Cruise ships, the Large and the Small ones

**AIDAprima**, 3300 passengers, 900 crew

**Seven Seas Navigator**, 490 passengers, 340 crew
Cruise ships, the Large and the Small ones

• Me,

• A Naval Architect, born in the Netherlands

• Shipyard new construction manager

• 33 years working for Lloyd’s Register of which 8 years in Miami, looking after cruise ships.

• Now working as a Marine Consultant, mainly for the The US based Marshal Islands Ship Register
Cruise ships, the Large and the Small ones

• Schedule

• Week one:
  • Introduction of some large and small cruise ships
  • The Oasis of the Seas
  • Cruise ships of the past
  • A small cruise ship
Cruise ships, the Large and the Small ones

- **Eurodam**
- Holland America Line
- 86273, t gross
- Length, 935 ft, 285 m
- Beam, 105.8 ft, 32.2 m
- Draft, 26 ft, 8 m
- 64,000 KW
- 23.9 kn
- 2,104 passengers
- 929 crew
- Built, 2008
Cruise ships, the Large and the Small ones

- **Prinsendam**
- Holland America Line
- Ex, *Seabourn Sun* and *Royal Viking Sun*
- 38948 t gross
- 835 passengers
- 460 crew
- Built 1988, Wartsila, Turku
- Length, 674 ft, 205.5 m
- Beam, 91.8 ft, 28 m
- Draught, 23.6 ft, 7.2 m
- Speed, 22 kn
Cruise ships, the Large and the Small ones

- **Fram**
  - Operators Hurtigruten
  - Year built 2007
  - Shipyard Fincantieri, Italy
  - Passenger capacity 318
  - Beds 276
  - Car capacity 0
  - Gross tonnage 11647
  - Length 114 m
  - Beam 20.2 m
  - Speed 13 kn
Cruise ships, the Large and the Small ones

- Marina
- Oceania Cruises
- Builder, Fincantieri, Genoa
- Tonnage, 66,000 gt
- Length, 781 ft
- Beam, 105 ft
- Draft, 24 ft
- Propulsion, 2 CP props
- 1,252 passengers
- 780 crew
Cruise ships, the Large and the Small ones

- Mein Schiff 6
- TUI Cruises
- Meyer Werft, Turku
- Completed, May 2017
- 98,811, t gr
- Length, 969 ft
- Beam, 42,39 ft
- Draft, 27 ft
- 2790 passengers
- 1030 crew
Cruise ships, the Large and the Small ones

- **Pearl Seas**
- American Cruise Line
- Along the Main Coast
- 2 Caterpillar main engines
- 2610 HP each gear to two propulsion shafts with FP propeller
- Speed 17 knots
Cruise ships, the Large and the Small ones

• Pearl Seas

• Standard Passenger Cabin
Cruise ships, the Large and the Small ones

• Pearl Mist
• 5109 t gross
• Length, 99.10 m, 325 ft 2 in.
• Beam 16.8 m, 55 ft
• 210 passengers
• 70 crew
Cruise ships, the Large and the Small ones

- Pearl Mist
- Dinning room in the aft end of the ship
Cruise ships, the Large and the Small ones

• Pearl Mist

• Observation lounge uppermost deck forward.

• Three sky lights
Cruise ships, the Large and the Small ones

• Pearl Mist

• Departing Port Everglades with a destination of Cuba
Cruise ships, the Large and the Small ones

- **Oases of the Seas**
- **Royal Caribbean Cruises**
- **Tonnage 225.282 t gross.**
- **Length 361 m, 1,186 ft oa.**
- **Beam 47 m, 154 ft**
- **Height oa 72 m, 236 ft**
- **Depth 22.55 m, 74 ft**
- **Draught 9.32 m, 30.6 ft**
- **Decks 16 passenger decks**
- **Passengers +/- 6,000**
- **Crew +/- 2,400**
Cruise ships, the Large and the Small ones

- **Oases of the Seas**

- **Installed power**
  - 3 x 13,860 KW, 18,590 HP
  - Wartsila diesel

- **Propulsion**
  - 3 x Azipods
  - 20 MW, 27,000 HP each
  - 4 x Bow thrusters
  - 5.5 MW, 7400 HP each
  - Speed 22.6 knots, 26 mph
Cruise ships, the Large and the Small ones

- **Oases of the Seas**

- **Azipod Propulsion**

  - 3 x 20 MW,
  - 27,000 HP each
  - 81,000 HP total
Cruise ships, the Large and the Small ones

- Oases of the Seas
- Bow thrusters
- 5.5 MW,
- 7,400 HP each
Cruise ships, the Large and the Small ones

- **Oasis of the Seas**
  - 225,282 gross tons

- **Costa Magica**
  - 102,587 gross tons
Cruise ships, the Large and the Small ones

- Oasis of the Seas

- Stern view with open air theatre
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• The ship offers features such as two-story loft suites and luxury suites measuring 150 m² (1,600 sq ft) with balconies overlooking the sea or promenades.

