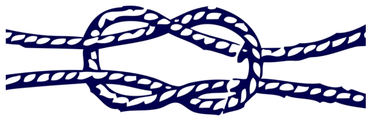

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Effect of Twist on Strength of Braided Rope

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Abstract

Twist significantly decreases strength and elastic modulus in large marine braided ropes [1], but little is known about the specific effect of twist on small-diameter synthetic ropes, which may be used in home/DIY projects in strength-critical applications. To model the effect of twist on strength and elastic modulus in small braided ropes, samples of 3/16" diamond braided nylon rope were twisted and tension-tested to failure on an Instron. Results show twist decreases breaking strength by **(0.51 ± 0.14) %** per twist/m, and decreases elastic modulus by **(4.75 ± 0.79) × 10^{-3} %** per (twist/m)^2. Overall, small-diameter nylon ropes are more resilient to twist than larger marine ropes.

Background

How Twist Weakens Braided Rope

Uneven load sharing [1]

untwisted twisted

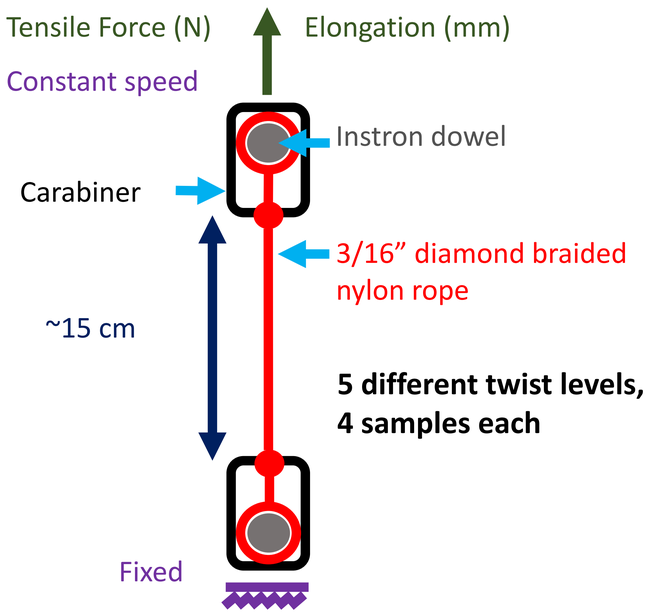
Introduces torsion [2]

$$\tau = c_1 F d + c_2 F d^2 \frac{d\phi}{dz} + c_3 G d^4 \frac{d\phi}{dz} \ldots.$$

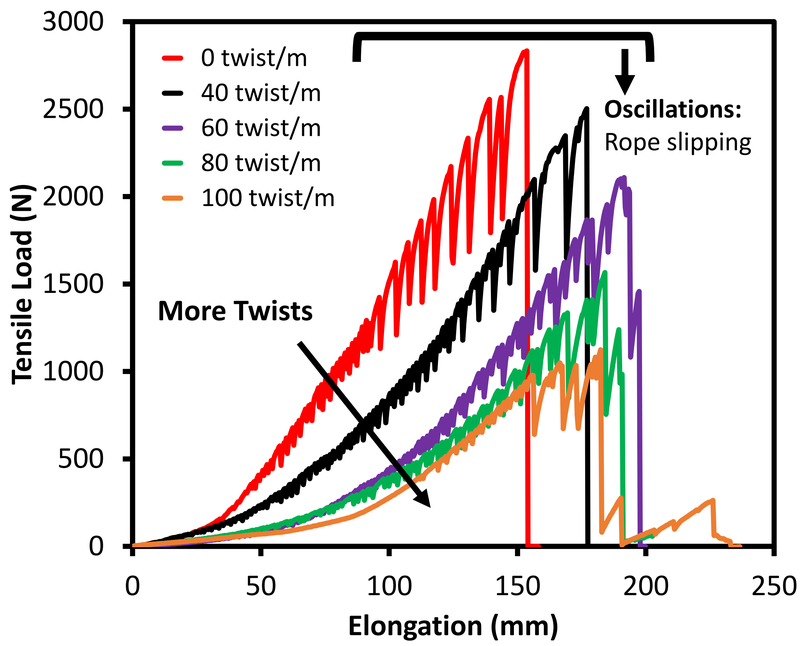
τ = torsion
F = tension
ϕ = rotation
z = length
d = diameter
G = shear modulus
c_i = rope properties

