Quality of Translucent Building Structures: Control Technologies

S B Baurina¹, E V Nazarova²

¹Academic Department of Industrial Economics, Plekhanov Russian University of Economics, Stremyanny, 36, Moscow 117997, Russia
E-mail: baurinaaa@yandex.ru

Abstract. This article is devoted to research of technologies of control and quality assurance of building structures. The object of the study is translucent structures. Indicators of quality and consumer properties of translucent structures are specified. Characteristics of methods of quality control and assurance are given. The technology of input quality control of raw materials and materials during production of translucent structures is analyzed in detail. The procedure for operational production control of translucent structures is defined. Features of acceptance quality control of finished products are revealed.

1. Introduction
At present, provision of the construction industry market with competitive construction materials, structures, products, as well as improvement of the methodology of determination of estimated prices of construction resources, possibly on the basis of thorough development and realization of the resource component of the construction materials industry.

The ambiguity of the problem is due to the fact that the supply of domestic producers on the nomenclature and assortment of products, far from always satisfying the demand, despite the apparent supersaturation of the market of goods with construction materials.

The development of new types of products is sometimes hampered by the underdevelopment of factors of production, among which it is necessary to highlight the high degree of wear and tear of fixed assets, the lack of working capital that constrains the growth of production, the shortage of skilled labour, the uncertainty of the economic situation, etc. The placement of production facilities of construction industry enterprises is not successful - more than 3/5 of them operate on the European territory of Russia. In addition, it is obvious that there is a need to improve national quality standards, develop a regulatory framework for the use of construction resources on the basis of progressive norms and regulations, organize a quality control process for products, etc.

However, this will lead to positive results if these circumstances are regulated by appropriate instructional and methodological documents containing an information component for all levels of quality management of construction industry products.

2. Background and methodology
Evidence of increased interest in translucent structures are various publications of a scientific nature, covering the issues of applied materials and technologies of the device (Abramyan S. G., Ohanesyan O. V., Farniyev D. K. 2016; Belov V. V., Petropavlovsk V. B., Schlapakov Yu. A. 2015; Hashirov Z.
A., Yermakov I. V. 2019; Eun, Yoon Jae 2015; Hoon Km. A 2015; Martens K., Caspeele R., Belis J. 2015).

The purpose of the article: research of technologies of control and quality assurance of building structures. Translucent structures were selected as the subject of the study.

Scientific significance: indicators of quality and consumer properties of translucent structures are systematized; Characteristics of quality control and assurance methods are given; Technologies of input quality control of raw materials and materials during production of translucent structures, procedure of operational production control and peculiarities of acceptance quality control of finished products are justified.

Practical importance:
- Methods of control and quality assurance of translucent structures are defined;
- Scientific conclusions and results of research can be useful to management of companies in determining technological trends of quality control of translucent structures.

3. Discussion and results

At present, one of the main conditions for the development of the domestic construction industry is the improvement of the quality of building materials and structures. However, the insufficient quality of the products offered by manufacturing enterprises significantly reduces the cost-effectiveness of investments. Construction materials, structures and products shall meet the specified quality parameters. Under these circumstances, an important condition is the improvement of the regulatory framework for the use of raw materials and materials, which provides for the application of economically and technologically sound progressive consumption standards in the production [3]. The quality of translucent structures is determined by the quality of materials (profile, etc.), consumables (fasteners, components, etc.), repaired items, etc. Indicators of quality and consumer properties of translucent structures are given in Table 1.

| Indicators                          | Types of technical means |
|------------------------------------|--------------------------|
|                                    | Materials and Product    | Products the account | not repaired | repaired |
| Functional appointments            | +                        | +                     | +            | +        |
| Reliability:                       |                          |                        |              |          |
| non-failure operation              | -                        | -                      | +            |          |
| durability                         | -                        | -                      | +            |          |
| maintainability                    | -                        | -                      | -            | +        |
| storageability                     | +                        | +                      | +            | +        |
| Standardization and unification    | -                        | ±                      | +            |          |
| Ergonomic                          | ±                        | +                      | +            |          |
| Esthetic                           | ±                        | +                      | +            |          |
| Resources consumptions             | +                        | +                      | +            |          |
| Technological effectiveness        | +                        | +                      | +            |          |
| Ecological                         | ±                        | ±                      | ±            | ±        |
| Safety                             | ±                        | ±                      | ±            | ±        |

Note. In the table, the sign "means applicability, the sign" means "non-applicability, the sign" ± "means limited applicability.

The choice of construction material and the justification of its expediency in the construction structure are conditioned by its ability to resist real loads [8]. Building materials must withstand the forces affecting them, including geo-climatic and chemical factors. In most cases, a reasonable choice
of material should be accompanied by consideration of all its properties, referred to as technical [4]. The quality of translucent structures is confirmed by:
- Input quality control of raw materials and materials;
- operational control;
- Control of finished products by technical control service (acceptance control).

