Umass Amherst
Adaptive Use Bridge Project
Sample assignment for instructors #1

This assignment has been designed for a junior level structural analysis course.
A solution to part b is available on page 2.

The Adaptive Use Bridge Project is an ongoing effort being conducted at the University of Massachusetts Amherst (UMass) to adapt historic trusses for use as pedestrian bridges on campus. The Southern Vermont (1906) Bridge has already been reconstructed near the McGuirk Football Stadium on the edge of campus. Use the resources available on the Adaptive Use Bridge Project website to answer the following questions:

(a) How would you idealize this bridge for analysis? What kinds of loads act on the bridge? What material is the bridge made of? What are the boundary conditions?

(b) Consult the drawings of the bridge available on the Adaptive Use Bridge Project website. Calculate the element stiffness matrix in global coordinates of the element connecting nodes U2 and L1. You must calculate the cross sectional area and length of the elements from the drawings provided.

- Assume the bridge is made of steel with E = 29,000 ksi.
- Assume that the direction of the element is from L1 towards U2. Place the global original at node L0. Orientate your coordinate system with x positive traveling to the right and y positive traveling upwards (relative to the drawings on this website).

The following web site links may be helpful:

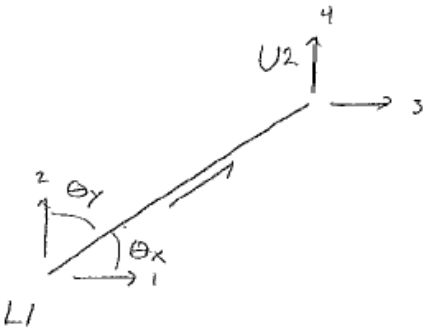
- The Adaptive Use Bridge Project homepage:
  http://www.ecs.umass.edu/adaptive_bridge_use/index.html

- The Southern Vermont (1906) Bridge webpage:
  http://www.ecs.umass.edu/adaptive_bridge_use/bridge_files/sVermont1906Bridge/sVermont1906Bridge.html

  This bridge's webpage can also be accessed by clicking on "**data**" then "**Southern Vermont (1906) Bridge**" from the project's **homepage**.

Solution to part b:

b)



$\theta_x = 36.9$
$\theta_y = 53.1$

$\lambda_x = 0.8$
$\lambda_y = 0.6$

$E = 29\,000$ ksi
$L = 100$ in

call L1 Near
U2 Far

note: Assume element length from center of joints

from drawings,

$$A = 2\left[(2)(.25) + (2.25)(.25)\right] = 2.125 \text{ in}^2$$

$$K = \frac{(29000)(2.125)}{100} \begin{bmatrix} 1 & 2 & 3 & 4 \\ .64 & .48 & -.64 & -.48 \\ & .36 & -.48 & -.36 \\ & & .64 & .48 \\ & & & .36 \end{bmatrix} \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix}$$

$$K = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 87.4 & 65.5 & -.64 & -.48 \\ & 49.1 & -.48 & -.36 \\ & & .64 & .48 \\ & & & .36 \end{bmatrix} \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix}$$