a 2-noded Timoshenko beam (with linear shape functions).

If rotations ϕ_A and ϕ_C (at A and C) are found to be (-1×10^{-4} rad) and (1×10^{-4} rad) respectively, calculate

(i) Strains ε_{xx}, γ_{xy}

(ii) Stresses σ_{xx}, τ_{xy}

at the bottom fiber of support C.

6. For the RC beam ABC of length $L_0 = (80 + R_0)'$ ($AB = BC = L_0/2$) with cross-section ($2' \times 5'$) of *Jatiya Sangsad Bhaban* [shown in Fig. 5 is modeled as a 3-noded Timoshenko beam (with quadratic shape functions).

Form the matrices **B**, **D** and **K** of the beam.

7. Fig. 6 shows an arch abc of span = $(60 + R_0)$ ft, height = $(5 + 0.1R_0)$ ft and thickness $t = 0.6$ ft.

This is a part of the gallery of *Mirpur Cricket Stadium* and modeled by a quadratic element.

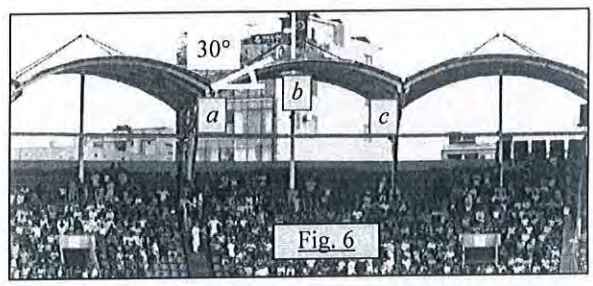

Fig. 6

If $\varepsilon_{xx} = (5 + 0.1R_0)\ 10^{-3}$
$\varepsilon_{yy} = -(3 + 0.1R_0)\ 10^{-3}$
$\gamma_{xy} = (1 + 0.1R_0)\ 10^{-3}$ at point a, calculate

(i) σ_{xx}, σ_{yy} and τ_{xy}

(ii) σ_{xx}' and τ_{xy}' on a plane $\theta = 30°$

(iii) Principal Stresses and Planes.

8. Evaluate the first three columns of matrix **B** at the bottom line of joint a of the arch element abc described in Question 7 (shown in Fig. 6).

9. Fig. 7(a) shows a pile AB [of length $L_{AB} = (50 + 0.1R_0)$ ft] subjected to axial force P at the end B.

The pile is fixed at A and supported on a spring (roughly representing the surrounding soil) at B.

Fig. 7(b) represents the same pile without the surrounding soil, which may be assumed to have liquefied in an earthquake.

Use the stiffness matrix **K** and geometric stiffness matrix **G** to calculate the buckling load P_{cr} of the pile

with soil support [Fig. 7(a)] and

without soil support [Fig. 7(b)].

[Given: EI of the pile = $(100 + R_0) \times 10^3$ k-ft^2], Stiffness $k_{soil} = (5 + 0.01R_0)$ k/ft]

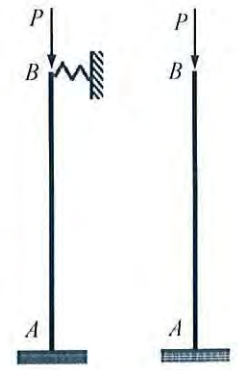

Fig. 7(a) Fig. 7(b)

10. Answer Question 9 without using the matrices **K** and **G**; i.e. using Gauss Integration (with $n = 2$) for the shape function

$$\psi(x) = 1 - Cos(\pi x/2L)$$

representing the deflected shape of the pile.

University of Asia Pacific
Department of Civil Engineering
Final Examination, Fall 2023
Program: B.Sc. in Civil Engineering

Course Title: Engineering VIII (GIS and Remote Sensing) | Credit Hour: 2 | Course Code: CE531

Time: 2 hours | Full Marks: 100

All questions are mandatory. Numbers in parentheses indicate marks assigned to each.

