Gill Athletics

Pole testing and Development
- Engineering the Pole -

Discussion Topics

- ✓ Why change anything
- ✓ What are we try to accomplish
- ✓ How does it relate to real world
- ✓ Structural testing
- ✓ Dynamic testing
- ✓ End loads
- ✓ Basics on Pole Materials
- ✓ Engineering Aspects
- ✓ Questions and discussion

Why?

- ✓ Improve Production Methods
- ✓ New materials
- ✓ Vaulters Needs
- ✓ Increase our understanding and knowledge
- ✓ Help improve performance

Different Poles!!

- Different people
- Different technique
- Ask Mr. Tim Lobinger who has vaulted on most types – and over 6m on various poles – currently using Pacer FX and has series of Carbon FX which he used with good exposure to win a big IAAF Season Finale.


2
482

What are we try to accomplish?

- ✓ It would be arrogant to think we could design one pole that would be the perfect pole for everyone
- ✓ Design Poles that can aid vaulters at all levels achieve their potential
- ✓ Design and test the F1 pole of pole vaulting – lighter carry weights – tuned responsiveness
- ✓ Continued improvement

Structural Testing

Structural bend test to 65%

Every Pole Built

- ✓ Embedded Bar coding – since Fall of 2003
- ✓ Bend tested to 65% Chord Length
- ✓ Flex measurement
- ✓ Data Recorded
- ✓ Pre-Bend Checked

Dynamic Testing

- ✓ Look for weaknesses in designs
- ✓ Comparison of various poles
- ✓ Analyze Performance components
- ✓ Another piece of the puzzle

POLE TESTER

Accelerometer

Load Cell

What does it consist of?

This device consists of two carriages, which run in a vertical track on the wall. The top carriage holds the gripping end of the pole and the bottom carriage holds the planting end of the pole. We also have sensory equipment attached to the tester, which includes an accelerometer and load cell.

What does it do?

Gill Athletics' pole vault pole testing device is to simulate a similar dynamic load to that of an actual person pole vaulting.=

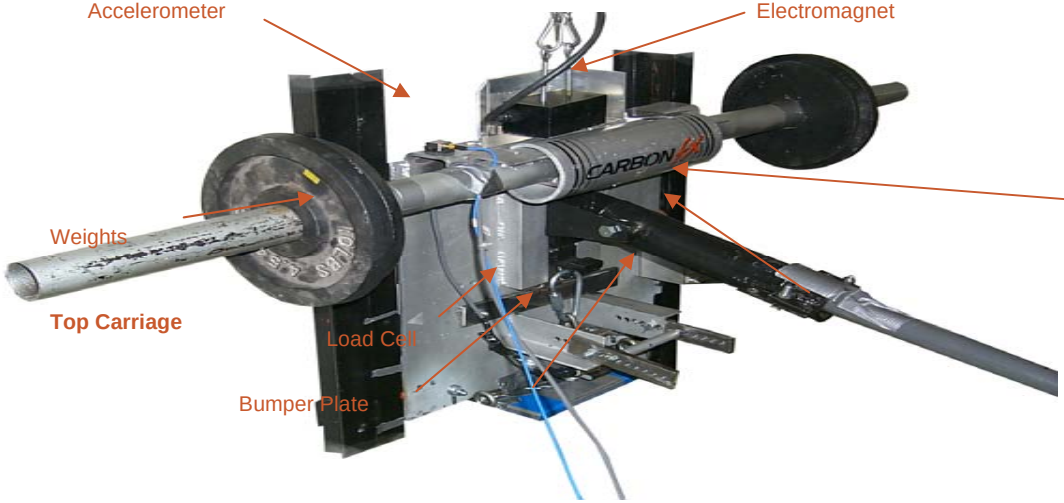
What is an accelerometer?

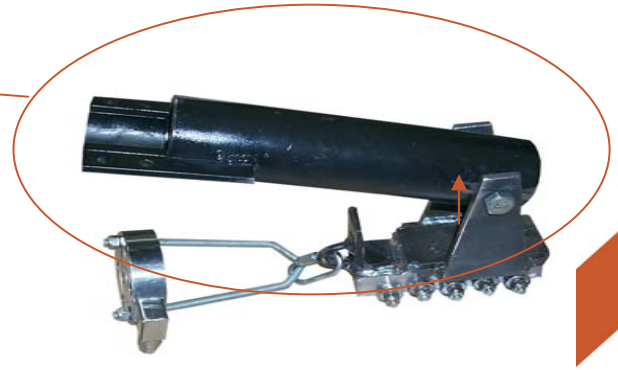
An accelerometer measures acceleration, in which it records the change of velocity. This helps us figure out how much, recoil or spring the pole has. So, when the pole is flexed it reads how fast the pole straightens back out.

So how does it work?

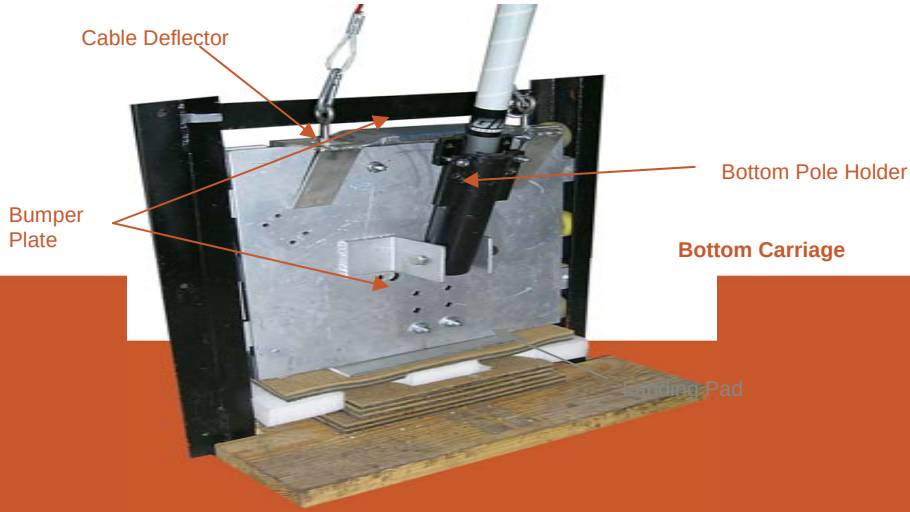
An electromagnet is attached to a cable and winch, which then magnetizes to a plate on the top carriage so it is able to pull the tester to a desired drop height. The lower carriage is attached to the top carriage by a cable, so when the top carriage is winched the bottom carriage travels with it. We chose an electromagnet for an optimum release factor. Just by eliminating the power to the magnet the test device is free to fall down the track creating an impact on the bottom carriage. This allows the top carriage to keep rolling down the track, and in turn flexing the pole.

