Monitoring Completed USACE Navigation Projects

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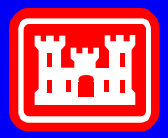
Transforming the Marine Transportation System
A Vision for Research and Development

June 29 – July 1, 2010
The Beckman Center of the National Academies
Irvine, California



USACE Support to the Marine Transportation System (MTS)

Resilience and Reliability

MTS includes ocean, coastal, and inland waterways, ports, and intermodal connections for commercial, military, and recreational craft.

Segments of the MTS are showing signs of strain which will intensify as projected cargo and passenger traffic increase.

Growth at containerized ports requires additional staging areas, expanded landside access, and logistics technologies.

Inland waterway systems are generally viewed as reliable, but face increasing operational and maintenance challenges as locks age, and repairs become more extensive and expensive.

Resilience

Increasing quantities of containerized goods and other commodities upon which our economy relies are moving through the ports. The Military's need to deliver troops, equipment, and supplies through U.S. ports to defense forces around the world emphasizes the importance of the MTS. The MTS must have the capability to respond quickly to disruptions.

Reliability

The USACE "Monitoring Completed Navigation Projects (MCNP)" program supports the Corps' Navigation Business Line by addressing Maintenance and Rehabilitation issues at both coastal and inland navigation structures.

Purpose of the MCNP Program

The Advancement of Coastal and Hydraulic Engineering Technology

To determine how well Coastal and Inland Navigation projects are accomplishing their purposes (how well they are resisting attacks by the physical environment)

- Create more accurate and economical engineering solutions
- Strengthen design criteria and methodology
- Improve construction practices and cost effectiveness
- Enhance Operation and Maintenance techniques
- Reduce O&M Cost

MCNP program identifies where current technology is inadequate.
(Determines where additional research is required.)

MCNP Program is Field Driven, addressing real-world problems.

Nominations for New Monitoring Projects are solicited from Corps Divisions and Districts by HQ as funding becomes available.

Nominations are Evaluated and Prioritized by the Corps' Navigation Research Area Review Group.

Structures with Unique Features and/or Distinct Problems.

Site-specific monitoring is intended to produce Generic results with conclusions applicable on a regional and/or national basis.

Monitoring Completed USACE Navigation Projects
FY10 Program

Kaumalapau Harbor,
Island of Lanai, HI

Periodic Inspections (coastal around the Nation)

