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INTRODUCING AN İNNOVATIVE CONNECTION WITH TUBULAR FLANGE SECTION

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After the Northridge earthquake, numerous steel MRF buildings had considerable damage between the beam flange and the column face because of brittle behavior of welded joints. In order to solve this problem, many different techniques have been proposed and investigated in earlier studies. These studies are based on reduction of ductility demand and strain concentration at the welded regions. To reach this goal, two solutions have proposed by researchers:

1) Strengthening the connection by using stiffeners and stronger welds.
2) Weakening the cross-sectional area of the beam in the vicinity of the connection.

Consequently, some new strategies, such as strengthening the beam at the column face by adding a haunch (Yu et al., 2000), using side plates (Chou et al., 2009; Shiravand et al., 2010), utilizing external T-stiffeners (Kang et al., 2001; Ghobadi al., 2009), weakening the beam section by trimming the beam flanges (Chen, 1996), weakening the beam section by drilling the beam flanges (Tahamouliroudsari, 2018) and perforating the beam web (Momenzadeh, 2017) were proposed and evaluated under cyclic loadings. One of the primary and useful manners to decline the stress concentration at this zone is using reduced beam section (RBS).

In this paper, an innovative RBS connection named Tubular Flange Section (TFS) connection is introduced and assessed numerically using ABAQUS finite element software. TFS connection is composed by replacing a part of beam flange with a tube at the expected location of the beam plastic hinge. The mechanical properties of steel material, section properties of members and geometry of model is illustrated in Table 1 and 2 and Figure 1, respectively.

Table 1. Mechanical properties of materials.

Material type	Elasticity modulus (GPa)	Yield stress (MPa)	Ultimate stress (MPa)	Elongation (%)
ST37	210	240	370	20

Table 2. Section properties of members (units in mm).

Beam				Column				Tube		Continuity plate		Stiffener	
IPE 240				IPB 300									
b_f	t_f	h_w	t_w	b_f	t_f	h_w	t_w	D	t	B	W	B	W
120	9.8	240	6.2	300	19	300	11	114.3	8	262	114.5	127.5	60

h_w: Depth of section
b_f: Width of flange
t_f: Thickness of flange
t_w: Thickness of web

D: Diameter of tube
t: Thickness of tube

B: Length of plate
W: Width of plate

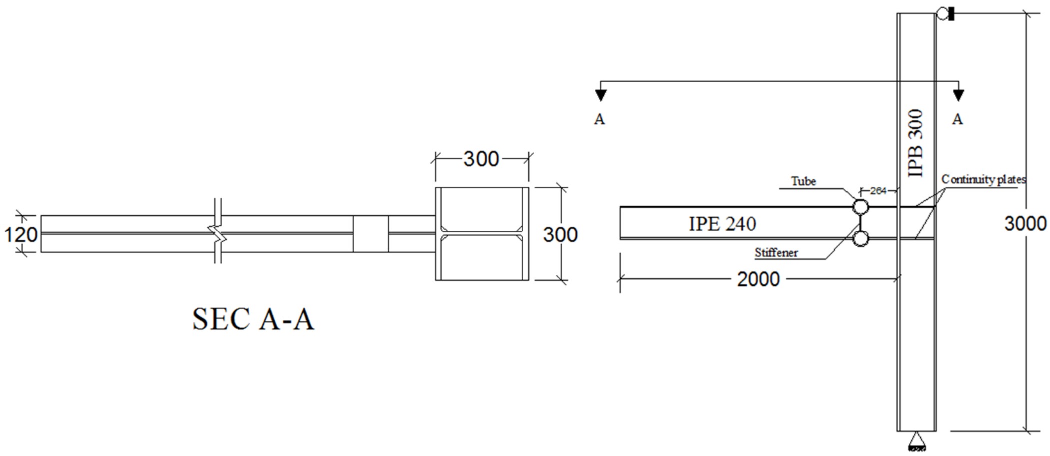

Figure 1. Geometry of TFS model (units in mm).

As shown in the figure, in a limited zone near the column face, a specified part of the beam flanges and web is replaced by a steel tube. To assess cyclic behavior of model, the cyclic load, based on loading protocol provided in FEMA-350, was applied at the tip of the beam.

The results indicate that the TFS connection exhibits stable hysteresis behavior. Besides, due to the presence of the tube, TFS can effectively concentrate the plastic strains within the reduced region and result in substantial reduction in the developed strain demands near the critical CJP welds. Furthermore, strength degradation does not occur up to 4% story drift ratio. Therefore, the TFS connection can successfully satisfy AISC seismic provisions (2016) and FEMA (2000) acceptance criteria.

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