1. Suppose you are working on a project to select the optimum alignment for a new highway between two cities. Your task is to conduct a reconnaissance survey and present two alternatives showing the main features. (You will use smartphones as required.)
   a. Describe the steps to bring the travel points to the map using a suitable app. **(10)**
   b. Describe how you can show the photographs taken with a separate phone you will take along the routes. (Consider using QGIS plugins.) **(10)**

2. Suppose you are a Highway Engineer designing a national highway. The alignment goes through private lands; you will prepare land acquisition maps. Your manager wants you to prepare it with GIS.
   a. What kinds of data will you need to do this job? **(8)**
   b. What is the sequence of activities to prepare the land acquisition maps? You may draw figures to explain your answer. **(12)**

3. Your company is designing a water reservoir in a hilly area that will hold excess water during the monsoon and release it during the dry season. You want to find out the watershed before conducting a detailed topographic survey.
   a. From which source would you collect DEM data and how? Describe the steps. **(10)**
   b. Write down the steps to calculate the catchment area of the watershed. Mention the data and software you will require. **(10)**

4. Describe how GIS can help find a lost person's location. You have all the necessary data, such as detailed maps, the person's family size, personal needs, lifestyle, health conditions, and physical features. You also know his friends and enemies.
   a. Write down the steps to locate the person. (consider the example discussed in class) **(15)**
   b. Why can a GIS-based search operation fail? **(5)**

5. You are working on a project to protect the Sundarbans. Your manager wants you to prepare flood maps for different water levels and create an animation.
   a. What types of data would you require to build a flood simulation with GIS? If you don't have topographic data, how can you collect DEM data from USGS or NASA? **(5)**
   b. Describe the steps for preparing the animation. **(15)**

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2023
Program: B.Sc. in Engineering (Civil)

Course Title: Structural Engineering X | Course Code: CE 425
Time: 2 hours | Credit Hour: 2.00 | Full Marks: 70

QUESTION 1 [10 MARKS]

"Use of alternative cement combinations can reduce the chloride ingress into concrete" – Justify. **[10]**

QUESTION 2 [10 MARKS]

Explain the factors influencing Carbonation-induced corrosion. **[10]**

QUESTION 3 [10 MARKS]

(a) Explain the mechanism of water reduction by superplasticizer in concrete. **[6]**

(b) State the benefits of using Accelerators admixture into fresh concrete **[4]**

QUESTION 4 [10 MARKS]

(a) State the purposes of non-destructive tests of concrete. **[4]**

(b) Ultrasonic Pulse Velocity Test is an effective NDT test for estimation of compressive strength of concrete – Do you agree or disagree? Justify your answer. **[6]**

QUESTION 5 [10 MARKS]

Explain the role of superabsorbent polymers (SAPs) on the autogenous healing process of concrete. **[10]**

QUESTION 6 [20 MARKS]

A reinforced concrete wall needs to be constructed at a construction site. The following necessary data are provided for the wall and its formwork.

Cross sectional size of the wall: Thickness = 350 mm, Length = 10 m.

Height = 3 m

Concrete type: Blended cement containing 20% of fly ash with an accelerating admixture.

Form height = 3.5 m.

Density of concrete = 2400 kg/m^3.

Concrete temperature at placement = 30 °C.

Uniform volume supply rate = One 7 m^3 truck every 30 mins.

Table 1: Values of coefficients C1 and C2

Walls: C l = 1 .0	
Columns: C l = 1 .5	
Concrete:	**Value of C2**
Ordinary Portland Cement (OPC) without admixture	0.3
OPC with any admixture, except a retarder	0.3
OPC with a retarder	0.45
Blended cement containing less than 70% slag or 40% fly ash without admixture	0.45
Blended cement containing less than 70% slag or 40% fly ash with any admixture, except a retarder	0.45
Blended cement containing less than 70% slag or 40% fly ash with a retarder	0.6
Blended cement containing more than 70% slag or 40% fly ash	0.6

