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CONSIDERATION OF THE HELICOPTER ROTOR WAKE IN THE DESIGN OF A BUILDING

The vortex loads generated by a helicopter are a consequence of the movement of air around the helicopter's blades. When a helicopter approaches or flies over a building, the airflow that forms around the blades can interact with the building and cause vibrations in the structure of the building.

These oscillations can have different frequencies and amplitudes, depending on the speed and altitude of the helicopter, the shape of the building and its structure, as well as the characteristics of the helicopter itself, such as its weight, speed and type of blades.

To reduce the impact of vortex loads, buildings can be designed to accommodate these loads and reinforced with additional structural elements. These elements may include strengthening the foundation of the building, installing anti-

wind shields on the roof of the building, changing the shape and geometry of the building, and other measures.

However, despite all precautions, vortex loads can have a significant impact on a building if the building design does not adequately consider these loads or if the helicopter landing procedure is not correct. Therefore, it is important to strictly follow the rules and recommendations for the safe operation of helicopters near buildings and design buildings taking into account vortex loads.

The use of modern computational fluid dynamics (CFD) methods can be useful in the design of buildings, especially if they are intended for use near helipads or in areas with a high concentration of helicopter traffic.

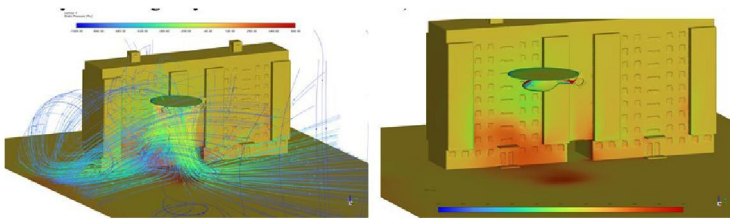
Computational fluid dynamics methods make it possible to simulate the movement of air around a building and evaluate the effect of vortex loads on the building structure. These techniques can be used to identify critical points on a building that are most exposed to eddy loads and also to pre-determine the reinforcement measures that may be required to protect the building from these loads. One example of such methods is the numerical solution of the Navier-Stokes equations, which can be applied to simulate the movement of air around a building and estimate eddy loads.

Another example is the finite element method, which can be used to model the mechanical behavior of a building when subjected to vortex loads.

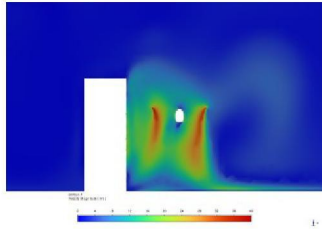
However, it should be noted that the use of modern CFD methods can be expensive and require specialized knowledge and skills to apply them. In addition, the results of calculations may have limited accuracy and require additional checks and tests on mock-ups or full-scale models of buildings.

Thus, the use of modern methods of computational aerodynamics can be useful in the design of buildings, but should be considered as an additional tool within the framework of an integrated approach to the design of building structures.

For example, let's consider the consideration of vortex loads on a typical 9-storey panel building from an EC-135 helicopter (which are in the service of the Ministry of Emergency Situations of Ukraine).



a – Visualization of the vortex wake near the building; б – Static pressure contour of the helicopter and the building;



c – Velocity contour in plane of the building and helicopter.

Figure 1 – Visualization of the vortex wake

A brief calculation algorithm can be summarized as follows. To import loads obtained in the Ansys Fluent software package into LIRA CAD, you must perform several steps:

- 1) Export of loads in .csv format from the Ansys Fluent software package
- 2) Loading exported data into LIRA CAD
- 3) Assignment to the exported data of the corresponding elements of the building structure in LIRA CAD (columns, walls, beams, etc.)
- 4) Check the correctness of the assigned loads, check whether the limits are exceeded
- 5) Make calculations in LIRA CAD.

REFERENCES

1. Sharma, Abhinav & Padthe, Ashwani & Friedmann, Peretz. (2020). Simulation of Helicopter Hover and Landing on a Moving Ship Deck using a Dynamic Ground Effect Model. 10.2514/6.2020-1137.
2. Wadcock, Alan & Ewing, Lindsay & Solis, Eduardo & Potsdam, Mark & Rajagopalan, Ganesh. (2008). Rotorcraft Downwash Flow Field Study to Understand the Aerodynamics of Helicopter Brownout. 28.
3. WANG, Biao & Sun, Shuai & Duan, Minglei. (2018). Impact of building form on the wake flow wind potential. Energy Procedia. 153. 383-388. 10.1016/j.egypro.2018.10.070.
4. Burgo, Artur & Cezana, Fernanda & Hülle, Bianca. (2012). STUDY OF WAKE REGION OF A TYPICAL ISOLATED BUILDINGS. PART I: FLOW VISUALIZATION