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Section 8. Transport

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Development of improved technical means for transportation fruits and vegetables

Abstract: this article discusses the need to develop and use of containers for the fruits and vegetables transportation. It includes the requirements for the container construction and proposals of a new containers construction for the fruits and vegetables transportation. The article also provides for the theoretical studies of the stress-strain state of developed container construction.

Keywords: container, fruits and vegetable products, finite element model, operational load, stress-strain state, strength.

Introduction

For the last years in Uzbekistan the strategy of agriculture development is consistently implemented and this is aimed on ensuring food security of the country. This approach to the production of fruits and vegetables as an important part of the whole system of livelihood, maintaining their health, as well as the creation of conditions of employment has become one of the main vectors of economic and social policy of the state.

Today in the republic, a lot of attention is paid to the development of farming and annually over 17 million tons of fruits and vegetables are produced.

Thanks to measures taken by the system is steadily increasing export potential of the industry. In the last years Uzbekistan has become a major exporter of high quality and competitive fruits and vegetables products. In order to ensure it throughout the year a lot of attention is paid to the processing, storage and transportation. The geography of exports of horticulture and viticulture. Previously Republic traditionally supplied it mainly to Russia, Kazakhstan and other CIS countries, then today it is shipped from Uzbekistan to the markets of more than 100 countries.

The Republic of Uzbekistan has a powerful transport including a rail, road, air, pipeline and river. The main transport takes place in the railway transport, which accounts for over 60 % of the total freight turnover in the international direction.

Railways in Uzbekistan are in good condition and suitable for operation of freight trains at a speed of 90 km/h, and some reconstructed road sections allow to pick up speed over 100 km/h.

Along with the ongoing work on the renew and reconstruction of railway lines, it is necessary to take measures to optimize the entire chain of the organization freight transportations. Many experts noted that the solution to this problem could be the widespread use of containers, as well as the modernization of infrastructure, locomotive and rolling stock fleet of JSC "Uzbekiston Temir Yullari" [1–3].

Multi-party system and manifold of transportation Horticulture products makes exploitation of such containers, which would create the conditions to ensure keeping quality of fruits and vegetables during transport, taking into account their biochemical composition and microbiological contamination related to the organization of transport — by road and rail.

Short description of researches

Therefore, it became necessary to create a structure of container that meets the requirements. The Tashkent institute of railway engineering staff conducted studies for the universal containers creating for fruits and vegetables transportation.

Researches construction of these containers were based on conceptual approaches and requirements, while providing the following possibilities:

- mechanized loading and unloading of products from containers;
- production loading and unloading operations using cranes and forklifts;
- stacking containers in two or three tiers of in warehouses and container areas;
- maintain of fixity on rolling stock;
- waterproofness for the goods, which "afraid" of atmospheric effects.

Types, basic parameters and sizes of specialized containers for transportation of bulk, piece and liquid cargo, perishables and foods without packaging, in packaging's and in a lightweight package, on platforms and open wagons railways, cars, trailers, boats and ships, and for the temporary storage on the storage areas are set to meet the requirements of the international standard [4].

On the results of research, using modern engineering programs was designed 3D model construction of container with hatches (Fig. 1) for transportation of fruits and vegetables. This construction of the container was designed on the basis of 20 and 40 foot universal containers.

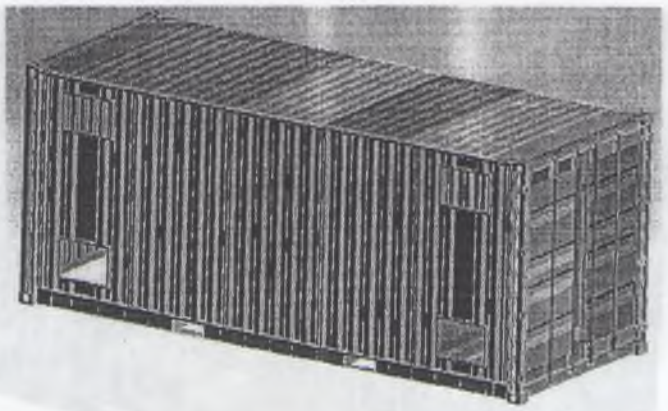

Fig. 1. General view of the 3D model of construction of the designed container for transportation fruits and vegetables

The main elements of the container construction for fruits and vegetables transportation are made of steel grade GOST 19281–89 09G2 C, which admissible voltage is 295 MPa [5].