• The ship features a casino, a miniature golf course, multiple night clubs, several bars and lounges, a karaoke club, comedy club, five swimming pools, volleyball and basketball courts, theme parks and nurseries for children.
Cruise ships, the Large and the Small ones

- Oasis of the Seas
- Outside cabin
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• Inside Cabin
Cruise ships, the Large and the Small ones

• Allure of the Seas

• Ship entering Port Everglades, Fort Lauderdale.

• No tugs assisting.
Cruise ships, the Large and the Small ones

- Oasis of the Seas

- Outside and inside view of the ship.
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• Board Walk

• Features restaurants, bars, shops, climbing walls, 750 outdoors seats, aqua theatre, large fresh water pool
Cruise ships, the Large and the Small ones

- Oasis of the Seas
- Royal Promenade, Central Park
- This features, many shops, restaurants.
- Also a living park at sea with 12,000 plants and trees
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• Vessel under construction at STX Europe Turku Shipyard, Finland. Yard # 1363

• Costs US $ 1.4 billion, (2006)
Cruise ships, the Large and the Small ones

• Oasis of the Seas

In September 2014 STX Finland was sold, 70% to Meyer Werft and 30% to the Finnish government. The operations were continued under name Meyer Turku thereafter. Meyer Werft acquired the Finnish government's 30% in April 2015.
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• The ship was completed on 28 October 2009

• Two days later she departed Finland for the US

• While exiting the Baltic Sea, the vessel had to pass underneath the great Belt fixed bridge, which connects
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• The Great Belt Bridge connects the Islands of Zealand with Funen in Denmark.

• The bridge is 6.790 km long
• Opened 14 June 1998
Cruise ships, the Large and the Small ones

- Oasis of the Seas

- Why the Great belt Bridge and not the Oresund bridge, Copenhagen-Malmo.

- Clearence of the Great Belt bridge is 65 m the Oresund bridge is 57 m
Cruise ships, the Large and the Small ones

• **Oasis of the Seas**

• The bridge has a clearance of 65 m, 213 feet, above the water.
• The Oasis normally has an air-draft of 72 m, 236 feet above the water.
• The passage under the bridge was possible due to the retracting of the telescoping upper part of the funnels
• An additional 30 cm, 12 inches, was gained by the squat effect whereby vessels traveling at speed in a shallow channel will be drawn deeper into the water.
• Approaching the bridge at 23 knots, 43 km/hour, 26 mph, the ship passed under the bridge with less than 60 cm, 2 feet clearance
Cruise ships, the Large and the Small ones

• Allure of the Sea

• Delivered 28 November 2010
• 225,282 t gross
• Length 362 m, 1,187 ft
• Beam 47 m, 154 ft
• Sister ship of the Oasis passing under the fixed bridge over the Danish Great Belt
Cruise ships, the Large and the Small ones

- **Oasis of the Seas**

- The lifeboats
- Length 16.7 m
- Beam 5.6 m
- Weight 17 t
- When fully loaded with persons 45 t
- Two 170 HP diesel engines
- Speed 6 kn
Cruise ships, the Large and the Small ones

- **Oasis of the Seas**
- SOLAS-LSA Code 4.4.3.1 states:
  - Lifeboat capacity shall be no more than 150 persons
  - Larger lifeboats with equivalent safety level may be accepted
  - Schat-Harding has developed a 370 persons lifeboat for the Oasis of the Seas
  - A total of 44 of the traditional 150 persons lifeboats would have to be fitted to accommodate the same number of persons
  - The Oasis of the Seas is fitted with 18 of the mega lifeboats with a total capacity of 6,660 people, Inflatable life rafts provide for additional crew.
Cruise ships, the Large and the Small ones

- **Oasis of the Seas**

- The seating arrangement is for two levels to reduce the time taken to board all persons into the lifeboat

- The main cabin deck will seat 280 persons, the upper area will seat 80 persons, another 10 in the large steering tower
Cruise ships, the Large and the Small ones

• Oasis of the Seas

• The lifeboats are stowed and launched from a special designed davit system fitted outside the shell/hull plating line
• This system allows the boats to be lowered directly into the water
Building a Cruise Ship

The plan

• Many existing ships were used as cruise ship some of them after a conversion.