(a) Calculate the concrete lateral pressure and draw the pressure envelope as a function of height for form work design. **[12]**

(b) Explain the effect of workability of concrete on the lateral pressure of formwork. **[8]**

Formula:

$$P_{max} = D\left[C_1\sqrt{R} + C_2 K\sqrt{H - C_1\sqrt{R}}\right] \quad \text{and} \quad D \times h$$

University of Asia Pacific
Department of Civil Engineering
Final Examination Fall 2023
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering VI | Course Code: CE 417
Time: 2 hours | Credit Hour: 2 | Full Marks: 100

QUESTION 1

Determine the effective length factor (K) for EF, IJ, JK and GH columns of the frame shown in **Figure 1**. Given: $I_{column} = 1100\ in^4$ and $I_{beam} = 500\ in^4$. **[20]**

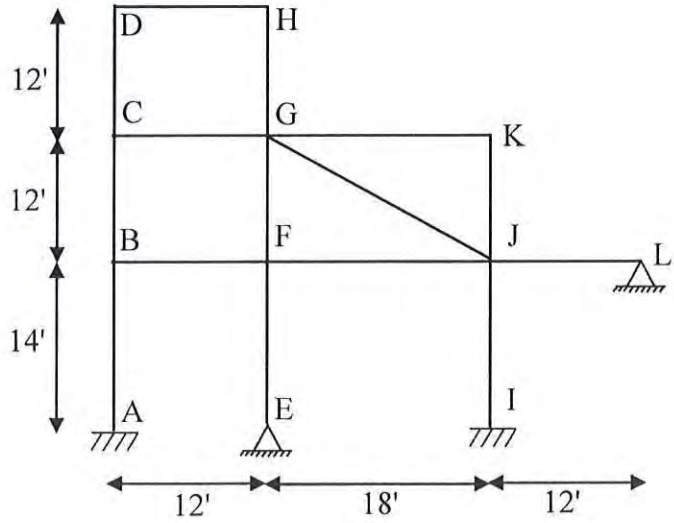

Figure 1

QUESTION 2

Select the lightest W section (from **Table 1**) to carry a superimposed service dead load of 1.0 kip/ft and a service live load of 1.5 kip/ft on a simply supported beam. The length of the beam is 20 ft, and adequate lateral support is provided. Use A572 Grade 70 steel, and follow the **AISC-ASD** approach. Note: Beam self-weight is not negligible and hence it must be accounted for. **[20]**

Table 1

Shape	b_f (in)	t_f (in)	I_x (in^4)	I_y (in^4)	Z_x (in^3)	Z_y (in^3)
W 10×45	8.02	0.620	248	53.4	54.9	20.3
W 10×33	7.96	0.435	171	36.6	38.8	14.0
W 12×22	4.03	0.425	156	4.66	29.3	3.66
W 12×35	6.56	0.520	285	24.5	51.2	11.5
W 12×26	7.65	0.380	204	17.3	37.2	8.17

QUESTION 3

Determine Yield Moment, Plastic Moment and Shape Factor for the steel beam section shown in **Figure 2**. The yield and ultimate strengths of the steel are 50 ksi and 65 ksi, respectively. **[20]**