The side walls of the proposed container have been equipped with hatches with size of 550 × 400 mm. for the natural ventilation of goods carried. To ensure the strength of the developed design of the container, place of the hatches around the perimeter of the hatches were reinforced stringers angular profile. For natural ventilation in line with international standards it is most expedient to place the hatches in the four corners side wall, respecting the distances indicated in Fig. 2.

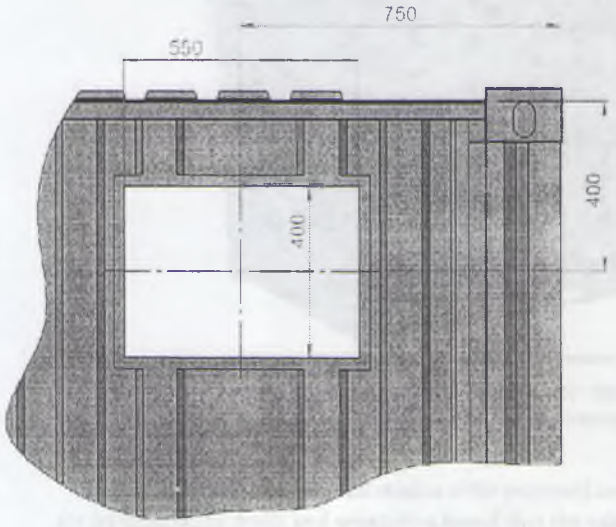

Fig. 2. The main sizes of the hatch of the container for transportation fruits and vegetables, mm

Researches of stress-strain state of designed construction of the container for transportation fruits and vegetables under the action of operating loads carried out using industrial software that implements the finite element method. The essence of the method and examples of its use for various calculations detailed in a lot of the literature [6–8].

In order to design scheme of the container for transportation fruits and vegetables as much as possible most accurately corresponds to the actual performance and character of the work to describe the elements of the container were used plate-rod finite elements.

Elements have six degrees of freedom at each node: displacement in the direction of axes X, Y, Z coordinate system node and turns around the axes X, Y, Z coordinate system node. Elements such as the mass connected with the elements of the carcass using an absolutely hard links. The design scheme of the construction container for transportation fruits and vegetables is shown in Fig. 1, and with the finite element mesh is shown in Fig. 3.

Calculated plate-rod finite element model of designed container for fruits and vegetables transportation includes 208 392 finite elements and 71 958 nodes.

The loads acting on the elements of the container during loading and unloading, transport, handling and storage operations are presented in detail in many sources [9–10].

In modeling, allowable stresses of elements of container had been taken in accordance with [3]. For all the steel modulus of elasticity was assumed to be $2.1 \cdot 10^5$ MPa and the Poisson's ratio — 0.3.

Selective results of distribution fields of equivalent stress in the elements of the container shown in Fig. 4, and Fig. 5 shows the results of field distribution equivalent to movements in the elements of the container for transportation fruits and vegetables.

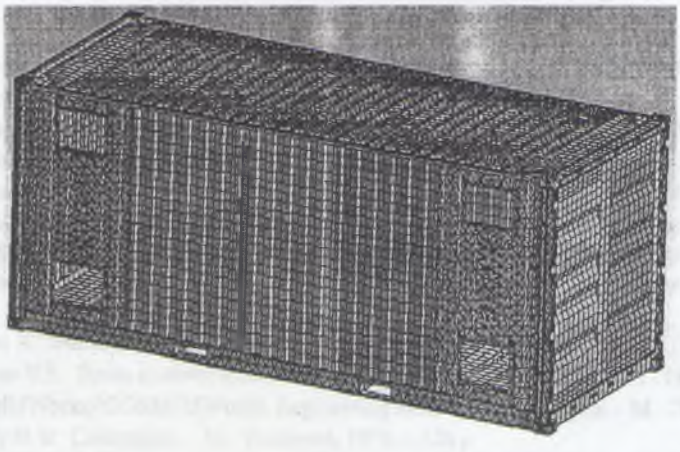

Fig. 3. General view of the finite element model of developed universal container for transportation fruits and vegetables

