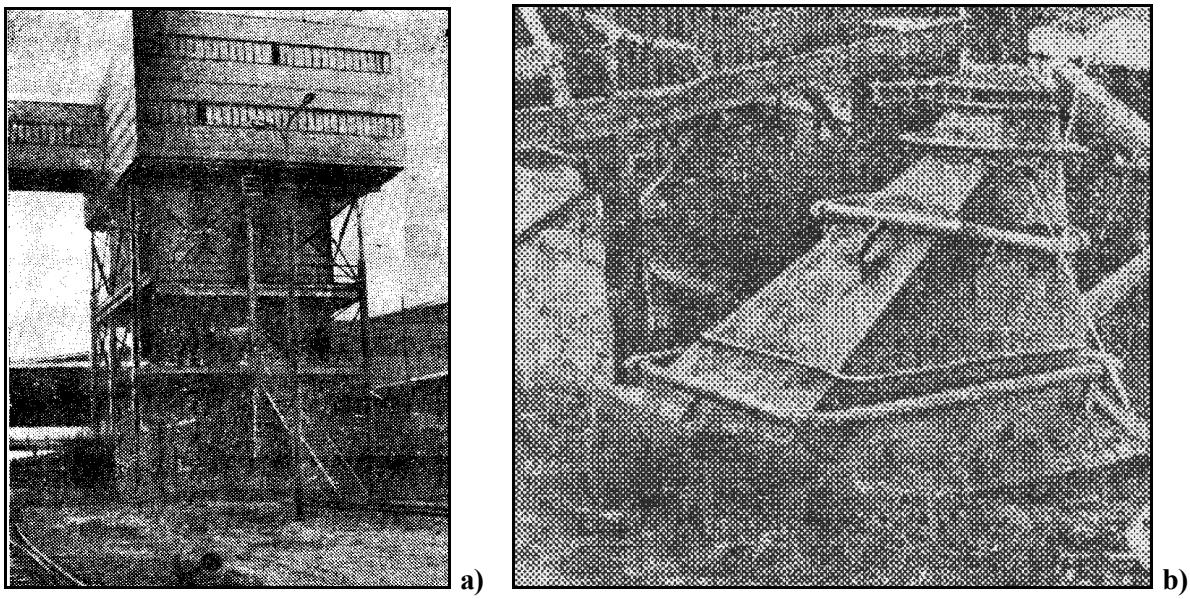
of the structural loads. Currently it has two aspects. The first is that the determining type of load in the design of hoppers and silos is the pressure of the bulk material exerted by it on the bottom and walls of the capacities, and there is currently no consensus on this aspect among experts. More than two dozen of different theoretical models describing the interaction of the bulk material with elements of the capacitive structures are developed and used in varying degrees. The obtained results on them differ both qualitatively different distribution of pressure, and quantitative values of their maximum, having the run up to several times.

Besides, when determining the pressure not actual but the average characteristics of bulk materials are used, presented in special manuals. And according to various sources for the same materials they are also different (the difference is in specific gravity, for example, it can reach 50%). Therefore, the task of the correct determining of pressure of the bulk material on the bottom and walls of the vessel and it is one of the primary and most urgent problems in the structure rationalization of hoppers and silos.

For instance, in paper [4] there is an example of the hopper collapse with volume about 150 m3 for storage of cement, which took place after several days of its operation. At the next charge there was a hopper separation at the site of its connection to the vertical part. The hopper collapsed at the service platform, which in turn was destroyed and fell to the bottom of the railcar (**Figure 1**). The main cause of the accident was stated "... the mistaken value of the estimated load...".



a) **b)**

Figure 1. The view of the hopper for cement storage before (a) and after the collapse (b).

Exactly the same reason according to the data of [5] led to an accident of 1830 m3 welded cement silo at the Magnitogorsk cement plant. During unloading of cement from steel silo into railcars the cone bottom of the silo came off and the collapsed cement caused significant structural damages of the silo, brick walls of the silo department, aerial and electric networks and trains, located under the load. At the same time silo was in operation only 2,5 months.

During the the analysis of the causes of a series of grain elevator accidents [6] an incorrect determination of the pressure from the stored grain in silos is also stated. The silos were made of reinforced concrete, but this only further demonstrates the generality of the problem, regardless of the type of material supporting the structure.

These examples quite clearly show the second aspect of the mentioned above problems of accurate determining the loads, namely, a significant narrower range of the considered in the design loads and impacts. A considerable role is given to dynamic effects accompanying the operation of capacitive structures, including the forced discharge during the use of special devices. The work [7] is focused on this.

The second specific mistake, made at the stage of projecting steel capacitive structures for bulk materials, is the wrong application of cross-sections of the structural elements. As the previous error it also has two aspects.