Let’s look at the existing technologies for quality control of translucent structures.

Input quality control of raw materials and materials during production of translucent structures shall be carried out by the OTC specialist in accordance with TU 2247-007-07252549-00 (Table 2).

**Table 2.** Name and value of monitored indicators at input quality control of raw materials and materials.

| № n/n | Name of monitored parameters | Number of samples | Length mm | Period |
|-------|-----------------------------|-------------------|----------|--------|
| 1     | Deviation from form         | 3                 | 1000     | Each batch, at least 1 times per shift |
| 2     | Appearance key figures      | 3                 | 1000     | same |
| 3     | Mass 1 running meter        | 3                 | 1000     | same |
| 4     | Changing linear dimensions  | 3                 | 300      | same |
| 5     | Impact strength at negative temperature | 10 | 300 | same |

It should be noted that profile characteristics should comply with GOST 30673-2013 "Polyvinyl chloride profiles for window and door units. Specifications". For example, when storing PVC profile, it is not recommended to expose it to sunlight and heating devices. If the profile is stored in the unheated room during the cold season, it must be warmed up to temperature of not less than 17 °C before starting the treatment. (For this purpose the profile is entered into the heated room approximately one day before the beginning of treatment). The temperature of the production room should also be above 17 °C, since at a lower temperature the chips may appear when cutting and grinding the profile. All window production equipment shall undergo routine maintenance.

The composition of laboratory equipment for input quality control of raw materials and materials during production of translucent structures is given in Table 3.

**Table 3.** Composition of laboratory equipment for input quality control of raw materials and raw materials.

| № n/n | Name of test | Name of the equipment of | Characteristic of the equipment |
|-------|--------------|--------------------------|---------------------------------|
| 1     | Weight 1 p.m. | El. Weights              | Weighing limit 0-5 kg (tolerance 0.1 g) |
| 2     | Changing the Linear Dimensions | Thermal Cabinet |                                  |
| 3     | Impact strength at negative temperature | Koper | Load drop height 1.5m, weight 1000 g |
|       |              |                          | Refrigerating chamber t°C cooling to -10 °C, -15°C |
| 4     | Profile thickness, length and shape | caliper |                                  |

The marking shall be applied to the surfaces of the profiles in such a way that it can be visually inspected after manufacture and installation of the article [2].

Upon completion of the input quality control of raw materials and materials during the production of translucent structures, the OTC specialist shall issue a "Quality Control Protocol of Raw Materials and Materials," which shall specify: the date of manufacture and control, the name of the profile, X °
of the batch, the main parameters, possible deviations from the form, appearance indicators, weight 1 pg. M, change of linear dimensions, strength, heat resistance.

In the future, technological documentation regulates the procedure of operational control at workplaces. Quality assurance of translucent structures is achieved by systematic control of execution of each stage of production process: cutting and welding of profile, installation of mullions (straps), rubber seals, fittings, installation of glazing units. Quality control should be based on enterprise standards [5].

At the same time, practical experience shows that the competitive market is dominated by economic management methods and, judging by the price sensitivity of sellers and buyers of resources, as well as the common practice of price discounts, price remains an important tool in competition [13].

Acceptance quality control of ready translucent structures is carried out separately for each article, checking:
- appearance (absence of defects visible to the naked eye);
- operation of window devices;
- sagging of the opening elements and deviation of the size of the distance between the flaps;
- availability of drain and other holes;
- availability and correctness of sealing gaskets installation;
- other requirements established in standards for specific types of products.

Items that have passed acceptance inspection are to be marked, and items that have not passed quality control are counted manually and rejected [1].

Quality control of finished structure is carried out on special stands by the controller of OTC. The quality of translucent structures is assessed by the parameters of GOST. Using the scanner, information on the quality of each translucent structure is entered into the base, where it is analyzed by specialists.

After the finished structure quality inspection, the product is sent to the finished product warehouse and then to the customer.

In enterprises producing translucent structures, as a rule, various methods of quality control and assurance are used (Table 4).

Table 4. Methods of quality control and assurance in production of translucent structures.

| Material inspection or testing                        | Quality assurance method      |
|--------------------------------------------------------|-------------------------------|
| Inner sealing layer (if used)                          |                               |
| Sizes                                                  | Measurement                   |
| Detection of excess                                    | Visual                        |
| The external pressurizing layer                        |                               |
| Sizes                                                  | Measurement                   |
| Detection of excess                                    | Visual                        |
| Glass components or type of glass used                 | Visual                        |
| Dimensions of the glazing unit (length and width)      | Measurement                   |
| Defects of glass                                       | Visual                        |
| Storage                                                | Visual                        |
| Marking                                                | Visual                        |
| Deviation from flatness (immediately after sealing of glass) | Visual                     |

