Presentation of various aspects related to the third semester of EMSHIP at ZUT in Szczecin

Prof. Zbigniew Sekulski
EMSHIP Vice Local Coordinator
Nicolaus Copernicus (Polish: Mikołaj Kopernik) (born in 19 February 1473, died on 24 May 1543) was a Renaissance mathematician and astronomer who formulated a model of the universe that placed the Sun rather than the Earth at its center.

The publication of this model in his book *De revolutionibus orbium coelestium* (*On the Revolutions of the Celestial Spheres*) just before his death in 1543 is considered a major event in the history of science, triggering the Copernican Revolution and making an important contribution to the Scientific Revolution.
Faculty of Maritime Technology and Transport
Advanced ship and offshore structural mechanics

**Ultimate strength:** nonlinear finite element analysis: review of theory and applications to ship structures, FEA guidelines for ship modelling, linear and non-linear analysis, static and dynamic analysis; strength of ship structures subject to impact loads.

\[
\left[ \int_V \rho N_{mq} N_{mp} \, dV \right] \ddot{d}_q + \left[ \int_V D_{kl} B_{lj} B_{kp} \, dV \right] d_q = \int_A p_m N_{mp} \, dA + \int b_m N_{mp} \, dV
\]

**Fatigue and fracture:** fundamentals of the fracture mechanics, mechanisms of fatigue failure, methods of fatigue analysis: nominal stress approach, hotspot stress approach, notch stress approach, long-term stress distributions.

\[
N \Delta \sigma^m = \frac{1}{C_0 \left( \sqrt{\pi} \right)^{\alpha_i}} \int_{a_i}^{a} \frac{da}{\left( Y \sqrt{a} \right)^{\alpha}}
\]
Advanced ship and offshore structural mechanics

Structural reliability and risk assessment:
Uncertainties, limit state, failure modes, first and second order reliability methods, safety indices, uncertainties in ship structural design, integration of reliability concepts (loads and strength) in calculation of ship structures (rule based approaches and direct calculations).

\[
S_1 = \Phi(-\beta)\prod_{j=1}^{n-1}(1 - \beta \kappa_j)^{-0.5}
\]

\[
S_2 = \left[\beta \Phi(-\beta) - \varphi(\beta)\right]\left\{\prod_{j=1}^{n-1}(1 - \beta \kappa_j)^{-0.5} - \prod_{j=1}^{n-1}(1 - (\beta + 1) \kappa_j)^{-0.5}\right\}
\]

\[
S_3 = (\beta + 1)\left[\beta \Phi(-\beta) - \varphi(\beta)\right]\left\{\prod_{j=1}^{n-1}(1 - \beta \kappa_j)^{-0.5} - \text{Re}\left\{\prod_{j=1}^{n-1}(1 - (\beta + i) \kappa_j)^{-0.5}\right\}\right\}
\]
Advanced ship and offshore structural design

Main characteristics and design objectives of various ship types (passenger ships, bulk-carrier, containership, chemical tanker, liquefied gas tanker, ro-ro, ropax, etc.), use of new materials in the construction of specific ship types (metallic and non-metallic materials, sandwich and core structures), structural arrangement of these specific ship types, loads and strength of these specific ship types, structural details of these specific ship types, IMO conventions and classification societies rules requirements of these specific ship types.
**Elastic Plate Buckling Under Uni-axial Compression**

<table>
<thead>
<tr>
<th>Longitudinally framed system</th>
<th>Transversely framed system</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram of longitudinally framed system" /></td>
<td><img src="image2" alt="Diagram of transversely framed system" /></td>
</tr>
</tbody>
</table>

### Axial compressive stress $\sigma_c$
- Calculated on the basis of formula:
  \[ \sigma_c = \frac{\pi^2 E}{(a/b)^4} \]
- From global buckling bending

### Allowable FOS:
- \( FOS = 2.5 \)

### Dynamic amplification factor (DAF): \( DAF = 1.00 \)
- Include if appropriate

### Plate thickness $t$
- \( t = 16.0 \text{ mm} \)

### Longitudinal side $a$
- \( a = 2,000 \text{ mm} \)

### Shorter side $b$
- \( b = 700 \text{ mm} \)

### Elastic modulus $E$:
- \( 210,000 \text{ MPa} \) Steel
- \( 1.39 \times 10^5 \text{ MPa} \) from global buckling bending

### Yield stress $\sigma_y$
- \( \sigma_y = 0.3 \text{ MPa} \) Steel
- \( \sigma_y = 33,426 \text{ MPa} \) from global buckling bending

<table>
<thead>
<tr>
<th>Actual FOS</th>
<th>OK?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>OK</td>
</tr>
<tr>
<td>0.7</td>
<td>FAIL</td>
</tr>
</tbody>
</table>

### Plate thickness $t$
- \( t = 16.0 \text{ mm} \)

### Longitudinal side $a$
- \( a = 2,000 \text{ mm} \)

### Shorter side $b$
- \( b = 700 \text{ mm} \)

### Elastic modulus $E$:
- \( 210,000 \text{ MPa} \) Aluminum alloy
- \( 1.39 \times 10^5 \text{ MPa} \) from global buckling bending

