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RESEARCH RESULTS OF METAL SPIRAL-FOLD SILOS

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Metal capacity structures for storing various types of bulk materials are one of the most common types of building sheet metal structures. This is confirmed by their structural variety, which includes solid welded, prefabricated and spiral silos. One of the most advanced types of thin-walled sheet metal structures is the highly industrial and economical spiral-fold metal silo (fig. 1, a).

Spiral-fold silo has a cylindrical body, which is a system of spiral connection of the steel strip by double folding. Unique technology allows for compact and fast installation of high-strength and hermetical silos directly at the construction site, without the use of bolts and welded joints.

Spiral-fold structures are universal and cost-effective, as they can be used in various industries: silos for various types of bulk materials; tanks for storing various liquids; and digesters as part of bioenergy plants.

Silos are subjected to many loads, so during the operation of metal containers there is a possibility of structural failure due to wall destruction. The most common type of collapse of metal silo walls is bending failure, which is usually sudden and often leads to catastrophic accidents (fig. 1, b).

In the study, it is assumed that a spiral-fold silo as a system consisting of short shells and it is considered the stress-strain state of the zone between the ribs (folded locks) of the shell with a constant wall thickness. The section is elastically connected to the neighboring short shells and undergoes a stress-strain state of the longitudinal-transverse bending type.

The study presents a comparison of theoretical analyses with finite element analysis in the LIRA-CAD software package (fig. 2).

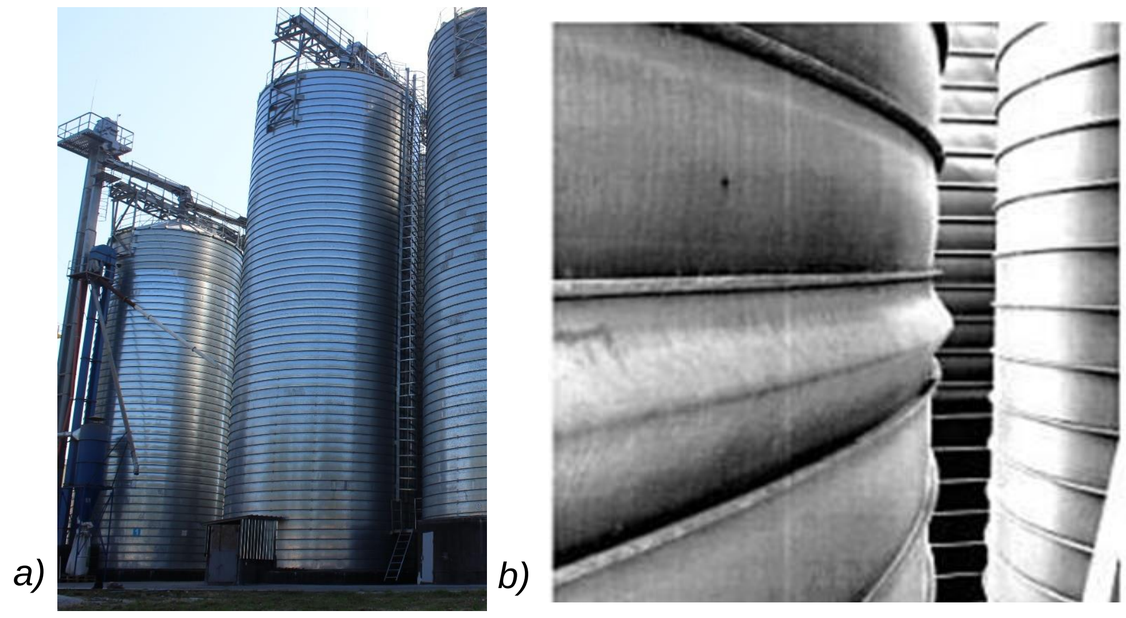

Fig. 1. The spiral-fold silo: a) general view; b) bending of the inter-rib zone of the spiral-fold silo wall

