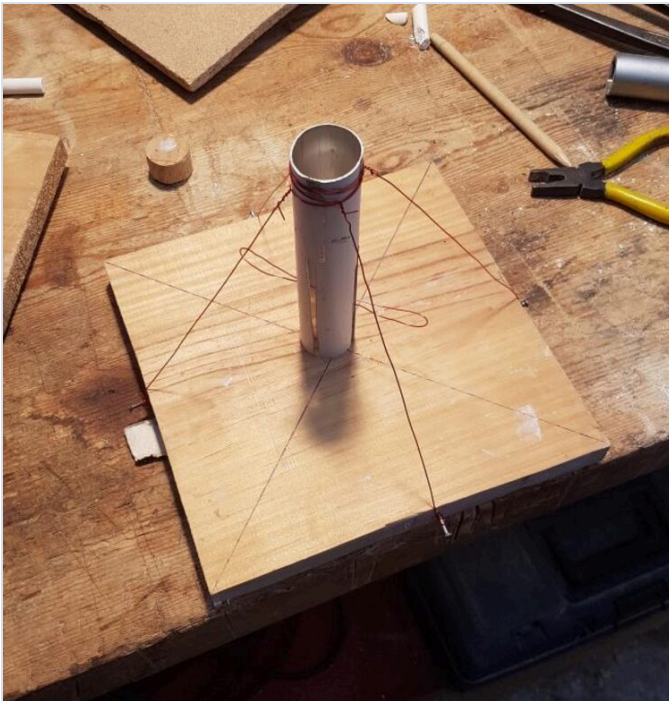


Measuring the Unmeasured — chalk resistance

Quantifying the mechanical limits of school chalk with no lab, no testing machine, and no reference data to compare against.

THE STUCK PROBLEM

Find the failure strength of ordinary chalk under five load types — bending, tension, shear, torsion and compression — using only household tools. Each load type had to be isolated cleanly, or the number would be meaningless.



Compression rig — a box-spanner piston in a slotted cylinder, kept axial by four guide wires.



Characteristic helicoidal fracture from the torsion rig — evidence the load was correctly isolated.

CONCEPTS GENERATED

Bending & tension — water-bottle load cells. A bottle filled gradually until fracture, weighed on a kitchen scale, gave a repeatable force. Two opposed constrictor knots kept the tension load perfectly axial.

Pure shear — twin-plate guillotine, v2. The first rig let the sliding plate rotate, binding on its rails and adding friction that corrupted the reading. Fix: a larger contact surface and four guide rods instead of two, removing the parasitic moment.

Torsion & compression — isolation rigs. A grease-packed homemade bearing isolated torsion (residual friction measured and subtracted); a piston-and-cylinder press, borrowed from hydraulic-press principle, kept a high compressive load axial where a simple stack would topple.

OUTCOME

Consistent, physically sensible failure values across all five cases — with variance tightest for the simplest rig and widening as the apparatus grew, exactly as expected.

The real deliverable: a documented method for reaching a defensible answer from nothing but improvised tools and clear reasoning.