Wear Mechanisms applied to Lifeboat Slipway Launches

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Presentation Structure

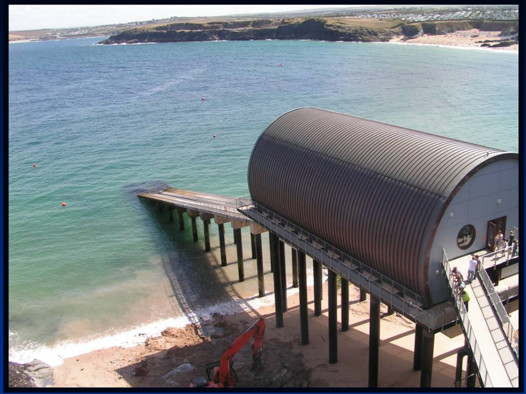
- Overview of lifeboat slipway launching
- Friction and Wear problems on lifeboat launch slipways
- Experimental Methodology
- Test rig design
- Tests Schedule
- Results
- Conclusions
- Recommendations & future work

Tamar Class Lifeboat

- The Tamar slip-launched lifeboat is designed as a replacement to the Tyne class lifeboat. It is significantly larger and heavier than the Tyne and this has meant new slipways and boathouses have had to be built to accommodate it.
- The Tamar currently operates from new boathouses and slipways at Tenby, Padstow and Cromer

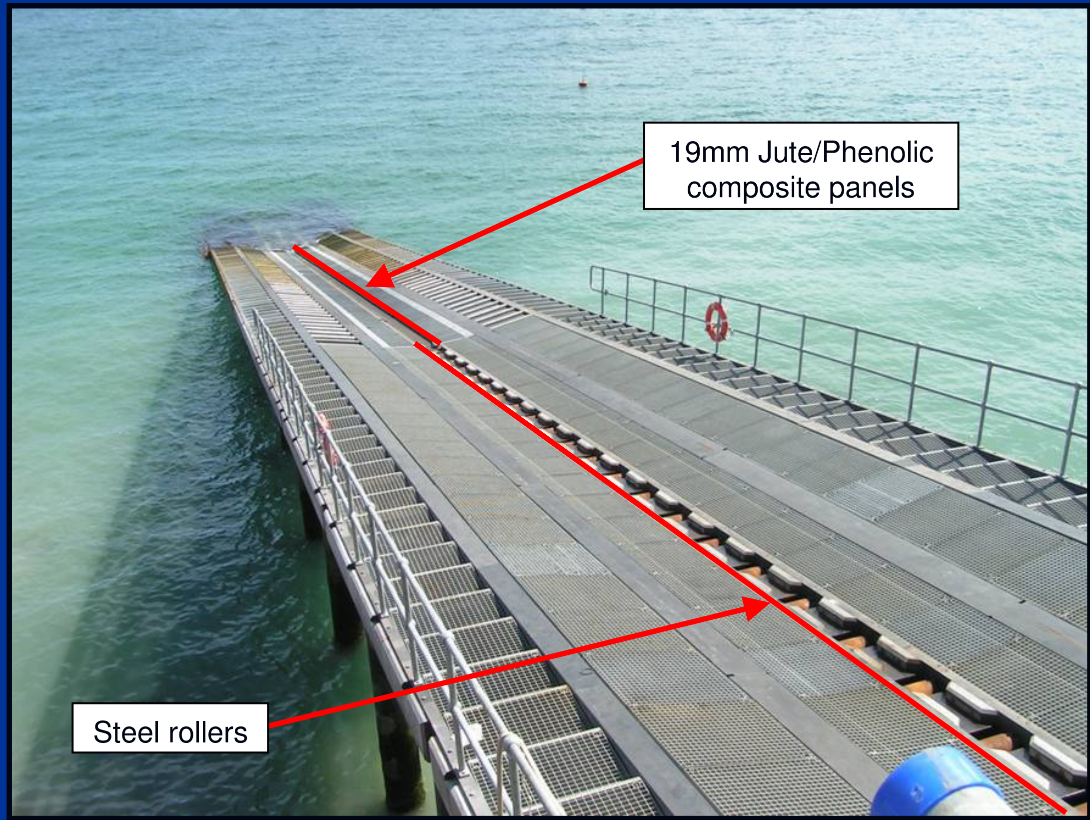
Slip-launched Lifeboats	Tyne	Tamar
Year Introduced	1982	2006
Length	14.3m	16m
Beam	4.48m	5m
Draught	1.26m	1.35m
Speed	17.6 knots	25 knots
Displacement	26 - 27 tonnes	~ 35 tonnes
Construction	Steel	FRP
Range	240n. miles	250n. miles
Crew	7	6

