Abstract

The objective of this experiment was to determine theoretically and numerically the large deflection of cantilever beams that are point loaded such that at all times the direction of the load is perpendicular to curvature of the beam at the point of application of load. The experimental data and the methodology used in this analysis was obtained from a previous project, M.F.O 04/2012.

The theoretical equation for large deflection of cantilever beam was derived according to the theory proposed by Professor M.F. Oduori. The equation states;

\[ 218\sin41\tan m \equiv \text{EIPXY} \]

Also, the theoretical equation of the angle of deflection was obtained as;

\[ \phi \equiv \text{mXY1tan2} \]

The experimental deflection together with the experimental angle of deflection used in this analysis were obtained from M.F.O 04/2012. (A previous project on large deflection of beams).

Numerical integration analysis was also performed for the same beam and the results obtained for the deflection and the angle of deflection compared with those obtained theoretically and experimentally. When the experimental values of deflection are compared with the theoretical values of deflection it is observed that the percentage deviation increases linearly to a maximum value of 8.18790677% and then decreases to -2.7412751% (the negative indicates that experimental value was higher than the theoretical value but the magnitude of percentage deviation remains 2.7412751%). The percentage deviation of the analytical deflection from the theoretical deflection is nearly a constant value of 1%.

This small percentage deviation is a contribution of the fact that numerical integration does not give precise results. The accuracy could be increased by dividing the beam into infinitesimally small units. The percentage deviation of the analytical angle of deflection compared with the theoretical angle of deflection was observed to increase gradually from a minimum of 0.8234269% to a maximum value of 14.28645890%. The percentage deviation of experimental angle of deflection compared with the theoretical angle of deflection was approximately 2%.

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The experimental sources of error are not clear because the results used in this analysis were obtained from a previously carried out experiment but the following might have caused the slight deviation in the results.

i. The error in experimental values might have been caused by sensitivity of the deflection indicators to any slight vibration (which is a possibility due to the presence of wind tunnel next to the testing apparatus).

ii. The indicators currently on the apparatus do not give direct reading of the deflection and they require a lot of mental math on the fly to determine the actual value of deflection.

iii. The slight deviations of the analytical deflection results from the theoretical values could have arose from rounding off of the values obtained analytically.

From the analysis it is seen that the percentage deviations of the experimental deflections from theoretical deflections was small and the percentage deviations of the analytical deflections from the theoretical deflections was even smaller and hence with the experimental errors corrected all the results would be the same and hence the validity of theoretical equation proposed by professor M.F.Oduori.

Improvements to this experiment are in order. One such improvement would be to use digital deflection indicators.