• Most of the older passenger ships were steam ships.

• A passenger ship carried people from A to B, a cruise ship carries people to sight seeing places and entertain them during the voyage.
Building a Cruise Ship

Mardi Grass
- Built 1961
- Scrapped 2003
- Carnival 1972-1993

Carnivale
- Built 1956
- Scrapped 2008
- Carnival 1976-1994

Festivale
- Built 1961
- Scrapped 2003
- Carnival 1978-1996
Building a Cruise Ship

Mardi Grass
• Ex Empress of Canada, Canadian Pacific Lines, Liverpool, UK.

Carnivale
• Ex Empress of Britain, Canadian Pacific Lines, Liverpool, UK.

Festivale
• Ex Transvaal Castle, Union Castle Lines, London, UK.

• All three ships were steam ships, turbine ships with oil fired boilers.
Building a Cruise Ship

Empress of Canada
SS United States

Built 1952
Newport News Shipbuilding
For $ 80 million

Out of service 1969

Presently laid up in Philadelphia

990 feet long, 101 feet wide

Max speed 44 mph
Building a Cruise Ship

Federico C

- Built 1958 for Costa Line
- 1983-1997 Sea Breeze of Dolphin Cruises
- Sunk in 2000 off the Virginia coast
Cruise ships, the Large and the Small ones

• Week two:

• Cruise ship stability

• Details of other large and small cruise ships

• Where are those ships going

• Small ships, expedition ships.
Building a Cruise Ship

Regulatory and inspection agencies.

- IMO, Inter-Governmental Maritime Organization.
- Member states are mostly maritime country administrations.
- Meet in London, UK, they are connected to the UN.
- Produce the maritime safety laws and guidance notes
- **Classification Societies.**
  - Inspections surveys and for most countries authorized to act on behalf of the maritime administration.
  - Issue statutory certification to the ships they have inspected/surveyed and are authorized to do so.
- The major ones are a member of IACS, International Association of Classification Societies
Building a Cruise Ship

- ABS American Bureau of Shipping
- DNV-GL Det Norske Veritas, Germanischer Lloyd
- LR Lloyd’s Register
- BV Bureau Veritas
- RINA Registro Italiano
- CLASSNK Japanese Class Society
- KRS Korean Register of Shipping
- CRS Croatian Register of Shipping
- IRS Indian Register of Shipping
- PRS Polish Register of Shipping
- RS Russian Register
- CCS Chinese Class Society
USCG

- USCG has an alternative compliance program for a number of authorized class societies to carry out statutory surveys on behalf of the USCG and issue certificates. USCG inspect ships entering US water on an a regular basis.
- Many other flag states/countries have similar arrangements. Port State Control.

- Some of the class societies have the alternative compliance program approval are, e.g. ABS, DNV-GL, LR, RINA, ClassNK, KRS.

- A class society has construction rules and regulations, complying with IMO requirements/flag state requirements.
- They employ plan reviewers, surveyors, etc.

- They have offices and surveyors world wide.
Building a Cruise Ship

Stability

- $B^2/12t$ is an indication of the stability of a ship or the GM value,
- $M$ being the metacenter level.
- $G$ the center of gravity of the vessel
- The correct value of the GM is in accordance with following:
- $GM = \frac{t}{2} + \frac{b^2}{12t} - h$
Building a Cruise Ship

- GZ is the righting lever
- GZ should be at least .20 m at an angle equal to or greater than 30 degrees.

- GM should not be less than .15 m

- A small GM gives a soft/slow rolling pattern, a large GM gives a rough fast rolling pattern, high gyro forces and is uncomfortable for crew and passengers
Building a Cruise Ship

- CB = Center of Buoyancy

- CG = Center of Gravity

- B is the point where the vertical of the CB crosses the ship’s center line, or B = M

- When CG or G is above B, the ship is unstable
Free surface effect

• When a tank is completely full of liquid, there is no free surface.
• When the tank contents are slack, a list of the vessel will result in the contents of the tank flowing to the lower side.
• Moving the CG, center of gravity of the vessel, decreasing the GM value, also increasing the list of the vessel.
Building a Cruise Ship

Damage stability

• Damage of a cruise/passenger ship side is assumed as follows:
• Damage length of .03 Lbp but not less than 3 m
• Vertical damage from the base line to 12.5 meter above the deepest subdivision draught
• Side penetration of .75 m
• The ship to stay afloat when two water tight compartments are flooded, probabilistic calculation.
Building a Cruise Ship

Water Tight Bulkheads.

