Specifics and Application of Wooden Constructions in the Agricultural Sector

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Abstract. Over recent years farming has undergone fundamental changes and many aspects of the industry, including farm buildings, have been transformed thereby. Modern farm buildings are large and as cheap and maintenance free as possible reflecting the need for better performance and greater efficiency. These modern buildings however are much larger than traditional buildings and are constructed of materials which are not only artificial and ‘foreign’ to the area but are also very light coloured. As a result, modern economic buildings are characterized by specific features as traditional construction. Response to this trend are the modern methods of construction based on wood offering effective procedures (design and implementation of construction), resulting in a larger volume of products (production), with higher quality and with shorter time of their purchase. The aim of this paper is to present selected aspects of agricultural construction and their application at present.

1. Introduction

Agriculture is an organic component of the national economy of each country, and also an essential pillar of the very existence of society and humanity [1,2]. Agricultural production is one of the oldest sectors of the economy in each country. In recent years, agriculture has undergone fundamental changes and many aspects of the sector, including agricultural buildings [3,4]. Modern farm buildings are large and relatively inexpensive and maintenance-free, which ultimately translates into higher efficiency as such. These modern buildings, however, are much larger than traditional buildings and are built of different materials and structural elements [5-7].

The development of construction industry is increasingly offering new and more efficient and sustainable technologies, technological processes and material bases. Reacting to this trend are also modern wood-based construction methods that offer efficient procedures (design and construction), resulting in a larger volume of products (production), with higher quality and with less time to acquire them [8,9].
Wooden construction according to [10] is a construction or construction work where the main supporting structure consists of elements made of wood. The main building material for timber constructions [11] as well as possible superstructures of already existing buildings or hall buildings is the mentioned wood. The widespread use of woodworks is increasingly being used in almost all segments, for example in individual, residential, administrative, public, industrial, sports or commercial construction and others [12]. It is a natural building material that does not harm health, and thanks to its excellent properties and advantages it has gained an excellent reputation in the area of construction, which has been verified by many generations. By its properties and price, wood has not been overtaken to date by any material. Buildings made of wood and materials on its basis are now able to compete with steel and concrete structures and overcome them in many ways. The wood is considered environmentally friendly, for several reasons. Wood is a health-conscious material that regulates moisture and provides a pleasant climate at all seasons. Last but not least, the processing of wood and wood-based products is far more environmentally friendly than the production of cement or steel. In construction, unlike concrete structures, the wet process of construction is degraded, which accelerates the construction time [13,14]. Another advantage is the instant bearing capacity, which eliminates the time of acquisition of the strength of the structure.

In the context of the presented background, the aim of the article is to present the selected aspects of agricultural construction and their application at present.

2. Specifics of constructions in the agricultural sector

Agricultural production as part of agriculture has several specific features that are transferred to selected products and affect the entire reproduction process.

Specific features include:
- the biological nature of the manufacturing process,
- seasonality of the production process,
- inconsistency between the length and the course of the production process,
- inconsistency between the length and the course of the work process,
- the limitation of land as a basic production resource,
- the high number of combined products.

Basic classification of agricultural buildings

1. According to production specification as agricultural buildings for:
   - animal production (objects for breeding and fattening of cattle, pigs, poultry, sheep ...),
   - plant production (objects for storing potatoes, grain, vegetable production, granaries, greenhouses),
   - agricultural services (chemical plant protection, veterinary care, service),
   - combined focus (breeding of dairy cows - rearing of calves - fattening of cattle).
2. Depending on the nature and complexity of the links to objects:
   - one purpose - for animal or plant production,
   - multi-purpose - when two or more dedicated operations are concentrated,
   - agrokomplex - greenhouse cultivation of mushrooms, flowers, vegetables,
   - agriculture - industrial complexes.

Construction systems

1. Wall system - a system with longitudinal supporting walls,
2. Skeletal system - with transverse frames, for non-floating objects up to 13 m in the form of hall space without internal pillars. At larger spans, the frame construction is divided by multiple-support supports [12,15].
Division by material basis:
- Reinforced concrete one-storeyed halls - the nosing constriction consists of columns with a three-lane junction at a span of 30 m.
- Steel halls - Three-sided full frame frames are used. The steel spacing of the bundles and frames is 6 - 24 m. The longitudinal module is 3 to 4.5 and 6 m.
- Wooden halls - 15, 18 and 21 m span frames. Girders are, in addition to the frames, the most widely used wooden roof structure. They are used for single-storey farm buildings with a range of 6 to 15 m.