POLE TESTER





Software

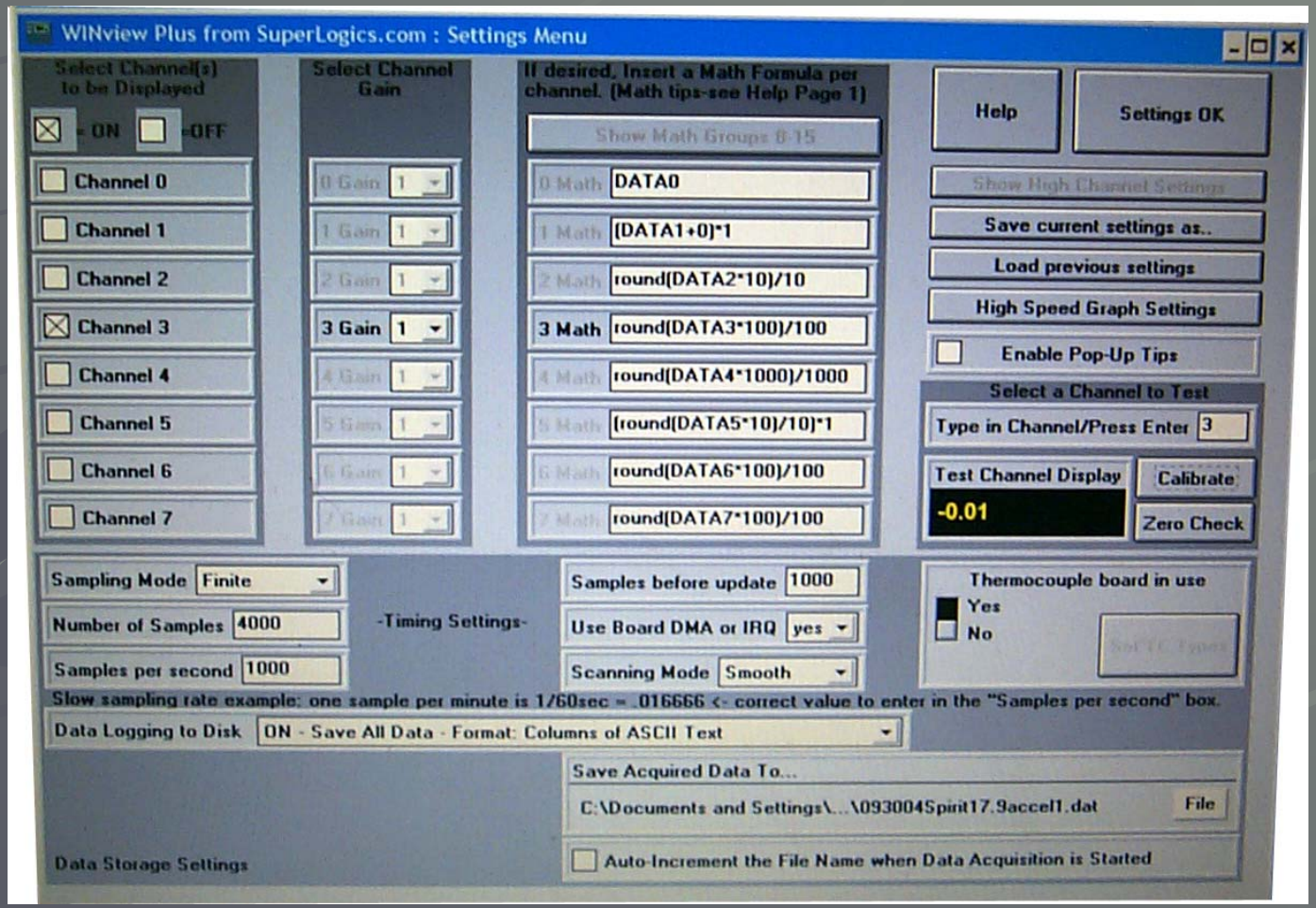


Bottom Carriage

Top Carriage

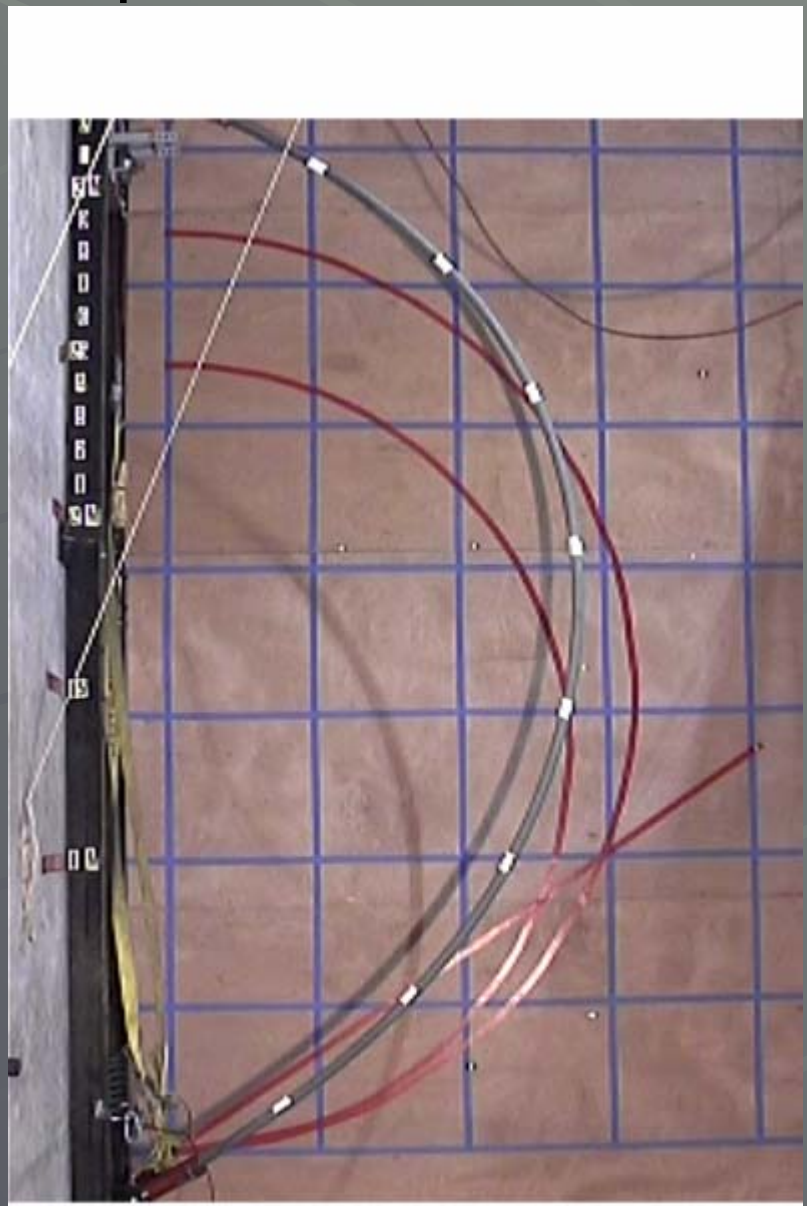
Spring Hinged Wheel – This wheel rides down the top of the rail rolling over the touch pads to activate the timing system.
Weights – The tester is designed to use standard Olympic weight plates, so weight can be easily added and subtracted. (Carriage wt + nylon strap/cable is 98 pounds.)
Top Pole Holder – Holds the top of the pole in place.
Load Cell Activator – This bearing wheeled trolley pulls and strains the load cell while the pole is flexing
Accelerometer – Records the change of accerleration
Load Cell – Measures the end load of a pole
Electromagnet- release mechanism
Bumper Plate – In case of a pole failure, this bumper softens the impact and protects the load cell from harm.
Stop / Flexor – Stops the pole holder from rotating inward.

