COURSE OUTLINE
MECH 487, Introduction to Ship Structures, 3 credits, Term 1, 2013-14

Schedule
- 13 consecutive weeks, starting September 4
- Wednesdays, 4-7pm in Hugh Dempster Pavilion 201

Instructors

- Dr. Iain Braidwood, Director, Teekay Engineering and Consulting
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- Dr. Reza Vaziri, Professor and Head, Department of Civil Engineering, UBC
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- Dr. Terje Haukaas, Professor, Department of Civil Engineering, UBC
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Teaching Assistant
- Mr. Alfred Larsen, MASc student, Department of Civil Engineering, UBC

Calendar Description
Structural theory and practice of ship structural design; longitudinal and transverse strength of hull girder; plates and shells; matrix analysis; introduction to classification society rules; ship section design synthesis; finite element analysis. Three weekly lecture hours. No lab or tutorial hours. Prerequisites: One of MECH 360, CIVL 332, or permission of the instructor

Learning Objectives
Upon completion of the course, it is expected that students will be able to:
- Describe the structural components of a ship and the structural properties of those components
- Apply basic hull girder analysis for the design of a ship structure, including calculations of vertical global hull girder bending loads, section modulus, and bending stresses
- Apply basic concepts of shear stresses in ship primary and tertiary structures, including shear flow and shear lag effects.
- Apply basic concepts for the bending of beams, plates, and stiffened panels as applied to a ship structure.
- Apply basic concepts for the buckling of columns, plates, and stiffened panels as applied to a ship structure.
- Calculate loads on the structural components of a ship, taking account of hydrostatic loads and specified loads from ice, wind, waves and mooring lines

- Assess potential failure modes of the structural components of a ship, and be able to predict the onset of such failures

Topics

- Introduction to Ship Structures (Braidwood)
    - Terminology
    - Structural design process
    - Common problems in ship design
    - Typical failures
    - Fatigue in practice
- Elastic Analysis of Primary Hull Structure (Haukaas)
    - Beam theory
    - Structural analysis methods
    - Finite element method
    - Shear lag
    - Section modulus calculations
    - Hull-superstructure interaction
    - Buoyancy and weight distribution curves
    - Stresses from beam bending
    - Stresses from St. Venant torsion
    - Stresses from warping torsdion
    - Fatigue theories
    - Beams on elastic foundation
- Analysis of Secondary and Tertiary Structures, Buckling and Plasticity (Vaziri)
    - Analysis of plates
    - Analysis of stiffened panels
    - Buckling
    - Elasto-plastic analysis
    - Impact

Textbooks

The following books will be extensively used in this course and are available as "eBooks" in the UBC library:

[ML] Mansour & Liu (2008) "The Principles of Naval Architecture Series: Strength of Ships and Ocean Structures" Published by the Society of Naval Architects and Marine Engineers

[HP] Hughes & Paik (2010) "Ship Structural Analysis and Design" Published by the Society of Naval Architects and Marine Engineers

The following books are also relevant for this course, and some of them are available either as an eBook or as a regular book in the UBC library:

[RT] Rawson & Tupper (2001), "Basic Ship Theory, Combined Volume, Fifth Edition" Published by Butterworth Heinemann

[L] Lamb (2003) “Ship Design and Construction, Volumes 1 and 2” Edited by Thomas Lamb and published by the Society of Naval Architects and Marine Engineers
[T] Tupper (2013) “Introduction to Naval Architecture: Formerly Muckle's Naval Architecture for Marine Engineers” Published by Butterworth Heinemann
[PT] Paik & Thayamballi (2007) “Ship-Shaped Offshore Installations. Design, Building and Operation” Published by Cambridge University Press
[OT] Okumoto, Takeda, Mano, Okada (2009) “Design of Ship Hull Structures. A Practical Guide for Engineers” Published by Springer
[B] Bai (2003) “Marine Structural Design” Published by Elsevier
[S] Shama (2010) “Torsion and Shear Stresses in Ships” Published by Springer
[F] Faltinsen (1990) “Sea Loads on Ships and Offshore Structures” Published by Cambridge in the Ocean Technology Series
[T] Timoshenko (1956) “Strength of Materials, Volumes I and II” Printed by D. Van Nostrand
[TGo] Timoshenko & Goodier (1970) “Theory of Elasticity” Published by McGraw-Hill in the Engineering Mechanics Series
[TW] Timoshenko & Woinowsky-Krieger (1959) “Theory of Plates and Shells” Published by McGraw-Hill in the Engineering Mechanics Series
[TGe] Timoshenko & Gere (1963) “Theory of Elastic Stability” Published by McGraw-Hill in the Mechanical Engineering Series

Assignment Strategies

Student performance will be assessed through several components as follows:

- Assignments/Quizzes: Each instructor will issue homework assignments and/or in-class quizzes during the term to allow application of the subject matter
- Final Exam: A 3-hour final exam will cover the entire course curriculum, with emphasis on what is covered in assignments/quizzes

Grading System

- Assignments & quizzes: 40%
- Final Exam: 60%