*The Hashemite University*
*Civil Engineering Department*

# *Investigation of Shear Link Performance on D-Braced EBF System*

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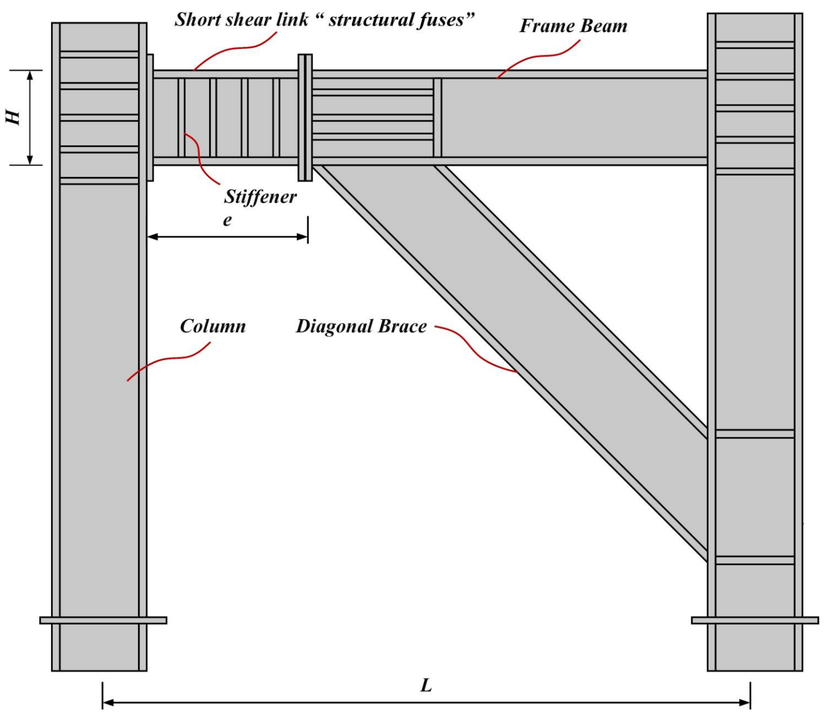
## 1.Introduction

Eccentrically braced frames (EBFs) combine high ductility, stiffness, and strength. Energy dissipation occurs via yielding in a designated beam segment called the "link," while other frame elements like outer beam segments, braces, and columns largely remain in an elastic state. [1] Eccentrically braced frames (EBFs) have emerged as effective seismic load resisting systems, fulfilling stiffness and ductility requirements in modern building codes. [2] Originating in Japan during the 1970s, EBFs offer substantial lateral stiffness and excel in dissipating energy through yielding of links, which play a crucial role in energy dissipation during severe earthquakes. [3] In the realm of eccentrically braced frames (EBF), intentional gaps are introduced between bracing elements, columns, and beams. These gaps, known as "links," strategically weaken sections of the frame to absorb seismic forces through plastic deformation. This allows the frame to effectively dissipate the energy generated by seismic events. [2]




## 2.Objectives

1- Investigate the current practice of the AISC 341 for designing D-Braced EBF frames. A comprehensive investigation to the available experimental results in the literatures shall be performed.

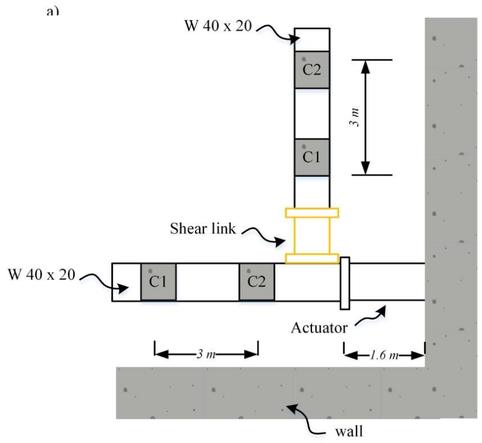
2- Investigate the critical factors that hinder the D-Braced EBF frames from achieving specified required drift ductility by AISC 341.