Lifeboat Slipway Launch



Typical Slipway - Padstow

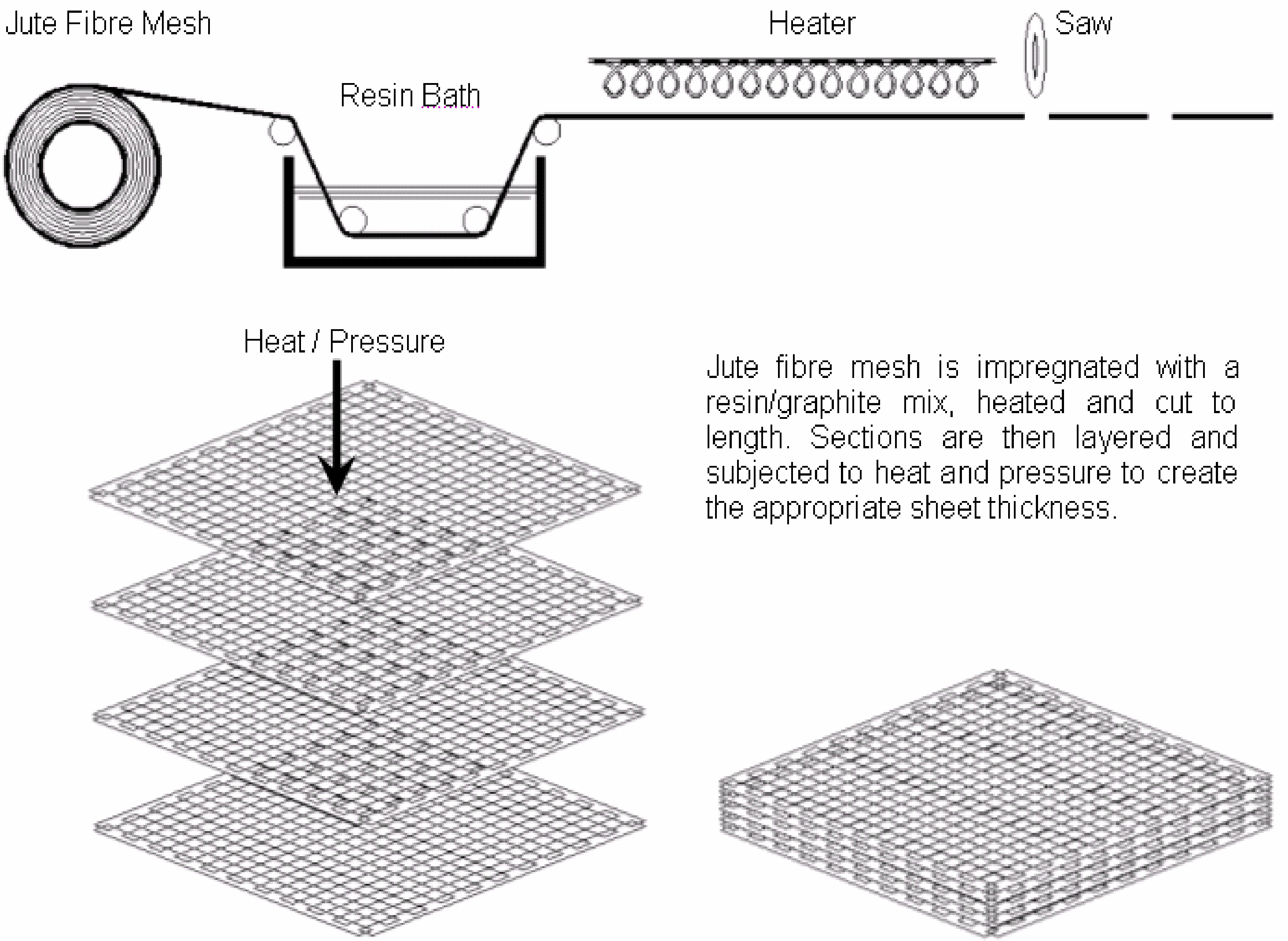
- Padstow has recently received a new boathouse in order to accommodate the new Tamar class slip-launched lifeboat
- The slipway layout is typical of the next generation boathouses and slipways being built for the Tamar
- The slipway consists of an upper section of steel rollers and a lower section lined with low-friction 19mm thick Jute/Graphite infused Phenolic resin Composite panels



Slipway Lining Materials

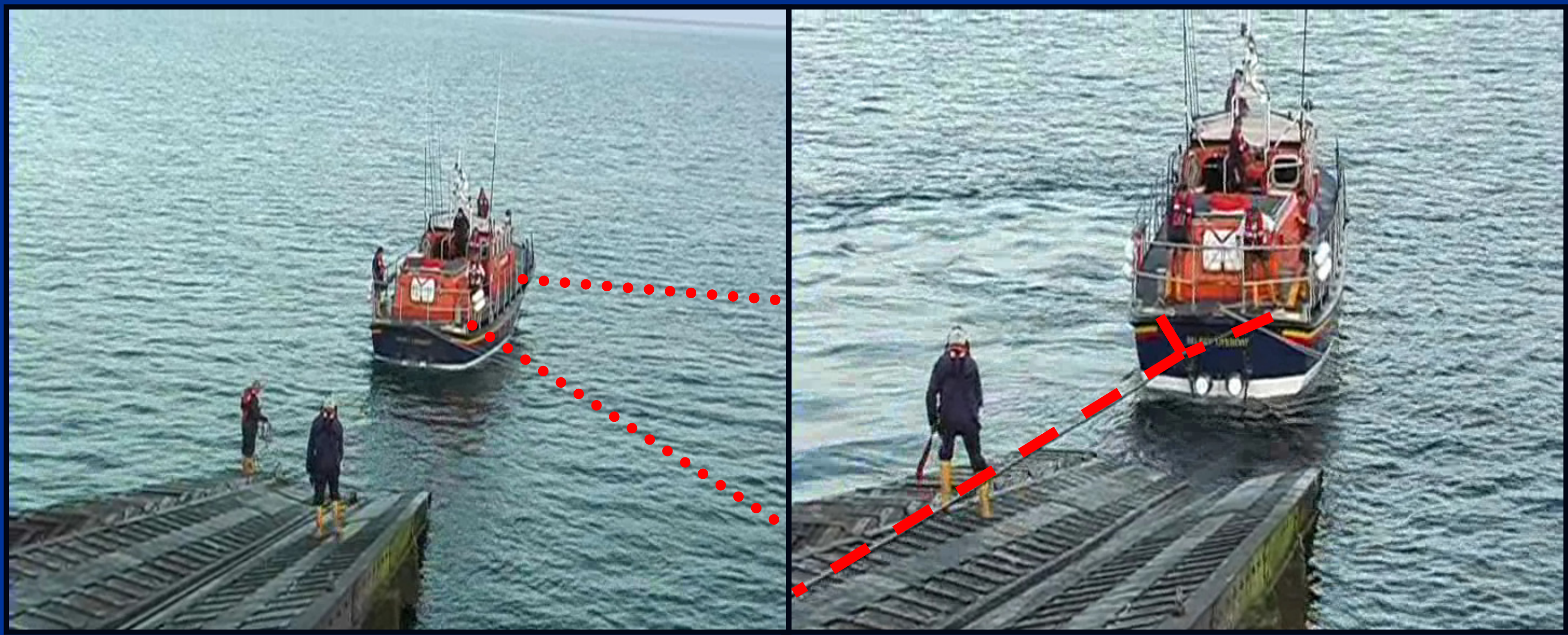
- Weather Treated Wood – Traditional c.1850
- Nickel/Chromium carbide coated Steel – c.1980
- Jute/Graphite Infused Phenolic Resin Composite – c.1996

Jute/Graphite Infused Phenolic Resin Composite



Jute fibre mesh is impregnated with a resin/graphite mix, heated and cut to length. Sections are then layered and subjected to heat and pressure to create the appropriate sheet thickness.

