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IMPROVING PLASTIC THEORY BASED FORMULA FOR ULTIMATE STERNGTHS OF INFILLED FRAMES

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Infills are panels constructed in the structural frames. They improve stiffness and strength of the buildings considerably (Moghaddam and Dowling, 1987) and increase absorbing energy in earthquakes. Up to now, many formulas have been proposed to estimate ultimate strengths of infill panels, including Wood, Liauw, Mainstone, etc. (Mohammadi, 2012). Based on experimental observation, plastic hinges in the surrounding frame elements and corner crushing in the infill corners occur simultaneously. Therefore, formulas which are based on plastic theory seem accurate and thus are preferred. In this regard, Liauw formula is investigated in this paper and improved based on experimental data of 43 specimens. These specimens, previously reported in the literature, are 17 concrete frames and 26 steel frames, all having infill panels. The main subject of this paper is proposing a new modification factor for Liauw formula. The modification factor, proposed by Liauw, was calculated based on a few numbers of experiments which is improved in this paper. Liauw's modification factor is as follows (Liauw and Kwan, 1983):

$$\gamma_p = 2.633m^3 - 1.37m + 0.406 \le 0.45 \quad (1)$$

Four different correction factors (γ_p) are considered in this paper for Liauw formula in order to obtain the most accurate formula and has the best correlation with experimental data, as follows:

1- As it is suggested by Liauw

2- $\gamma_p = 1.0$

3- A new constant γ_p for all failure modes considered in Liauw formula

4- A γ_p for each failure modes.

The obtained results, shown in Table 1, shows that the first case underestimates the ultimate strength almost 30%, however the second case overestimates 40% with standard deviation 18%, greater than that of the first case. Considering a single correction factor for all failure modes (case 3) gives much accurate results, in comparison with two previous cases. The average results of the case 4 is very close to case 3, however case 4 is a little more accurate. These two cases estimate ultimate strengths of the infilled frame specimens so accurately that their averages of analytical to experimental strengths are very close to 1.0.

Table 1. Average and standard deviation of analytical to experimental ultimate strengths of specimens

Frame	First state		Second state		Third state		Fourth state	
	Average	standard deviation	Average	standard deviation	Average	standard deviation	Average	standard deviation
Concrete	0.74	0.35	1.49	0.53	1.04	0.37	1.03	0.37
Steel	0.67	0.21	1.39	0.41	0.98	0.29	0.98	0.28
All	0.7	0.27	1.43	0.46	1.00	0.32	1.00	0.32

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