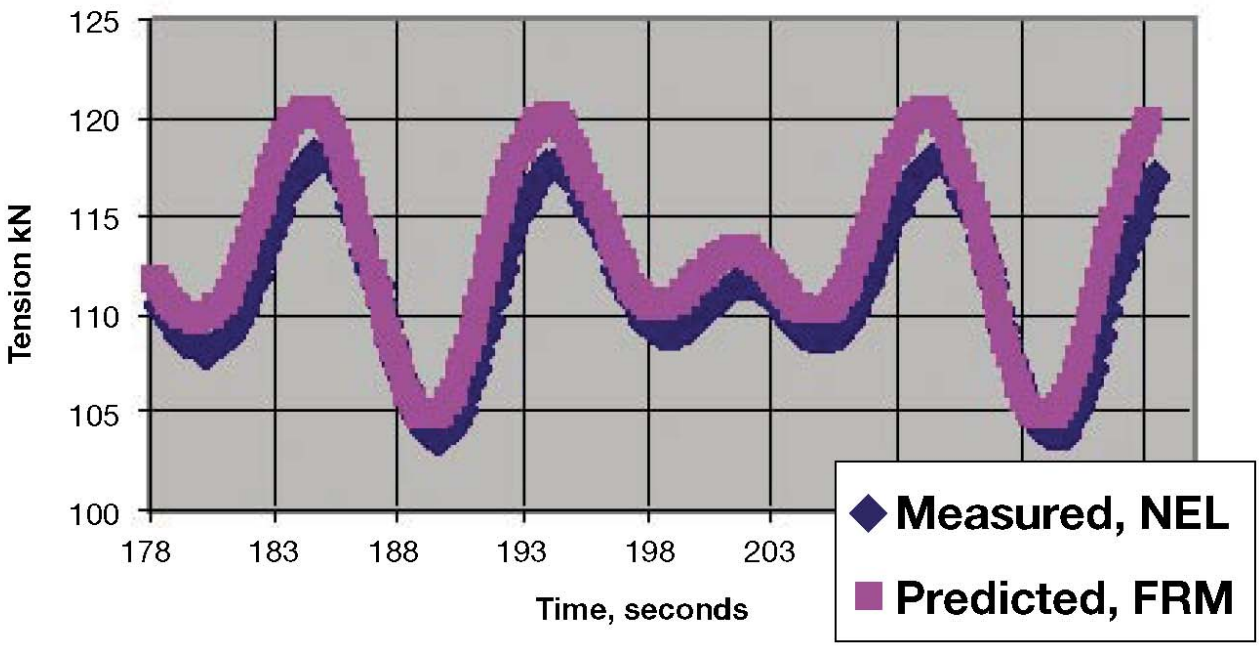
FRM - FIBRE ROPE MODELLER

Computer Modelling for Rope Design and Performance Prediction

Technical Notes 05, April 2016



New major break through computer modelling of modulus modulation
Comparison of FRM modelled load/time biharmonic series against measured in test machine on 80 tonne polyester sub-rope

FRM is an advanced suite of calculation and simulation modules, encompassed in a single computer program for use by engineers in the design or selection of synthetic fibre ropes. The modules are based on work performed by TTI for the US Navy and is intended to supplement or replace expensive prototype rope testing.

The FRM program is presently available for use in two ways:

- TTI staff can perform analyses to meet the needs of rope makers and rope users.
- TTI can license the program for use by experienced rope engineers.

USES OF FRM

When used during rope design and development, FRM replaces the time-consuming and expensive trial-and-error prototype rope production and testing. Alternative yarn properties and construction details can be input to predict important properties, for both new and cycled ropes. More precise predictions are achieved when FRM is "calibrated" against known properties of a similar "bench-mark" rope.

Comparison of predicted and measured test results provides a quality check to reveal errors during rope manufacturing. In addition to their immediate utility, the FRM program can be enhanced to provide manufacturing information, costings, dimensions, and a range of rope properties for all types of rope, cord and cable, according to the needs of clients.

For ease of use, the program is split into a series of modules:

FRM-I accepts input of basic data on the yarn properties and rope construction.

FRM-T predicts load/extension/torque/twist properties of twisted ropes.

FRM-F predicts cyclic load performance, e.g. residual strength and the S/N curve.

FRM-P predicts load/extension and cyclic load responses of parallel-yarn ropes.