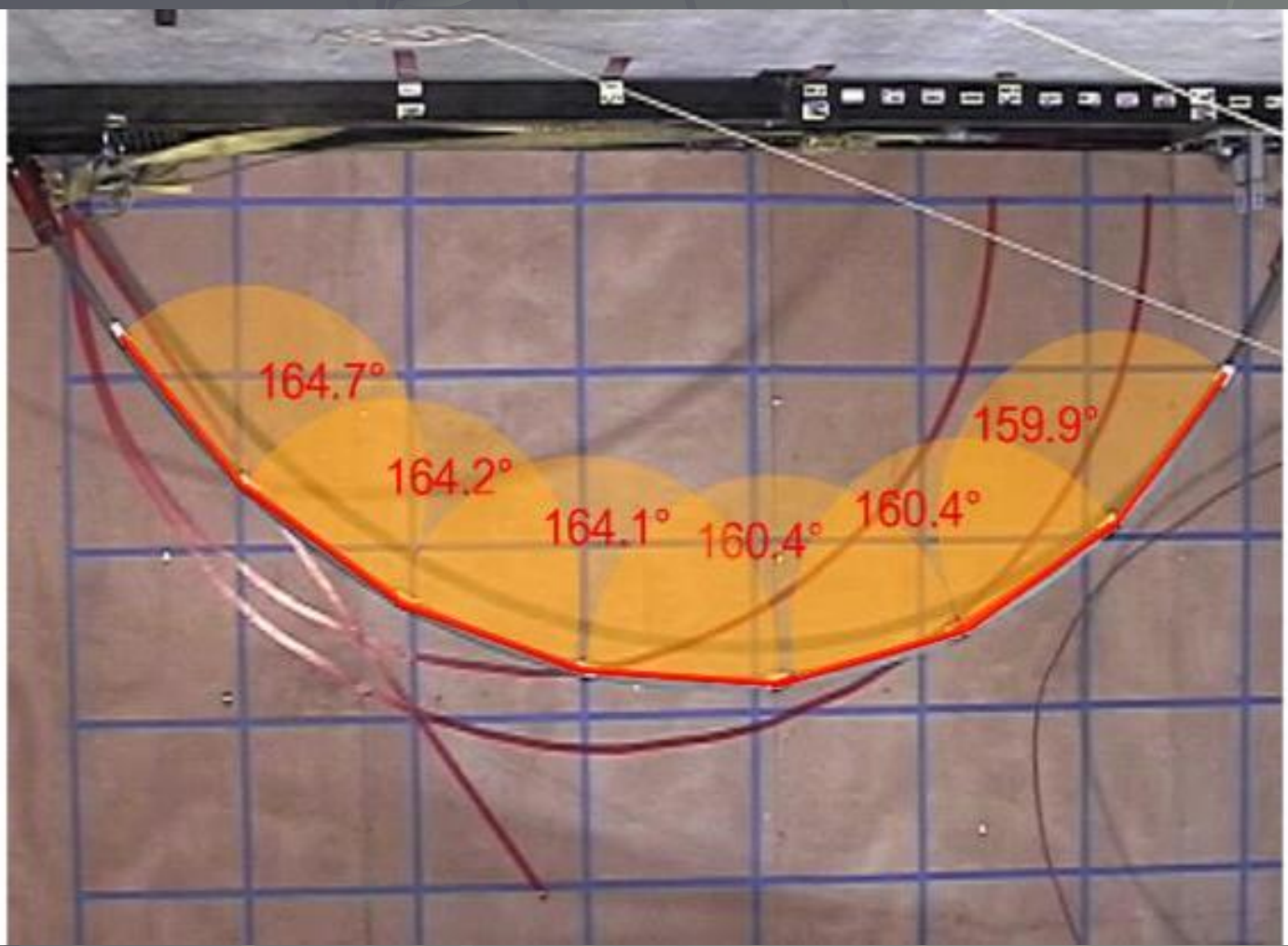
Data Collection

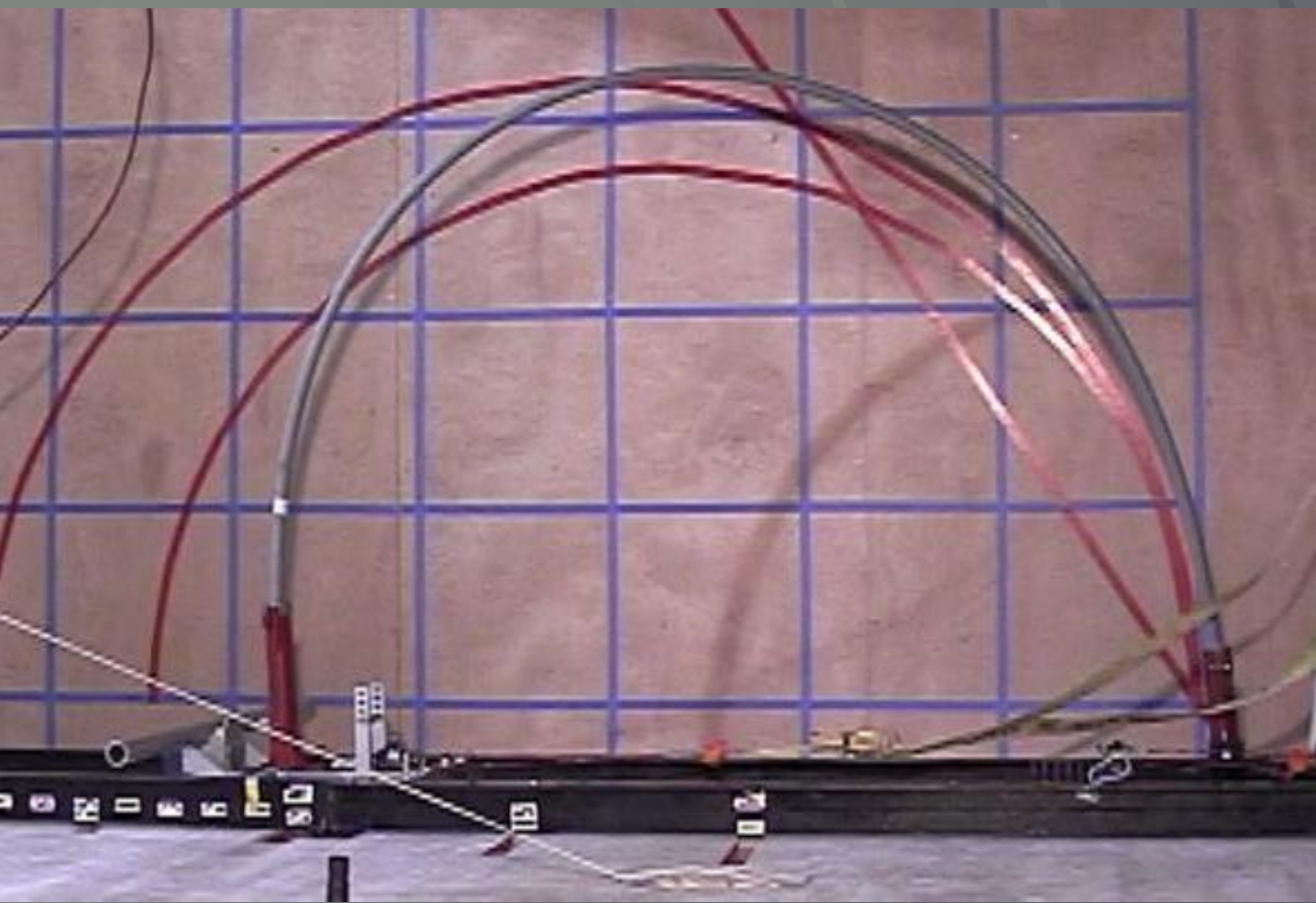


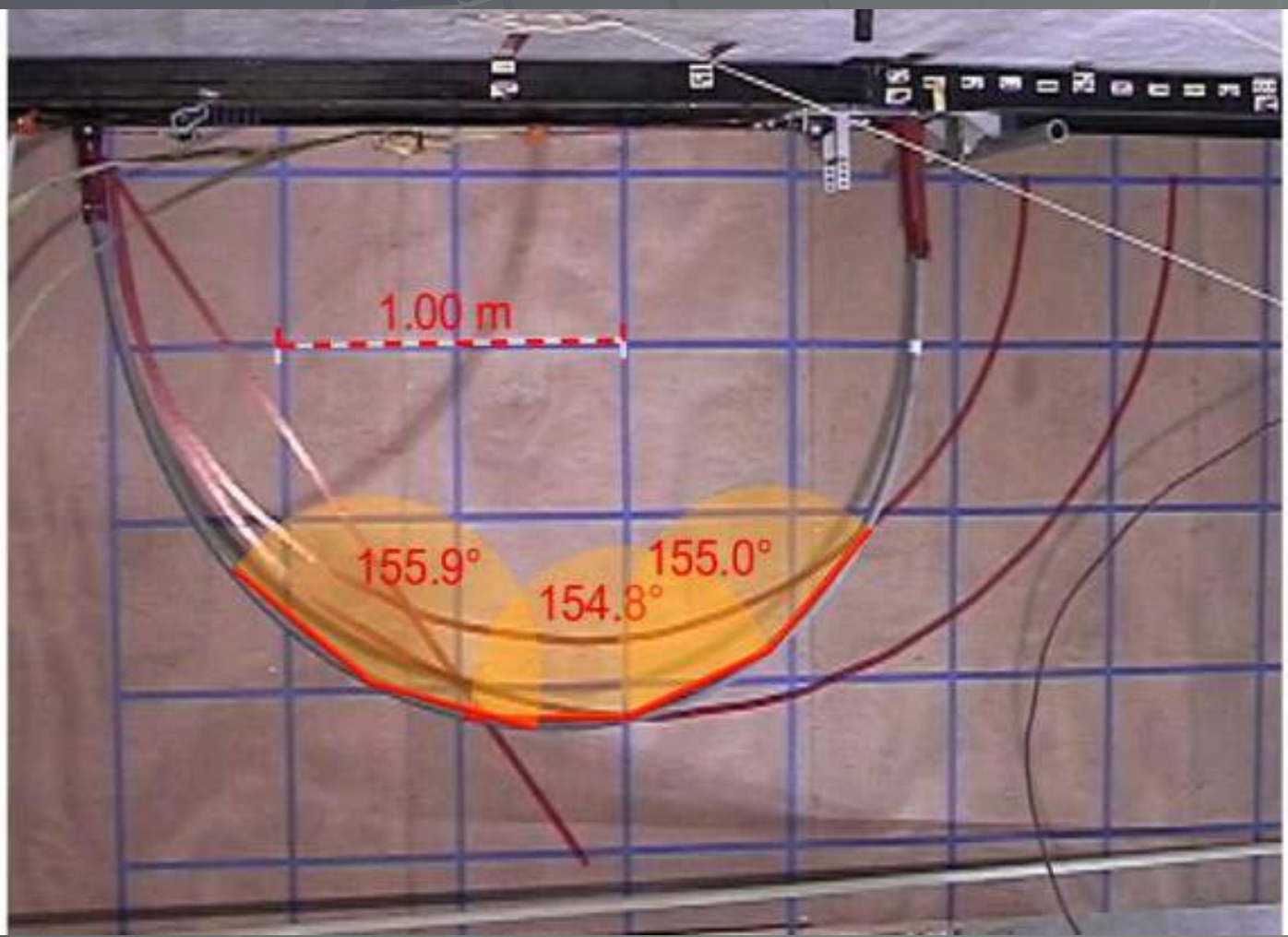
Programs that aid in evaluation

Reflective taped added to aid in tracking

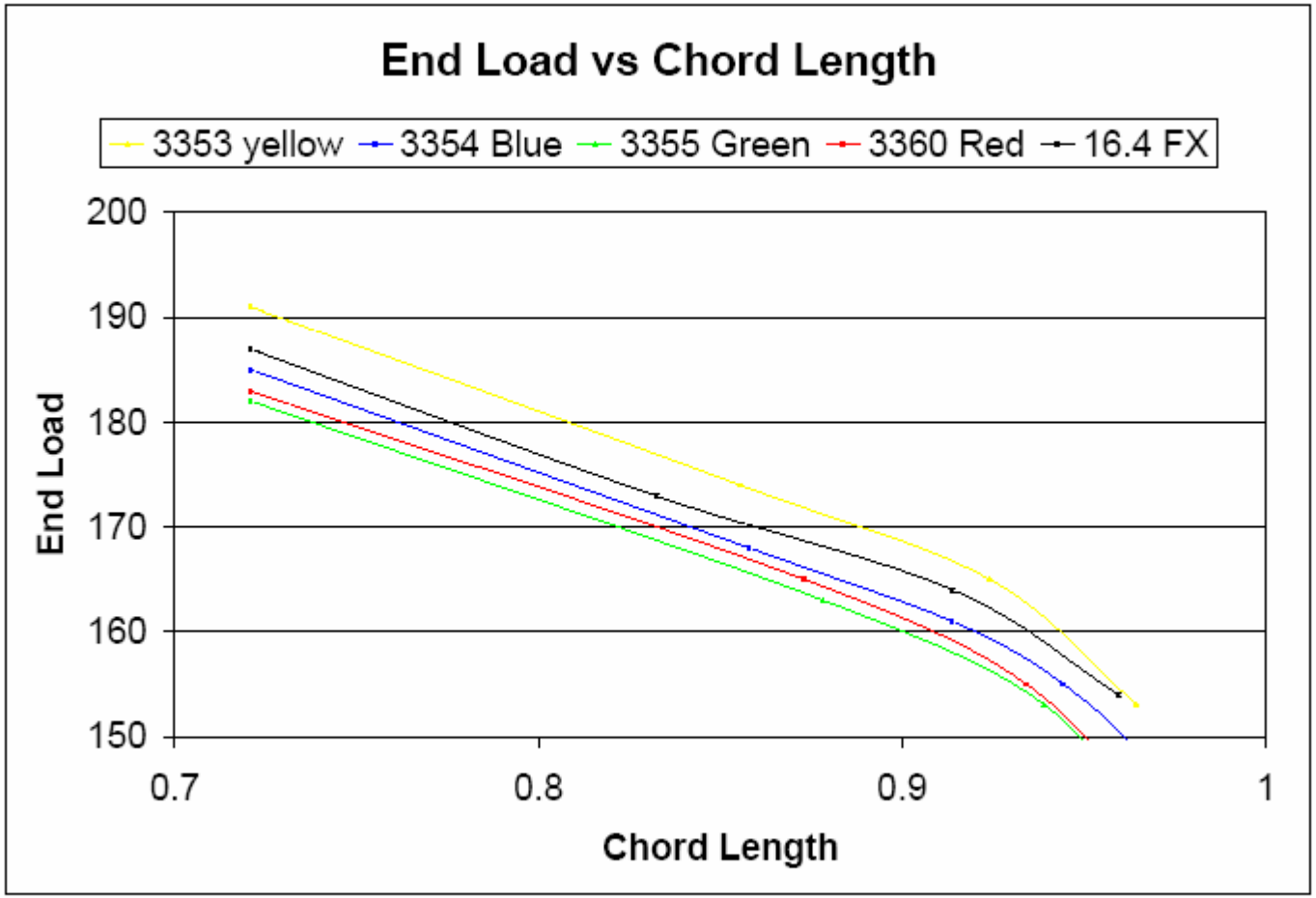



164.7°
164.2°
164.1°
160.4°
160.4°
159.9°




1.00 m
155.9°
154.8°
155.0°

2004 Test Poles


End Load vs Chord Length
3353 yellow
3354 Blue
3355 Green
3360 Red
16.4 FX
200
190
180
170
160
150
End Load
0.7
0.8
0.9
1
Chord Length

Vaulter Feedback

- From: Steve Rippon [steverippon@hotmail.com]
- Sent: Wednesday, June 16, 2004 8:24 AM
- To: Jeff Watry
- Cc: David Hodge
- Subject: mens test poles
- Jeff/David

- Today we got a chance to jump on the test poles.

- Tim Thomas jumped from 14 steps indoors, so conditions where very constant. He did about 20 jumps in total.
- He really liked the yellow/white (15.8) and blue/white poles (16.4). They did however appear to be about 0.3 softer than the same Fx pole.

- If you take Fx as the base line here is how the poles compare-

- +0.3 Red/White/Blue (first batch of test poles)
- 0.0 Carbon FX
- -0.3 Blue/White
- -0.5 Red/White
- -0.7 Green/White

- so Green/white was 0.7 softer than the carbon fx of the same flex.

- Tim really like the Blue/White-Yellow/white model.

