Conformity assessment of metal framing elements

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Abstract. Metal framing elements made of thin sheets in combination with gypsum board panels create the system widely used in construction, primarily for partition walls and suspended ceilings. The quality of the metal framing elements depends on the quality and metal sheet thickness from which they are made of, the geometric shape of the profile, the equipment used to produce them, etc. Before being placed on the market, all products used in construction and manufactured in production facilities must meet prescribed technical requirements and specifications. The paper will present the conformity assessment of metal framing elements in accordance with the European harmonized standard EN 14195:2014 and Regulation on Construction Products No. 305/2011. The Regulation defines the conditions for the marketing of construction products on the EU internal market, as well as methods and systems for evaluation to demonstrate the continuity of the characteristics of construction products.

1. Introduction

The use of metal framing elements in construction has a number of advantages that are reflected in economy, flexibility, quick and easy installation, price, etc. In addition, one of the advantages can be seen in the production performed by cold forming of thin sheets using rollers which save energy and material. The quality of metal framing elements depends on several factors, such as quality and thickness of the sheet metal, profile geometry, design method, equipment used for their production, etc. Factory production control is a constant task of every manufacturer which ensures the quality and consistency of product performance before the product is placed on the market.

Customer demands are constantly increasing, so the process of product design in industrial production is becoming more complex challenge for designers, constructors and engineers. The method of metal framing element design is especially important and significantly affects the quality of the product - the elements. Among many methods, the floral rolling method is still used and developed on a daily basis, so that the cold rolling process is generally considered an art rather than a science.

In their paper, Jurković et al. [1] discuss the degree of utilization of the production line for the production of thin-walled profiles by cold forming using rollers.

The importance of the mechanical properties of materials and parameters in the process of cold rolling that affect quality is emphasized by many scientists.

Bui et al. [2] have studied the material parameters, roller distance, friction coefficient and speed of profile formation by cold sheet metal forming, and discovered that the speed and friction that occur do not play a major role in product quality.
Chen et al. [3] dealt with the design and analysis of rollers in cold forming machines and found that the transverse and longitudinal stresses of the roller are very high especially when rolling steel sheets. Many research papers have established that the mechanical properties of the material, the thickness of the sheet, the size of the angle and the distance of the rollers have a great influence.

The majority of the above-mentioned research is focused on the reliability of the simulation model and the effects of process parameters. Several studies have been conducted on cold rolling residual stress.

Weng et al. [4] have studied and discussed residual stresses in metal profiles. They have adopted measurement processing techniques, and established models for their predictions.

In their paper on quality analysis of the formation of a cold rolled C-channel steel, Hui and Wang [5] discuss the residual stresses in the formation of the C-profile. They use measurement by X-ray diffraction, and search for a simulation model. They pay special attention to the place of bending and the number of rollers through which the C-profile passes during rolling.

Conformity assessment plays a very important role in providing safe and harmless products and services, and contributes not only to mutual recognition, but also to the reliability of performed operations. Conformity assessment can vary in level of difficulty and complexity, depending on the level of risk associated with the product, as explained by Delaney [6].

The significant role of certification in product quality assurance is also emphasized by Auriol [7] who points out that certification can be defined as a process in which the consumer is shown a discreet level of product quality by some labeling or branding.

Liepina et al. define certification as widely used in the conformity assessment process, and states that its subject can be a person, process or service as well as a specific action, scheme or agreement [8]. By analyzing and evaluating the most common definitions of the certification concept, we can conclude that certification is a conformity assessment procedure in which the object can be not only a product but also a person, process, service or action and under which an independent third party inspects the object to assess whether it meets the necessary conditions, and issues a certificate as a proof of conformity.

In their work Certification of Persons: An Important Conformity Assessment Procedure, Kavosaa and Lapinab [9] discuss the importance of human resources, i.e. the certification of persons who carry out conformity assessment procedures.

An example of conducting certification and conformity assessment for a welded reinforcing mesh is given by Muminović et al. [10] where they show the process of testing and evaluation of properties.

In their paper Application of CPR 305/2011 to precast concrete elements, Bajramović and Đzidić [11] also discuss this topic.

As can be seen above, many scientists have dealt with the parameters and the methods of obtaining and analyzing the quality of metal framing elements with thin-walled sheets.

The aim of this paper is to present the theoretical procedure of FPC implementation and conformity assessment in order to indicate the importance of the procedure, as well as to determine the advantages of the organization that implements such measures in production and marketing.

FPC and conformity assessment for metal framing elements is carried out in accordance with the European harmonized Standard EN 14195:2014 and the Regulation on construction products No. 305/2011. The Regulation defines the conditions for the placement of products on the EU internal market, as well as the methods and systems of assessment to demonstrate the consistency of the characteristics of construction products.

2. Quality requirements for metal framing elements

Before placed on the market, metal framing elements must meet the prescribed technical requirements and specifications required by standard EN 14195. The requirements set according to the Standard and the Regulation on construction products 305/2011 can be presented in a table.
Table 1. Relevant clauses for metal framing elements

| Essential characteristics | Clauses in this and other European standard(s) related to essential characteristics | Regulatory classes | Notes |
|---------------------------|--------------------------------------------------------------------------------------|--------------------|-------|
| Reaction to fire          | 4.1                                                                                  | A1 to F            | Declared class |
| Flexural tensile strength | 4.2                                                                                  | -                  | Expressed as yield strength in N/mm² |
| Loadbearing capacity of the suspension components | 4.6.2                                                                             | -                  | Declared class |
| Dangerous substances      | 4.3                                                                                  | -                  |       |

Table 1 shows relevant clauses for metal framing components used for gypsum board systems and intended use.