Periodic Inspections, Coastal Nationwide

Problem

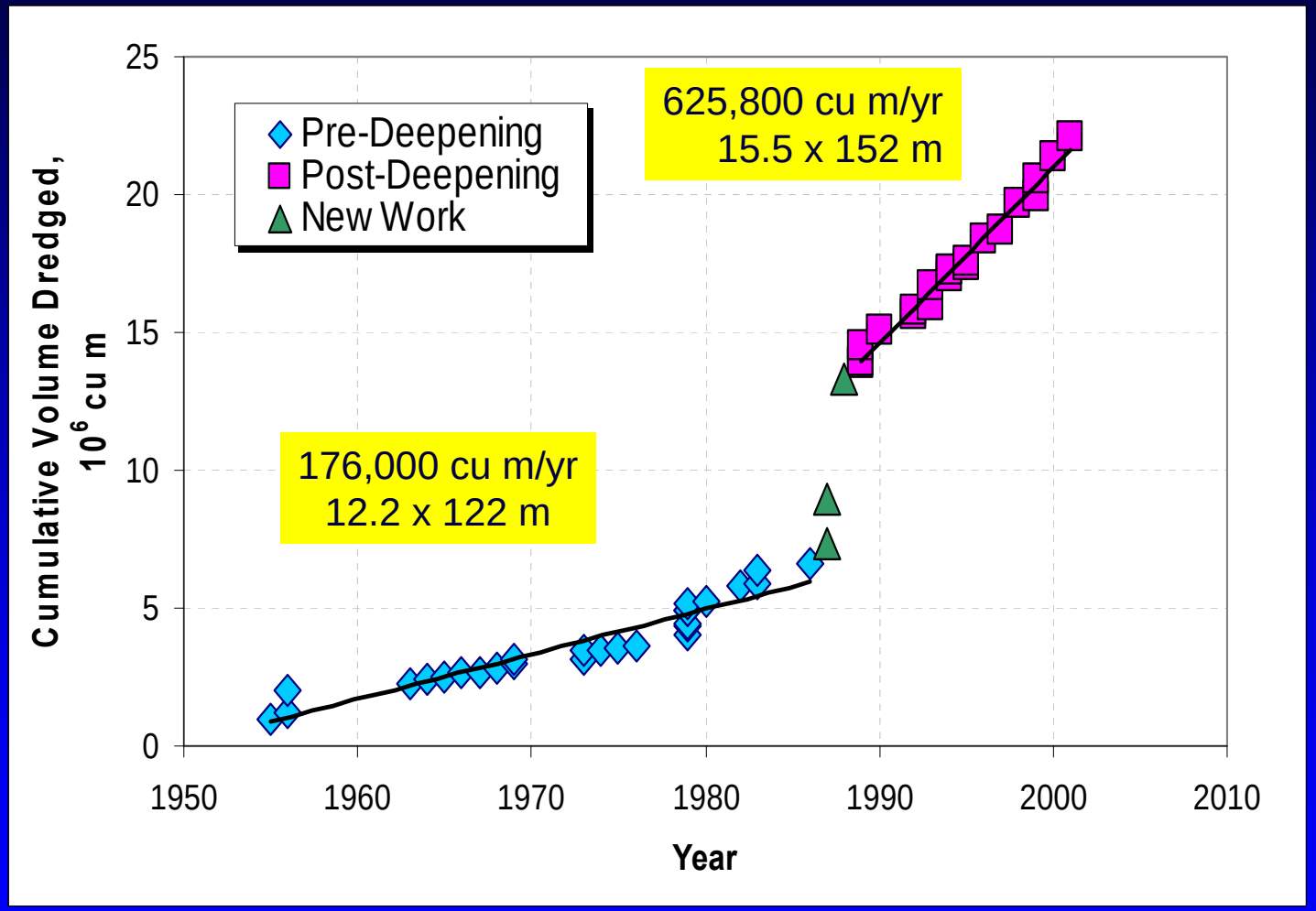
Lack of long-term structure performance data in a consistent format.

Need to gather, analyze, and archive detailed coastal structure condition, performance, and response data on a relatively small number of structures.

Benefits

Better performance knowledge translates to better designs and lower O&M costs.

Galveston Ship Channel, TX



Montgomery Point Lock and Dam, White River, AK

Marmet Locks and Dam, Kanawha River, WVA

John Day Lock and Dam, Columbia River

Kaumalapau Harbor Breakwater

Before

After

US Army Corps
of Engineers

Coastal and Hydraulics Laboratory - ERDC

Great Lakes Breakwater Armor, Stone Testing Protocols and Durability

Product Delivery Team

Danny Harrelson (PI) and Joe Tom, GSL, ERDC; Mansour Zakikhani, EL, ERDC
District Team Members: Joe Kissane, LRC; Michael Allis, LRE; Jon Kolber, LRB
Ron Erickson, Consultant (formerly LRE District Geologist)

Problem

Specifications for armor stone for breakwaters and jetties include objective criteria from laboratory tests, and subjective criteria based on quarries and stockpiles. Issues related to stone durability. Variability of quality between and within quarries exceedingly problematic.

ASTM tests presently used were designed for small concrete aggregate and stone many orders of magnitude smaller than stone on breakwaters. These small-scale tests are not appropriate for stone weighing tens of tons.