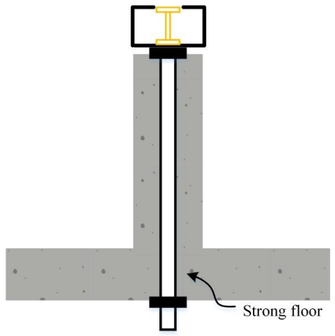
3- Conduct experimental tests to investigate the performance of D-Braced EBF frames for various link detailing.

4- Recommend a potential design practice for designing D-Braced EBF frames.

## 3.Experimental Program

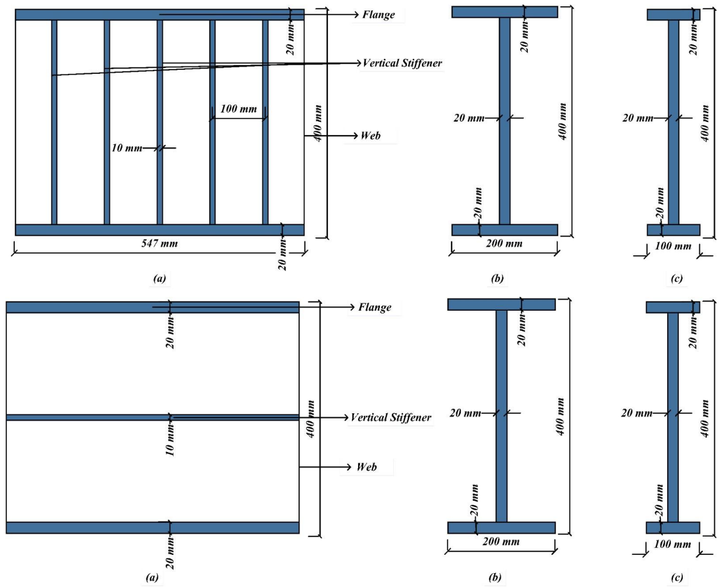
The experimental program is expected to consist of testing four short links that are part of the D-Braced EBF. Figure 2a shows the top view of the test setup, where the actuator that is attached to the strong wall will be used to create cyclic loading in the specimen. The setup includes a shear link that is attached to a horizontal member (which represents the column in a D-braced EBF, as shown in Figure 1) and a vertical member (which represents the beam in a D-braced EBF, as shown in Figure 1). The supports C1 and C2 in both members are to prevent the out-of-plane movement of the setup; a typical detailing of these supports is shown in Figure 2b. The supports represent sliders that are expected to allow the setup to move along the beam (or column) neutral axis but prevent the movement in the other directions. Because the setup is about 2 m above the strong floor level, they will rest on a concrete block (column) and be tightened to the strong floor using suitable number of bolts.




The experimental program consists of four specimens. The detailing variables are the stiffeners configuration (vertical or horizontal) and the flange width (100 mm or 200 mm). Figures 3-4 and Table 1 illustrate the detailing and configuration of the specimens. Shear link length (e) is calculated as follows:

$$e = 1.2\ Mp/Vp$$




| *Specimen Designation* | *Stiffener Direction* | *Flange Width (mm)* | *Flange Thickness (mm)* | *Shear Link Length (mm)* |
|---|---|---|---|---|
| ***VSL100*** | ***Vertical*** | ***100*** | ***20*** | ***356*** |
| ***VSL200*** | ***Vertical*** | ***200*** | ***20*** | ***547*** |
| ***HSL100*** | ***Horizontal*** | ***100*** | ***20*** | ***356*** |
| ***HSL200*** | ***Horizontal*** | ***200*** | ***20*** | ***547*** |

## 4.References

[1] Musmar, M. A. (2012). Effect of link on eccentrically braced frames. *JES. Journal of Engineering Sciences*, *40*(1), 35–43. https://doi.org/10.21608/jesaun.2012.112712

[2] Okazaki, T., Engelhardt, M. D., Drolias, A., Schell, E., Hong, J.-K., & Uang, C.-M. (2009). Experimental investigation of link-to-column connections in eccentrically braced frames. *Journal of Constructional Steel Research*, *65*(7), 1401–1412. https://doi.org/10.1016/j.jcsr.2009.02.003

[3] Li, H., Zhang, W., & Wei, Q. (2022). Seismic demand assessment on K-configuration eccentrically braced frames. *Structures*, *45*, 1225–1238.

## 5. Acknowledgements

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