3. Conformity assessment
The manufacturer shall establish, document and maintain a factory production control system to ensure that the product placed on the market meets the requirements of EN 14195 and that it conforms with the specified and declared values defined in the technical documentation.

The manufacturer must draw up technical documentation proving the conformity of the product with the requirements of the European directives. The technical documentation can be compiled according to the following content:

- Product description/product family
- Checklist for the essential requirements of all applicable directives
- Risk analysis of critical components lists
- List of applied standards
- Market monitoring
- User manual
- Marking
- Packaging
- Test reports
- Data related to the safety of raw materials/components
- Parts list/Drawings/ Figures
- Packaging validation
- Budget results
- Work procedures/Work instructions/ Factory production plan
- EC type-examination certificate/ Notified Body certificate
- Quality management certificates
- Annexes

3.1. Determination of the product type
Determination of the product type shall be performed at the beginning of the production of a new metal framing component type or at the beginning of a new method of production. Tests previously performed in accordance with the provisions of Standard EN 14195 (same product, same
characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account.

3.2. Factory production control (FPC)
The factory production control system consists of factory production control manual, procedures, instructions and other elements which explain the input of raw materials, production process, control during the production process, as well as control of finished products.

A manufacturer who has established and implemented quality management system in accordance with the ISO 9001 Standard and who takes into account the specific requirements of the product Standard EN 14195, is considered to meet the requirements of the factory production control system.

It is necessary to define the competencies, authorities and responsibilities of the staff involved in the factory production control system. This applies in particular to staff who need to take action to prevent non-conformity of products, and in case of non-conformity to identify and register product conformity problems.

All equipment used in the production process should be regularly inspected and maintained to ensure that use or error does not cause inconsistencies in the manufacturing process. All monitoring and measurement equipment must be calibrated and regularly maintained in accordance with documented procedures. In that sense, it is necessary to provide regular periodic calibration of measuring and control equipment listed in the specification and whose characteristics and calibration periods are specified in the Measurement and control equipment card. Specifications for all input raw materials and components, as well as inspection scheme, should be documented. Traceability is ensured by identifying and recording all technical characteristics of the base material, and responsibilities for verification during production, so as to ensure traceability in case of non-conformity.

The organization shall ensure that all non-conforming products are separated, clearly and visibly identified and stored in a specially designated area. Product identification enables traceability backwards, from the final product, to the contract and offer and vice versa, and is achieved through precise marking of products and documents, as well as connection of markings. The manufacturer should have documented procedures that encourage action to eliminate the cause of the non-conformity to prevent it from recurring.

3.3. Declaration of performance (DoP) and CE marking
The manufacturer draws up the DoP and affixes the CE marking on the basis of the different AVCP systems set out in Annex V of the Regulation (EU) No. 305/2011. The CE mark (French Conformité Européenne – European conformity) is not a quality marking, but indicates that the product is safe to use, if used as intended.

The marking confirms that the product meets the essential requirements for customer safety, health or environmental protection. The basic characteristic of the European Union single market is the free movement of people, capital, goods and services, but also the fact that products placed on the market must meet the essential requirements in regard to health, safety, customer protection and environmental protection.

CE marking is a synthetic way of physically affixing this information to a product that complies with the provisions of the relevant directives. Another method is EC Declaration of conformity for the relevant product issued by and under the responsibility of the manufacturer or his authorized representative. Conformity with the essential requirements is physically indicated by affixing the CE marking to the product. The marking must consist of the initials “CE”, the shape of which is described in Council Decision 93/465/EEC or in the applicable Directive.
The Figure 2 gives an example of the information related to products subject to AVCP under system 3 to be given on the accompanying label, or on the packaging or on the accompanying commercial documents.

| CE marking, consisting of the “CE” – symbol | Identification number of the notified test laboratory |
|--------------------------------------------|-----------------------------------------------------|
| BE Consulting Ltd, Put Armije BiH, 77000 Bihać, Bosnia and Herzegovina | Name and the registered address of the manufacturer |
| 20 001DoP2020-06-15 | Last two digit of the year in which the marking was first affixed |
| EN 14195:2014 C/40/48/40 | Reference number of the DoP |
| In building construction works in conjunction with gypsum boards | No. of European standard applied |
| Reaction to fire – R2F: A1 | Unique identification code of the product type |
| Yield strength – s: 140 N/mm² | Intended use of the product as laid down in the European standard applied |
| Dangerous substances –DS: NPD | Level or class of the performance declared |

**Figure 2.** Example CE marking information of products on the label

The CE marking is an administrative marking (“passport”) and shows that the product conforms with the essential requirements of all relevant directives and has been subject to conformity assessment procedures in accordance with the relevant directives. The CE marking is mandatory and must be affixed before the product is placed on the market.
4. Conclusion
This paper presents the procedure for implementing FPC, conformity assessment and the method of marking metal framing elements. The importance of carrying out this procedure is very great and is reflected in the safety of the product that is placed on the EU market.

The basic feature of the single market of the European Union is the free movement of people, capital, goods and services, but also the fact that products that are placed and placed on the market must meet the essential requirements of health, safety, consumer protection and environmental protection. Organizations that comply with the requirements of standards and regulations, have a great advantage because they are entering the market with an annual turnover is around 1,500 billion euros.

CE marking is a "passport for the product" that can enter the EU market. This label confirms that the product meets the minimum safety requirements set by the legislator. However, whether the product will be accepted by the market depends on many other factors, such as the attractiveness of the product (whether the product is made based upon the results of relevant research and development of technology), unit price, delivery timeframe, and others. Research and development of technology are the main reasons why the most successful countries in the world market invest the most in research and development.

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