STRESS – STRAIN RELATIONS FOR STEEL FIBRE REINFORCED CONCRETE BEAMS IN SHEAR

By:

NYOMBOI TIMOTHY

B.Tech (Hons) Eng, Grad. Eng.

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF MOI UNIVERSTY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE IN STRUCTURAL ENGINEERING

ABSTRACT

Fibre reinforced concrete is a relatively new construction material, with increasing application by the construction industry worldwide. Steel fibres have been found to offer significant increase in the shear strength of plain concrete. Recent research has shown that steel fibre reinforced concrete beams exhibit ultimate shear strengths of the same order as those obtained from conventionally reinforced beams (with stirrups) even at a fibre volume of 0.25%. This can be quite advantageous when used in structural members such as ring, lintel, and foundation beams because problems associated with fabrication and placement of conventional steel stirrups, labour and overall costs can be reduced. However, the limiting factor in the use of this material for the purpose discussed above is the lack of design guidelines that can be used in the design for shear in the structural members utilising the material. As a contribution to the development of design guidelines, evolution of the shear stress - strain behaviour in steel fibre reinforced concrete beams was investigated and linear limit and ultimate strengths were determined.

Seventeen beams with varying shear span to depth ratio and steel fibre content were tested in three point bending while monitoring the load and the strains at selected points. The beams were reinforced in bending using steel bars with steel fibres as the shear reinforcements. Twelve cylinders with same fibre content as that of the beams were tested in compression while monitoring the load and strains (horizontal and vertical).

Theoretical predictions of the non-linear behaviour based on a modification of hooke's model in which a strain dependent factor is introduced and a more advanced model based on the Imam et.al [23] were made and the two models could describe the

experimental results satisfactorily. The prediction of the non-linear behaviour of the shear stress strain – strain was quite good from the two models particularly for the 0.5% steel fibre content. It was established that the linear limit is about 67% of the ultimate shear strength on average.

The design application of the two proposed models with steel fibres as shear reinforcements and the classical design method of using shear links was made based on a practical design situation of ring/lintel beam. With the worst condition of loading on the design beam chosen, it was established that the shear stress that arise in lintel / ring are not so high to warrant the use of shear links and could be replaced by steel fibres with use of the proposed models for design.