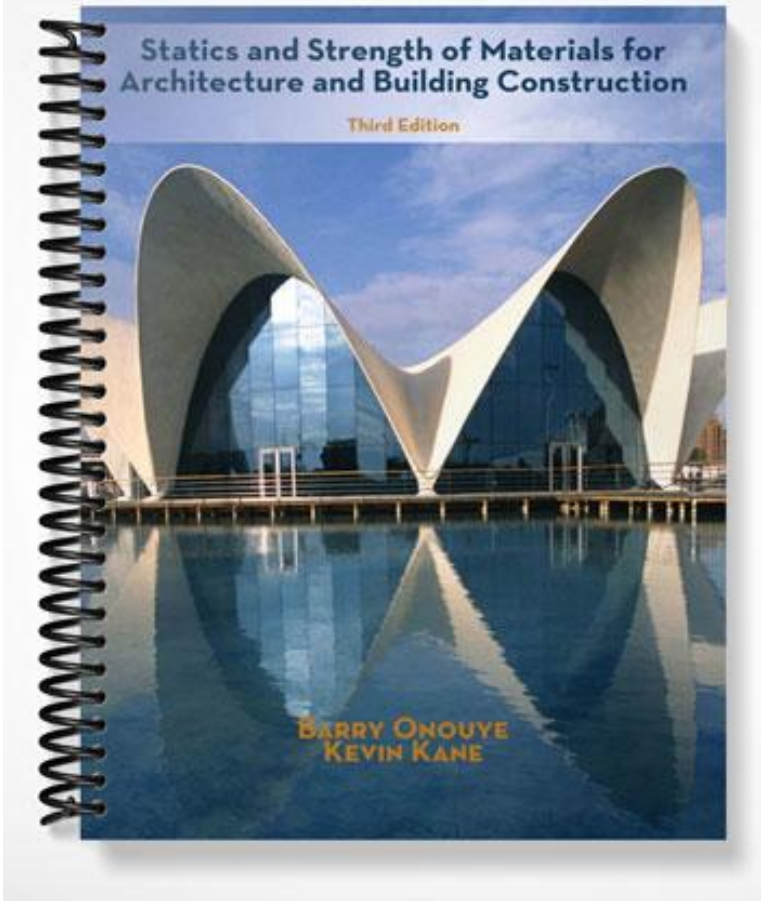
SOLUTIONS MANUAL



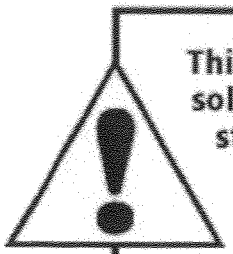
Instructor's Manual
to accompany

Statics and Strength of Materials for Architecture and Building Construction

Third Edition

Barry Onouye
Kevin Kane

Upper Saddle River, New Jersey
Columbus, Ohio



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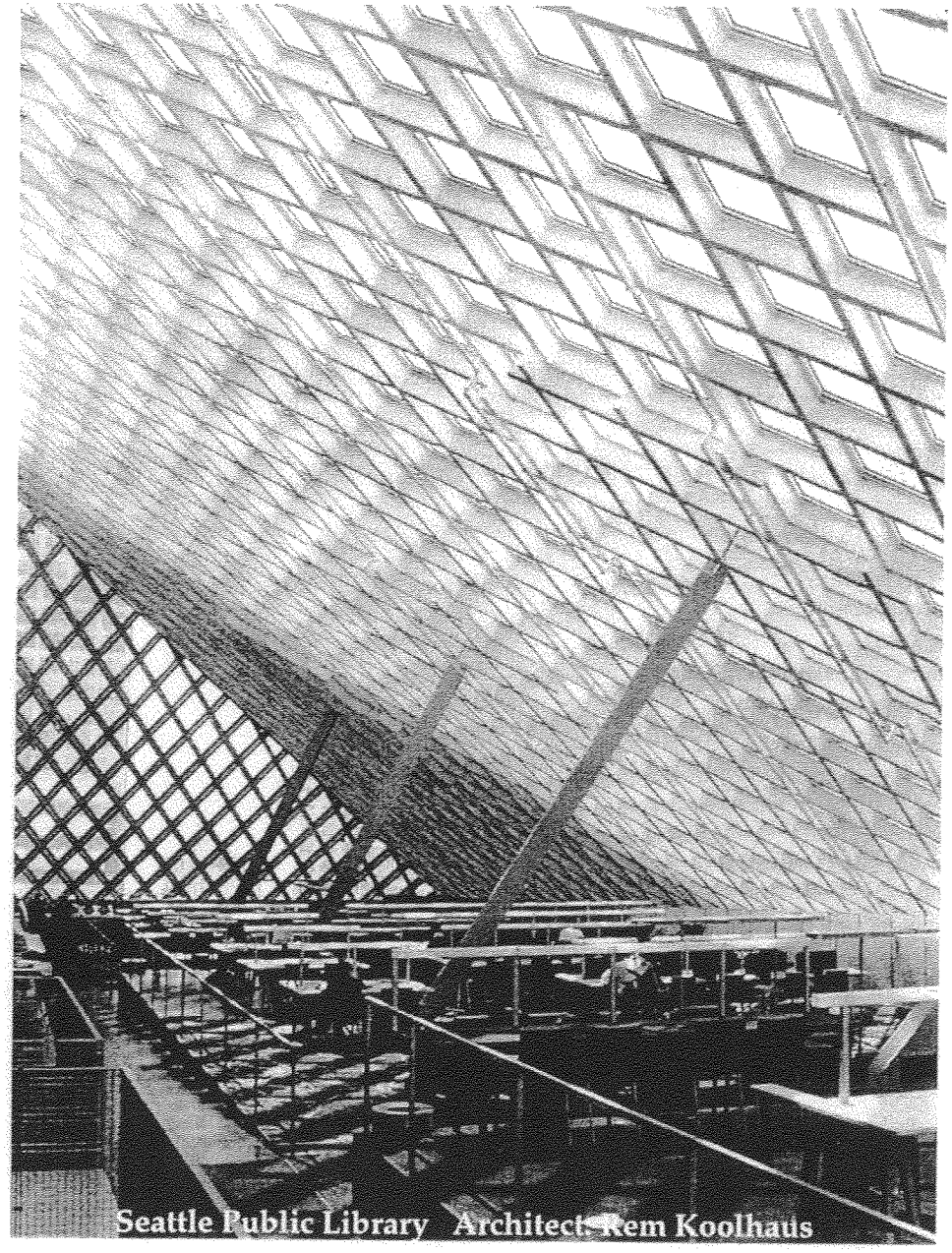
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Instructor's Manual *to Accompany*

Statics and Strength of Materials

For Architecture and Building Construction

Third Edition

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Preface

This *Instructor's Manual* to accompany *Statics and Strength of Materials for Architecture and Building Construction*, was initially developed as a study guide for students taking my beginning structures classes. All of the problems were developed in sufficient detail to allow students to use these problems as additional examples, paralleling the content covered in the text. In the 3rd edition of *Statics and Strength of Materials for Architecture and Building Construction*, a CD is provided with approximately 250 additional problems and solutions for practice.

Although all of the problems have been worked and reworked and scrutinized very closely by many of the students over the years, errors are still inevitable. Alternate interpretations of certain problems are also quite possible. If you discover discrepancies and/or errors, please bring them to my attention. I appreciate hearing from you so that I will be able to incorporate the corrections in future editions. My e-mail address is:
barryo@u.washington.edu.

I hope that you find this *Instructor's Manual* helpful and feel free to allow students access to these problem solutions.

