Safety at Sea
Safety Through Innovation

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Dynamic Energy Modelling

Fuel Saving, verified!

Simulation of complex energy flows by advanced modelling

SafetyatSea has teamed up with the Energy Systems Research Unit (ESRU) of the University of Strathclyde to develop design evaluation tools for assessing and improving energy efficiency onboard large passenger ships at early design stages.

Benefits

While energy efficiency has long been a major driver in ship design and operation, rising energy costs combined with political and social pressure from environmental concerns are driving the marine industry towards re-examining ways to reduce their energy consumption. Currently, design and operational decisions are made on simple "energy balances" which often only consider worst case design conditions which can bear no relation to how the vessel is operated or the physical processes involved.

- Reduced air conditioning & ventilation life-cycle costs
- Lower energy consumption
- Reduced fuel consumption and associated emissions – lower carbon foot print

Dynamic Energy Modelling

The approach is well established in the build environment where it has been applied for more than a decade.

It consists of simulating the vessel's energy consumption through its entire lifetime considering all relevant factors (speed, wind/wave conditions, irradiation, humidity, temperature, occupancy, hull condition, machinery performance, etc). In this way, design and operational decisions can be made on the basis of lifetime cost and environmental impact which are as close as possible to reality. The simulation is carried out with the ESP-r method, developed by the ESRU of the University of Strathclyde.

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The ESP-r method

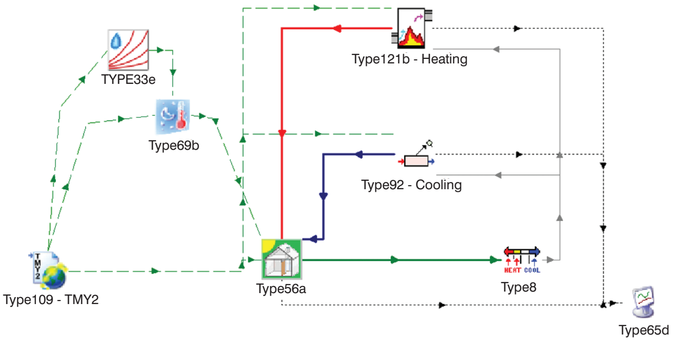
ESP-r Marine is an integrated computer simulation tool which can model the flows and transfer of energy and fluids in a ship environment. ESP-r has been developed for two decades at the University of Strathclyde and is used extensively in built-environment projects, for example by civil engineering contractors.

Using this tool, the comfort properties of environments such as restaurants and other public spaces in terms of air quality, temperature and acoustics can be assessed and optimised through effective analysis and design.

Problems such as solar glare and condensation can be addressed and minimised using models developed in the ESP-r environment.

The performance of control systems and strategies may be simulated and problem areas within these addressed.

The sensitivity of a ship's internal environment to design parameters such as geometry and materials can be evaluated and used to drive the design process.



ESP-r analysis can direct ship design towards lower energy requirements and carbon emissions incorporating:

- Fast and reliable calculation of actual energy usage in early design stage
- Rapid what-if scenario calculation for operation
- Modelling of complex physical processes important in understanding design implications.

Photos are courtesy of Royal Caribbean International

Example Analysis – Cruise liner Restaurant

The main dining room of a modern cruise liner presents a particular problem for ship designers and operators. Not only do the spaces tend to be large, in some cases encompassing entire fire zones over as much as 3 decks, the energy flows tend to be complex with large changes in casual gains (caused by occupants, lights and electrical appliances), potentially high irradiation levels and a requirement for optimal comfort for diners.

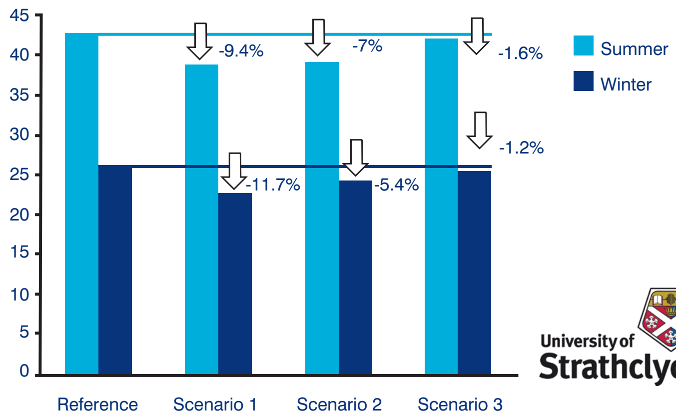
The model is run for a time period of several days in summer and then in winter, and the corresponding energy usages assessed. The results include:

- Solar gains through windows at every time instant taking into account radiation levels, external shading blocks and model geometry.
- Heat capacitance of space representing the transient heating / cooling-up of structure and outfitting.
- Climate data with ambient temperature, relative humidity and wind speed profiles.

Scenario Definitions

Scenario	Description
Reference	Basic settings – min fan speed 40% of maximum, no energy saving mode.
Scenario 1	Min fan speed reduced to 30% of maximum.
Scenario 2	Energy savings mode between 23:00-06:00 (dead zone between 20 and 24^{C}).
Scenario 3	Lights switched off between 23:00-06:00

Energy Savings Scenarios



University of Strathclyde

Further Information

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