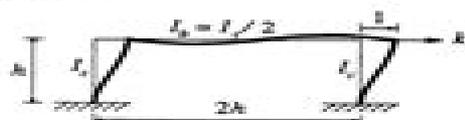


Problem 1.15



Define degrees of freedom (DOF):



Form structural stiffness matrix:

$$u_1 = 1, \quad u_2 = u_3 = 0$$



$$k_{11} = 2 \frac{12 EI_c}{h^3} = \frac{24 EI_c}{h^3}$$

$$k_{21} = k_{31} = \frac{6 EI_c}{h^2}$$

$$u_2 = 1, \quad u_1 = u_3 = 0$$



$$k_{22} = \frac{4 EI_c}{h} + \frac{4 EI_b}{(2h)} = \frac{4 EI_c}{h} + \frac{EI_c}{h} = \frac{5 EI_c}{h}$$

$$k_{32} = \frac{2 EI_b}{(2h)} = \frac{EI_c}{2h}$$

$$k_{12} = \frac{6 EI_c}{h^2}$$

$$u_3 = 1, \quad u_1 = u_2 = 0$$



$$k_{33} = \frac{4 EI_c}{h} + \frac{4 EI_b}{(2h)} = \frac{4 EI_c}{h} + \frac{EI_c}{h} = \frac{5 EI_c}{h}$$

$$k_{23} = \frac{2 EI_b}{(2h)} = \frac{EI_c}{2h}$$

$$k_{13} = \frac{6 EI_c}{h^2}$$

Hence

$$k = \frac{EI_c}{h^3} \begin{bmatrix} 24 & 6h & 6h \\ 6h & 5h^2 & \frac{1}{2}h^2 \\ 6h & \frac{1}{2}h^2 & 5h^2 \end{bmatrix}$$

The lateral stiffness k of the frame can be obtained by static condensation since there is no force acting on DOF 2 and 3:

$$\frac{EI_c}{h^3} \begin{bmatrix} 24 & 6h & 6h \\ 6h & 5h^2 & \frac{1}{2}h^2 \\ 6h & \frac{1}{2}h^2 & 5h^2 \end{bmatrix} \begin{Bmatrix} u_1 \\ u_2 \\ u_3 \end{Bmatrix} = \begin{Bmatrix} f_1 \\ 0 \\ 0 \end{Bmatrix}$$

First partition k as

$$k = \frac{EI_c}{h^3} \begin{bmatrix} 24 & 6h & 6h \\ 6h & 5h^2 & \frac{1}{2}h^2 \\ 6h & \frac{1}{2}h^2 & 5h^2 \end{bmatrix} = \begin{bmatrix} k_{11} & k_{12} \\ k_{12}^T & k_{00} \end{bmatrix}$$

where

$$k_{11} = \frac{EI_c}{h^3} [24]$$

$$k_{12} = \frac{EI_c}{h^3} [6h \quad 6h]$$

$$k_{00} = \frac{EI_c}{h^3} \begin{bmatrix} 5h^2 & \frac{1}{2}h^2 \\ \frac{1}{2}h^2 & 5h^2 \end{bmatrix}$$

Then compute the lateral stiffness k from

$$k = k_{11} - k_{12} k_{00}^{-1} k_{12}^T$$

Since

$$k_{00}^{-1} = \frac{4h}{99 EI_c} \begin{bmatrix} 5 & -\frac{1}{2} \\ -\frac{1}{2} & 5 \end{bmatrix}$$

we get

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Safety, Reliability, Risk and Life-Cycle Performance of Structures and Infrastructures George Deodatis, Bruce R. Ellingwood, Dan M. Frangopol, 2014-02-10 Safety Reliability Risk and Life Cycle Performance of Structures and Infrastructures contains the plenary lectures and papers presented at the 11th International Conference on STRUCTURAL SAFETY AND RELIABILITY ICOSSAR2013 New York NY USA 16 20 June 2013 This set of a book of abstracts and searchable full paper USB device is must have literature for researchers and practitioners involved with safety reliability risk and life cycle performance of structures and infrastructures

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Dynamic Analysis of Offshore Structures Colin L. Kirk, 1982 **Applied Mechanics Reviews**, 1975 *Advances in Analytical, Experimental, and Computational Technologies in Fluids, Structures, Transients, and Natural Hazards* K. Karim-Panahi, 1997 Forty two papers presented at the July 1997 conference discuss recent research in the development and application of advanced models and computational techniques to aid in the understanding of complex fluids and structures systems and natural hazards Topics include advances in FSI computational te Catalogs of Courses University of California, Berkeley, 1995 Includes general and summer catalogs issued between 1878 1879 and 1995 1997 *Seismic Engineering*, 2002 **Report**, 1985 **Ductile Design of Steel Structures, 2nd Edition** Michel Bruneau, Chia-Ming Uang, S.E. Rafael Sabelli, 2011-07-14 Comprehensive coverage of the background and design requirements for plastic and seismic design of steel structures Thoroughly revised throughout Ductile Design of Steel Structures Second Edition reflects

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