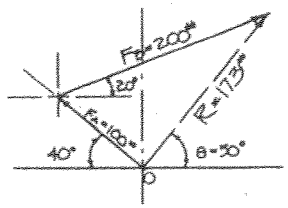
March 2006

Barry Onouye
University of Washington

Contents

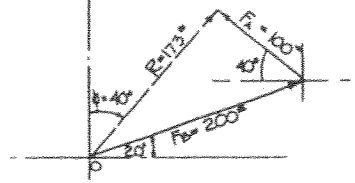
Solutions to Chapter Problems:

2.1

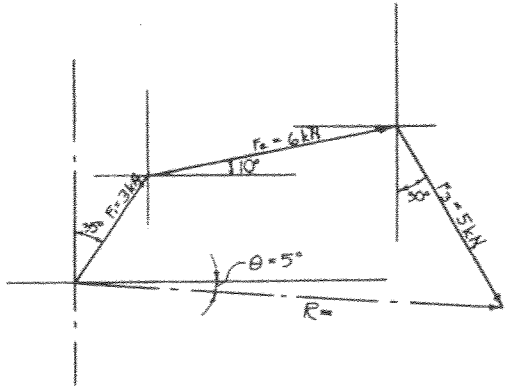


R = 173#
θ = 50° FROM HORIZ.
φ = 40° FROM VERT.

OR

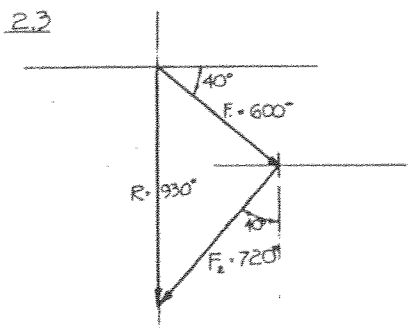


2.2



R = 10.2 kN
θ = 5°

2.3



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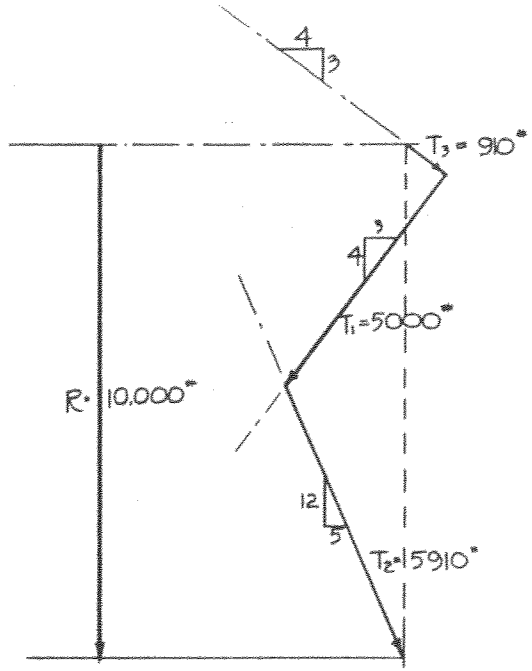

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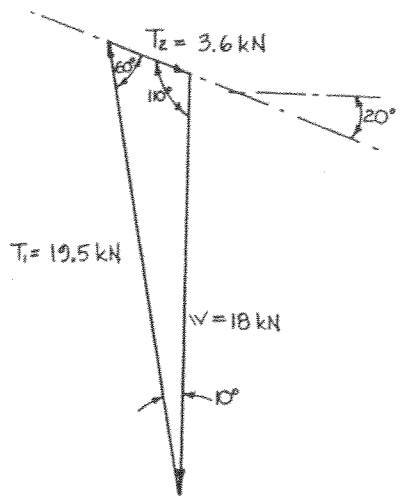

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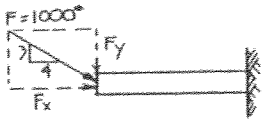
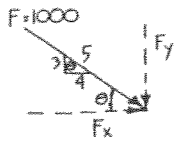


By SIMILAR TRIANGLES:

