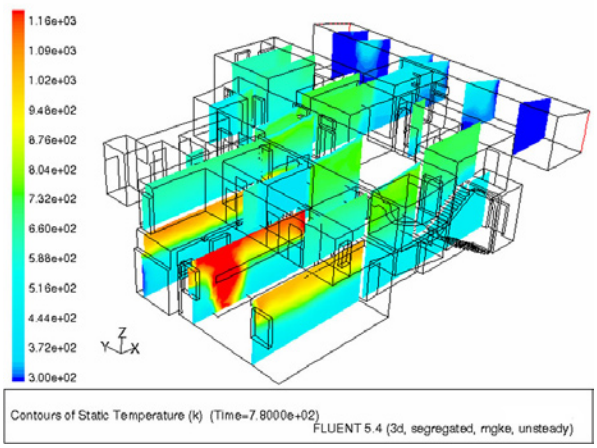
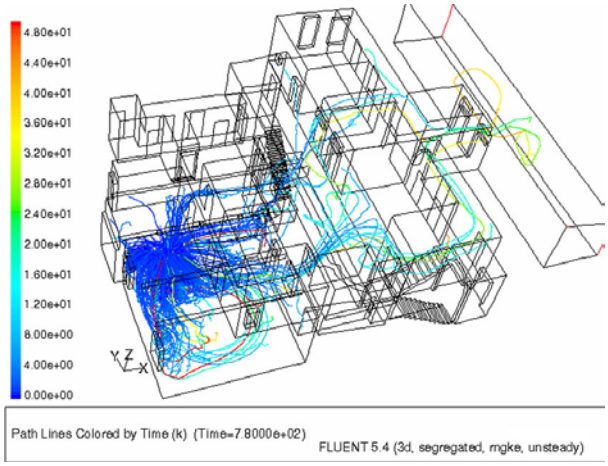
CFD

COMPUTATIONAL FLUID DYNAMICS

engineering3000
new product design & development





For a decade, Gilmore Engineers Pty Ltd and its New Product Division, e3k, have been developing and expanding expertise in CFD analysis. e3k is well positioned to analyse a wide range of fluid flow regimes.

Computational Fluid Dynamics (CFD) has grown from an academia-based research method requiring substantial computing resources, into a highly adaptive and accessible Computer Aided Engineering and Design tool. The development of faster, more powerful computers means it is now possible to run CFD models effectively on a desktop.

CFD can be fully integrated into the design process – the same 3D CAD models built for prototype construction and Finite Element Analysis (FEA) can be imported into the CFD software.

Essentially CFD can provide the middle ground between pure mathematical analysis and experimental testing. By creating 2D or 3D images and data for analysis, CFD can enable a concept to be developed through to prototype stage with speed and efficiency, minimising the time and expense required for experimental testing. CFD can also be effectively used to simulate flows in situations where experimental testing would not be possible, for example in analysing fires after the event, or in undertaking fire safety audits for new infrastructure.

The applications for CFD are endless – from weather prediction to HVAC applications to race car aerodynamics. Any machine or object experiencing fluid flows can be modelled. e3k utilises the software Fluent to produce accurate models of fluid behaviour for a vast range of flow problems. The software allows engineers to study diverse flow situations including free surface flows, acoustics, combustion behaviour, fluid mixing and turbomachinery.

The accuracy of results produced using CFD software depends greatly on the way in which the problem is set up. A correctly posed problem implemented by a knowledgeable user is fundamental to the accuracy of the final results.

Examples of CFD studies undertaken over the past decade include:

Modelling of a Building Fire
A CFD study was undertaken on a well-publicised fatal building fire within an accommodation complex. Results from the six-month long study were integrated into the police investigation enabling determination of cause and qualification of the overall building hazard. The same simulation technology has since been successfully validated by Gilmore Engineers Pty Ltd against experimental data in a full-scale mock building burn.

Ore Skip Passing through a Mine Shaft
An investigation of the lateral motion of an ore skip within a vertical mine shaft due to aerodynamic and other effects was carried out using CFD. This analysis looked at the forces on the sides of the skip as it travelled towards the surface. The model included details of the openings in the top of the skip and the air velocity down the shaft.