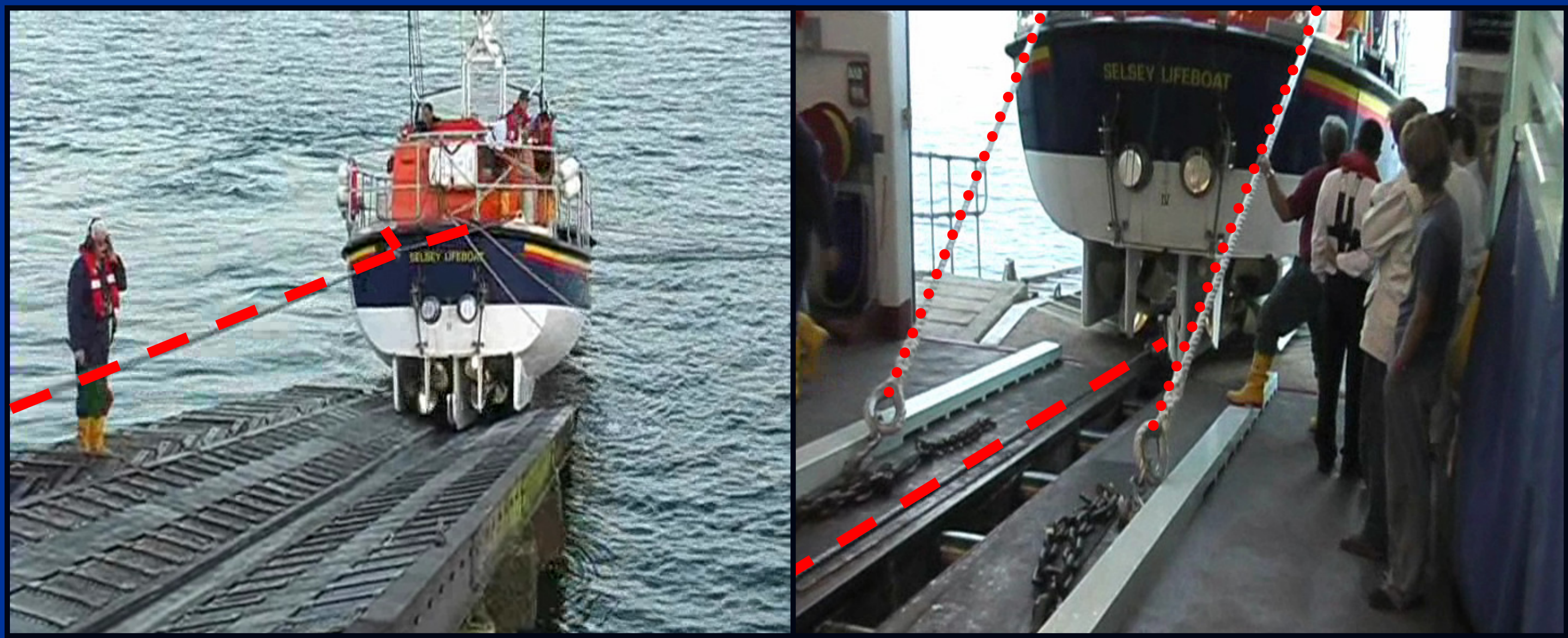
Lifeboat Slipway Recovery



- Alignment ropes - Winch cable

Lifeboat alignment and attachment of winch cable – alignment ropes and winch cable indicated

Lifeboat Slipway Recovery



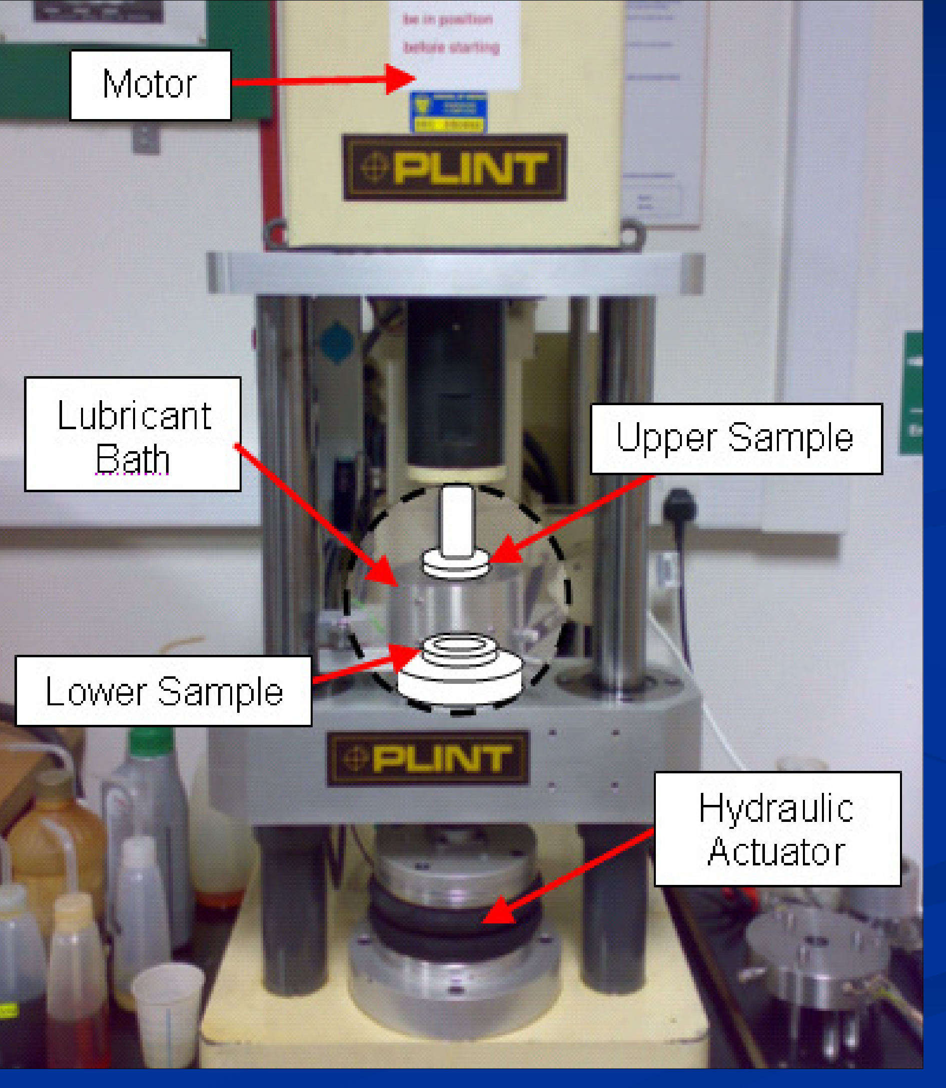
- Quarter stop ropes - Winch cable

Fig. 3.1.2i: Haul Stage – Rope quarter stops and winch cable keel attachment position shown

Problems..