### Yield stress $\sigma_y$
- \( \sigma_y = 0.3 \text{ MPa} \) Aluminum alloy
- \( \sigma_y = 33,426 \text{ MPa} \) from global buckling bending

<table>
<thead>
<tr>
<th>Actual FOS</th>
<th>OK?</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>FAIL</td>
</tr>
<tr>
<td>0.2</td>
<td>FAIL</td>
</tr>
</tbody>
</table>
Advanced ship and offshore production technology

Technology of building of specific ship types, technology of building ships supporting offshore industry, technology of building offshore floating steel and concrete structures, application and manufacturing technology using innovative sandwich structures to ship hull, non-conventional methods of ship launching, underwater technology – fabrication and application of manned and unmanned vehicles.
EMSHIP – lectures at ZUT

- ANSYS
- DNV Software:
  - GeniE
  - PreFEM
  - Sesam
  - Sestra
  - WaveShip
  - Nauticus Hull
- Poseidon
- Aveva (Tribon)
Structural response of the ship hull elements subject to excitation generated by the main engine

Structural Design of Helicopter Landing Platform on Offshore Ship

Andrey Smolko

Wai Lin Tun

Zbigniew Sekulski, ZUT, Szczecin

EMship

Nantes, February 2015
Calculation of Fuel Consumption and Exhaust Emissions from Ship in Ice Conditions

Investigation of the hull-superstructure interaction in order to predict the contribution of superstructures to hull girder strength
Structural design of Platform Supply Vessel less than 90m

Analysis and prediction of welding deformations of ship panels in prefabrication process

Hailemariam Desalegn Eltiro

Huggo S. Batista
Internship / Thesis

Arnaud Le Pivain

Pillars definition and dimensionning, Verification and Validation of FEM parametric model

Yue Wu

Concept Design of a Station Keeping Vessel Dedicated to Maintenance of the Far Shore Wind Farm

Rasih Onur Suzen

Discrete Event Simulation Helps to Improve Terminal Productivity for New Design Container Ships

Zbigniew Sekulski, ZUT, Szczecin
Prabu Duplex

Novel application of large area propeller to optimize Energy Efficiency Design Index (EEDI) of ships

Md Rezaul Karim

Fatigue Analysis of Offshore Drilling Unit
Internship & Thesis offer for 5th cohort

DNV-GL Group, Gdynia:
- Fatigue calculations analysis of floating drilling platform.

Crist Shipyards, Gdynia:
- Analysis of manufacturing process with respect to automation and mechanization of welding of ship structures.

Finomar Shipyard, Szczecin:
- Technology of ship hull building.

Marine Repair Yard GRYFIA:
- Analysis of structural strength of floating dock,
- Structural design of icebreakers – modifications.

Ship Research Centre, Gdańsk:
- Thermal/fatigue finite element analysis of structural strength of ship hull elements,
- Experimental investigation of hydrodynamic properties of ships.

Groot Ship Design Poland, Szczecin:
- An investigation into damaged ship stability.

Westcon Design Poland, Szczecin:
- Structural design of a PSV.

Marine Teknikk, Szczecin:
- Structural safety analysis of tankers/containers/bulk carriers/offshore oil rigs in a view of accidents.

Interocean-metal Joint Organization, Szczecin:
- Preliminary and structural design of a mining ship.
Internships abroad are possible!
Not only in Poland!

http://nssdc.gsfc.nasa.gov/planetary/image/earth_day.jpg
Practical aspects - orientation

- Faculty
- dormitory
- centre
- campus
- 2km
- 200m

Zbigniew Sekulski, ZUT, Szczecin
EMship
Nantes, February 2015
Practical aspects - dormitory

Single room  – 490 PLN (120 €) / month
Practical aspects - prices

Lunch: 10 – 20 PLN (2.5 – 5 €)

1 € ≈ 4.20 PLN

Entrance ticket: 10 – 50 PLN (2.5 – 12 €)

A beer: 3 – 6 PLN (0.75 – 1.5 €)
Practical aspects – Bike-S

Initial fee: 20 zł
Minimal fee: 10 zł
From 0 to the 20th minute: 0 zł
From the 21st to the 60th minute: 1 zł
From the 61st to 120th minute: 3 zł
From the 121st to the 180th minute: 5 zł
Each subsequent hour: 7 zł

https://www.bikes-srm.pl
Practical aspects - formalities

International office in ZUT
(paper-copy and electronic versions in PDF format)

- EMSHIP application form
- 3 photos, size 35x45 mm
- A copy of passport or ID
- A copy of student ID
- Accommodation form, if applicable
- Acceptance letter
- Room reservation in dormitory

Dean’s office in Faculty
(personally during registration)

- 3 photos (if have been not send earlier)
- Passport or ID card (for EU citizens)
- Student’s cards (ULG and ECN)
- Scholarship certificate
- Insurance policy
- 17.00 PLN for student ID

- Student’s ID card (ZUT)
- Access to computer system / wi-fi network (login, password)
Why not coming to Szczecin ???