$\frac{F_x}{4} = \frac{F_y}{3} = \frac{F}{5}$

$\therefore F_x = \frac{4}{5}F = \frac{4}{5}(1000) = \underline{800^{\#}}$

$F_Y = \frac{3}{5}F = \frac{3}{5}(1000) = \underline{600^{\#}}$



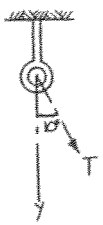
$\sin\theta = 3/5$

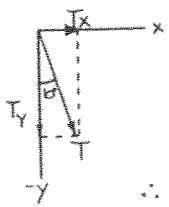
$\cos\theta = 4/5$

$\therefore F_x = F\cos\theta = (1000^{\#})(4/5) = \underline{800^{\#}}$

$F_Y = F\sin\theta = (1000^{\#})(3/5) = \underline{600^{\#}}$

2.7





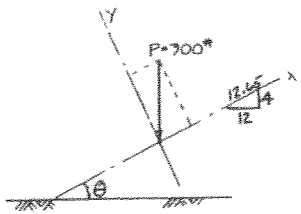
$T_x = T\sin 10°$

$T_Y = T\cos 10°$

$\therefore T = \frac{T_Y}{\cos 10°}$

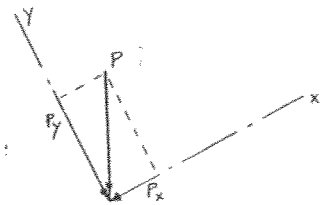
$T = \frac{250N}{.985} = \underline{254N}$

2.8



$\theta = \tan^{-1}\left(\frac{4}{12}\right) = 18.43°$

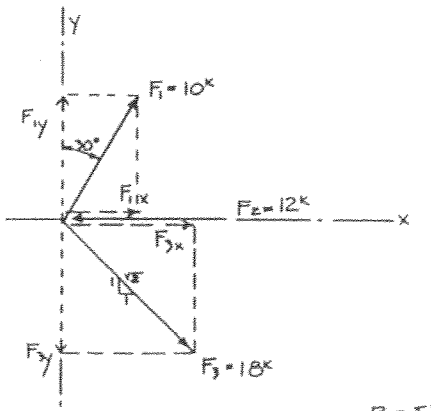
2.8



$P_x = P\left(\frac{4}{12.65}\right) = 300^{\#}(.316 = \underline{94.9^{\#}}$

$P_y = P\left(\frac{12}{12.65}\right) = 300^{\#}(.949) = \underline{285^{\#}}$

2.9



$F_{1Y} = +F_1\cos 30° = 10^K(.866) = 8.66^K$

$F_{1x} = +F_1\sin 30° = 10^K(.5) = 5^K$

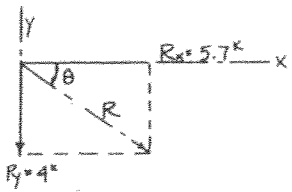
$F_2 = -F_{2x} = -12^K$

$F_{3x} = +\frac{1}{\sqrt{2}}F_3 = +\frac{18^K}{\sqrt{2}}$

$F_{3y} = -\frac{1}{\sqrt{2}}F_3 = \frac{-18^K}{\sqrt{2}}$

$R_x = \Sigma F_x = +5.0^K - 12^K + \frac{18^K}{\sqrt{2}} = +5.7^K$

$R_Y = \Sigma F_Y = +8.66^K - \frac{18^K}{\sqrt{2}} = -4^K$

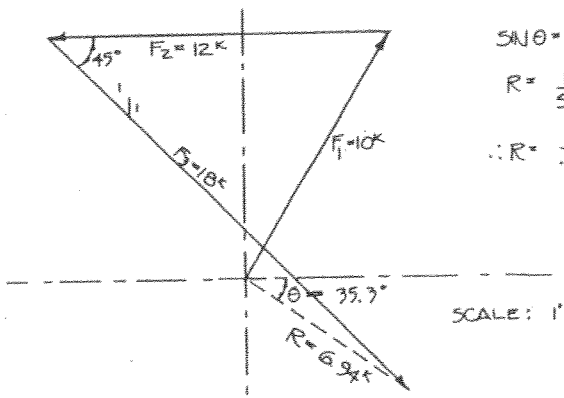


$\tan\theta = \frac{R_y}{R_x} = \frac{4}{5.7} = .702$

$\theta = \tan^{-1}(.702)$

$\therefore \theta = 35.1°$ FROM HORIZ.

