Watertight doors as treated in DESSO
– some observations from a design oriented research project on safe ship design
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Content
• The inspiration to DESSO
• Chain-breakers
• Workshop results
• Design concept
• Importance of water tight doors
• Summary

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What it all started with

SS Titanic and SOLAS
DESSO is a concept ship. The main effort when designing the concept ship was to have it upright after severe damage, until people can be evacuated in an orderly way. Even if it is sinking slowly, it should stay upright and never capsize.

WT doors are of course a prerequisite for such a design.

unstable equilibrium

stable equilibrium
DESSO – A concept ship design for survival onboard

Naval architect's response to accidents with Ro-ro-ships and Ro-pax
The sinking of MS Estonia.
T.S. Andrea Doria - the radar assisted collision
MS Stena Nautica in collision with the freight ship, MS Joanna, 2004
WT doors not closed worsened the situation
Lost lives per lost ship and ship type

- Passenger/ro-ro cargo: 50
- Passenger ship: 15
- Other: 5
- Bulk dry: 5
- Passenger (cruise): 5
- Chemical: 5
- Container: 5
- General cargo: 5
- Research vessels: 5
- Oil products tanker: 5

Lost lives
Total losses by incident type, RoPax

- Foundered: 41.5%
- Fire/explosion: 34.1%
- Collision: 9.8%
- Wrecked/stranded: 12.2%
- Hull/machinery: 2.4%
Ship 1 did not use the east-bound ship-lane
Inadequate interpretation of radar
Fog

- Chain breakers
  - Use the recommended ship-lanes
  - Better training in radar operation

Emergency course alteration in the same direction
High speed

- Chain breakers
  - Education “Always” to starboard at risk of collision
  - Education “Low speed in fog”

Collision with casualties
Two compartments flooded
Empty fuel tanks on starboard side flooded
Pump and control room flooded through access tunnel

- Chain breakers
  - Bridge indication and alarms for all watertight doors between compartments.

Unable to flood the portside fuel tanks

- Chain breakers
  - Remote operation of the tank system (valves and pumps) from the bridge
  - Cross flooding of fuel tanks and ballast tanks

The ship’s list > 20’
Compartment after compartment is flooded

- Chain breakers
  - High watertight bulkheads (Height of compartments)
  - Horizontally limiting bulkheads

The ship rolled over and sank
Chain breakers
- Bridge indication and alarms for all watertight doors between compartments.

Chain breakers
- Remote operation of the tank system (valves and pumps) from the bridge
- Cross flooding of fuel tanks and ballast tanks

Chain breakers
- High watertight bulkheads (Height of compartments)
- Horizontally limiting bulkheads

The ship rolled over and sank
Eight of the chain-breakers concern stopping the event after it has started, often at an early stage. The ongoing problems of open doors between watertight compartments are a matter of great concern.

The crew’s training and organization in fire-fighting and evacuation were poor. In the fire accidents analysed, fire alarms were found not to be working and fire doors not closed during the fire. If this does not work, the whole strategy of fighting a fire and evacuating people might fail.

Seeing to it that the functionality of the equipment is adequate also falls under the authorities whose task it is to inspect the equipment.
Collision damages – significant for sinking – probabilistic considerations

A Panamax container ship in collision with a handy-max/general cargo ship
Collision damages – significant for sinking – probabilistic considerations

A VLCC after a collision with an OBO in ballast
Collision damages – significant for sinking – probabilistic considerations

A VLCC in ballast after a collision with a fully loaded cape size bulkship
As a definition of ‘severe damage’, the DESSO project has adopted the 3 compartment MCA (Maritime and Coastguard Agency, UK) damage. In plain language this means that the DESSO ROPAX would sustain damage from the ship side that extends into more than half of the ship breadth, and in the longitudinal direction of the ship three water tight compartments would be damaged.

The consortium knows of no existing Ro-Pax that can remain upright and afloat after sustaining such damage. Ro-Pax operating today will probably capsize and sink within minutes after sustaining this type of damage. A high-speed collision with another ship, or perhaps a terrorist attack, would cause this type of damage.
DESSO Design Concept in 3D
DECK 8
33185 ob. B.L.

DECK 7
30385 ob. B.L.

DECK 6
27000 ob. B.L.

DECK 5
24200 ob. B.L.

DECK 4
21400 ob. B.L.

DECK 3
15950 ob. B.L.

DECK 2
10000 ob. B.L.

DECK 1
4250 ob. B.L.

B.L.

3750
32100
Cross flooding to minimize asymmetry
To maintain the buoyancy in the undamaged parts, the ventilation ducts are designed in such a way that they create a watertight passage from the outside of the hull to the area they are ventilating, thus leaving the space they are passing, dry.
Final words
The DESSO Project demonstrates that it is possible to design a ship that has a very high survival capacity after a damage and that if she sinks, does it without capsizing.

The Project demonstrates that this is possible to achieve without limiting any carrying capacity or commercial quality.

The additional costs for satisfying the DESSO requirements are possible to keep modest.

The EuRoPax 3000 and the DESSO ROPAX, may both satisfy the required probabilistic index but will, as demonstrated, behave completely differently in case of a damage.
If safety is built in at the design stage an increase in safety is usually arrived to without much cost.

When a safer design costs more money it may help to take decision, to know the value of life lost. It is possible to find out what the society is prepared to pay to reduce the number of fatalities.

Partners are to be gratefully acknowledged

THANK YOU FOR YOUR ATTENTION!