Best Practice in Application of CAA CAP 437 Standards for Offshore Helicopter Landing Areas

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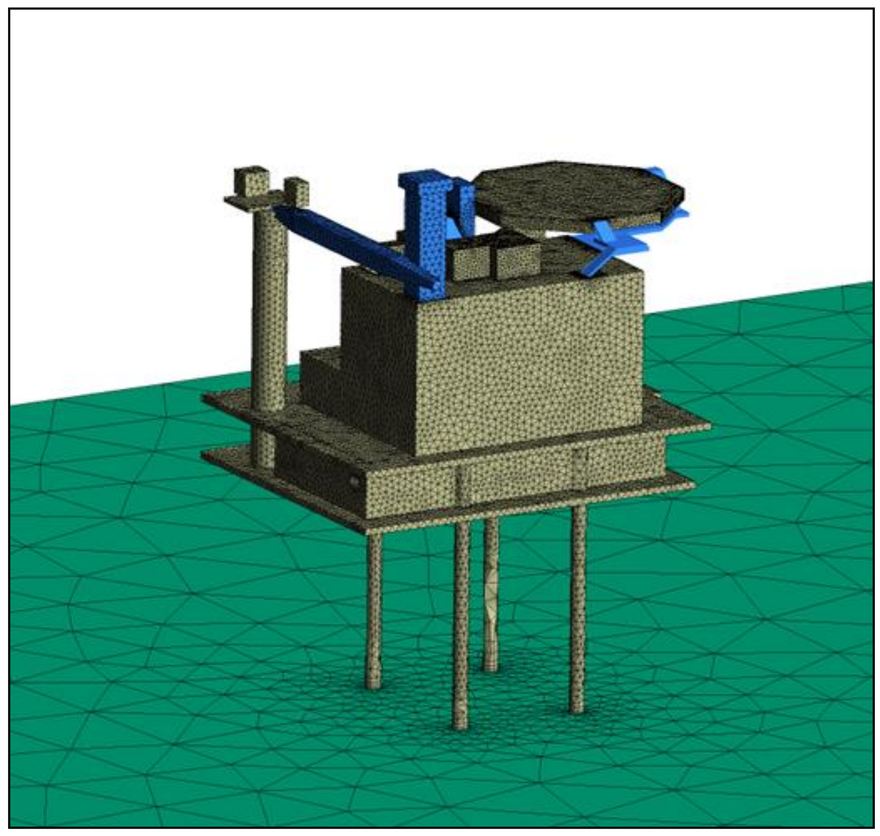
Introduction

The UK Civil Aviation Authority publishes a set of guidelines for offshore helidecks – ***"CAP 437 Standards for Offshore Helicopter Landing Area"*.**

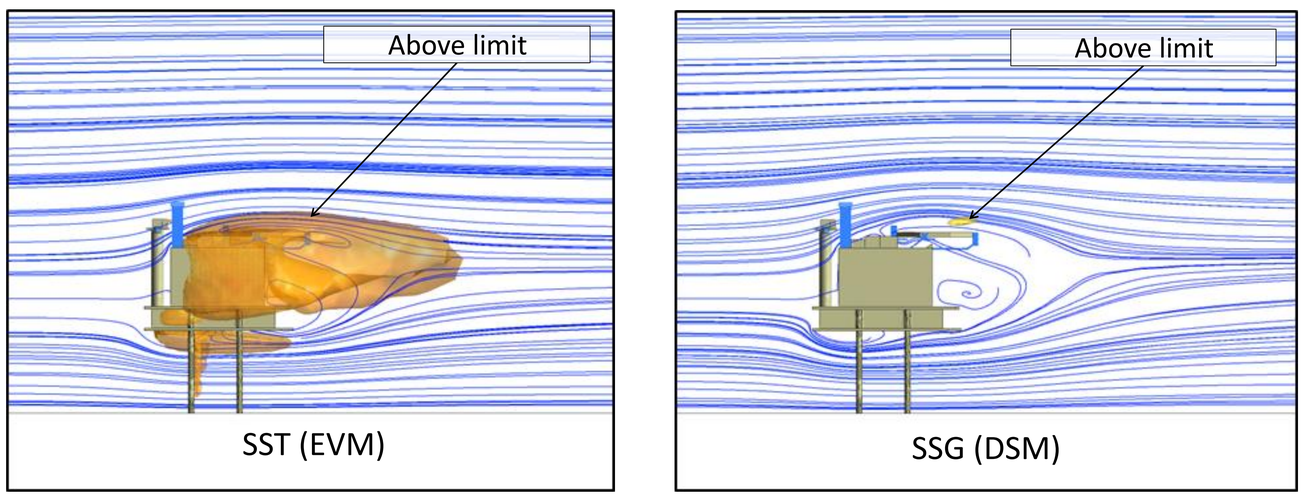
- Used as the standard for offshore installations in UK waters and to provide guidance worldwide by various duty holders.
- It provides guidance on helideck layout and equipment and places limits on environmental variables over the helideck for turbulence, temperature and hydrocarbon gas plumes.
- CAP 437 stipulates that modelling should be used to demonstrate these limits are met and this is usually carried out using computational fluid dynamics (CFD). The specific requirement for turbulence over the helideck is that the standard deviation of the vertical airflow velocity should be less than 1.75 m/s.