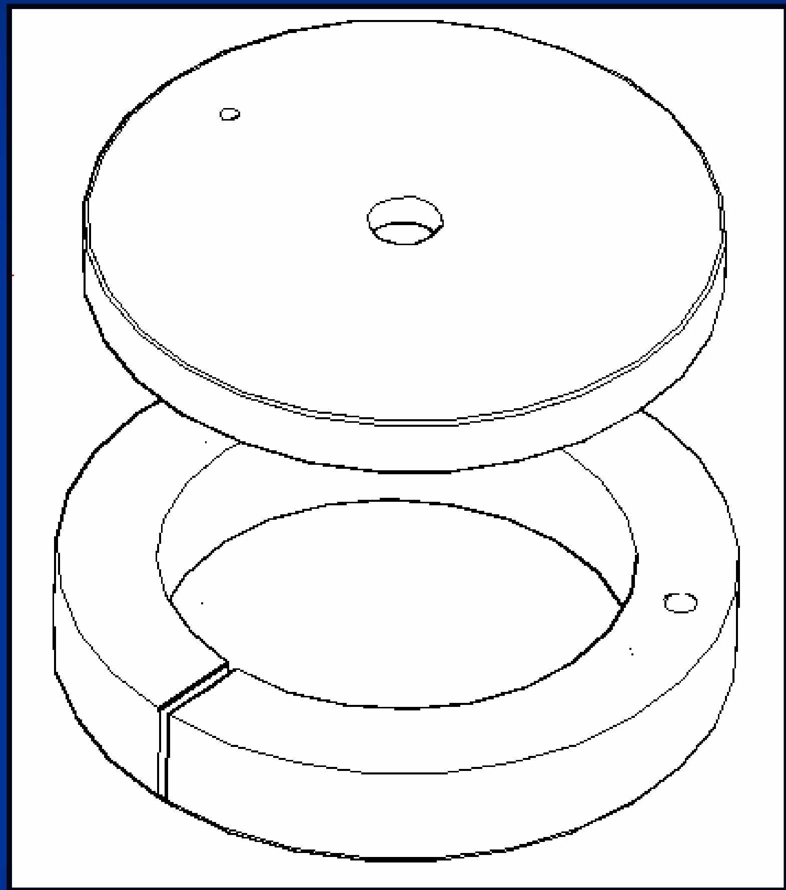
- High friction is often present along the slipway panels – this is particularly apparent as high winch loading during lifeboat recovery
- Currently marine grease or in some cases other lubricants, are manually applied to the slipway before each launch and recovery
- Due to the exposed nature of the slipway and the unpredictable intervals between lifeboat launches the lubricant grease can be washed away, dry out or become contaminated with wind blown sand etc. resulting in unpredictable friction coefficients
- Severe cracking and wear of composite slipway panels has been observed at both Tenby and Padstow requiring regular replacement

TE92 Rotary Tribometer - Schematic



TE92 Rotary Tribometer

- Original geometry is designed to measure wear in ball bearings
- Geometry is modified to a ring/disc arrangement to mirror the slipway/keel situation
- New geometry design features a self levelling pin to ensure even contact through stroke
- Tests are designed to incorporate dwell effects to simulate launch intervals



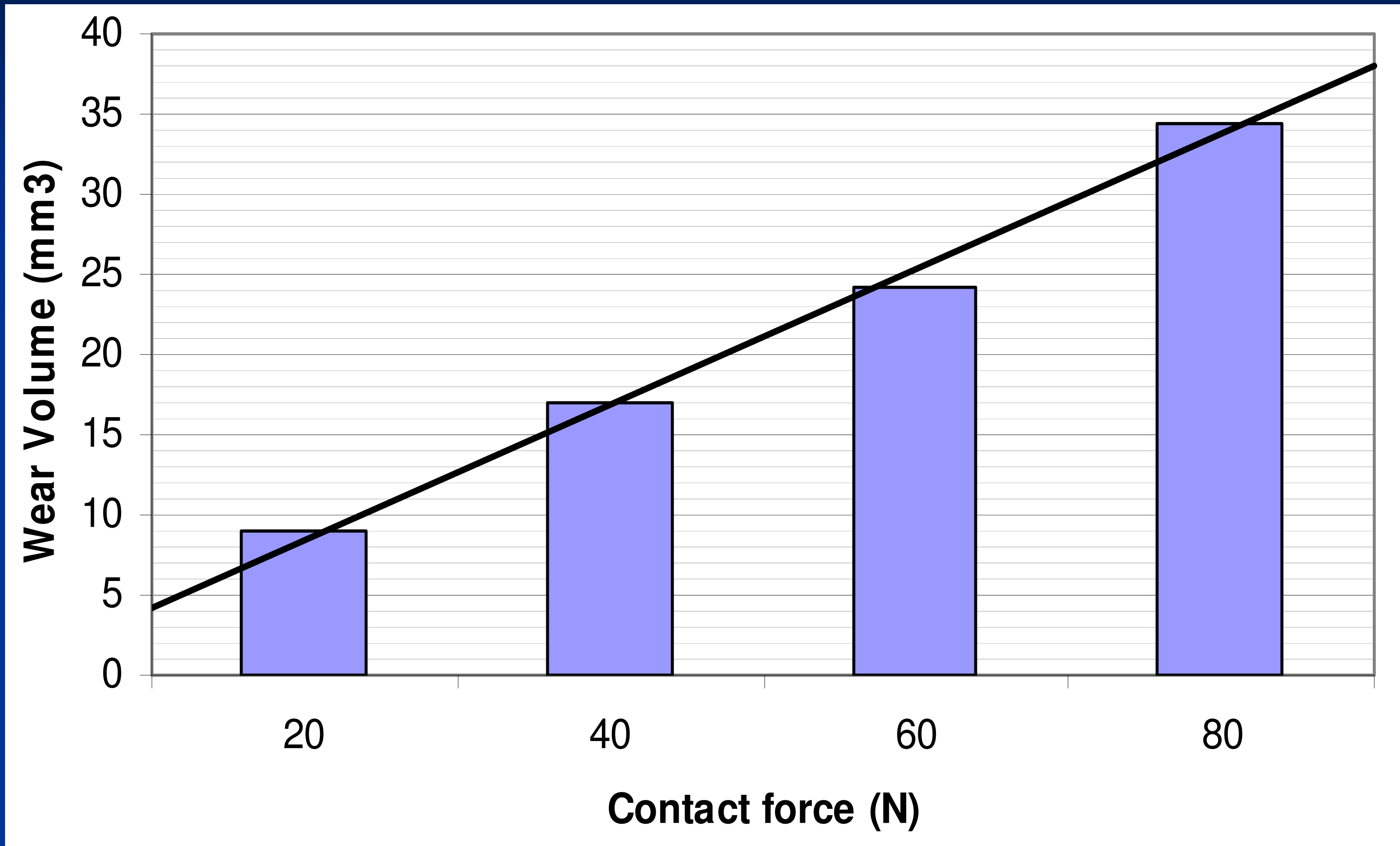
Tests Schedule

Test ID	Lubricant	Test Duration (#passes)	Contact Pressure (N)
CR1	Dry	1000	20
CR2	Dry	1000	40
CR3	Dry	1000	60
CR4	Dry	1000	80