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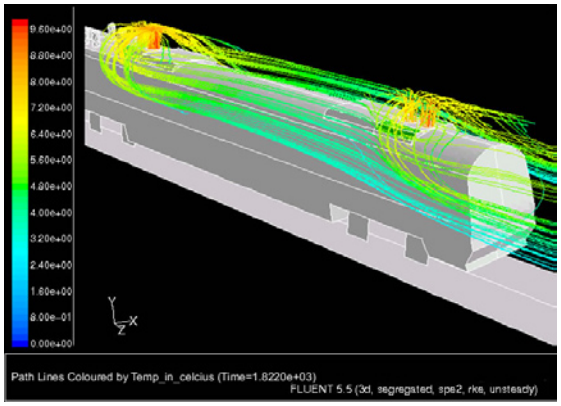
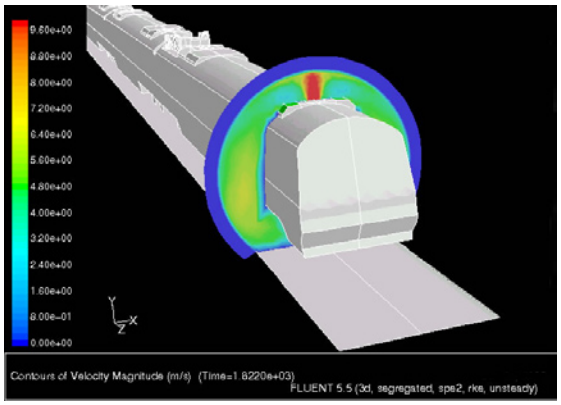
Renewable Energy Device
CFD was used to predict flow behaviour during the development of an innovative renewable energy device which generates usable electrical power from underwater tidal and ocean currents. The use of CFD by e3k was part of an integrated design process which also included 3D modelling and Finite Element Analysis.

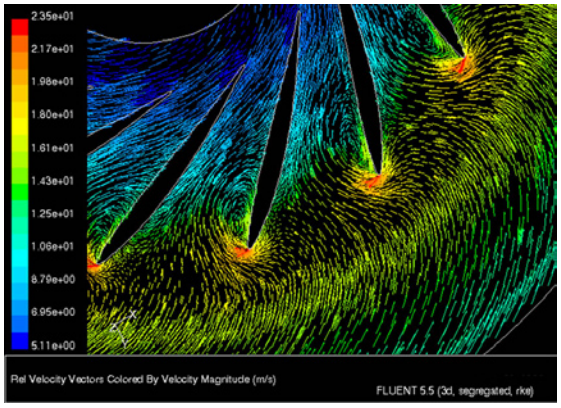
Livestock Transportation
A study was conducted in order to optimise ventilation conditions on board a vessel designed to carry livestock. The simulation included such things as heat emanating from the animals, CO_2 production through their breathing and spacing of the animals along the length of the vessel.

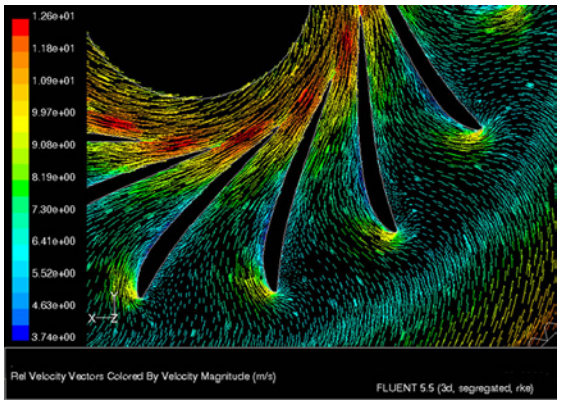
HVAC Study of a Railway Train Subway
Gilmore Engineers Pty Ltd was engaged to undertake a computational fluid dynamics study of a new subway in Delhi, India. The modelling was used to optimise tunnel ventilation to ensure operational air-conditioning in the event of a train failure mid-tunnel. The simulation included heat transfer to the ground and through tunnel walls. Traditionally this process had been an exercise based on in-house empirical data. In addition, modelling was undertaken of a typical railway platform situation to enable optimisation of the station ventilation systems. Heat input from carriage brakes and air-conditioners was incorporated into the simulation.





Optimisation of a Francis Turbine for Hydroelectric Power Generation
A comprehensive hydraulic design optimisation was undertaken for a customised 4MW low-head hydro installation in New Zealand. The study involved computational fluid dynamics modelling of the water flow through the machine and application of hydraulic engineering principles. Cavitation performance was also examined. Modifications were made to the scroll case as well as to the runner blade profile to improve overall hydraulic performance. The CFD results were validated when an absolute increase of approximately 5% in efficiency was attained as a result of the improved geometry.





Cutting Performance and Noise Limitation of Lawn Mowers
This project aimed to identify improvements which would provide additional competitive advantage for an already successful product. A theoretical analysis of the typical grass cutting action using particle tracking software was performed prior to designing and manufacturing experimental prototypes. Product development work has continued with this company with Fluent software being used to compare mower blade profiles for their cutting and noise attributes. Again recommendations made by Gilmore Engineers Pty Ltd have been validated with field tests showing a marked decrease in blade noise.

Contact: the New Product Division of Gilmore Engineers Pty Ltd

General Manager, e3k Global
BTP Technology & Conference Centre
Brisbane Technology Park
1 Clunies Ross Court
PO Box 4037 Eight Mile Plains 4113
Brisbane Queensland Australia

Phone: +61 7 3853 5250
Fax: +61 7 3853 5258
Email: cfd@e3k.com
Web: www.e3k.com