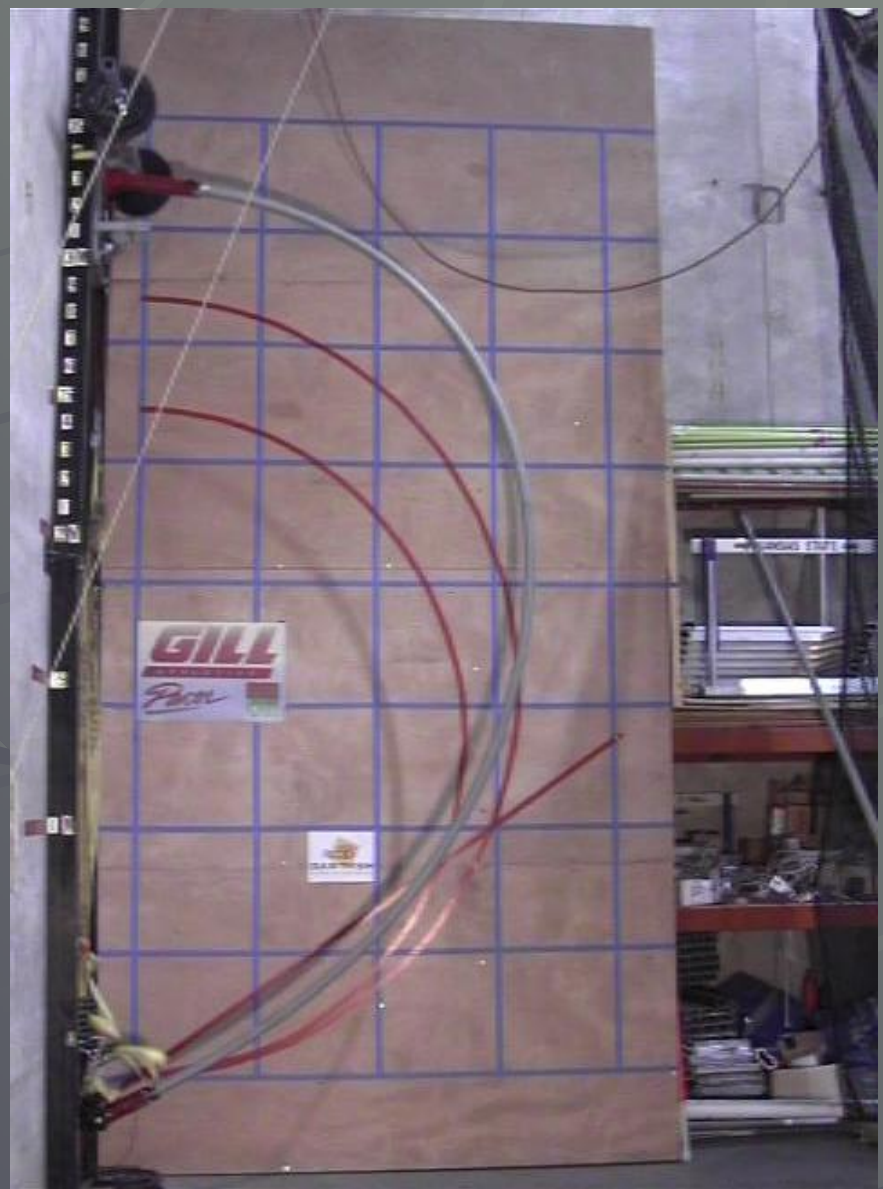
Engineering Aspects

- ✓ Moment of Inertia of Pole
- ✓ Elongation of Material versus usable bend
- ✓ End Loads
- ✓ Engineering Formula's and how they relate
- ✓ See www.gillathletics.com PVNews

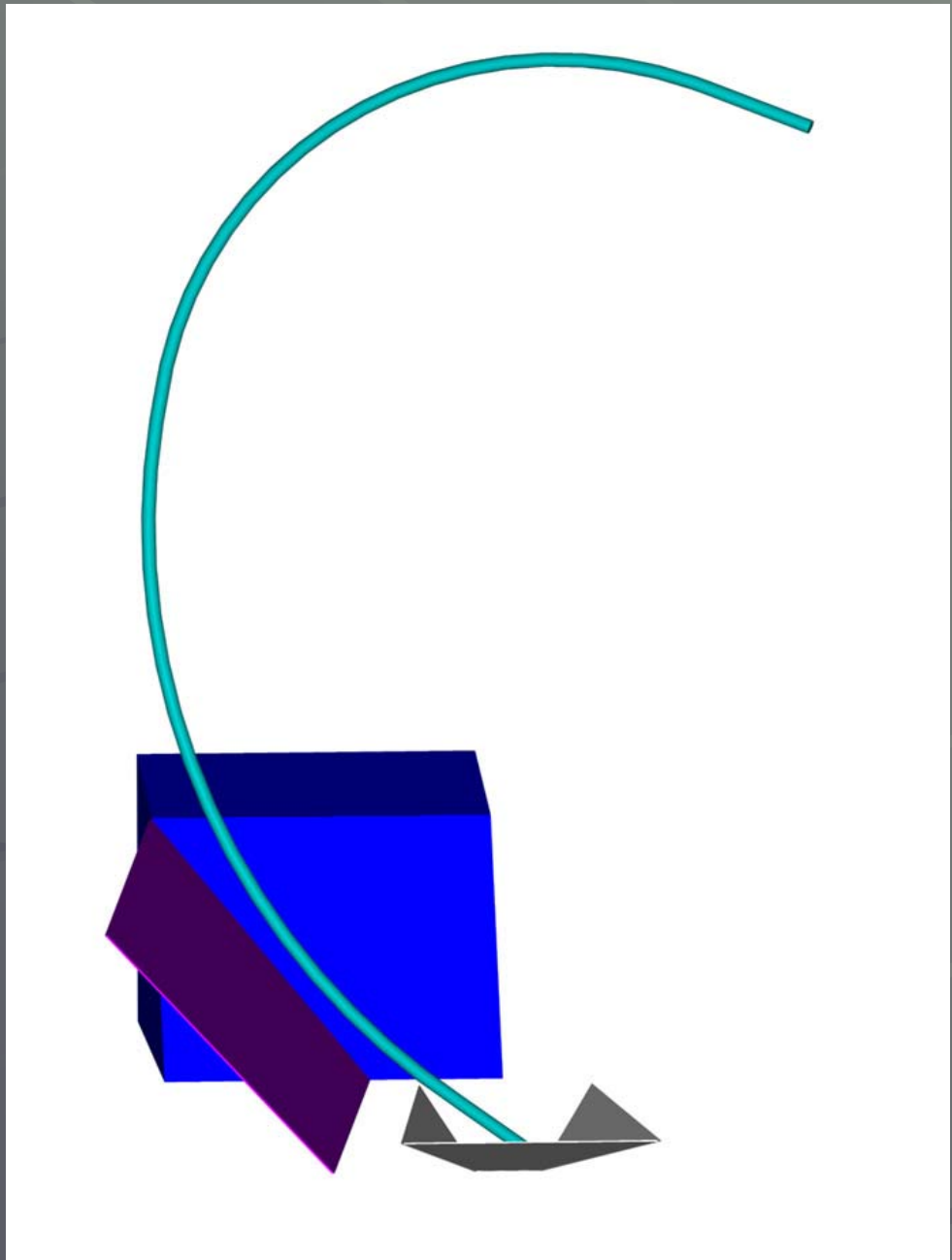
Shorten the Chord Length

- ✓Bending the pole
- ✓How it bends
  - ✓Elongation
  - ✓Compression
  - ✓Oval
- ✓Usable Shortening of the Chord
- ✓Localized Over bend