• Only one WT door is permitted in a WT bulkhead.

• The door shall be a sliding door capable of being closed from remote locations, navigating bridge, above the bulkhead deck, locally on both sides of the door.
Building a Cruise Ship

Seven Seas Explorer

- Being constructed at Fincantieri Genoa, Italy
- For Regent Cruise Line
Double Bottoms

The tank top shall be continued to the ship’s side.
The height $h$ shall be $B/20$, but in no cases less than 760 mm and no more than 2000 mm.
Need not to be fitted in way of water tight tanks.
Damage shall be as follows:
Longitudinal extent $1/3 \ L_{db}$ or 14.5 m, whichever is less.
Transverse extent $B/6$ or 10 m, whichever is less.
Vertical extent $B/20$ or 2 m, whichever is less.
Building a Cruise Ship

Sliding Door in a WT bulkhead

- A WT sliding door operable from the;
- Wheelhouse
- The bulkhead deck
- Locally
- Doors normally close automatically after the door has been opened.
- Can be over ridden
- Should always be closed at sea
- Only let a person pass.
Building a Cruise Ship

The design and purpose of the ship

• Company standard appearance
• How many passengers to carry
• For which itinerary suitable
• Design office input
• Shipyard input
• Regulatory requirements, which flag state
• Restricted dimensions
• Propulsion/machinery
• Delivery date
Building a Cruise Ship

The design

• Underwater lines
• Frames plan/lines
• Tank testing on scale model to determine the propulsion power for the required speed.
• Preliminary stability determination
• Lay out for the accommodation/ passengers and crew.
• Required navigation and communication equipment
• Pollution prevention requirements
Building a Cruise Ship

Frame Plan

• Right hand forward part, bow
• Left the aft part, stern
• Frame plans are now digital
• Basic information to supply cut and shape plates and profiles.
Building a Cruise Ship

Preparation for the actual building of the ship

• Programming of the input of; cut, shape and mark the steel plates and profiles.
• Ordering necessary equipment for the ship. Lead time may be long.
• Organizing sub contractors to carry out tasks during the building.
• Sub contracting parts of the vessel to outside workshops and shipyards.
• Preparing a detailed planning for the building of the ship
Cruise ships, the Large and the Small ones

- Koningsdam

- Holland America Line
- 99,500 t gross
- Dedicated:
- May 2016, by H.M. Queen Maxima of the Netherlands.
- \( L \times B \) 975 x 114.8 ft
- Capacity 2650 passengers
Cruise ships, the Large and the Small ones

• Koningsdam

• Builder: 2016-03 Fincantieri-Cant. Nav. Italiani S.p.A. (Breda) - Venezia Yard/hull No.: 6241

• Her name’s roots, like the ship itself, are a mix of something contemporary and something classic:

• “Koning,” means king in Dutch—and is a salute to King Willem-Alexander, the Netherlands’ first king in more than 100 years.
Cruise ships, the Large and the Small ones

- Koningsdam
  - Formal dining room
  - Located on the aft ship
  - Labeled seating
Cruise ships, the Large and the Small ones

• Koningsdam

• Atrium
Cruise ships, the Large and the Small ones

• Koningsdam

• Larger cabin with balcony
Cruise ships, the Large and the Small ones

- Koningsdam
- Outside cabin
Cruise ships, the Large and the Small ones

• Koningsdam

• Suite on the upper deck
Cruise ships, the Large and the Small ones

- Koningsdam
- Swimming pool.
- One of many
- Rolled cover available
Cruise ships, the Large and the Small ones

- **Koningsdam**
- In the Panama Canal

The expanded canal began commercial operation on 26 June 2016.

The new lock chambers are 180 ft (54.86 m) wide, 1,400 ft (426.72 m) long, and 60 ft (18.29 m) deep. These dimensions allow for an estimated 79% of all cargo-carrying vessels to transit the canal, up from 45%.
Cruise ships, the Large and the Small ones

- Xanterra Parks & Resorts, Inc.,
- YACHT FACTS
- CAPACITY: 310 Guests
- STATEROOMS: 122 deluxe ocean view staterooms
- SUITES: 31 deluxe ocean view suites
- BRIDGE DECK SUITES: 2 deluxe ocean view bridge suites
Cruise ships, the Large and the Small ones