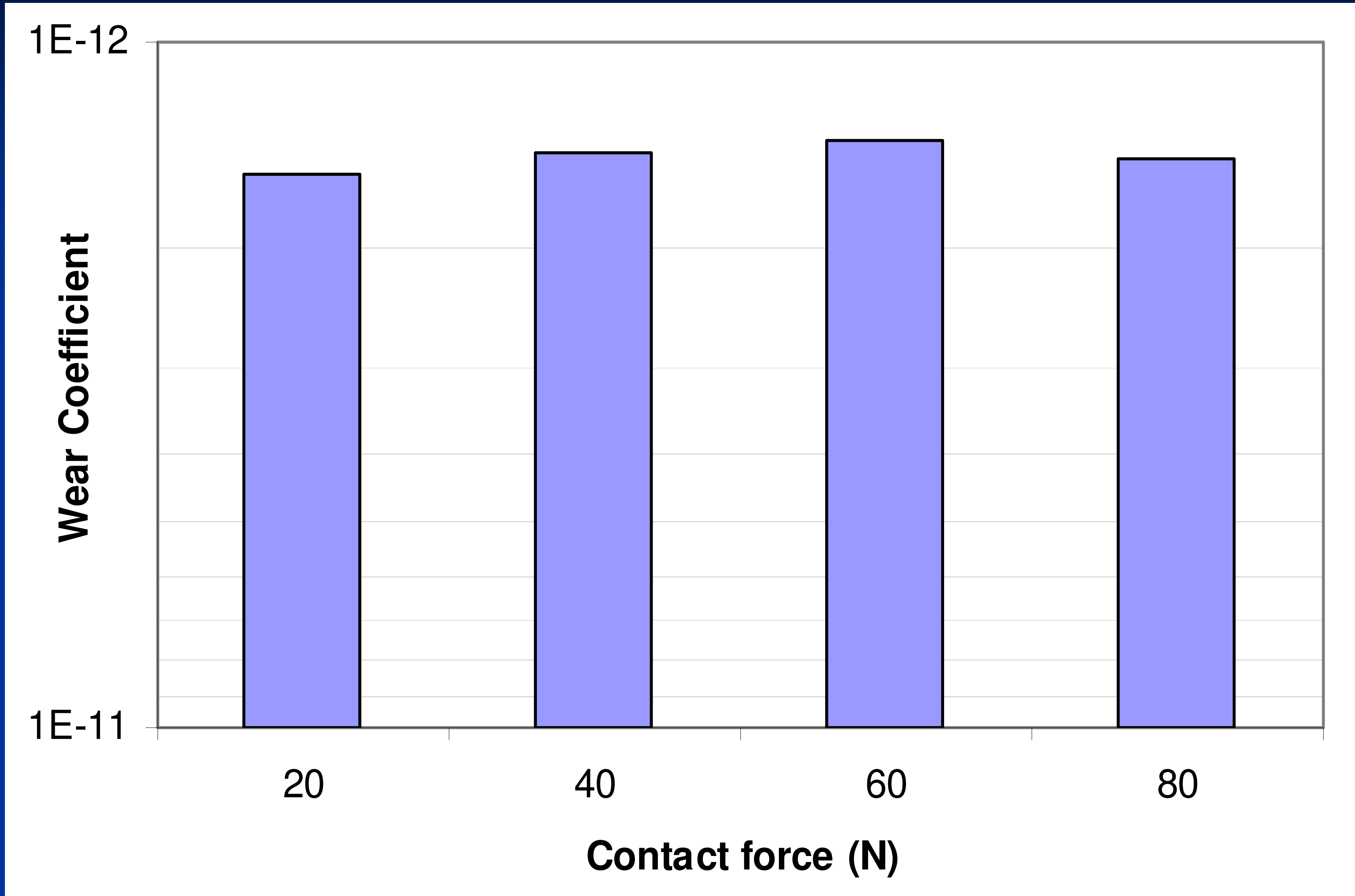
Contact Force Tests

Test ID	Lubricant	Test Duration (#passes)	Contact Pressure (N)
LR1	Dry	1000	20
LR2	Seawater	1000	20
LR3	Freshwater	1000	20
LR4	Marine Grease	1000	20
LR5	Silicon Microsphere Lub.	1000	20
LR6	Biogrease #1	1000	20