Present Lab Test Criteria

• Specific Gravity	ASTM C 127
• Absorption	ASTM C 127
• Los Angeles Abrasion	ASTM C 535
• Freeze/Thaw	ASTM D 5312
• Wetting/Drying	ASTM D 5313
• Petrographic Examination	ASTM C 295
• Field Examination	ASTM D 4992

Great Lakes Armor Stone Design

Field Monitoring and Observations

Laboratory Testing and Analyses

Numerical Modeling and Software Development

Innovative Technology Development

Index Stone on Keweenaw Waterway Structure, MI Lake Superior

Concrete Armor Units, Ashtabula Harbor Breakwater, OH
Lake Erie

US Army Corps
of Engineers

Coastal and Hydraulics Laboratory - ERDC

Great Lakes Armor Stone Study

Field Monitoring and Observations

- Selected Sites (Index Stones):

1) Burns Harbor (10)
2) Cleveland Harbor (10)
3) Keweenaw Waterway (10)

- Conducted six rounds of monitoring at Keweenaw Waterway
- Conducted five rounds of monitoring at Cleveland Harbor
- Conducted four rounds of monitoring at Burns Harbor

Cleveland breakwater

Great Lakes Armor Stone Study

Laboratory Testing and Analysis

- Laboratory Test Stones

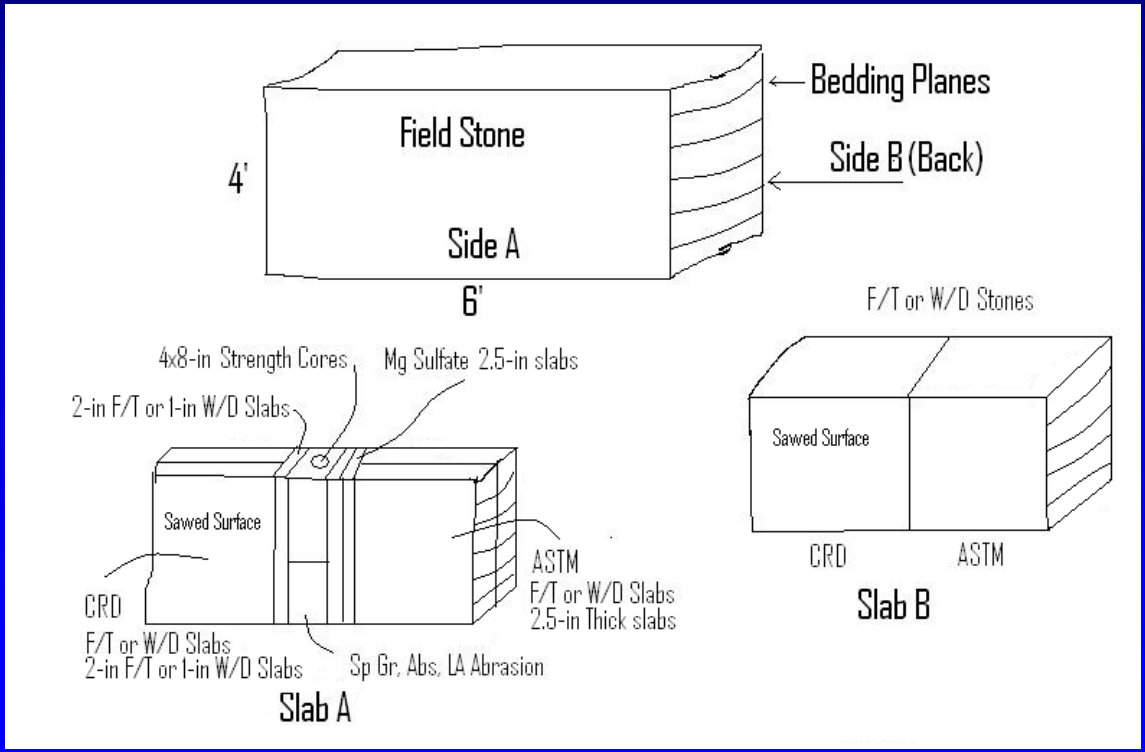
1) Granite
2) Quartzite
3) Valders Limestone
4) Indiana Limestone
5) Cleveland Sandstone

- Laboratory Tests:

