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Definition of Link Rotation Angle for Application in Eccentrically Braced Frames

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ABSTRACT

Eccentrically Braced Frames (EBF) utilizes the advantages of the Moment Resisting Frames and Concentrically Braced Frames to provide a large elastic lateral stiffness and stability while maintaining controlled ductile deformation, resulting in a large amount of energy dissipation. Shear links, which have been commonly used as structural fuses in the EBF design, experience inelastic rotation while other components of the EBF remain elastic. The link rotation angle is generally used to describe inelastic deformation of a shear link. The AISC Seismic Provisions define the link rotation angle as the plastic rotation angle between the link and the beam outside of the link, which can be computed from the relative transverse displacements at two ends of the link. But researchers in cyclic testing do not necessarily use a consistent method to compute the link rotation capacity. Similarly, the procedure used by the designer to compute the link rotation demand in a performance-based seismic design may not be consistent to that used to report the link rotation capacity. This paper investigates the appropriate definition of link rotation angle for use in both testing and nonlinear analysis.

1. INTRODUCTION

Fig. 1(a) shows the expected yield mechanism of one EBF bay, where points *A* and *D* represent the inflection points of the beams outside the link. The AISC total link rotation (γ_{total}) includes both elastic and inelastic components of the deformations of the link and the beams outside the link (AISC 2005). The free-body of the link is shown in Fig. 1(b). For testing purpose, a rigid-body rotation of the deformed configuration can be made such that the ends of the link (points *B* and *C*) are always in the horizontal position. Therefore, the target deformation configuration can be reproduced by loading

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at the inflection points *A* and *D* vertically with an equal but opposite displacement. Fig. 1(c) shows the total displacement (δ_{total}) to be imposed to each end of the beam, where,

$$\delta_{total} = l_b \gamma_{total} \tag{1}$$

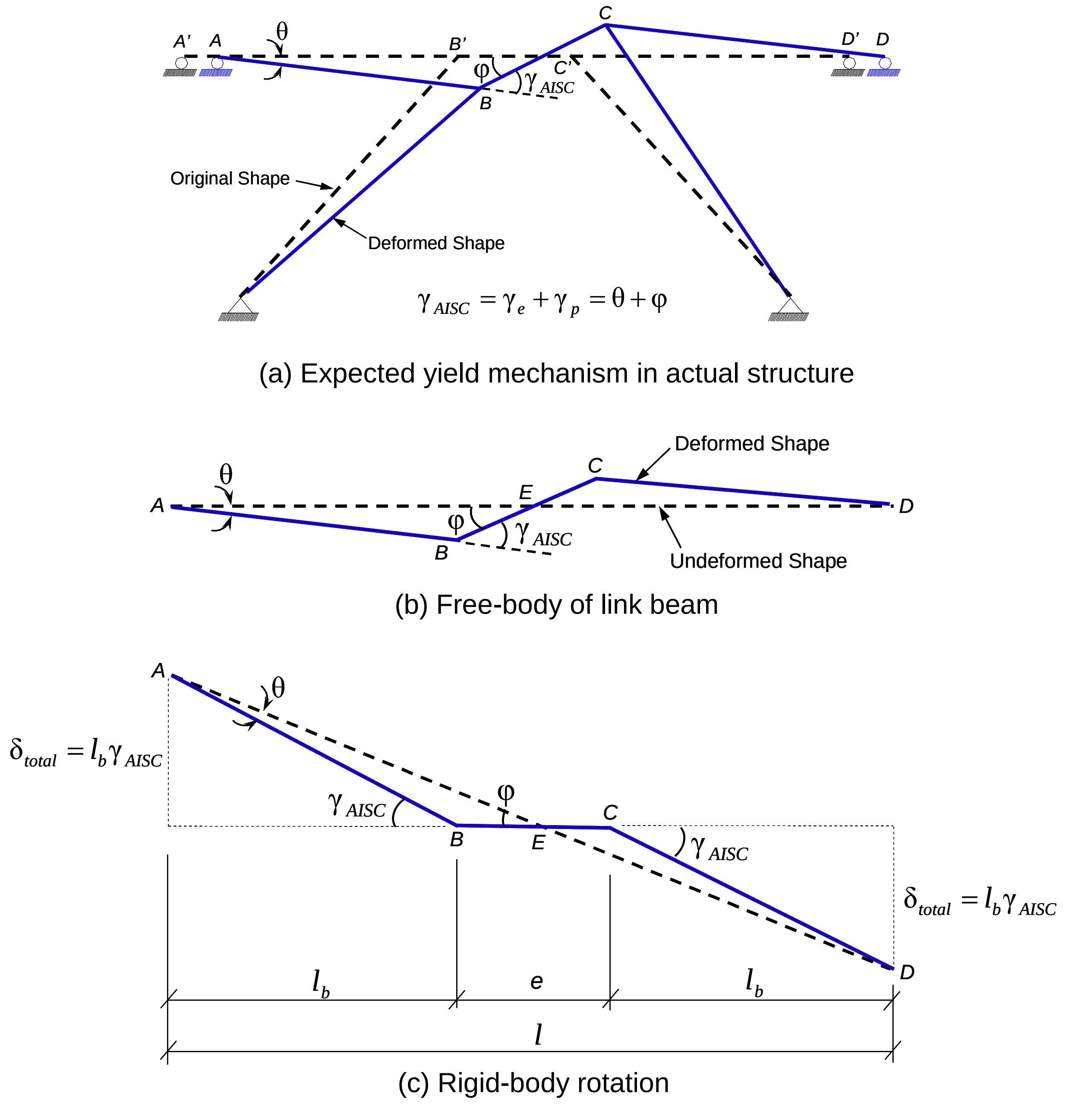

Fig. 1 Actual and test yield mechanism