2.9



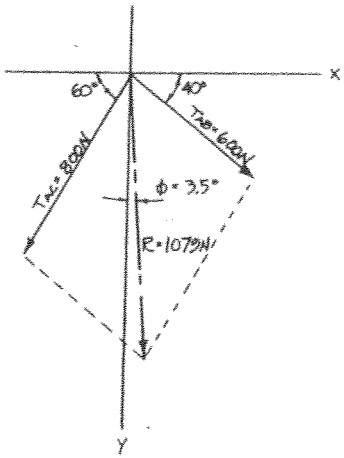
SCALE: $1" = 4^K$

$\sin\theta = \frac{R_y}{R}$

$R = \frac{R_x}{\sin\theta}$

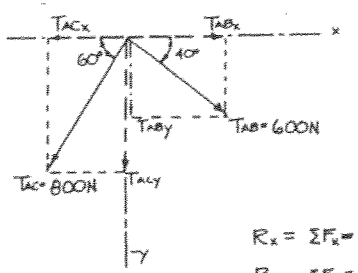
$\therefore R = \frac{4^K}{.577} = \underline{6.94^K}$

2.10



SCALE: $1mm = 10N$

2.10



$-T_{ACx} = -T_{AC}\cos 60° = -.5T_{AC}$

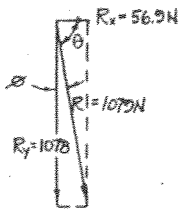
$-T_{ACy} = -T_{AC}\sin 60° = -.866T_{AC}$

$+T_{ABx} = +T_{AB}\cos 40° = +.766T_{AB}$

$-T_{ABy} = -T_{AB}\sin 40° = -.642T_{AB}$

$R_x = \Sigma F_x = -.5(800N) + .766(600N) = 56.9N$

$R_y = \Sigma F_y = -.866(800N) - .642(600N) = -1078N$

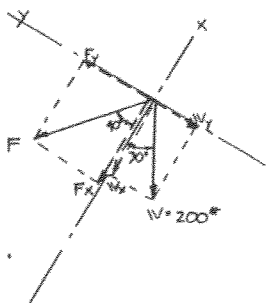


$\theta = \tan^{-1}\left(\frac{1078}{56.9}\right) = \tan^{-1}(18.1) = 86.8°$

$\phi = \tan^{-1}\left(\frac{59.6}{1078}\right) = \tan^{-1}(.056) = 3.2°$

$R = \sqrt{59.6^2 + 1078^2} = 1079\ N.$

2.11



ROTATE AXIS SO THAT THE RESULTANT THRU THE BOOM AXIS LIES ON THE X-AXIS.
THEN, $R_y = \Sigma F_y = 0$

$-W_x = -W\cos 30° = -.866W$

$-W_y = -W\sin 30° = -.5W$

$-F_x = -F\cos 40° = -.766F$

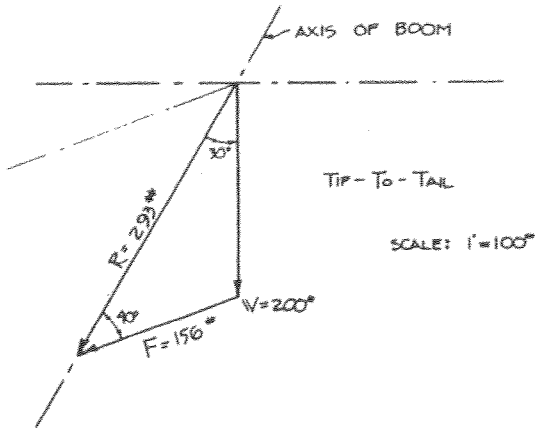
$+F_y = +F\sin 40° = +.642F$

$R_y = \Sigma F_y = 0 \qquad -.5(200^{\#}) + .642F = 0$

SOLVE FOR F; $\qquad F = \frac{100^{\#}}{.642} = \underline{156^{\#}}$

$R = R_x = \Sigma F_x = -.866(200^{\#}) - .766(156^{\#}) = -173^{\#} - 120^{\#} = \underline{-293^{\#}}$