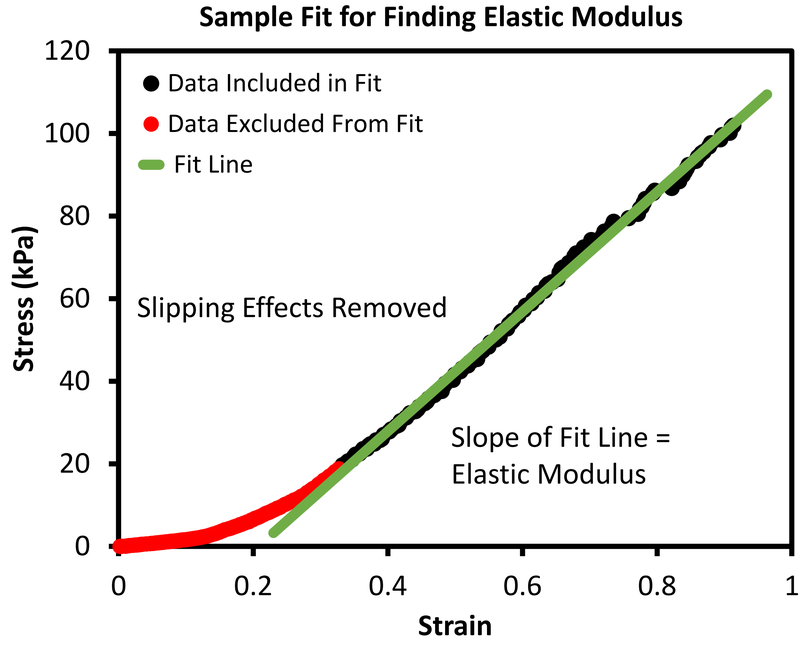
Experiment

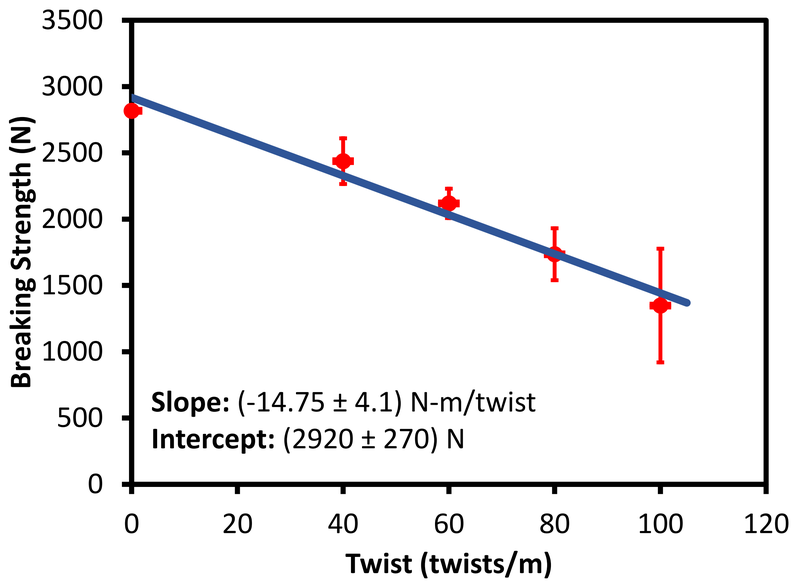
Instron Testing

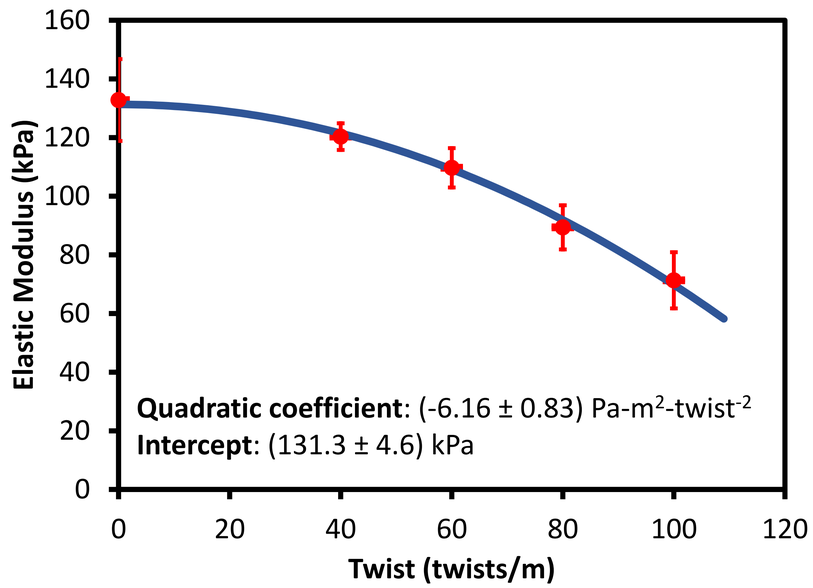


Results









Conclusions

- Breaking strength **decreases by (0.51 ± 0.14) %** per twist/m
- Elastic modulus **decreases by (4.75 ± 0.79) × 10^{-3} %** per (twist/m)^2
- More resilient to twist than previously studied large-diameter ropes
- Most typical applications: don't need to worry about twisting!

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References

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[2] Chaplin, C.R., Rebel, G., and Ridge, I.M.L, "Tensions/Torsion Interactions in Multicomponent Mooring Lines." Offshore Technology Conference 2000: pp 1-8. Houston, TX, May 1-4, 2000. DOI 10.4043/12173-MS.

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