Construction technology
According to the gross building technology, we recognize the following objects:
- brickwork made of bricks, blocks and blocks,
- monolithic, concrete and reinforced concrete,
- assembled from steel, wood, reinforced concrete.

1. Muddy objects - abandoned by them in wider agricultural construction for work.
2. Monolithic objects - plants for plant production and cereal silos, silage towers). The walls are concreted by sliding formwork.
3. Pre-assembled objects - semi-mounted and fully assembled,
   - the semi-assembled objects have a masonry supporting walls of a perimeter cladding (monolithic) and mounted ceilings, or vice versa,
   - fully assembled have vertical load-bearing walls, perimeter shell and ceiling mounted [12,16].

3. Application of wooden constructions in the agricultural sector

Wood as a building material was used mainly during the construction of trusses, beam ceilings, large-scale precasting, for example, by bonded or dyed bonding, as well as other building elements. In recent years, Central European construction has gradually returned to a significant use of wood. It is represented not only in the roof structures of buildings and the filling structures of all categories of residential buildings, but is very often used as a structural construction material or for the exterior and interior of buildings of different types such as agricultural buildings. The following figures show the use of wood and structural elements in the construction of agricultural buildings.
Figure 2. Building for breeding bulls (Schardenberg, Austria) [17].

Figure 3. Building for agricultural use (D - Eslarn, Germany) [17].

Figure 4. Construction of a wooden construction structure for cattle breeding (Velky Bor, Czech republic) [18].
Figure 5. Building for cattle breeding (Velky Bor, Czech republic) [18].

Figure 6. Building for cattle breeding (Nečín, Czech republic) [19].

The wide use of wood and wood-based structural elements used in the construction of agricultural buildings is documented in the examples in figures 1-6. Based on our experience, wood-based structural elements exposed to extreme conditions in agricultural objects can meet both static, technical and aesthetic properties as compared to commonly used materials such as steel, reinforced concrete, bricks and other materials. The main advantage of using wood is its low or, in some cases, the negative balance of the so-called carbon footprint compared to conventional building materials. Another advantage of the so-called dry construction process is the construction of structures during the winter months, which contributes to the overall efficiency of the construction process and a better appreciation of the financial resources.

Similar findings have been made by Koppelhuber et al. [20] on the basis of its research into the use of wood in the construction of industrial buildings. These authors state that an important role in the process of designing and implementing building elements of wood in the construction industry plays economic, qualitative and ultimately sustainable factors. Furthermore, the authors state that taking into account a number of factors such as the choice of a suitable type of wood, processing technology and
the right design of the constructional details, it is possible to implement wood-based structural elements for almost all types of civil and industrial constructions.

The environmental balance of the so-called environmental footprint of wooden structural elements used in construction has been reviewed by Sandanayake et al. [21]. Similarly to us, these authors state that wood as a building material has unquestionable advantages in terms of its impact on environment compared to conventional materials. In addition, the authors analyzed the construction process and the process of transporting structural elements of wood-based construction and concrete-based construction. In a more detailed analysis, they concluded that timber-based structures during their construction and the transport of structural elements were much less of a burden on the surrounding environment.

On the basis of the above, it can be stated that the use of timber and timber construction components in construction is an increasingly discussed topic. As more and more investors and building users are looking at the environmental aspect of construction projects. As a result, the use of wood as such has a great prospect of being a renewable building material with a number of structural, technical and economic advantages.

4. Conclusions

This contribution refers to the issue of agricultural construction. This article outlines the basic aspects of this specific area of construction. Within the specification, the segregated divisions of these specific structures were presented in terms of both technology and material basis. As this paper presents the constructional and technological benefits of using wood are undoubted, and wood and timber construction materials have also begun to be used in the construction of agricultural buildings in recent years. Not only does the construction of wood-based agricultural buildings provide efficiency, speed and quality of the construction process, but also a healthier and more environmentally friendly alternative to construction in the context of sustainability.

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