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Gravity's Effect on Non-uniform Suspended Chains

The curve for a uniform chain, which is known, is represented by the catenary equation, $y = A/2 * e^{(x/A)} + e^{(-x/A)}$. The equation of the curve for non-uniform chains is not known. The goal of this project is to find the equation of the curve for non-uniform chains. Solving for this unknown curve was done by hanging uniformly and non-uniformly weighted chains in order to record the curve of each chain. A picture of each was inserted into the Logger Pro Video Analysis program to be fitted by a best fit curve. Each chain was fitted for the catenary equation and a modified version of the catenary equation, $y = A/2 * e^{(x/E)}$. The coefficients of A and E were given for the modified catenary when fitted. The relationship between the coefficients and the amount of change in mass for the non-uniform chains is desired.

The non-uniform chains showed a different curve than the uniform chains when suspended. The modified catenary fit the non-uniform chains much closer than the original catenary. It also fit the uniform chains slightly closer. The relation between the coefficients from the modified catenary and the amount of change in mass for the non-uniform chains was found. By knowing the span, length of chain, the magnitude and direction of change in mass for a non-uniform chain, the curve for that specific chain can be calculated. With the modified catenary, engineers can know the height of a suspended tapered cable at any point to avoid any obstacles.