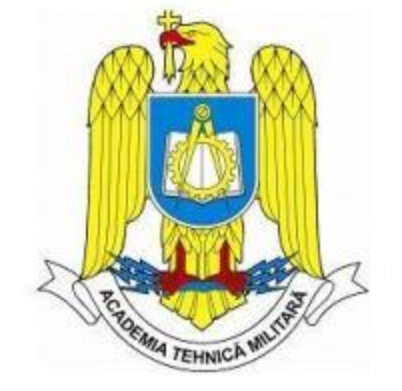

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Mechanical Simulation of Metal Perforated Sheets in Facades

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Contents

Abstract

The aim of this study is to show an increasing tendency in modern building design. The work can be divided in three parts. First, contain information about mechanical properties of perforated metallic materials as strength and stiffness, which are based on the equivalent solid material concept. This concept is based on the evaluating the effect of the perforations and analytical results of the behavior of the solid or unperforated materials under bending and stretching. Next, is present a yield criterion for the perforated sheets with low ligament ratios. In second part is presented an experimental investigation whose purpose is to analyze the effect of perforated elements on pressure drops in a double skin cavity. Three different air flow rates and two different perforated plates are used in order to assess the experimental results. The paper is ending with the principal material used for manufacturing perforated sheets facades.

1.Introduction.

Perforated metallic materials have a big potential to be used in different building constructions. Stiffness, strength and elastic/plastic properties of perforated metallic materials open up good opportunities for their wide range of use in the building industry.

For example, they could be used as spacers for wall and floor constructions, reinforcement materials [1], fixtures and connectors for nodes of wooden constructions, etc. [2]. Because of high strength, light weight, good painting abilities and easy installation, perforated materials are becoming widely used in the design of decorative building facades and frame structures of light party walls [3]. The application of perforated metallic materials for electromagnetic shielding [5] and acoustic barrier constructions is also known [4].

Perforated sheets can be used to benefit in many situations, e.g. noise and weight reduction, air control, filtration, as a decorative finish or simply for anti-skid flooring. The varied qualities offered by perforated sheets make them ideal for sorting, facades, ceilings, lamps, shelves, shielding, stairs and many other applications, far too many to mention!

Perforated, embossed or indented facades can be created from metals including aluminum, steel or copper, and manufacturers offer a range of finishing techniques such as bending, rolling, forming, coating or anodizing. The shape, size and pattern of the holes in a perforated material can all be specified during the manufacturing process to meet a project's exact requirements. While perforations involve the complete penetration of the metal, patterns can also be embossed or indented, either instead of or in combination with perforation. In some cases, the embossing or indenting process and the choice of pattern can also add rigidity to the materials.

5. Conclusion

Perforated metallic materials (tapes, plates, strips) have a big potential to be used in construction. The implementation of metal perforated sheet facades is showing a marked tendency in modern building design, mostly based on esthetic aspects, whereas the basic energy saving principles are not taken in account. Thereby, for a good usage of the metal perforated sheets it's recommended to have knowledge about technical details, mechanical properties, some experimental results, as well as the main materials for producing. Findings and major conclusions can be described as:

- The plastic behavior of a perforated sheet depends largely on the hole size and arrangement. Hence, the actual yielding condition of perforated sheet is extremely complex and the yielding location is not fixed for various ligament ratios and different stress states. Hence, the assumptions of the yield location of a perforated sheet are not always practical over the whole range of ligament ratio. Yielding of the perforated sheets occurs close to the minimum ligament. Then, the stress components in the base metal across the minimum ligament width are calculated by the stress states of a perforated sheet. The von Mises yield criterion is assumed to govern the base metal of a perforated sheet. Next, the average values of stress components are substituted into the von Mises yield criterion to derive the yield criterion for a perforated sheet. Furthermore, the yield locus can be plotted by the yield criterion proposed herein. The yield locus is smooth and no singular point is present on the yield surface.
- Big diameter perforated plate created lower pressure drop relatively compering with the small one. There is no significant relation between the solar radiation effect along the dimensionless pressure drop coefficient. Solar radiation affected the surface temperature values of the cavity. Results from the 18 experimental studies under steady-state conditions were collected to create an extended data set for the validation of numerical studies.
- The principal materials used for the manufacturing the metal perforated sheets are the steel, aluminum and the cooper. All of this can be classified by the mechanical properties, quality or term of cost. Thereby a wide range of products can be organized, developing an increasing tendency in modern building design.

6. Acknowledgements

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