Economizing Materials on a Pratt Truss Bridge

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The United States Military Academy (USMA) released a design to the public for a Pratt truss bridge made from file folders. The purpose of this project was to modify that original design so as to use less material while supporting a similar load. Ten bridges of the USMA design were weighed and tested for load-bearing capacity. The point of failure was the end post tube components, so no attempt was made to lighten the end post tubes. 15.24cm lengths of tube components were individually tested by applying a compressive force. Ten each of the following square cross-section tubes were tested: 10mm2, 9 mm2, 8 mm2, 7 mm2, 6 mm2 and 5 mm2. For rectangular cross-section tubes, ten each of the following tube components were tested; 10mm x 6mm, 9mm x 6mm and 8mm x 6mm. Bar components were tested by applying tension. All bars tested were 30cm in length. Twenty each of the following bar widths were tested: 4mm, 3.5mm, 3mm, 2mm and 1mm. Based upon the results of these trials, two new bridges were constructed using 8mm2 top chord tubes, 5mm2 top strut tubes, and 8mm x 6mm vertical tubes. Both bridges used 3.5mm width bar components throughout except one bridge retained the original 4mm bottom chords. Both new bridges were lighter than the original design. The new bridge with 4mm bottom chords out-performed the bridge with 3.5mm bottom chords. The load-bearing capacity of both new bridges fell within the range of capacities observed for the ten original bridges.

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