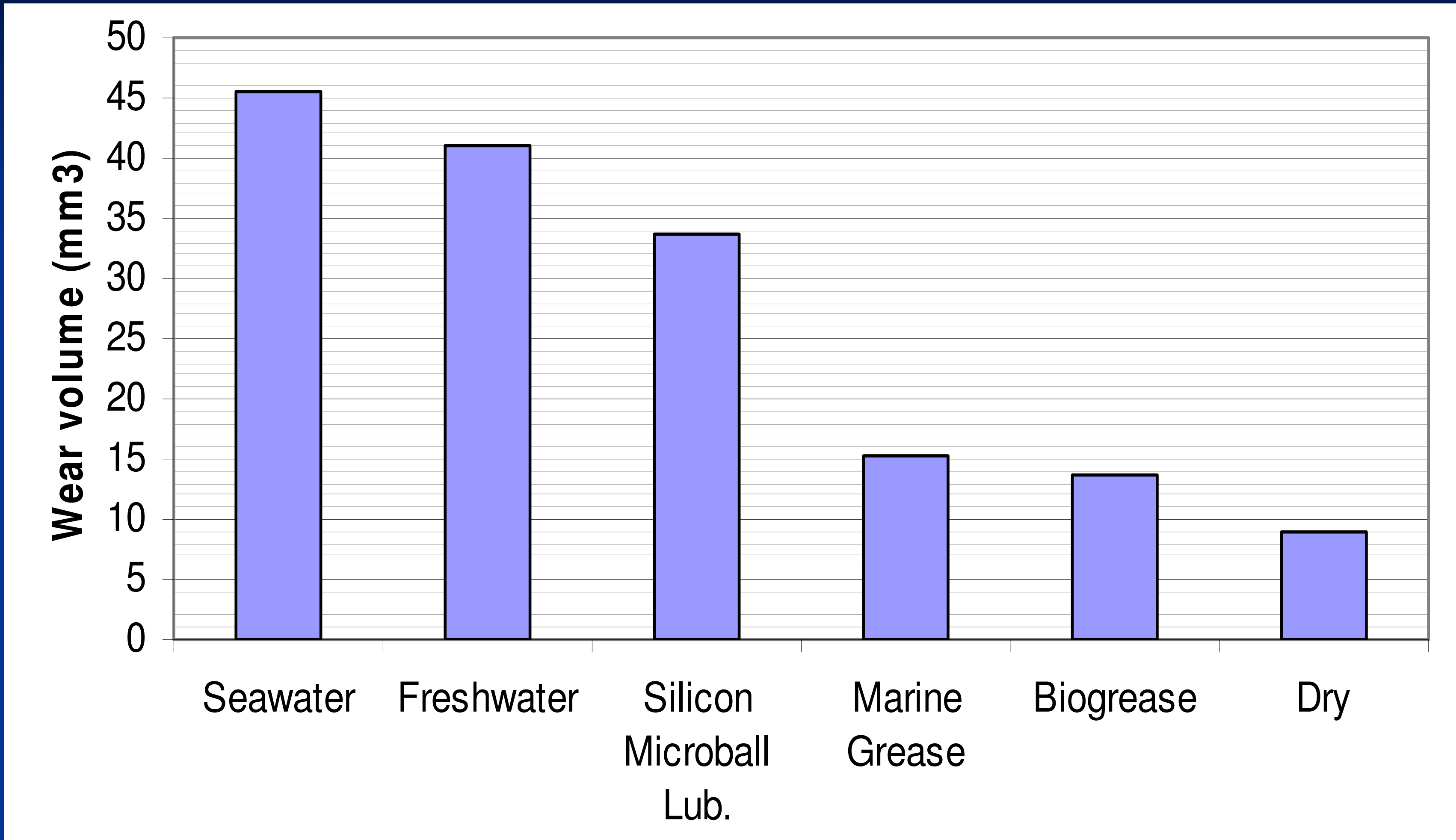
Wear Tests



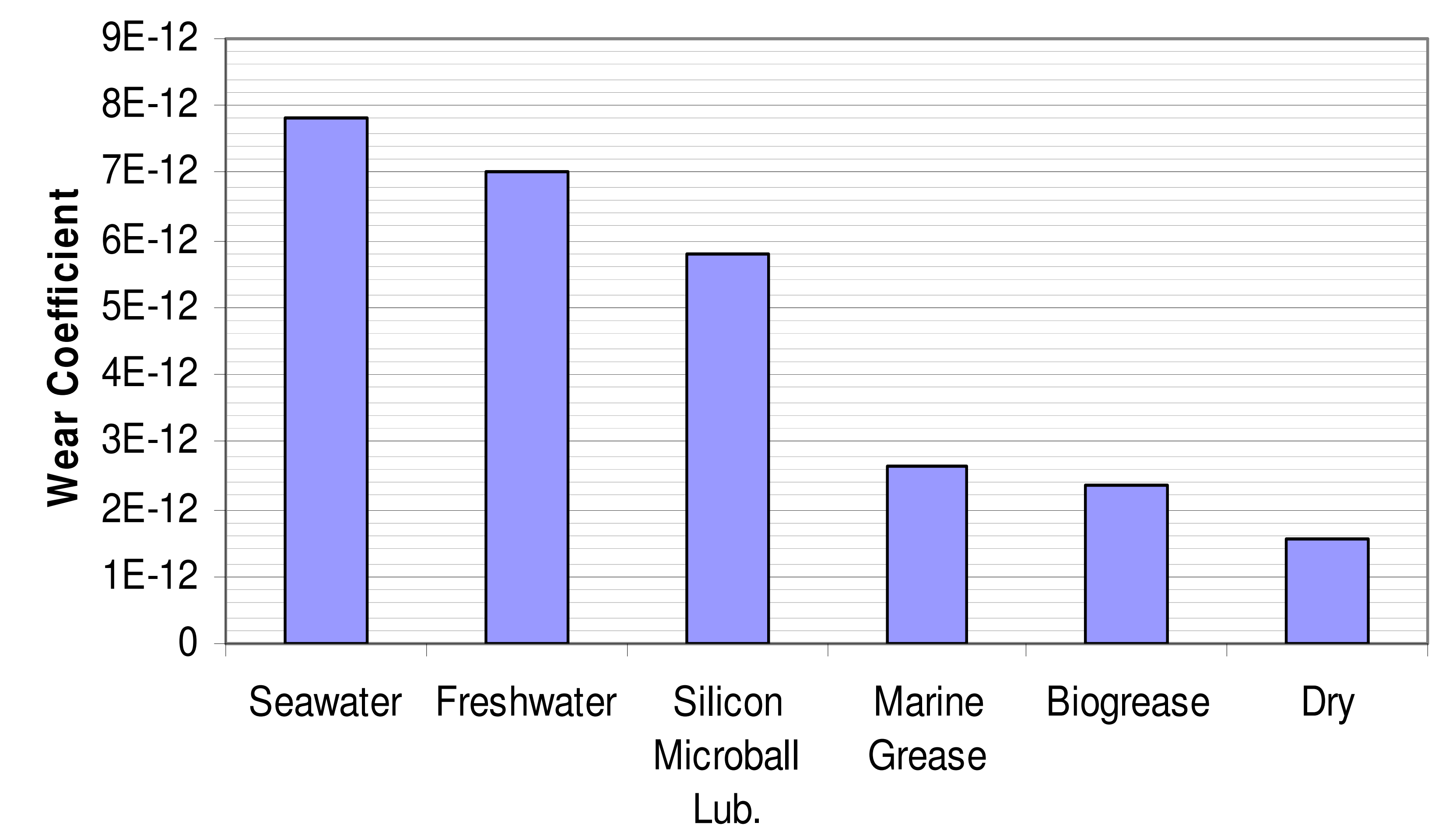
TE92 Jute/Phenolic Composite: Wear Volume vs. Contact Pressure



TE92 Jute/Phenolic Composite: Wear Coefficient vs. Contact Pressure



TE92 Jute/Phenolic Composite: Wear Volume vs. Lubricant Regime



TE92 Jute/Phenolic Composite: Wear Coefficient vs. Lubricant Regime

Case studies

- Slipways were examined at Selsey, Tenby, Swanage, Padstow, Bembridge, Sennen Cove and The Lizard
- Jute/Phenolic composite sections at Selsey, Bembridge, Padstow, Tenby and Sennen Cove were all found to have similar wear patterns

Bembridge

Selsey

Padstow

Tenby

Case Studies

- Slipways panels were found to be longitudinally misaligned
- Misalignment ranged up to 4mm with an average of 0.88mm
- FEA simulations were conducted to show the effects of panel misalignment on panel stress concentrations

