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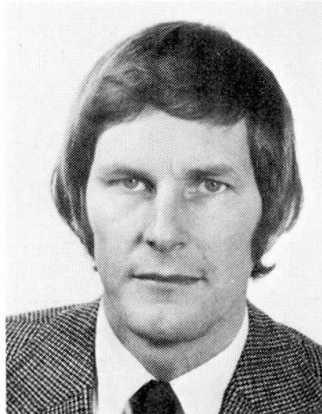
## Quality Assurance of Prefabricated Products

Assurance de qualité d'éléments préfabriqués

Qualitätssicherung für vorgefertigte Produkte

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### SUMMARY

Quality assurance of prefabricated products used in buildings is discussed. Questions of Requirements, Responsibilities, Control Bodies, Test Houses and quality assurance-programs in factories are treated.

### RESUME

L'article traite de l'assurance de qualité d'éléments préfabriqués dans l'industrie de la construction. Divers aspects sont traités: exigences, responsabilités, instances de contrôle, laboratoires d'essai et assurance de qualité en usine.

### ZUSAMMENFASSUNG

Die Sicherung der Qualität vorgefertigter Bauprodukte wird diskutiert. Fragen bezüglich Anforderungen, Verantwortlichkeiten, Kontrollinstanzen, Versuchslaboratorien und Qualitätssicherungs-Programmen werden behandelt.



## 1. INTRODUCTION

### 1.1 Definitions

The framework for Quality Assurance (QA) of prefabricated products used in buildings is discussed. Quality means "fitness for use" regardless of price and time schedules, but the QA-concept must include even those aspects. Thus QA should be interpreted as "Planned and systematic actions taken in the production to achieve products with relevant quality at agreed time and cost".

The experience shows that requirements and specifications in contracts, even with penalty clauses, are not enough to assure the agreed quality in complicated and costly projects. Next step is to require a QA-program in the production as a condition for delivery. This may be done by prescribing the use of "type approved products", where production control and supervision are compulsory for the producer.

### 1.2 Scope

The requirements and specifications specified for a product are of vital importance for the outcome of quality. This paper is limited to QA for prefabricated products used at building sites. Key elements are requirements and the responsibility for their verification.

## 2. REQUIREMENTS

### 2.1 Classification

Building codes are based on law. They are restricted to considerations about safety, comfort and durability. (Requirements of 1 st order). Other requirements are described in standards (2 nd order) and finally there are specifications in individual contracts (3 rd order). The requirements can be classified according to the responsible party.

This division forms a basis for organizing quality control and supervision. If a property of a product is claimed to be important enough to be covered by the building codes the same importance should be applied to the supervision and verification of the quality of conformance. On the other hand if the property of a product is not under the restriction of codes, there is no authority responsible for the supervision. Then trade organisations, private institutes etc can organize external supervision of the conformance to requirements if requested. Finally the client is responsible for supervision of the conformance to requirements and agreements specific for his contract.

### 2.2 Type approvals

Many products used in buildings have a "type approval certificate" issued by the responsible authority. The approval of a production entitles the producer to

mark his product with a quality mark, which simplifies the acceptance by local inspectors at the building site. In certain cases it also decreases the fee for the building permit and allows for more favourable design values. In most cases the approval implies production control at the factory, supervised by an authorized control body. Requirements are defined in the approval certificate and are based on the building codes. (1 st order requirements).

### 2.3 Official testing

"Official Testing" is a special notation in the Swedish legislation, covering inspecting and testing the conformance to 1 st order requirements when this is specified in codes. The legislation (issued 1975) states that "Official testing" has to be administrated by "National Test Centers" that fulfill certain requirements of competence and impartiality. The legislation is not yet adopted within the building codes but in one field, "Structural Timber and Wooden Materials", the Swedish National Testing Institute (SNTI) is pointed out as the "National Test Center".

## 3. SUPERVISORY

### 3.1 Control bodies

Traditionally control bodies develop from trade-organisations as a consequence of their needs to produce products of good quality. According to the development of regulations they become more "official" and include representatives from governmental authorities in their boards.

For supervision of requirements of 1 st order, independent bodies with technical competence and proper legal background should be pointed out. Based on increasing experience, quality control programs, compliance testing, external supervision etc may develop independently.

The competence required for a successful AQ-program within the factory lies with the producer and his people and may not be maintained outside the factory. The corresponding competence for successful supervision of the conformance to 1 st order requirements of the production, is knowledge of regulations, testing techniques of the properties in question and statistical quality control concepts. This competence is best maintained by personal working in laboratory environments. Distributing the responsibilities between these parties may lead to a less effective result.

### 3.2 Test houses

Testing of products as part of the (external) supervision program should be made by authorized test houses. The authorization should involve tracable calibration of equipment and round-robin tests at least once a year. Very often the result



of a test as a number of figures is not the only information that is necessary for the judgement of conformance. Thus there is a link between the judgement of conformity and the testing technics. This speaks for a close cooperation between inspectors and test houses.

#### 4. PRODUCTION CONTROL AND INSPECTIONS

##### 4.1 Works control

Before a permanent approval is given, the producer will propose a control program, choose control steps, testing methods, frequencies of testing, procedurs of documentation and internal supervision. In this work the producer and his personal generally show a great interest and positive attitudes to the program. The program often results in a remarkable increase in quality of the product.

##### 4.2 Compliance testing

The judgement of conformance to requirements will be based on test records. Thus relevant test methods and testing frequencies have to be applied. In the production line the simplest possible methods should be applied with relatively high frequencies. Completion with more sophisticated methods may be needed at intervals. Test results are documented in journals. The laboratory equipment will be regularly calibrated and round-robin tests performed to assure the reproducibility of test results.

##### 4.3 Inspections

The inspections at the factory is part of the external supervision of the production. The main purpose is to verify that the quality of the products according to documented test results conforms to requirements. This may be done by compliance testing at external test-houses. If the documentations show that the product does not conform to requirements or if the compliance tests do not agree with the documented results the matter will be investigated and the approval may be put in question. At the time for inspection the QA-program will be discussed according to experienced results.

#### 5. CONCLUSIONS

Better conformance to requirements of products can be achieved by introducing a QA-program in the production. This program consists of production control at the factory by the producer and his personnel and supervision by an external control body. This system are applied when "type approved products" are prescribed in contracts. By an increasing interest for type approved products the QA-concept may develop within the building industry as in other manufacturing industries.