The International Standard *"**ISO 15138 Petroleum and natural gas industries - Offshore production installations - Heating, ventilation and air-conditioning**"*

- Requires that a Differential Stress Model, DSM (sometimes also referred to as a Reynolds Stress Model, RSM) is used for the CFD model calculation of turbulence over the helideck.
- This is an additional requirement to CAP437 but in keeping with the spirit of the CAP437 standard.

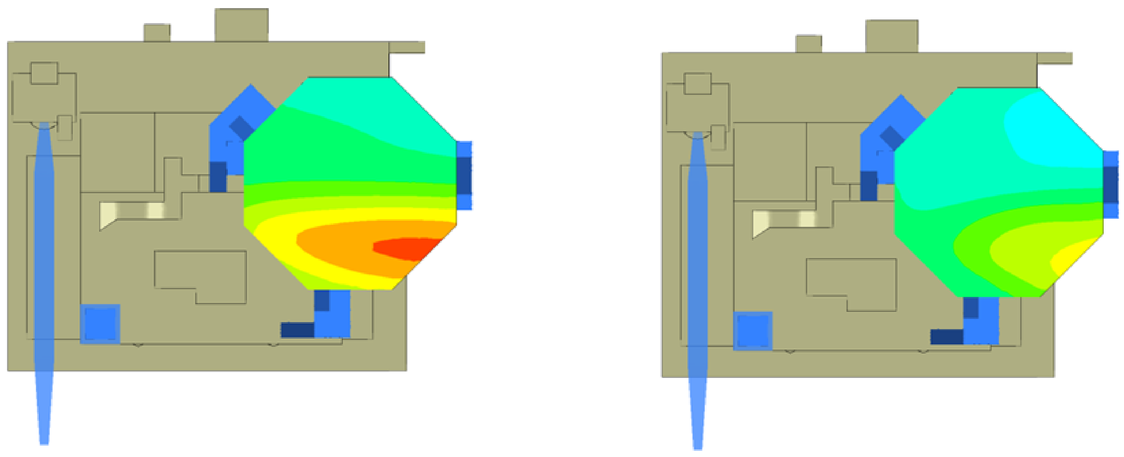


Typical CFD Model Geometry and Mesh for an Offshore Installation Living Quarters and Helideck.



CFD results showing streamlines and an iso-surface for the value v' = 1.75 m/s

CFD results showing contours of v' on a plane 5 m above the helideck



Modelling Turbulence

The standard deviation of the vertical airflow value required by CAP437 is not available in "standard" eddy-viscosity turbulence models such as the *k-epsilon, SST* model and other variants. These assume turbulent viscosity is isotropic and further assumptions have to be made about the distribution of turbulence between the coordinate directions to determine the vertical standard deviation of air flow.

In a Differential Stress Model (DSM) the distribution of turbulence between the coordinate directions is calculated. The standard deviation of vertical airflow is a result of the CFD model without the need for more assumptions. This makes DSM (or RSM) models in a CFD code inherently better suited to helideck modelling

A Helideck Example

A typical offshore helideck mounted on living quarters was used to test two turbulence models in ANSYS CFX:

- Eddy Viscosity Model (SST)
- Differential Stress Model (SSG).

When using the EVM-SST approach large areas over the helideck would be deemed to "fail" the CAP437 standard with the v' value in excess of the 1.75 m/s limit.

However, the DSM approach shows that the helideck would in general "pass" the CAP437 standard.

Best Practice Guidelines

1. ***Aim of calculation*** – CAP437 describes limits on hydrocarbon and thermal plumes over the helideck in addition to the turbulence limits; the aim should be considered at the outset of the work as it will affect the definition of the CFD model.
2. ***Turbulence Model and Software Selection*** – Aim for the DSM turbulence model specified by ISO 15138, but certain CFD codes do not have the capability.
3. ***Background Turbulence*** – The wind approaching the helideck over the sea will contain "naturally occurring" turbulence due to physical processes in the atmosphere. Ensure it is included by defining the atmospheric boundary layer appropriately.
4. ***Wind Speeds*** – At least three non-zero wind speeds should be calculated in each wind direction. Curvature and swirl effects in the wind have a non-linear relationship with mean velocity. If only two wind speeds are calculated and the turbulence at other wind speeds is extrapolated from these, it will not be possible to find the non-linear effects
5. ***Results' Height above Helideck*** – The highest turbulence values, including v', are typically found immediately above the helideck surface due to wall shear effects. However these are not significant to the CAP437 analysis. The purpose of limiting v' is to prevent adverse and unanticipated loads being placed on the helicopters rotors and hence increasing the pilots work load during the crucial stages of landing and take-off. Turbulence fluctuations need only be assessed at and above the position of the helicopters' rotors, typically around 3 metres above the helideck.
6. ***Availability*** – Helideck availability can be determined from the number of cases with different wind speeds and directions which fall within and outside the v' = 1.75 m/s limit stated in CAP437. If the frequency of these winds is taken from the wind rose, the overall availability of the helideck can be obtained. The acceptable frequency will usually be determined by the installation duty holder and may be dependent on a number of operational factors.

References

- Civil Aviation Authority, 2013. Standards for Offshore Helicopter Landing Area. Safety Regulation Group Report CAP437, Seventh edition incorporating Amendment 01/2013.
- International Standards Organisation, 2007 Petroleum and natural gas industries - Offshore production installations - Heating, ventilation and air-conditioning. ISO 15138. Second Edition 20
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