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What is Scale Effect?

In the recent history of building, mankind has begun to confront the issue that large-scale construction projects may just collapse unpredictably, in total or in part. This issue gained attention after the Second World War when two commissions of the United States and Great Britain had to explain a lot of mysterious accidents and disasters.

Some scientists think that Docherty was the first who investigated and pointed to the issue in question, but others consider Chechulin B. to be the first. Several studies have found that the scale effect diminishes the strength of all objects by increasing their size. It causes most major accidents, and affects the most expensive buildings, ships, bridges, aircraft, missiles, submarines, pipelines, etc.

The causes of the destruction of buildings when the reasons are unknown were united under the general definition of "mysterious technological disasters" - MTD. As a result of research and experiments, it was found that the causes could be the following:

- the strength of structures due to calculation errors;
- problems in manufacturing technology;
- the lack of qualifications of builders, etc.

The main conclusion from the representative commissions was that the reason lies in the elusive properties of materials.

Besides, it has been found in a number of experimental works that scale effect affects defects (cracks, pores). During experiments, researchers found out that the quantity of defects increases with the increase of the object size. Therefore, the strength of large objects decreases. This means that a small number of these defects are not significant and almost invisible, but with large objects these defects are much more visible and play an important role in the structure.

Thus, testing different materials (metals, rocks, coal, concrete, etc.) showed that, in practice, there can be a deviation from the law of deformed bodies' similarity. These deviations are called scale factor and catastrophic event – scale effect.

One of the most prominent scientists in the field of scale effect on rocks was Russian scientist Koyfman I.M. He was able to distinguish two kinds of scale effect. The first one involves the volume associated with the structural heterogeneity of the tested material and the presence of randomly distributed defects. The scale effect of the second kind involves the quality of the samples and the degree of destruction of the surface layer.

We can, therefore, make a conclusion that scale effect is a universal phenomenon and does not depend on the type of atoms or molecules that make up the material.