The aim of the project is to understand the mechanisms of propagation of damage in composite structural elements and their impact on the operation of this type of construction. The novelty compared to similar works known from the literature is to try to model the damage as the nearest in shape, size and type (delamination, matrix or fiber cracking or their combination) the actual damage.
To complete the project was decided on the basis of analysis of literature make a base laminates damage depending on the material they are made (the authors will focus on laminates of carbon fiber and glass fiber) the thickness of the layer stack and impact energy. Such prepared database being developed will help to validate numerical models to simulate allow the formation of such damage. The next step will be modeling of thin-walled composite profiles of entered damage on their real character. Considered the profiles will be subjected to compression or bending. Thin-walled open section profile made of a laminate will be analyzed. The influence of damage during their operation (in full load range), their types, sizes and locations on thin-walled composite profiles will be analysed. The results of numerical simulations will be compared with experimental results, which will allow for the introduction of possible improvements in numerical models. Experimental studies will be conducted for the previously selected cases. First the low velocity damages will be introduced, which will be examined by non-destructive methods allowing to describe their character. In the next step profiles with damages will be subjected to compression or bending load and will increase until the destruction of the structure, which will allow for researching and describing a work of structure in full range of load.
These studies are important not only cognitive but because the thin-walled composite parts are currently used in many responsible structures, such as: airplanes, cars, helicopters blades or turbines, or even sports equipment. The usage of thin-walled composite structures in bearing elements of different designs, allows to ensure a minimum weight design by optimizing the geometrical parameters and material, because they are characterized by high strength properties in relation to their specific weight. These factors determine the ever-growing use of these materials in modern designs. It should be noted that composites in contrary to steel or aluminum are less resistant to accidental impacts supplies, among which the most dangerous are those who are not visible from the outside and cause damage inside. This failure of the material could lead to a significant reduction in the mechanical properties of the composite structure. Therefore, an important issue from the point of view of safety design is the ability to determine the impact of such damage on the operation of the entire structure.
There was a thesis that operating damages of tin-walled composite profiles can have a significant impact on the nature of their work in a whole range of load and decrease the value of load-carrying capacity of these components. It should be mentioned that the location and size of defects in the structure and composite layer arrangement are also important.
Implementation of the specific objectives of the project will be carried out using interdisciplinary research methods, combining issues related to the experimental studies and numerical simulations.
To evaluate the destruction of the composite material will be employed known in the literature stress failure criteria. The results of numerical simulations will be used to assess the impact damage to the composite construction work - reducing carrying capacity and describe the nature of the destruction of the composite structure.
The need to know the mechanisms of formation and mechanism of destruction process in composite structures, which created internal failure is associated with insufficient knowledge in this area, important in terms of getting greater use of composite structures for the responsible elements of modern load-bearing structures. In the literature there is no publication relating to the behavior of composite structures with operating damage modeled in such a way that their shape and nature is similar to real damages.