that the developed equations are applicable for ferritic stainless steels, as the ferritic material responses are different from the other stainless steels such as austenitic stainless steel (Yousefi et al. (2020)).

Reliability analysis is conducted to evaluate the reliability of the new proposed equations. Based on the AISI S100 (2016) for relative evaluation of cold-formed steel structural members, an equation is reliable when the reliability index (β) is greater than 2.5. The shear coefficients required for reliability analysis have been presented in Table F1 of AISI S100. The mean coefficients for fabrication factors and material properties are $V_F = 0.05$, $V_M = 0.10$, $M_m = 1.10$, $F_m = 1.00$. The parameters such as mean value (P_m) and variation coefficients (V_P) from parametric study have been presented in Table 6. According to AISI S100. for reliability index (β) determination, the resisting factor (φ) and the correcting factor of 0.85 ($C_p=0.85$) were used. The AISI S100 has given the formulation procedure and can be referred to for more details. The reliability index (β) for the proposed design equations is more than the threshold of 2.5. The adequacy and reliability of these equations are assessed in the following section.

8. RESULTS COMPARISON FROM EXPERIMENTAL AND NUMERICAL ANALYSES WITH THE PROPOSED SHEAR STRENGTH REDUCTION FACTOR EQUATIONS

A comparison between shear strength reduction The shear strength reduction factor values determined from the experimental and numerical results are compared against the value results predicted from the Eq. (1) to Eq. (6). The comparisons of strength reduction factors against hole diameter to clear web height ratio (a/h) and clear web height to thickness ratio (h/t) for both web opening cases in Fig. 8 and Fig. 9, respectively. The results show that the proposed equations are agree well with experimental and numerical results for centred and offset perforated cold-formed ferritic channels under predominantly shear loads.

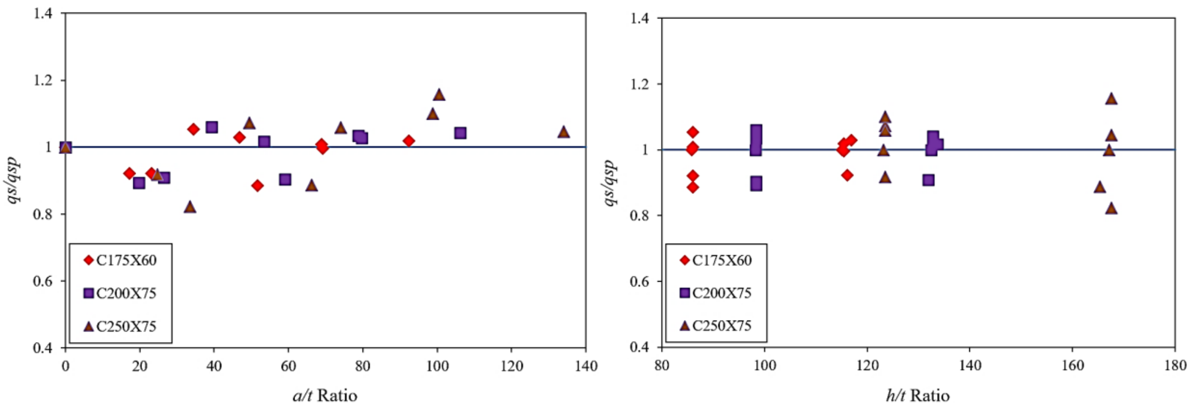

Fig. 8 Comparison of shear strength reduction factor for channels with centred web openings

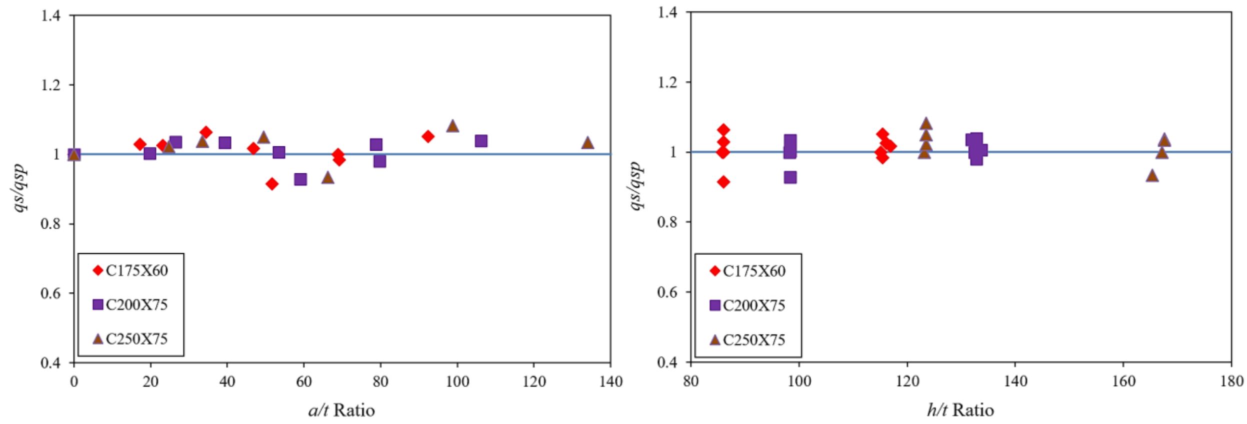

Fig. 9 Comparison of shear strength reduction factor for channels with offset web openings

From the results for centred perforated channels, the average value of ratio of experimental and numerical results ($q_{S(Test\&FEA)}$) over the values from the proposed equations is equal to 1.00, ranging from 1.00 to 1.02, with the variation coefficient ranging from 0.02 to 0.07 and the value of reliability index greater than to 2.50. For the offset perforated channels, the average value of ratio of experimental and numerical results over the values from proposed equations is equal to 1.01 with having coefficient of variation (COV) ranging from 0.01 to 0.05. The reliability index values obtained for the proposed design equations were above 2.5, which confirms their reliability to be used for design of cold-formed ferritic stainless steel channels with centred and offset web openings.

Therefore, the reliability analysis results obtained from the both experimental and numerical studies show that the proposed equations well predict the response of the channels with centred and offset openings in the web under shear loading, and they are reliable and conservative to be applied into design of perforated cold-formed ferritic stainless steel channels.

3. CONCLUSIONS

In this research, a comprehensive parametric study of cold-formed ferritic stainless steel channels with circular web openings under shear was undertaken, using quasi-static finite element analysis, to investigate the effects of web openings and cross-sections sizes. The circular web openings were located either centred at mid-span or offset to the applied load. While no stainless steel standard provides shear strength reduction factors, and only the North American specification AISI S100:2016 and Australian/New Zealand Standard AS/NZS 4600:2018 for carbon steel members provide two equations for channels with centred openings, it is found that such equations were unreliable and un-conservative for ferritic stainless steel channels by as much as 20%. The results also demonstrated that the current equations in the literature for carbon steel channels are unreliable, and are either unconservative or too conservative to apply for ferritic stainless steel channels by up to 44%. Based on both experimental and numerical results, new reliable design equations in the form of shear strength reduction factors were proposed.

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