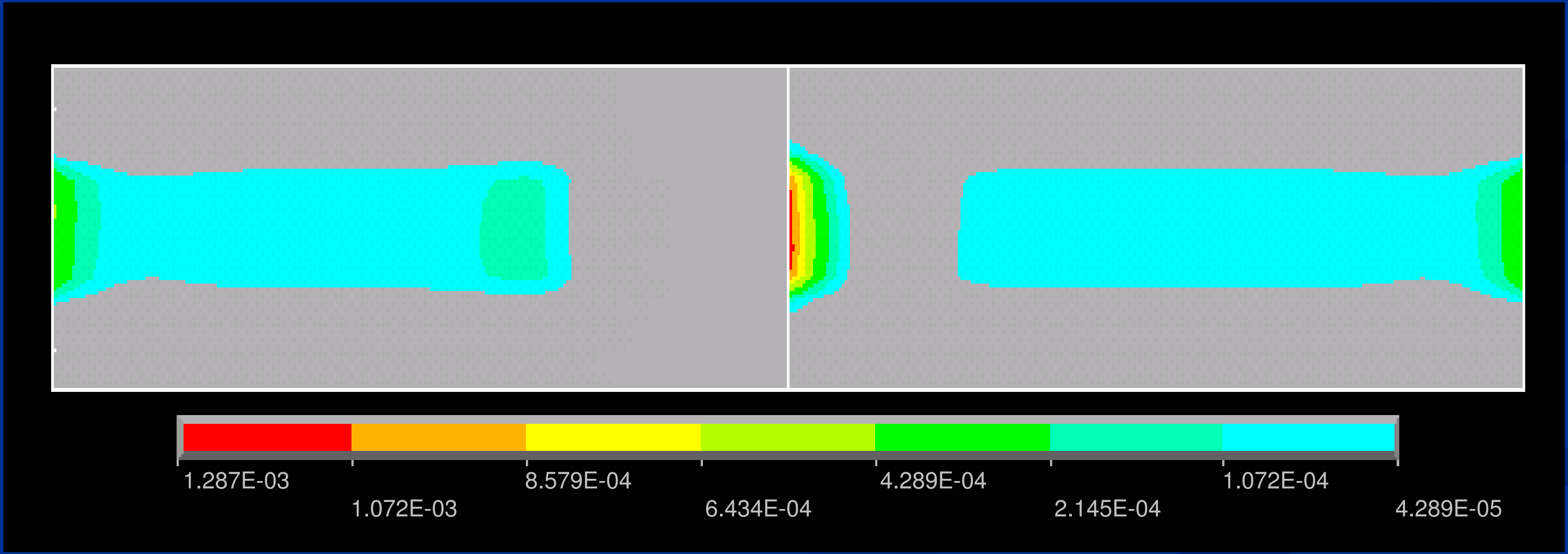
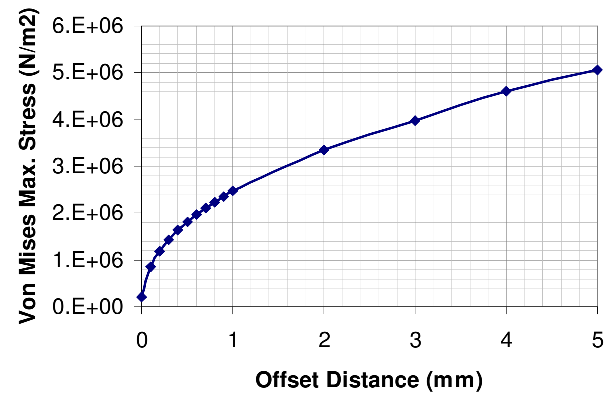
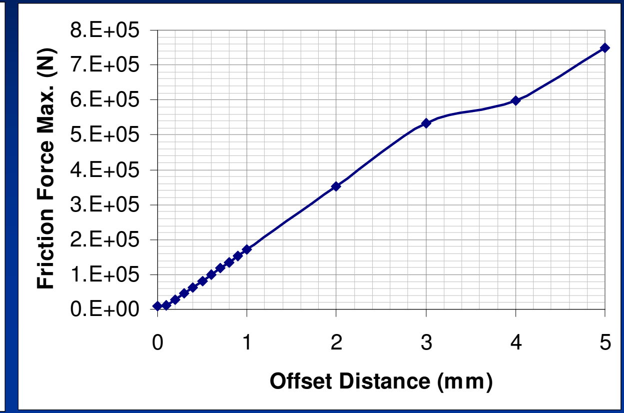


Fig #: Wear map for 1mm angled offset – Original panel (top), Chamfer panel (bottom)