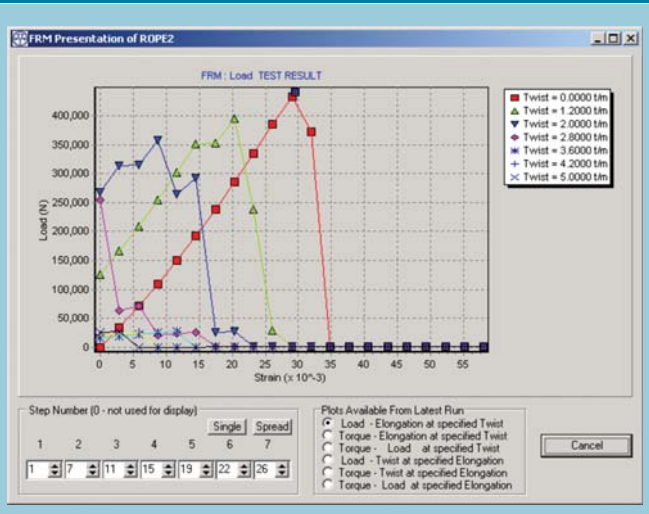
FRM-S covers features of twisted rope splice behaviour.

FRM-B, allows all types of braided, plaited, Braid-on-Braid and ropes with jackets to be modelled

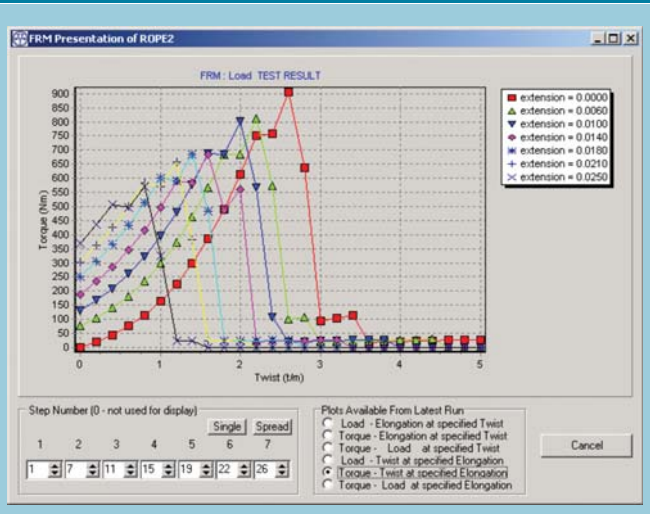
MECHANICAL PROPERTIES OF TWISTED ROPES

FRM-T, using FRM-I for data input, is a highly developed and well validated rope analysis module, intended particularly for high-performance synthetic fibre ropes. It can model almost any form of twisted or laid rope construction, including twisted yarns, simple 2-strand, 3-strand, 4-strand structures, multi-layered ("wire-rope" form) ropes of 6, 18 or 36 strands; and parallel-strand ropes. FRM-T predicts the important mechanical properties of ropes: break load, load-elongation, torque-twist, and interaction of tension and twist. It can

Example: Design of a 7-strand Aramid Rope



Load elongation



Torque Balance

also take into account friction and computes contact forces between components.

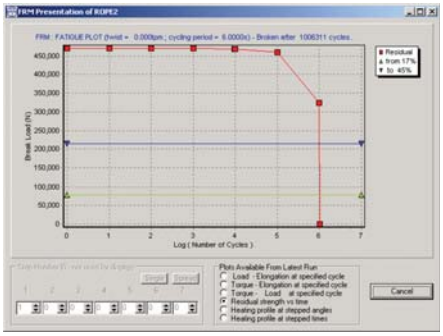
LONG TERM DURABILITY AND EFFECTS OF CYCLING

FRM-F quickly predicts changes in rope performance to cycling over long service life, for example by wave action. With yarn creep property input, it gives good predictions of rope creep rupture. Relative but not absolute predictions can be made of some other effects, because data on relevant yarn properties is limited. It can be used to explore the following problems: heating due to dynamic losses in fibres and friction between fibres, internal abrasion due to components rubbing on one another and “kink-band” failure when components suffer axial compression fatigue due to rope twisting or construction variability.

APPLICATION FOR FRM

Tension Technology International can now use FRM to advise:

- Ropemakers on changes in rope properties resulting from new materials or new constructions
- Fibre producers on the potential of new fibres or fibre finishes in rope applications
- Rope users, such as oil companies and civil engineers, on optimum choices and expected performance in critical situations
- Modelling stress-strain curves for type cords, elevator cables, helicopter lift ropes
- Use as a complentary tool for assessing rope material/construction/application, etc. as part apart of an investigation into rope failure



Predicted residual strength through lifetime of 7-strand aramid rope

TTI can provide complete training on the use of the FRM and useful input data.

For further information and a demonstration, contact:

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