Role of Ship Simulation in Channel Design

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Why Model Navigation Projects?

• Allows end-users a controlled environment to operate ships in their waterway of the future.
  – Safety check
  – Gets pilots “onboard” project.

• Allows comparison between multiple proposals to optimize design.

• Provides rationalization of project design to competing interests.
  – Excellent means to communicate results

• ER 1110-2-1403: Engineering and Design: Studies by Corps Hydraulic and Hydrologic Facilities and Others.
  – Paragraph 6b. Hydraulic design studies associated with the planning, design, construction, operation, and maintenance of navigation channels will include a ship-simulation investigation unless omission of such an investigation is approved by HQUSACE. This policy does not pertain to the design of commercial small-craft harbor channels.
ERDC Ship/Tow Simulators

• Calculate & reproduce vessel response to forces:
  - Rudder
  - Propeller
  - Tugs and Thrusters
  - Currents
  - Banks
  - Wind
  - Waves
  - Vessel Interaction

• Real-Time

• Three Simulators
  - Ships, Tows, or Small Craft
  - Ownship towing
Steps for Conducting a Simulator-Based Navigation Study

- Reconnaissance Trip
- Database Preparation
- Validation
- Pretesting
- Testing
- Result Analysis and Reporting
Databases

- **Visual Databases**
  - Represent the simulated world as realistically as possible.
    - Visual Scene
    - Radar
    - Electronic Chart Display and Information System (ECDIS)

- **Environmental Databases**
  - Channel Definition and Banks
  - Currents
    - Usually a separate model study
  - Waves
  - Wind

- **Vessel Models**
  - Ship, Tow, Assist Tug, Small Craft
  - Hydrodynamic and visual
Current Modeling

- 2-D or 3-D Hydrodynamic Model
  - Adaptive Hydraulics (ADH)
  - TABS or RMA
  - ADCIRC

- Existing Conditions
  - Validate to field data

- Proposed Conditions
  - Deeper, wider, realigned
Data Recorded

- Position
- Heading
- Rudder Angle
- Engine Speed
- Ship Speed
- Yaw Angle
- Rate of Turn
- Tug/Thruster Usage
- Port and Starboard Clearances
- Vertical Motion due to Waves (every second)
- Pilot evaluations and questionnaires
Conclusions

• ERDC Operates Corps' marine simulator.
  – Simulate ship and/or tow traffic.
  – Operates in real time.
  – Evaluates proposed changes to federal channels.
    ▪ Existing conditions (base)
    ▪ Proposed conditions (one or more)

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