Versuchsanstalt für Stahl, Holz und Steine

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SUMMARY

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Load-bearing behaviour of thin-walled structural elements made of perforated sheeting

The present report deals with the load-bearing behaviour of thin-walled structural elements made of perforated sheets and with the development of a design procedure for fully or partially perforated trapezoidal or corrugated sheeting.

Starting with the basic aspects of the load-bearing behaviour, the three parameters required for capturing the influence of the perforation are defined and determined for different perforation patterns.

By introducing these parameters into the design procedures for the calculation of the load-bearing capacity of thin-walled structural elements being at risk of buckling failure, the use of these procedures is expanded to fully perforated structural elements. Numerical investigations with the finite-elements-method allow the verification of these theoretically derived calculation procedures.

Using the method of field transfer matrices, an approach for the calculation of the buckling coefficients of partially perforated sheets under compression loading is introduced. Based on these buckling coefficients, a simplified approach for the calculation of the load-bearing capacity of these sheets is derived, allowing for the fraction of perforation of the cross section. This approach is verified by numerical calculations, too.

Based on comprehensive numerical and experimental investigations on web crippling, it can be shown for fully and partially perforated trapezoidal profiles, that the influence of the perforation can be captured by multiplying the capacities according to DIN 18807- 1 and DIN 18807-6 with a factor C for fully perforated profiles and for partially perforated profiles. A calculation procedure for these factors is introduced.

The recalculations of experimental tests with trapezoidal and corrugated sheeting which were performed since the 1980s at the Versuchsanstalt für Stahl, Holz und Steine show the good correlation between the calculation procedure and the test results.

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