4. Conclusions

Thus, the market for construction materials, including the segment of translucent structures, is characterized by progressive development. At the same time, only wooden structures can compete with translucent structures today. For enterprises producing translucent structures today, more than
ever, measures are needed to control and ensure quality and, accordingly, competitiveness. The most rational solution is to create an effective quality control mechanism within the framework of the process approach when implementing a set of measures aimed at improving the quality of translucent structures. The main recommendations for improving the production of translucent structures, which have a significant impact on quality assurance, include the formulation of the manufacturing enterprise strategy in the quality management sector and its documentation in the form of a strategic plan; Adoption of procedures to facilitate stakeholder opinion in the development of quality management policies and strategies; Improving forward planning, including long-term and strategic planning, as well as medium-term planning in the quality management system; Development of targeted programmes containing a set of measures aimed at improving competitiveness on the basis of the quality of the output; Development of material and technical, metrological, legal and other supporting subsystems of quality management; Organization of design, production, monitoring and testing of translucent structures within the process approach; Adaptation of quality management methods and tools, controls and testing in the construction industry; Formation of responsible behavior of the manufacturer’s management and all personnel for the quality of translucent structures; Improvement of organization and planning of technical preparation of production of translucent structures; Development of a set of measures to ensure efficiency of control, including tests during input control; Introduction of a unified system for recording controls, measurements and tests; Timely registration of acts in case of detection of marriage; Development and implementation of measures providing for coordination of activities of all subsections on analysis and prevention of inappropriate production; Creation of conditions for advanced training and retraining of personnel of the manufacturing enterprise in the field of quality, etc.

5. References
[1] Abramyan S G, Ohannesyan O V, Farniyev D K 2016 Light-transparent coatings of unique buildings and structures *European research*
[2] Baykov A S, Bayneva I I 2017 Peculiarities of organization of works and lighting in industrial premises with dangerous environment conditions XLV Ogaryovsky readings: materials of the test. Conf.: at 3 h. 1: Technical sciences holes For P V Senin (Saransk: Mordov. state. un-t) pp 119-124
[3] Baurina S B, Savchenko E O, Nazarova E V 2020 Methodology of evaluation the efficiency of road operation and construction IOP Conference Series: Materials Science and Engineering 753(5) 052071
[4] Belov V V, Petro pavlovskaya V B, Schlapakov Yu A 2015 Laboratory definitions of properties of construction materials *Publishing House of the Association of Construction Universities* 200 p
[5] Buildings and structures with translucent facades and roofs Theoretical basis of design of translucent structures C-Petersburg, Engineering and Information Center of Window Systems, 2012 400 p file:///C:/Users/pc/Desktop/Zdanija-i-isooruzhenija-so-svetoprozrachnymi-fasadami-i-krovlj.
[6] System of regulatory documents in construction General Provisions Access Mode: http://files.stroyinf.ru/Data1/43/43402/
[7] Khashirov Z A, Yermakov I V 2019 Design and experimental study of the effect of inter-wall space heating on the thermal protection properties of wooden window structures *Don Engineering Gazette* 4
[8] Yakovleva M V, Frolov E A, Frolov A E 2015 Construction structures Preparation, reinforcement, corrosion protection (M.: Infra-M) 208 p
[9] Chiba K, Nakatani K 1984 Photoenhance migration of silver atoms in transparent heat mirror coatings *Thin Solid Films* 112 pp 359-367
[10] Eun, Yoon Jae 2015 A Study on the Spatial Characteristics of Coop Himmelblau Architecture Represented in Busan Cinema Center Journal of Korea Intitute of Spatial Design Vol 10 (Iss.6) pp 9-22 URL: kisd.or.kr/upload/thesis/20151231165918616.pdf

[11] Von Kampen P, Kaczmarczik U, Rath H J 2006 The new drop tower catapult system 56th International Astronautical Congress, Fukuoka JAPAN ACTA ASTRONAUTICA Vol 59 Iss. 1-5 pp 278-283 DOI: 10.1016/j.actaastro.2006.02.041

[12] Hoon Km 2015 A Study on the Foreign Baseball Stadium Dome Cases for Determining Critical Planning Factors - focused on the 6 international game scaled baseball stadium domes in Japan Journal of the regional association of architectural institute of Korea Vol 17 Iss. 3 pp 9-16

[13] Khudyakov S V 2020 Macro-Factors in the Development of Industrial Concentration Processes IOP Conference Series: Materials Science and Engineering Vol 753 Issue 8 5 082013 International Science and Technology Conference on FarEastCon-2019 (Vladivostok, Russky Island; Russian Federation) 1 October 2019 code 158130

[14] Martens K, Caspeele R, Belis J 2015b Development of reinforced and posttensioned glass beams: review of experimental research ASCE Struct. Eng. doi:10.1061/(ASCE)ST.1943-541X.0001453