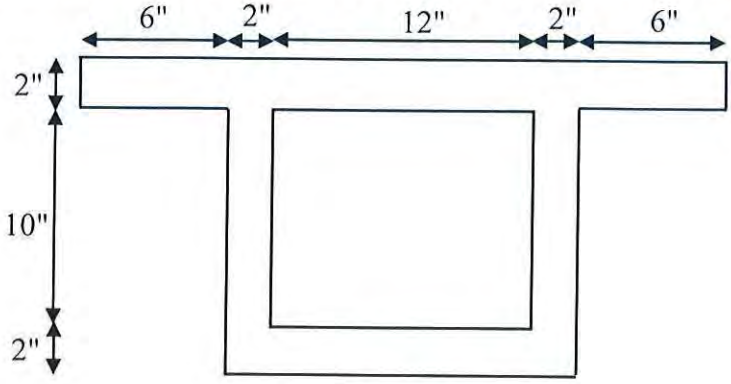

Figure 2

QUESTION 4

Use F_y = 36 ksi and F_u = 52 ksi, E60 electrodes, and the **SMAW** process to design side fillet welds for the full capacity of the 6×4×1/2-in angle tension member shown in **Figure 3**. The member is subjected to repeated stress variations, making any connection eccentricity undesirable. Assume that the **WT** chord member has adequate strength to develop the weld strengths and that the thickness of its web is 3/4 in. Use the **AISC-LRFD** method for the calculation, and assume that U = 0.9. **[15]**

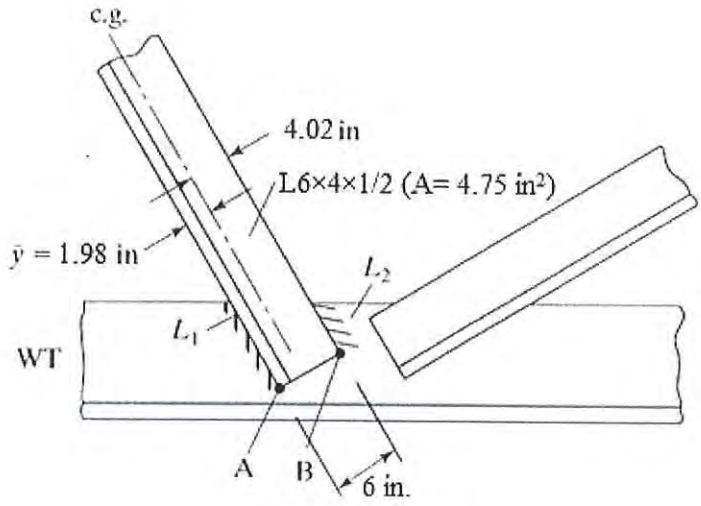

Figure 3

QUESTION 5

(a) With a neat sketch, explain the mechanism of lateral torsional buckling. Explain the effect of the lateral torsional buckling on the flexural strength of steel member. **[12]**

(b) Plastic neutral axis divides the cross section into two equal areas. Explain briefly. **[5]**

(c) Differentiate between:

(i) Compact and Non-compact Section, (ii) Stiffened and Unstiffened Section **[4+4]**

Formula

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right] F_y \quad \text{For } \frac{KL}{r} \le 4.71\sqrt{\frac{E}{F_y}} \qquad F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$

$$F_{cr} = 0.877 F_e \qquad \text{For } \frac{KL}{r} > 4.71\sqrt{\frac{E}{F_y}} \qquad P_n = F_{cr} A_g$$

$$C_b = \frac{12.5 M_{max}}{2.5 M_{max} + 3M_A + 4M_B + 3M_C} R_m \le 3.0 \qquad L_p = 1.76 r_y \sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7F_y} \sqrt{\frac{Jc}{S_x h_o}} \sqrt{1 + \sqrt{1 + 6.76\left(\frac{0.7F_y S_x h_o}{E \quad Jc}\right)^2}}$$

$$M_n = C_b \left[M_p - (M_p - 0.7F_y S_x)\left(\frac{L_b - L_p}{L_r - L_p}\right)\right] \le M_p$$

$$M_n = M_p - (M_p - 0.7F_y S_x)\left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p}\right) \qquad F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}}\right)^2} \sqrt{1 + 0.078 \frac{Jc}{S_x h_o}\left(\frac{L_b}{r_{ts}}\right)^2}$$

$$k_c = \frac{4}{\sqrt{h/t_w}}, \text{ where } 0.35 \le k_c \le 0.763 \qquad M_n = F_{cr} S_x \le M_p$$

$$\lambda_r = 0.56\sqrt{\frac{E}{F_y}} \qquad \lambda_r = 1.49\sqrt{\frac{E}{F_y}} \qquad \lambda_{pf} = 0.38\sqrt{\frac{E}{F_y}} \qquad \lambda_{rf} = 1.0\sqrt{\frac{E}{F_y}}$$

$$f'_x = \frac{P_x}{A} \qquad f'_y = \frac{P_y}{A} \qquad M_n = \frac{0.9 E k_c S_x}{\lambda^2}$$

$$f''_x = \frac{Ty}{I_p} \qquad f''_y = \frac{Tx}{I_p}$$

Alignment chart

Sidesway prevented
(Braced frame)

