Editorial

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Proceedings of the Institution of Civil Engineers – Engineering and Computational Mechanics (EACM) is always striving to publish papers that not only include the latest top-quality research, but also raise searching questions in engineering that demand greater attention and awareness. This issue of EACM publishes three papers from different fields with an evolving theme of turbulent flow and thermal effects in both fluids and structures. These are fields where there has been significant activity, but this issue addresses key gaps in our knowledge and engineering practice.

Taghia *et al.* (2015) present an investigation for slanted end-plate connections at elevated temperatures. End connections are essential in structures. In comparison to conventional connections, slanted end-plate connections have both considerable savings and advantages. Structural engineers often need to strengthen connections to minimise thermal effects when resisting lateral loads. Traditional techniques include increasing the area and using cooling systems. As the authors point out, while vertical steel connections at elevated temperatures have received much attention, slanted connections have received far less attention despite being widely used.

With an elevated temperature inducing an extra internal axial force in a beam, the paper presents fundamental analysis for slanted end-plate connections with friction support, or friction bolt support, or a frictionless support. These are investigated

under two cases of symmetric and non-symmetric gravity loads for both before and after application of elevated temperature (Figure 1). The paper finishes by making two important conclusions: (a) changing the angle of the slanted end-plate connection can help identify the optimum axial force for the beam to avoid buckling; (b) the presence of bolts reduce axial forces prior to elevated temperatures, but reduce damping with thermal application by resisting sliding.

Continuing the theme of novel structures, Jarman *et al.* (2015), present a computational investigation into the modelling of vortex flow controls (VFCs). With no mechanical components, VFCs are passive, self-activating throttling devices (Figure 2) that have found use in various areas such as regulating flows between different catchment regions during flooding. This paper examines the flow behaviour at high flow rates when a confined vortex is present in the flow, which can have significant effect on the throttling regime. The ability of numerical flow solvers to predict these types of swirling flows accurately is crucial for the design of these devices and Jarman *et al.* (2015) use the increasingly popular open-source OpenFOAM package with different Reynolds-averaged Navier-Stokes (RANS) turbulence models. With a rigorous investigation examining the effects of mesh size and transient effects due to a free-surface, the authors assess five turbulence models including different eddy viscosity models (EVMs) and differential second-moment turbulent closure models (DSMs). The EVMs over-predict the pressure loss across

Figure 1. Free-body diagram of beam with non-symmetric gravity load after temperature increase (Taghia *et al.*, 2015)

Figure 2. Dimetric projection of the 0.5 phase fraction isosurface for a VFC with an outlet (Jarman *et al.*, 2015)

a VFC, the internal pressure values and importantly the turbulent production. The DSMs, however, produced simulations in good agreement with the experiments up to a threshold swirl value. Above the threshold swirl value, however, the DSMs predict greater diffusive behaviour than expected, which naturally dissipates the vortex. Evidently, expert knowledge of the behaviour of turbulence models for VFCs is essential.

Finally, Grafsrønningen and Jensen (2015) also examine flows involving turbulence but this time looking at flow past a horizontal heated cylinder (Figure 3), a problem that appears simple but even RANS and LES turbulent models typically struggle. In their paper, different turbulent closure models are investigated but they show that the results approach the laminar solution whichever model is used. In doing so, they nicely show that intermittency modelling within the transport equations prediction will not aid prediction of the transitional buoyant flow but can be used to enforce a laminar solution upstream. Importantly, the authors point out that the simulations of real flows will involve simulations of domains containing many cylinders. Hence, erroneous flows will be restricted to a small lower portion of the domain where fully turbulent CFD models would be needed.

So the initial themes of this edition of EACM are research into thermal and turbulent effects in fluids and structures, but the papers have also reinforced a pivotal issue of engineering practice that all engineers and researchers should incorporate into their work. It is crucial that potential pitfalls in engineering practice are highlighted, particularly when this involves the use of software packages commonly used throughout the industry. The papers have made essential contributions to this important discourse that must continue and engage the engineering community.

Figure 3. Instantaneous velocity field above heated cylinder (Grafsrønningen and Jensen, 2015)

REFERENCES

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