Wind Surf

- DECKS: 6 decks
- CREW: 201 international staff
- SHIP'S REGISTRY: Bahamas
- LENGTH: 535 feet (162 meters) at waterline; 617 feet (187 meters) including bowsprit
- DRAFT: 16.5 feet (5 meters)
- TONNAGE: 14,745 gross registered tons (grt)
- BEAM: 66 feet (20 meters)
- SAILS: 7 triangular, self-furling, computer-operated sails with 26,881 square feet (or 2,600 square meters) of Dacron surface area
- MASTS: 5 at 221 feet (67.5 meters)
Cruise ships, the Large and the Small ones

Wind Surf

• ENGINES: 4 diesel electric generating sets, 2 electrical propulsion motor

• SPEED: 10 to 12 knots with engines only; up to 15 knots wind and engine assisted

Wheelhouse
ABOARD WIND SURF

Cruise ships, the Large and the Small ones

ONBOARD SPACES
1. The Bridge
2. Stella Bistro
3. Amphora Restaurant
4. Bridge Suites
5. Casino
6. The Veranda
7. Suites and Staterooms
8. Staterooms
9. The Lounge
10. Yacht Club Sandwich & Espresso Bar
11. Fitness Center
12. Compass Rose Bar
13. Reception
14. Nautlius Room
15. WindSpa
16. Signature Shop
17. Pool/Pool Bar/Whirlpools
18. Watersports Platform
19. The Terrace Bar
20. Candles Grill

Bridge Suites: 450 square feet or 46 square meters
Suites: 370 square feet or 35 square meters

Staterooms: 194 square feet or 18 square meters
Staterooms with 3rd Berths: 117-139; all suites (excluding 501)
Rooms with queen beds that convert into (2) twin beds: 103-155; 205-269; 305-339; 501, 502, 503

BRIDGE SUITE

SUITE

STATEROOM

Wind Surf features 5 guest decks and a total of 22,090 square feet.

BRIDGE DECK

BRIDGE DECK

MAIN DECK

DECK THREE

DECK TWO

DECK ONE

SHIP FACTS
LENGTH: 535 feet (162 meters) at waterline; 617 feet (187 meters) including bowsprit
DRAFT: 16.5 feet (5 meters)
TONNAGE: 14,745 gross registered tons (gnt)
BEAM: 66 feet (20 meters)
SAILS: 7 triangular, self-furling, bridge-operated sails with 26,881 square feet (or 2,560 square meters) of Dacron surface area
MASTS: 5 at 225 feet (69 meters)
ENGINES: 4 diesel electric generator sets, 2 electrical propulsion motors
SPEED: 10 to 12 knots with engines only; up to 15 knots with prevailing wind
SHIP'S REGISTRY: Bahamas
Cruise ships, the Large and the Small ones

- **Wind Surf**

- **Standard cabin**

- The world’s largest sailing yacht, *Wind Surf* sails with just 310 pampered guests in 154 total staterooms: 31 ocean view suites with his and her bathrooms, 2 Bridge Suites, and 123 deluxe ocean view staterooms.
Cruise ships, the Large and the Small ones

• Wind Surf

• Standard Cabin
Cruise ships, the Large and the Small ones

• Wind Star

• Large Suite
• CREW: 101 international staff
• SHIP'S REGISTRY: Bahamas
• LENGTH: 360 feet (110 m) at waterline; 440 feet (134 m) including bowsprit
• DRAFT: DRAFT: 14 feet (4.1 m)
• TONNAGE: 5,307 gross registered tons (grt)
• BEAM: 52.1 feet (15.8 m)
Cruise ships, the Large and the Small ones

• Wind Star
• Wind Spirit

• Sails with just 148 pampered guests in 74 total staterooms:
• 73 deluxe, ocean-view staterooms and:
• 1 deluxe Owner’s Suite with queen beds and a dining/sitting area.
Wind Star

- SAILS: 6 triangular, self-furling, computer-operated sails with 21,500 square feet (or 2,200 square meters) of Dacron surface area
- MASTS: 4 at 204 feet (62 m)
- ENGINES: 3 diesel electric generating sets, 1 electrical propulsion motor
- SPEED: 10 knots with engines only; up to 15.8 knots with prevailing wind
Cruise ships, the Large and the Small ones

Star Pride

- CAPACITY: 212 guests
- SUITES: 106 suites, all outside with ocean views
- OWNER'S SUITES: 2, with private verandas
- CLASSIC SUITES: 4, with private verandas
- BALCONY SUITES: 36, with French-style balconies
- OCEAN VIEW SUITES: 64, with picture windows
- DECKS: 6 guest decks
- CREW: 151 international staff
- SHIP'S REGISTRY: Bahamas