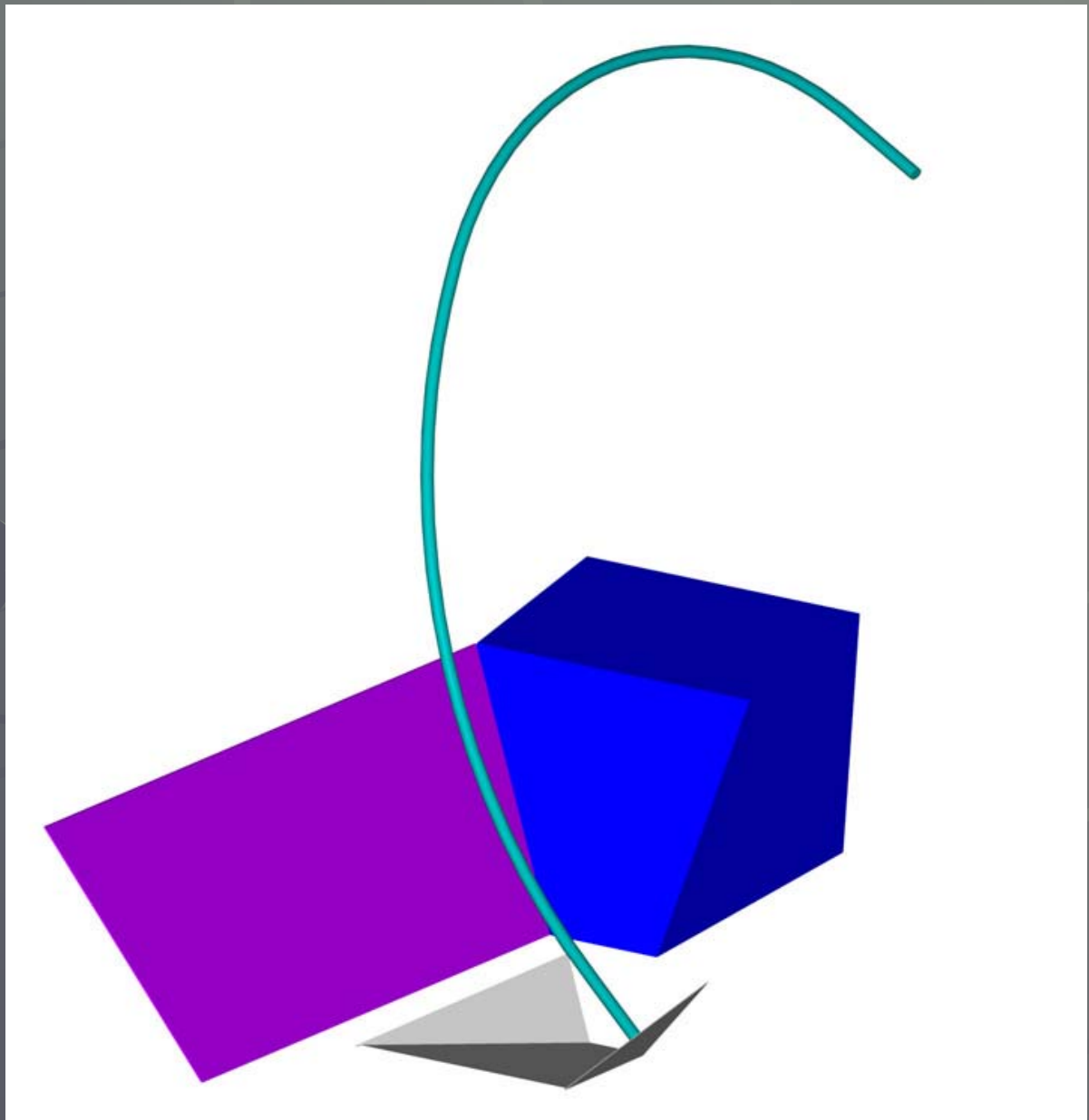
5m pole at 67%

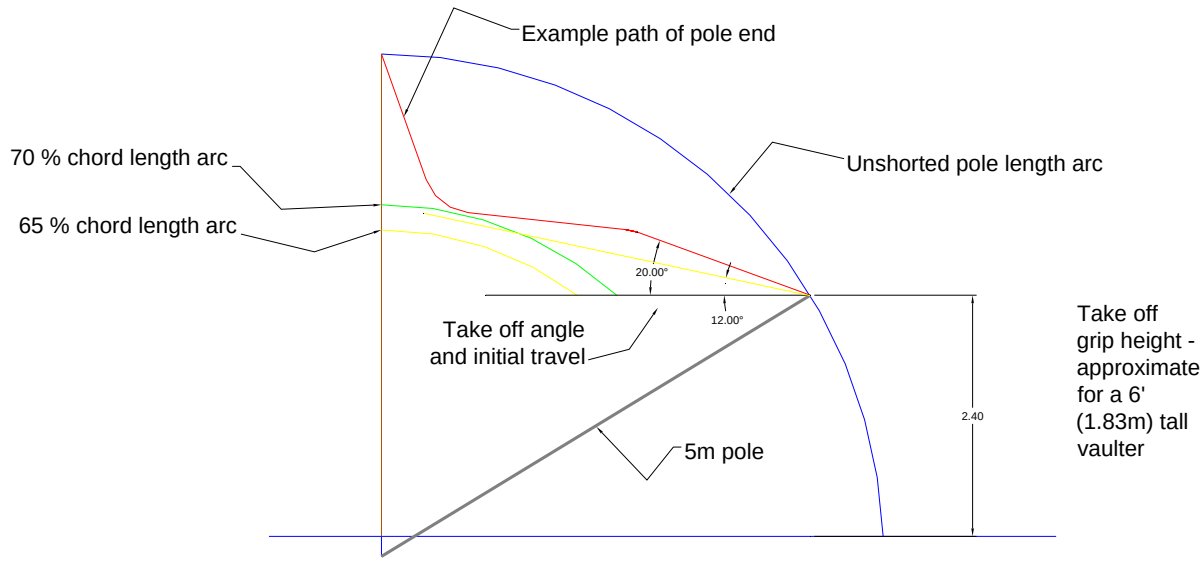


3D Modelling



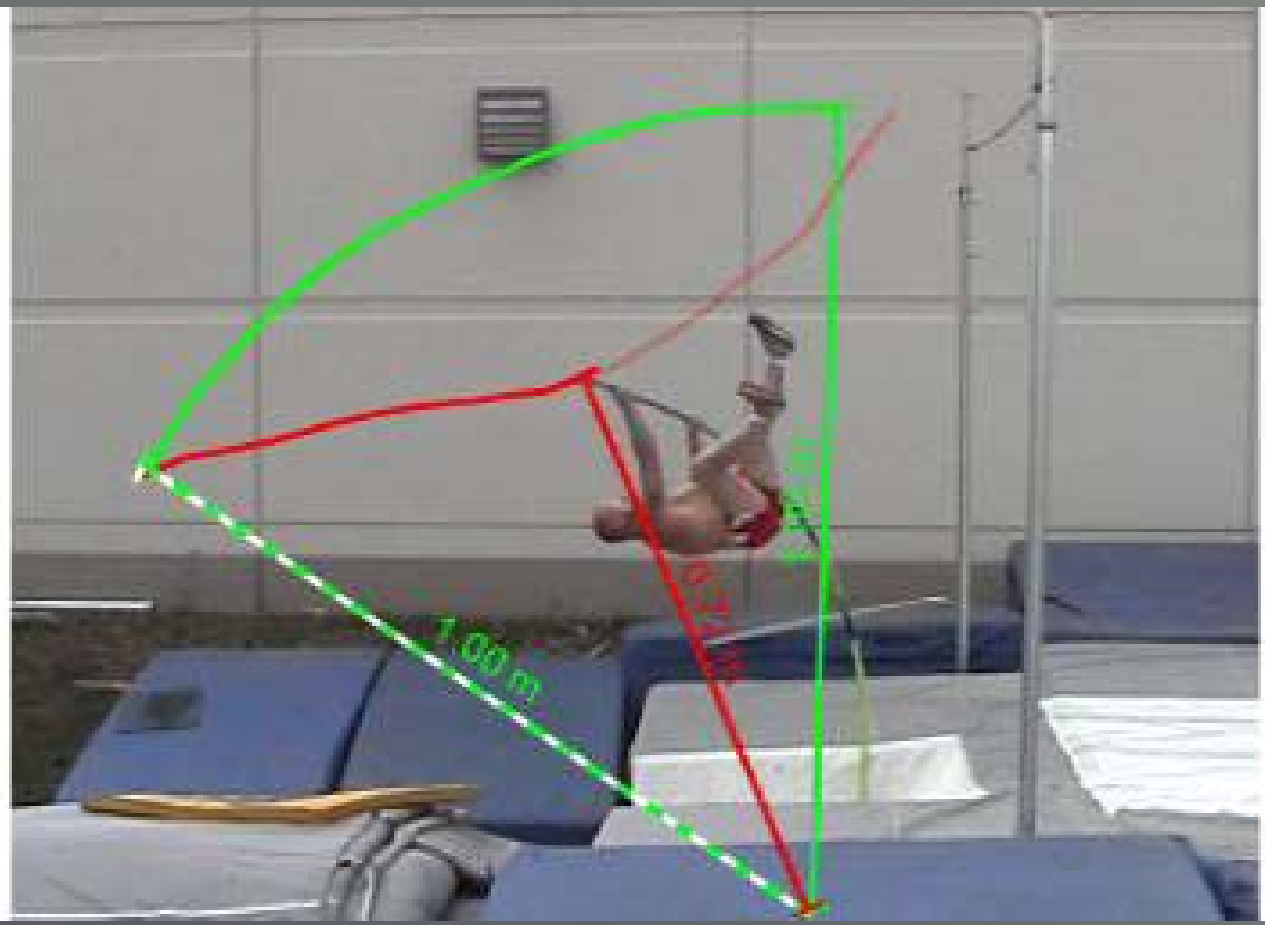
Allows rotation – views form different perspectives





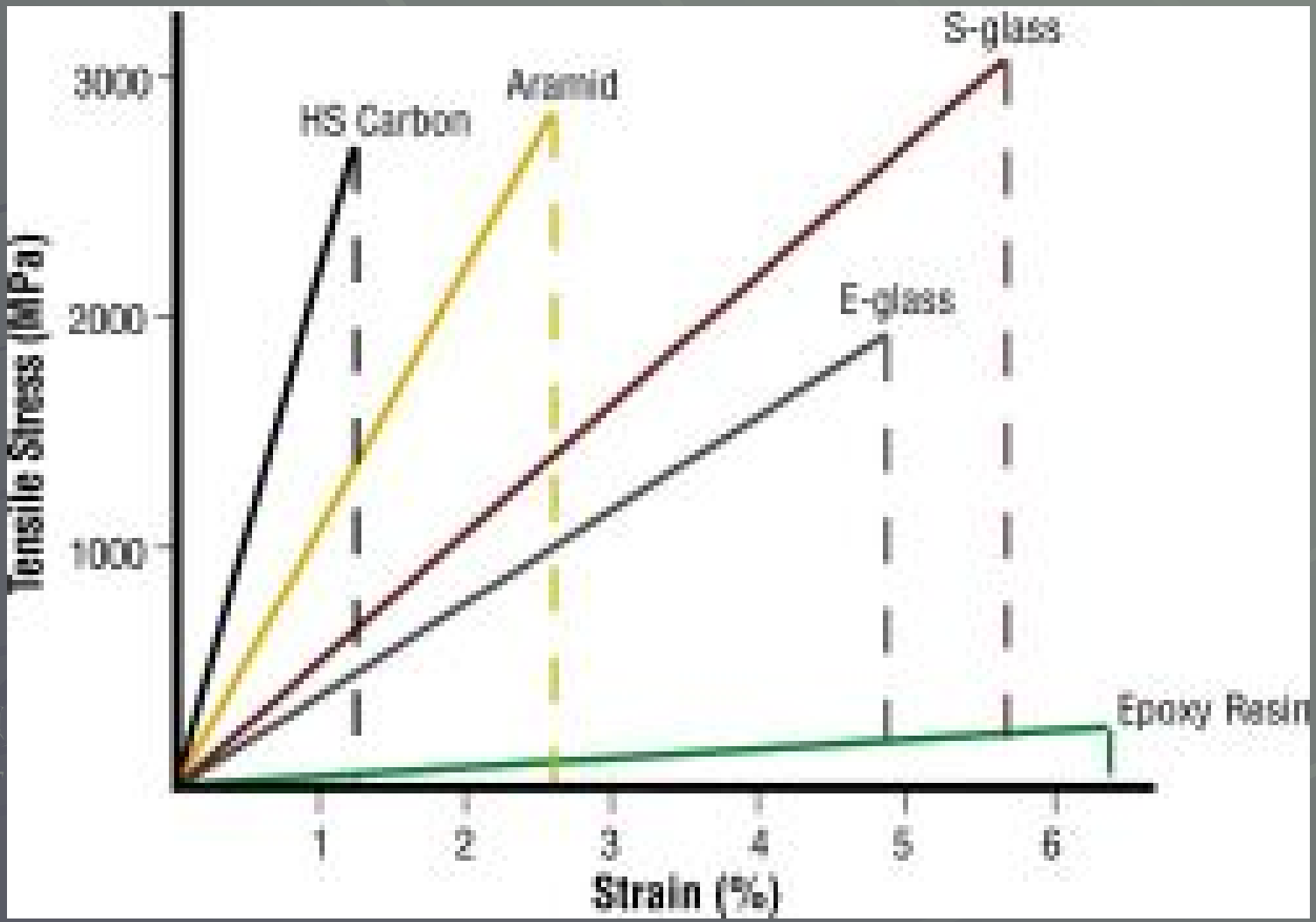
The above depicts a vaulter using a 5 meter long pole:
As long as the distance between the pole end path and the unshortened length arc is increasing, the pole is continuing to bend or shorten. At the point that the distance to the "straight pole" arc starts to decrease, the pole is unbending.

Tracking chord length during vault



Materials

- ✓S-Glass
- ✓E-Glass
- ✓Straight Carbon Fiber
- ✓Woven Carbon Fiber
- ✓Resin


S-glass
Aramid
HS Carbon
E-glass
Epoxy Resin
3000
2000
1000
Tensile Stress (MPa)
1
2
3
4
5
6
Strain (%)

846073W at 51%

Load Cell Readout


05/26/2005

Pole Carry Weight

All levels of vaulters as test pilots