March 27, 2019

To: ME 4300 Students, Winter 2019

From: M.A. Latcha, PhD

Re: Design project – Report due April 24, 2019

Background

A new concept for outdoor billboards is suggested where display signs are printed on 0.040" thick polymer sheets, 48 feet wide and 15 feet high, each weighing 20-lb. Twenty of these signs are joined together to make a sheet 45 feet wide and 300 feet long, with a total weight of 400-lb. The signs are initially spooled around a lower tube. Once per minute the tubes rotate and move the next sign up to the viewing position, in 1 second or less. At the end of each 15-min period, the signs are all rapidly moved back to the lower tube and the cycle repeats.



Challenge

The upper and lower tubes are essentially 48-ft long tubular-section beams. Because of the nature of the sign material, the smallest outside diameter for the tubes is 6". Any external supports along the length of the tubes would touch and damage the sign material. The sign material is not particularly flexible in shear, so the tubes must not deflect more than about 2" in order to not wrinkle the signs. Therefore, the tube supports can only be inside or at the ends of the tubes. In addition, the angle of the tubes at the ends must be small in order to provide for easy rotation.

Design problem

Design and present a support system for the tubular rollers that (1) allow no more than 1" of deflection across the 40-ft span of each roller, (2) adjusts for the weight of the signs on the roller, and (3) never touches the sign material. Specify all aspects of your design - sizes of all components, construction details, etc. For systems that include motors and/or computer control, specifications for the motors and control flowcharts are also required. Include an estimate of the cost of your system.