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Mechanical behaviour of bolt-channel joining technology for aluminium structures

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HIGHLIGHTS

- The extrusion process allows to conceive more rational connections: special joints.
- Bolt-channel joints consist in an extruded track where the bolt can be located.
- These joints are very competitive with respect to the traditional joining systems.
- Experimental tests aimed at investigating joint behaviour has been carried out.
- On the basis of experimental results, FEM models have been developed and calibrated.

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ABSTRACT

The wide choice of cross-sectional shapes obtainable by extrusion process provides the possibility to individuate new joining solutions for aluminium profiles. The achievable joining technologies are very competitive with respect to conventional solutions, because of the possibility of rapid execution, optimization of parent material, treatments and machining reduction. For these reasons, the aluminium industry is very interested to enhance the knowledge about the structural behaviour of these joint systems. Bolt channel joints are one of the possible technologies that entail the advantage of the extrusion shapes for joining aluminium elements. The system consists of a track or channel section profile where a bolt head, nuts or plates with threaded holes can be located. Bolt-channel joints are commonly used in building applications and in transportation structures. Nevertheless, very little literature is available for this system and no specifications are provided by aluminium structural codes. In order to evaluate the structural behaviour of bolt-channel joints, an experimental campaign has been carried out at University "Federico II" of Naples. Two different cross-sections corresponding to different bolt diameters have been selected and three different load directions have been considered. The obtained experimental results have been used for the calibration of non-linear numerical models.

1. Introduction

The profiles for aluminium structures are usually obtained by means of extrusion process that, as well-known, allows many possibilities of cross-sectional shapes. In particular, extruded shapes can be customized according to the different possible uses by incorporating essential design features, such as stiffener, rib, bulbs, slots and tracks. These features can be exploited to conceive, in a more rational way, connection technologies to join together aluminium profiles. The achievable joining methods are various and they may or may not involve the use of fasteners. These systems are generally known as "special joints" or "non-conventional joints" for aluminium extrusions. Typical special joints consist in tracks and slots obtained in the extruded shapes, in which mechanical fasteners, such as bolts and screws, can be located. The high competitiveness of these joining technologies is related to the ease and rapidity of assembly, machining reduction, optimization and saving of the parent material with a consequent cost reduction. These joint typologies are commonly used in many structural applications not only in building and civil engineering, but also in transportation industry. Typical applications in buildings are door and windows frames, photovoltaic support systems, staircases, shelves and industrial furniture. The possibility to use these joints in structural applications, even if under moderate loads,

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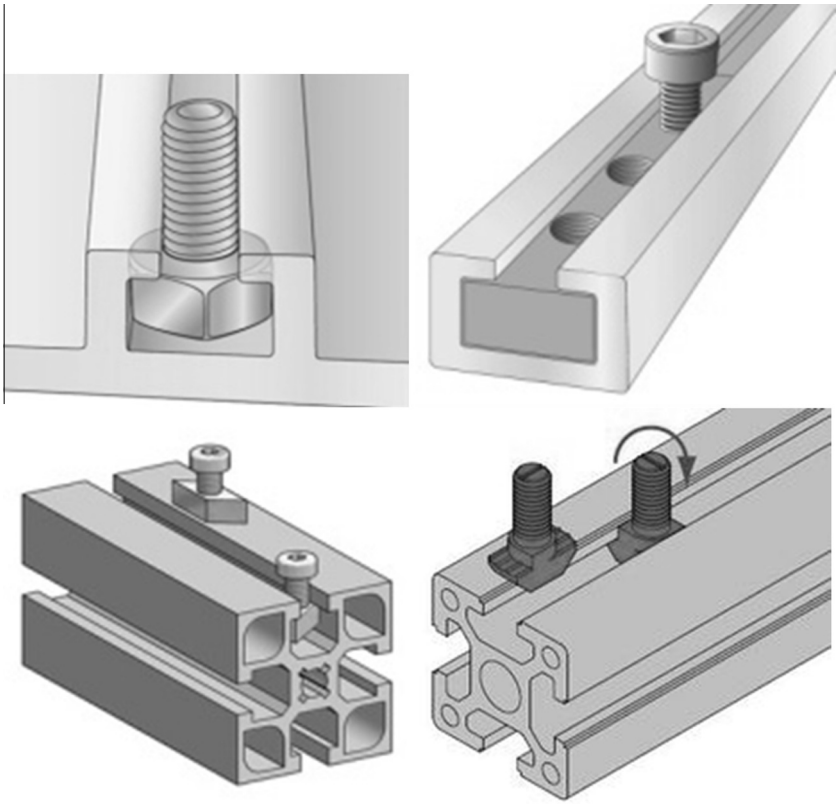

Fig. 1. Bolt-channel joint [4].

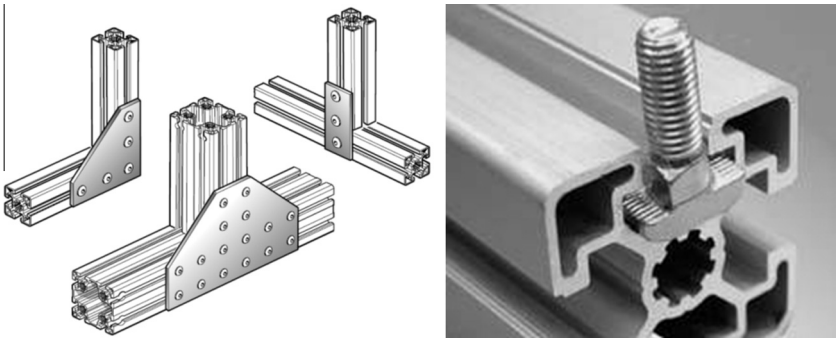

Fig. 2. T-slotted profile system [5].

Fig. 3. The "Loblolly House" [6].

requires their design calculation and verification. Nevertheless very little information for the design of special joints is provided by aluminium structural codes and few researches are available on this topic. Therefore, now-a-day the design assisted by tests procedure represents the only way to evaluate the joint strength.

As an attempt to overcome this lack of information, a research about the mechanical behaviour of special joints [1] was undertaken at University of Naples "Federico II" with the financial support of METRA S.p.A. In order to define the main issues related to the joint geometry, the influence of load type and the joint