Sidesway not prevented
(Unbraced frame)

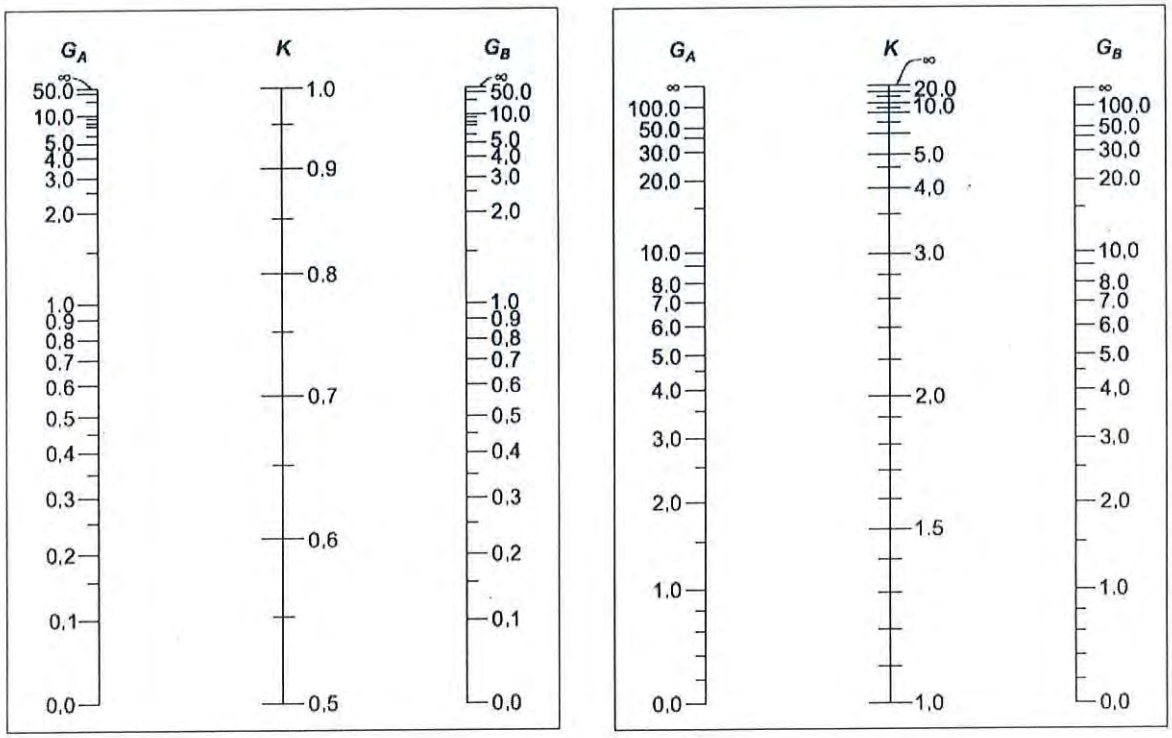

Table: Stiffness modification factors

Condition	Sidesway (unbraced)	No sidesway (braced)
Far end of beam hinged	0.5	1.5
Far end of beam fixed	0.667	2.0

Table: Minimum size of fillet welds

Material Thickness of Thinner Part Joined, in. (mm)	Minimum Size of Fillet Weld, [a] in. (mm)
To 1/4 (6) inclusive	1/8 (3)
Over 1/4 (6) to 1/2 (13)	3/16 (5)
Over 1/2 (13) to 3/4 (19)	1/4 (6)
Over 3/4 (19)	5/16 (8)