FE Analysis





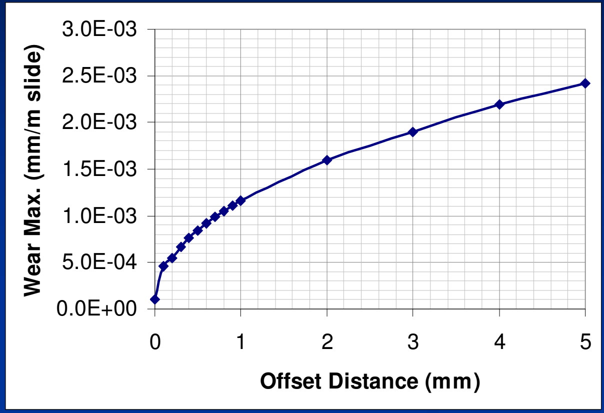


Chart #: Parallel Panel Offset Comparison

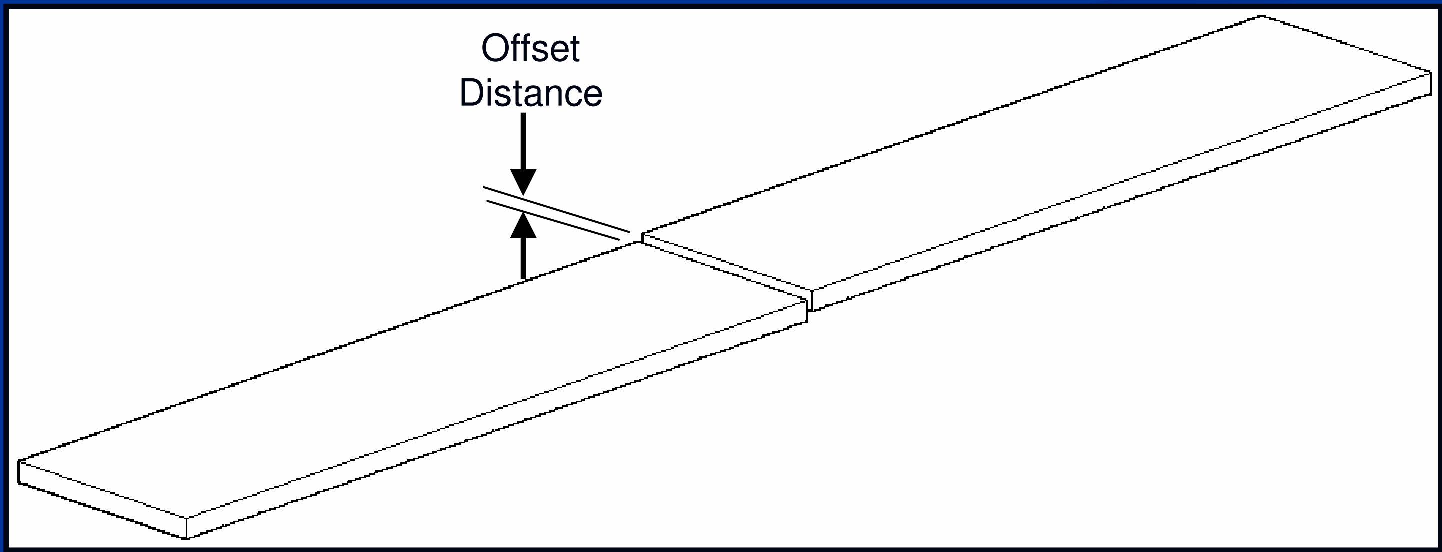
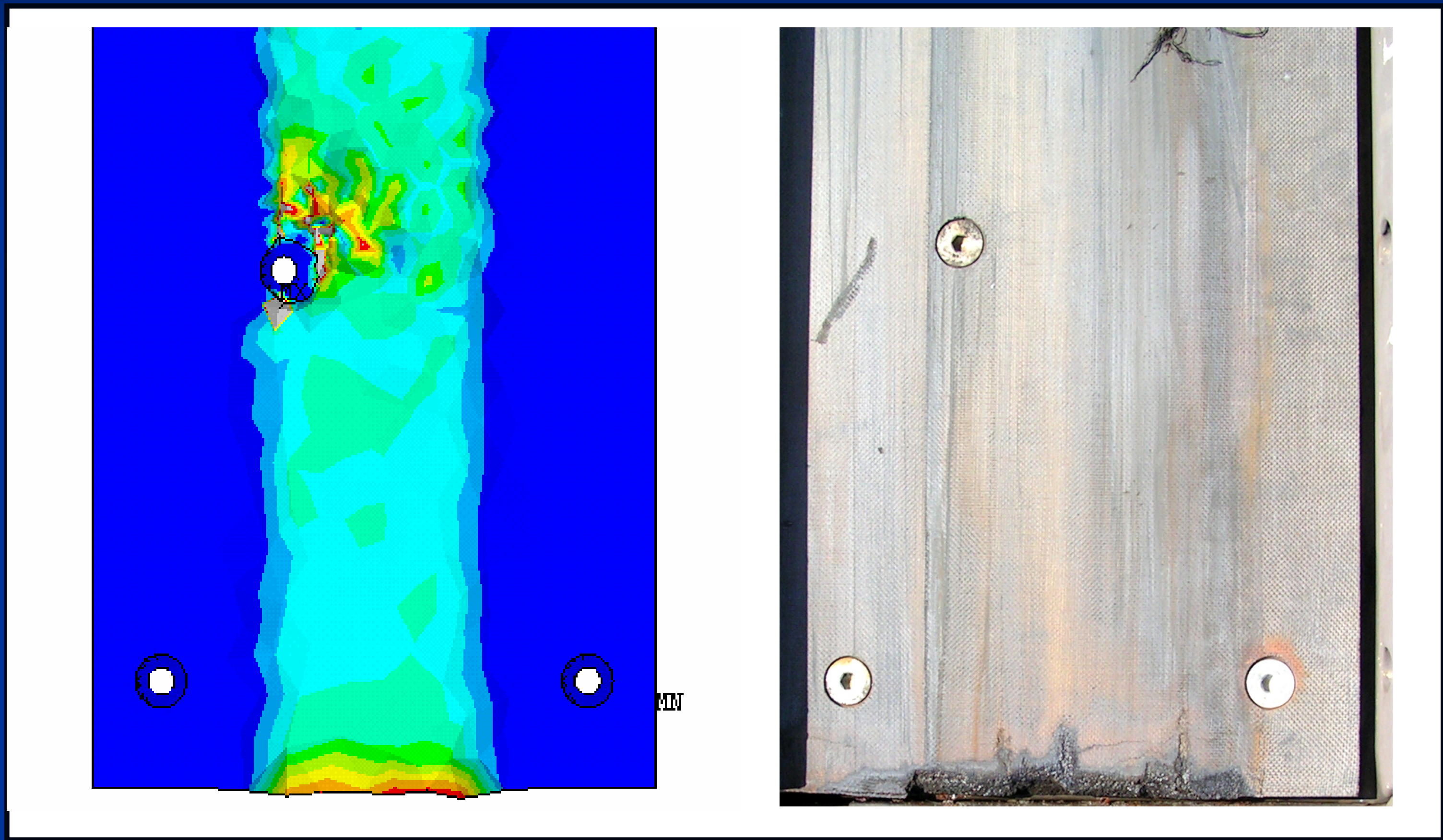


Fig #: Parallel Panel Misalignment Model

FE Analysis



FEA simulation vs. typical worn and misaligned jute fibre/phenolic resin composite lining section from Tenby slipway

FE Analysis

Lubricant	Eq. No of Launches & Recoveries for 19mm Wear Scar Depth
Seawater	16.80
Freshwater	18.66
Silicon Microball Lub.	22.65
Marine Grease	49.88
Biogrease	56.30
Dry	84.58

Equivalent number of lifeboat launches/recoveries required to generate a 19mm wear scar on a 4mm parallel offset misaligned slipway panel by lubricant used

Concluding Remarks

- Under ideal conditions the wear coefficients between slipway panels and lifeboat keel are not sufficient to cause failure during the expected 2-year lifespan of the panel.
- Real world slipways often exhibit misalignment between slipway panels.
- FEA shows that there a significant stress concentrations and correspondingly wear, at these misalignments.
- This increase in wear due to stress concentrations is sufficient to explain the high wear observed at Tenby and Padstow.
- The use of lubricants along the slipway should again have little effect under ideal conditions according to the test data. However, with panel misalignment included the choice of lubricant may become more significant.
- Previous work has indicated that lubricants are necessary to meet the friction specification of the slipway.
- It is therefore recommended to review and re-fit the affected slipways to reduce slipway panel misalignment.

Water Jet Adoption - Padstow