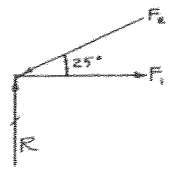
2.11



TIP - TO - TAIL

SCALE: 1" = 100#

2.12



$-F_{2x} = -F_2 \cos 25°$

$-F_{2y} = -F_2 \sin 25°$

SINCE THE RESULTANT MUST BE VERTICAL, THEN: $R_x = \Sigma F_x = 0$

$-F_{2x} + F_1 = 0$

$\therefore \quad F_2 \cos 25° = F_1$

FROM THIS EQUATION, IT IS SEEN THAT F_1 IS ONLY A FRACTION OF F_2, THEREFORE, $F_2 = 7\,kN$

THEN; $F_1 = F_2 \cos 25° = 7\,kN\ (.906)$

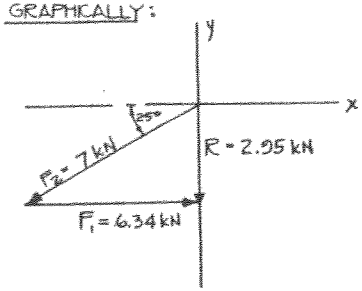
$F_1 = 6.34\,kN$

$F_2 = 7\,kN$

$R = F_{2y} = 7\,kN\ (\sin 25°)$

$R = 7\,kN\,(.422) = 2.95\,kN$

GRAPHICALLY:



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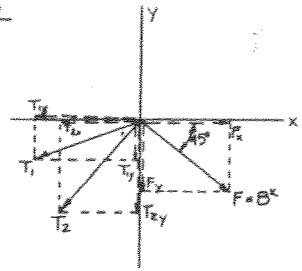


$-T_{1x} = -T_1 \cos 30° = -.866T_1$

$-T_{1y} = -T_1 \sin 30° = -.5T_1$

$-T_{2x} = -T_2 \cos 60° = -.5T_2$

$-T_{2y} = -T_2 \sin 60° = -.866T_2$

$+F_x = +F \cos 45° = +.707(8) = +5.65^K$

$-F_y = -F \sin 45° = -.707(8) = -5.65^K$

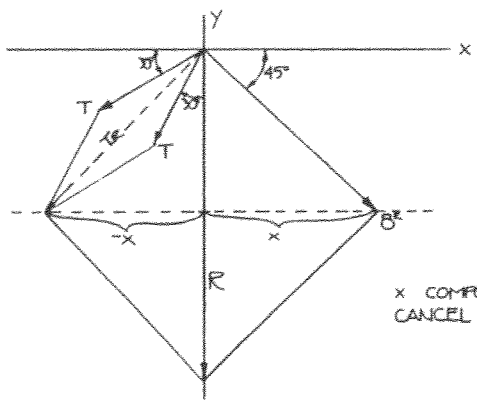
BUT $T_1 = T_2$

FOR RESULTANT TO BE VERTICAL, $R_x = \Sigma F_x = 0$

$\therefore \quad -.866T - .5T + 5.65^K = 0$

SOLVING FOR T; $\underline{T = 4.14^K}$

$R = R_y = \Sigma F_y = -.5(4.14^K) - .866(4.14^K) - 5.65^K = \underline{-11.3^K}$



x COMPONENTS MUST CANCEL SO THAT $R_x = 0$

USING PARALLELOGRAM LAW