

# **Risk of Shear Failure in RC Beams Strengthened in Flexure via External Prestressing**

*Timber Ng Chee Khoo*  
**\*Chee Khoo Ng<sup>1)</sup> and Joanne W.J. Wong<sup>2)</sup>**

<sup>1),2)</sup>*Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia*

<sup>1)</sup>*ckng@feng.unimas.my*

## **ABSTRACT**

This paper describes a study on the shear deficiency in RC beams strengthened in flexure via external prestressing. The provision of external prestressing in general leads to strengthening in both flexure and shear. The percentage increase in flexural strength is however not necessary the same as that in shear. A total of nine simply-supported beams subjected to third-point loading were theoretically evaluated in this study. The parameters varied in this evaluation are concrete strength, amount of shear reinforcement, amount of internal longitudinal reinforcement and beam span. The pseudo-section analysis based on bond reduction coefficient was used in the evaluation of flexural strength of the strengthened beam, and the evaluation of flexural strength of the unstrengthened beam was based on a simple section analysis. The shear strength for the strengthened beam was calculated using a strut-and-tie model, whereas the shear strength of the unstrengthened beam was calculated based on ACI Building Code. It was found that the flexural strengthening ratio is higher than the shear strengthening ratio in general. Therefore, there is a risk of shear failure becoming more likely to happen at ultimate for the strengthened beams. For an extreme case, the mode of failure may change from flexure for the unstrengthened beam to shear for the strengthened beam.

## **INTRODUCTION**

External prestressing refers to a post-tensioning method in which the tendons are placed on the outside of a structural element. It may be efficiently utilized in the construction of segmental box-girder bridges as well as in the strengthening of existing concrete beams (Naaman and Breen 1990,

---

1) Associate Professor  
2) Postgraduate Student