Watertight Doors in Passenger ship design

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Meyer Werft

- Founded in 1795
- 100% family owned
- 2 locations – 1 shipyard
  - Meyer Werft in Papenburg
  - Neptun Werft in Rostock

- 11 production halls
  - 2 covered building docks
  - 4 halls for unit and pipe production
  - 5 halls for laser welding and flow line for block production

- Largest covered shipbuilding hall in the world (504 m x 125 m)
- Europe's largest laser centre
- Crane capacity of up to 800 t per crane
- Own cabin production
Product Portfolio

Cruise ships
- Ships: 36 (+5)

River cruise ships
- Ships: 27 (+15)

Research ships
- Ships: 0 (+1)

Gas tankers
- Ships: 56

Island ferries
- Ships: 29

Ferries / Cruise ferries
- Ships: 32

Passenger ships
- Ships: 24

Livestock carriers
- Ships: 27

Container ships
- Ships: 4
Meyer Werft, Papenburg

Norwegian Cruise Line
Norwegian Getaway 2014

Royal Carribean
International
Quantum of the Seas 2014
Anthem of the Seas 2015

Research ship
Sonne delivery 2015

Neptun Werft, Rostock

Norwegian Cruise Line
S. 693 delivery 2015
S. 694 delivery 2017

16 River cruise vessels
delivery until 2014

Orderbook
15 years – 11 prototypes

2000 – Aurora  76,000 GT  Purpose-built for British market
2001 – Radiance o/t Seas  90,000 GT  Gas turbine & pod propulsion
2001 – Norwegian Star  92,000 GT  Freestyle design
2004 – Pont-Aven  41,000 GT  High-speed cruise ferry
2005 – Norwegian Jewel  93,500 GT  Largest panmax design
2007 – AIDAdiva  68,500 GT  Compact “Club“ design
2008 – Celebrity Solstice  122,000 GT  1st ship with 1000+ balcony cabins
2010 – Disney Dream  130,000 GT  Surprise for the industry
2013 – NCL Breakaway  146,600 GT  Optimized industrialized design
2014 – Quantum o/t Seas  167,000 GT  Energy saving as a key element
2015 – NCL Breakaway Plus  163,000 GT  Evolution of Breakaway
Introduction

- To achieve a good safety level a careful balance is needed
Damage Stability

- Internal watertight integrity requires high attention
- Operation of water tight doors
- Routing of pipes and ducts
- Bulkhead penetrations
- Up to 100 different systems need to be controlled during design and production
Types of watertight doors

- Different type of doors used
  - Normal WTD below bulkhead deck
  - Light WTD with reduced scantlings, otherwise like normal WTD
  - Semi-watertight doors: to be used with GZ range only, not below immersion line
  - Fire doors

- Use of doors during navigation may be different
  - WTD always closed
  - Semi-WTD and fire doors may be kept open
• All damage stability calculations are based on **closed** water tight doors
• Operational needs are not considered carefully during design in the past
• Layout of the vessel may be in conflict with operational needs
• Many ships have exemptions to have WTDs open during navigation

Many 3-zone damages are not survivable.
Purpose of WTD

- Why are ships built with watertight doors?
  - effective use of the available space
  - 2nd means of escape
  - Avoiding dead-end corridors
  - Used for transport of goods
  - Maintenance and transport of spare parts
Examples of use of WTD

2\textsuperscript{nd} means of escape

Avoiding dead-end corridors

Used for transport of goods
Examples of use of WTD

Maintenance and transport of spare parts
easy connection of engine rooms is desired by many chief engineers

Ships have been designed in the past without the right balance between daily operation and damage stability
Evacuation has a high priority in ship design
Each main vertical zone has a well protected staircase leading to the life boat deck and assembly stations
Each watertight compartment has a vertical escape to the boat deck inside a protected staircase
Each space requires 2 independent means of escape
• Design can be adapted to keep WTDs closed
• To be considered at an early design stage
• Survivability (attained index A) may be reduced

• Example “Laundry” in larger compartment:
Design to keep WTD closed

• Other examples

Laundry arrangement on two decks
In one compartment

Workshops in one compartment
Multiple lifts to access provision rooms
Design to minimize WTD

- Optimized cabin arrangement to minimize the number of doors

Six WTD in 2 compartments

One WTD in 2 compartments
• Layout of bulkhead deck to meet many different requirements
  – Subdivision with partial bulkheads
  – Escape from watertight compartments
  – Longitudinal corridor for crew and goods
  – Control stations
• Use of fire doors in way of central corridor
• Fire doors sustain 2.5m water level with only small leakage
• May be used to restrict progressive flooding on bulkhead deck
• Improves subdivision without the undermining overall risk
  – Fire doors may be used in escape ways
  – No risk for injuries like for WTD
Categories of doors

- MSC Circ 1380 defines different categories of doors
- The categories need to be discussed, but
- Doors may have significantly different influence on survivability
- Acceptance to use water tight doors should reflect the influence on survivability

Influence of a single open WTD on A-index
Categories of doors

- Design should be optimized to minimize the influence of open water tight doors
- Number of doors to be further reduced
- Latest designs show equal vulnerability for open water tight doors

**Influence of a single open WTD on A-index**

**Influence of open WTD on vulnerability**
• Design and operation need to be aligned from early design

• All damage stability calculations assume all WTD closed
• Operation may require the connection between certain spaces
• Risk for injuries for crew and passengers is very high during closing of WTD

• Good example for a possible balanced approach between stakeholders
  • Designers: design subdivision following operational needs
  • Operators. Cooperate in early design stage, change traditional procedures to maintain watertight integrity
  • Academia: provide methods and tools to keep crew alerted
  • Regulators: force all designers and operators to keep doors closed for new ships
Conclusion

• Safety is one of the key objectives of passenger ship design

• Watertight doors are a vital component to achieve the desired survivability

• The cruise ship industry works pro-active

• Safety levels need to be continuously reviewed and adjusted if needed

• Only with close cooperation between operators, shipyards and administrations the good safety record can be further improved