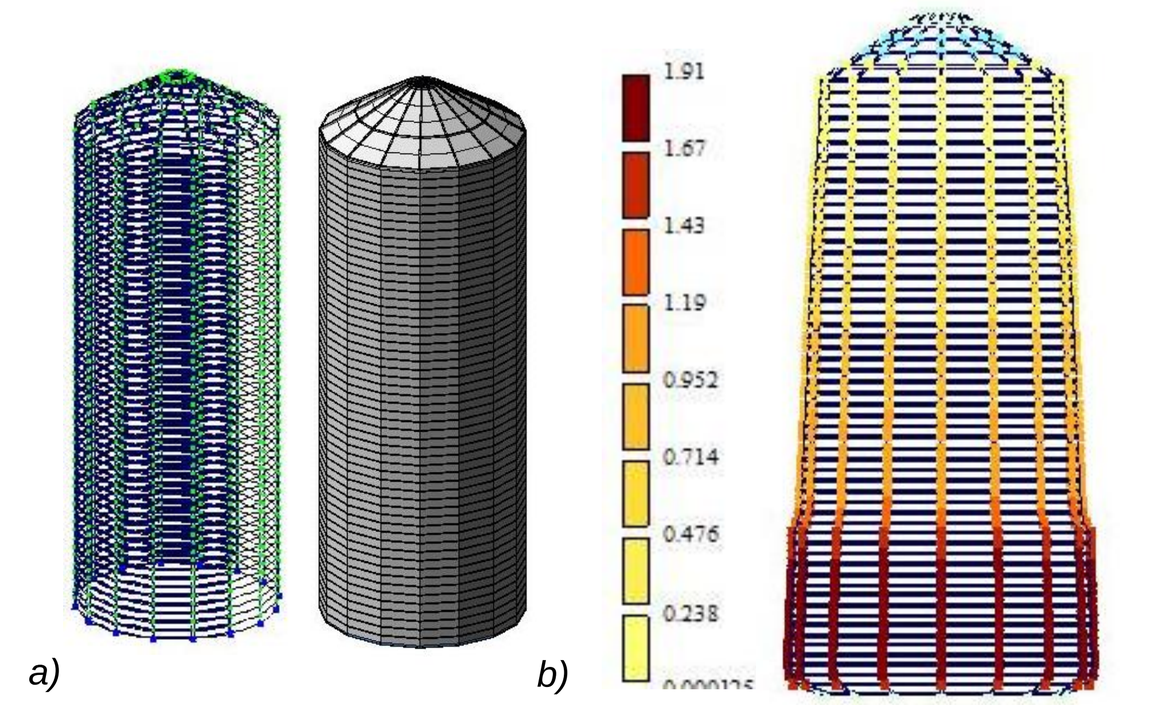

Fig. 2. Model of silo in LIRA- CAD: a) general view of the calculation model of the silo; b) mosaic of silo displacement

An experimental study (fig. 3) was conducted to determine the nature of the bending behavior of the spiral-fold silo wall. The aim of the study was to experimentally determine the stress-strain state of the silo wall at the bending stages

The results of the experiment showed that the revealed character of the wall operation at the loading stages mainly corresponds to the out-of-limit state of the spiral-fold silo shell and confirms its reliability under the influence of possible increased extreme loads.

Based on the conducted and above-described studies, a methodology was developed for assessing the reliability of a spiral-fold metal silo using an analysis of the strength reserve factor $\tilde{Y}$, taking into account its stress–strain state. The obtained numerical results confirmed the high reliability of spiral-fold metal silos.

Based on the results of the conducted research, this type of construction can be confidently recommended for broader implementation both in Ukraine and internationally.

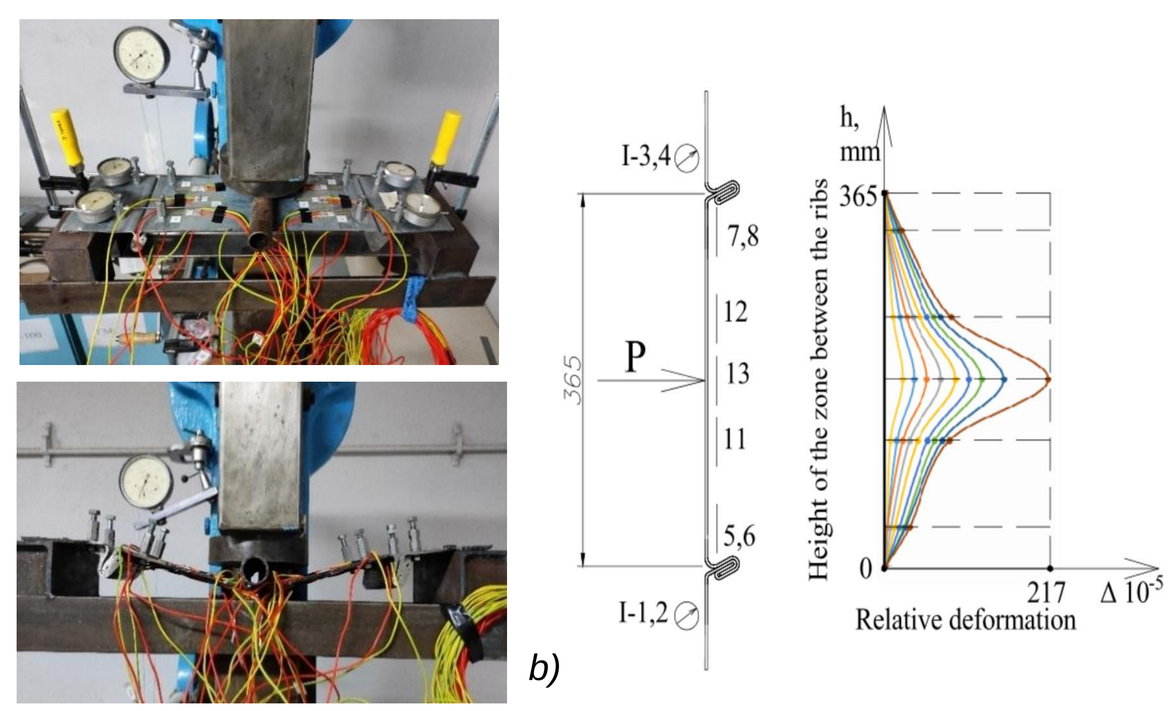

Fig. 3. Experimental study: a) experimental sample in a testing machine; b) Stress-strain state of a wall element, strain diagram