1) Abrasion
2) Freeze-Thaw
3) Wet-Dry

- Optimum Rock Size:

3 ft x 3 ft x 3 ft



US Army Corps of Engineers

Coastal and Hydraulics Laboratory - ERDC

Great Lakes Armor Stone Study

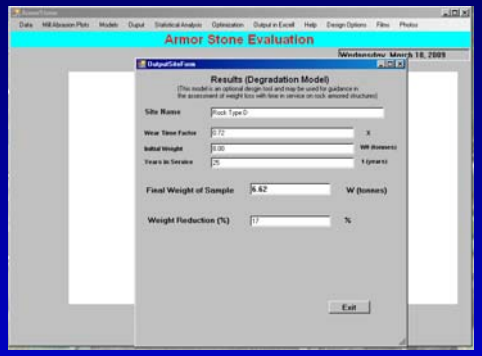
Numerical Modeling and Software Development

- **Evaluation Models:**

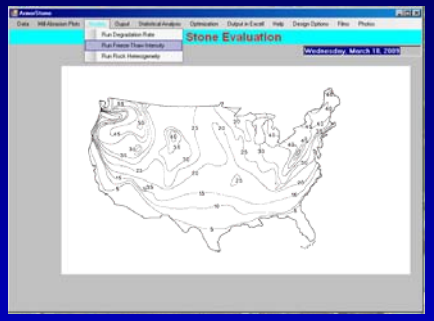
1) Degradation Model
2) Freeze-Thaw Model
3) Heterogeneity Model

- **Other Options:**

1) Optimization
2) Design
3) Animation
4) Statistical



Degradation Model Assessment



Freeze-Thaw Intensity Model Assessment

Heterogeneity Assessment

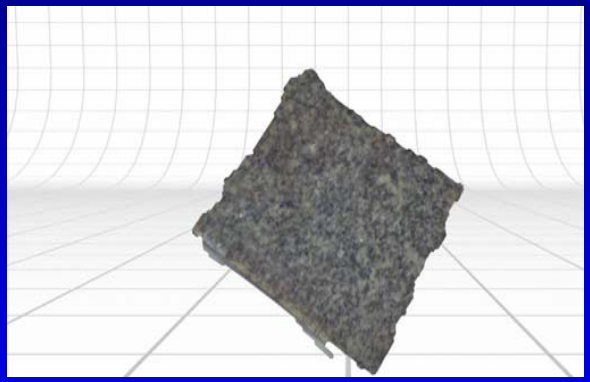
MCNP- Great Lakes Armor Stone Study

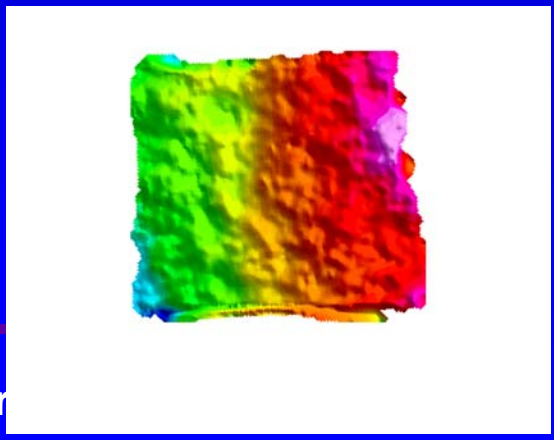
Innovative Technology Development

- Development of Advanced Field, Laboratory, and Numerical Techniques

1) Seismic
2) Magnetic Resonance Imaging
3) Rock Heterogeneity & Design

Magnetic Resonance Images





US Army Corps of Engineers

Coastal and Hydr

John T. Myers Locks and Dam, Ohio River

John T. Myers Lock and Dam, Ohio River

US Army Corps
of Engineers

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Upstream Entrance Innovative Repair Demonstration 2006

Downstream Entrance Innovative Repair Demonstration 2007

1,200-ft Guide Wall Innovative Repair Demonstration 2008

Comments

Questions?