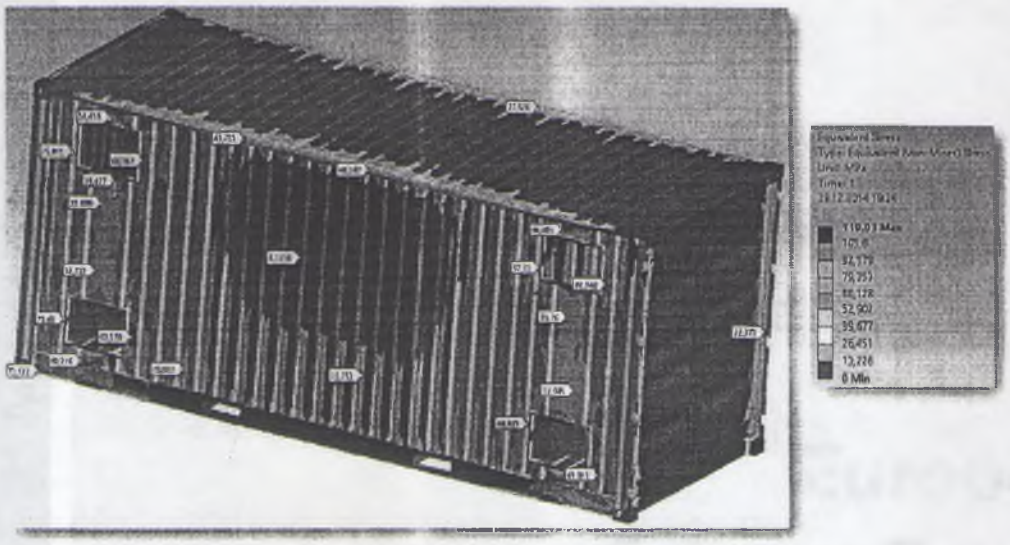

Fig. 4. The fields of distribution of equivalent stresses in the elements of the container for transportation fruits and vegetables, Mpa

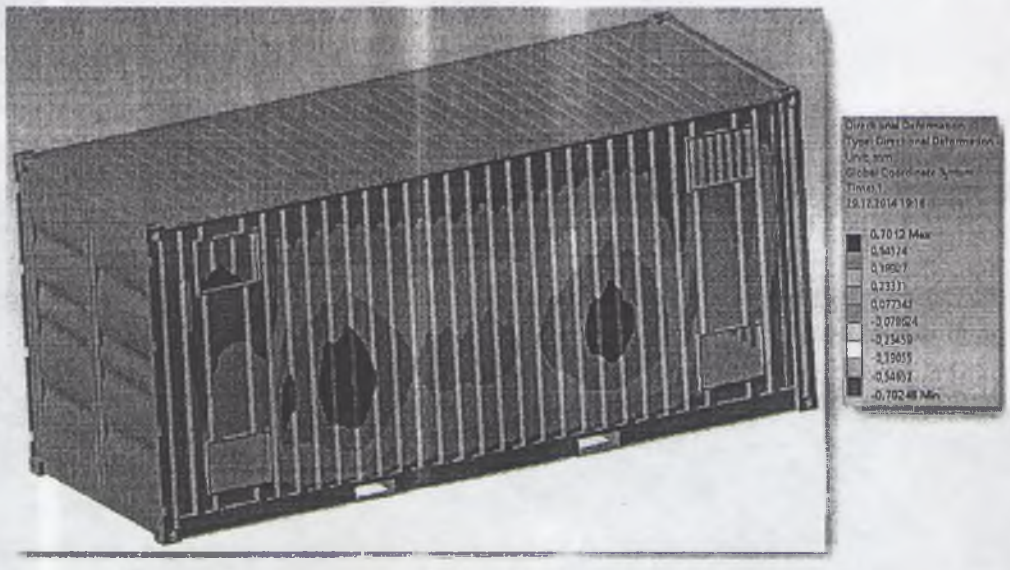

Fig. 5. Fields distribution equivalent displacements in the elements of the container for transportation fruits and vegetables, mm

Conclusion

On the strength of theoretical studies of the proposed container for transportation fruits and vegetables found that the calculated maximum stress in the structural elements of the container do not exceed the permitted (123.3 MPa < 295 MPa). Thus, the chosen design of the container meets the requirements for strength for all combinations of operating loads.

On the basis of studies the technical solutions of a universal container for fruits and vegetables transportation were developed.

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