Feasibility Testing Report – Fishing Line Deflection

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Test Date: 11/11/2014

Related System: ABBBB: Raise Foot

The reason for this test is to find:

a) What grade or fishing wire should be used?

b) How much deflection is absorbed by the elasticity of fishing wire?

Supplies:

1.) Green 60lb fishing wire
2.) Transparent 8lb fishing wire
3.) Weight hangar
4.) Carbineer, tape, ect.
5.) Weights

Weights:	Lbs	Running sum
Hangar	0.9265	0.9265
W1	4.586	5.5125
W2	4.6225	10.135
W3	4.7025	14.8375
Db1	1	15.8375
Db2	1	16.8375
Db3	1	17.8375
Db4	1	18.8375
Db5	1	19.8375
Db6	1	20.8375

Setup:

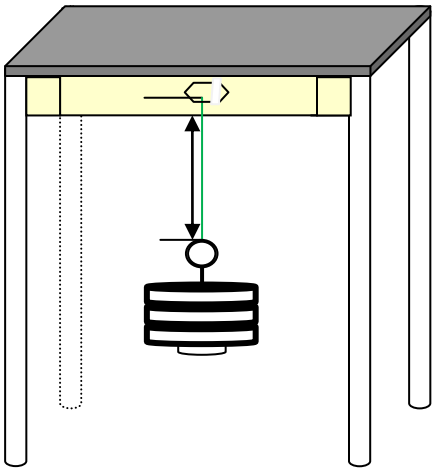

Figure 1: The rendering above depicts the test setup performed in the BAD Lab

Since it is somewhat of a tedious challenge to tie fishing wire many times, the fishing wire was tied to a carabineer and attached to an overhang in a secure fashion.
The carabineer was secured with masking tape to ensure that it would not slip overnight. There may have been some give in the fishing wire due to the nature of the setup, this was taken into consideration and steps were taken to arrange the carabineer in such a way that the fishing wire had a nearly direct path to the weights.

Procedure:

1. Two different fishing lines were found in the lab and tested using the test set up shown in figure 1
2. The first specimen tested was 8lb fishing wire:
    a) This fishing wire was so frail that it actually broke under 7.51lbs of weights
    b) This wire also was tested at 5.6lbs and broke before an accurate strain reading could be acquired
3. The second specimen was 60lb fishing line:
    a) This was tested by tying the wire to the upper carabineer and also to the weight hangar
    b) Under initial trials it was found that the know was not secure enough and slippage occurred
    c) Another knot was then used (the fisherman's knot) which held much better
    d) Three types of tests were performed on this wire:
        1. An incremental load and deflection test

2. An attempted destructive tensile test
3. Post-strain re-test
4. An overnight test

Results:

Observations for specimen two (green):

1. Incremental load test:
    i. The test results can be seen in the table below:

Length	Weight	Deflection (in)		Han	W1	W2	W3	Db
10.31	0.9	0.00		0.9				
10.38	5.5	0.06		0.9	4.6			
10.38	6.5	0.06		0.9	4.6			1.0
10.41	7.5	0.09		0.9	4.6			2.0
10.41	8.5	0.09		0.9	4.6			3.0
10.44	9.5	0.13		0.9	4.6			4.0
10.47	10.5	0.16		0.9	4.6			5.0
10.50	11.5	0.19		0.9	4.6			6.0
10.50	10.1	0.19		0.9	4.6	4.6		
10.63	14.8	0.31		0.9	4.6	4.6	4.7	
10.69	18.8	0.38		0.9	4.6	4.6	4.7	4.0
10.81	20.8	0.50		0.9	4.6	4.6	4.7	6.0

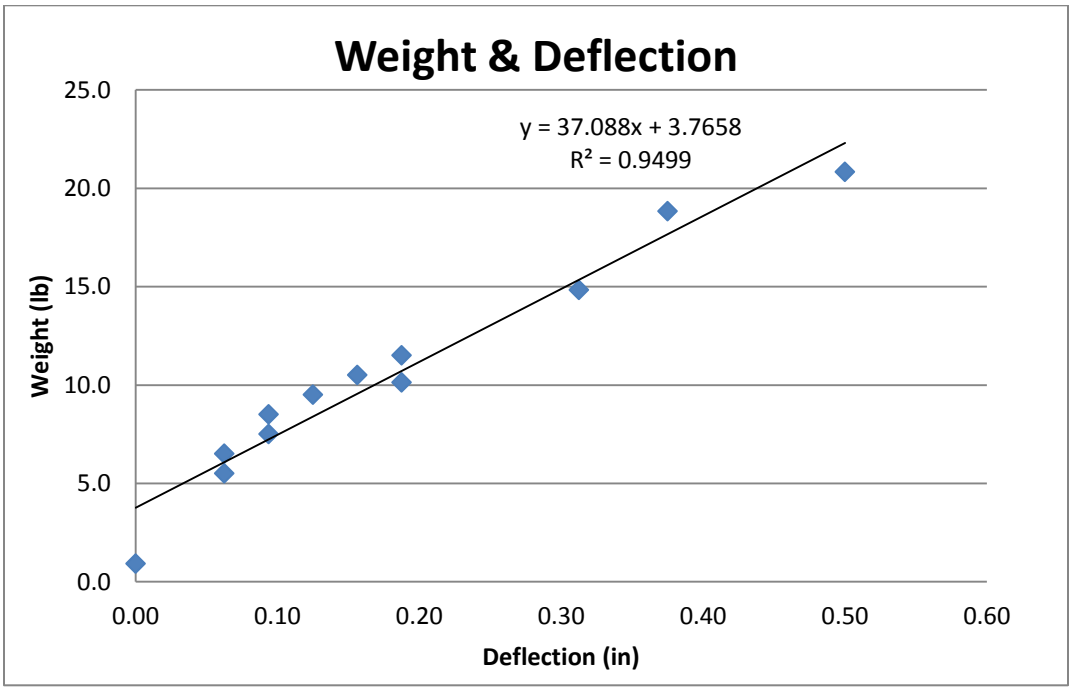

Figure 2: The figure above represents the trend in deflection corresponding to loading

2. Attempted destructive tensile test

Following the last loading of the fishing wire in Part 1, the weights were pressed upon with body weight in an attempt to break the string in tension.

This test failed to break the wire and no significant change in deflection was observed following the attempt

Note: After this test, the loading was incrementally removed and addition measurements were taken in order to determine accuracy. The second set of measurements did not indicate as much deflection as before. The recorded data that was taken during the weight removal period is shown below:

Length	Weight	Deflection (in)
10.41	0.9	0.00
10.47	5.5	0.06
	6.5	
10.47	7.5	0.06
	8.5	
	9.5	
	10.5	
	11.5	
	10.1	
10.75	14.8	0.34
	18.8	
10.81	20.8	0.41

Hangar	W1	W2	W3	Db
0.9				
0.9	4.6			
0.9	4.6			1.0
0.9	4.6			2.0
0.9	4.6			3.0
0.9	4.6			4.0
0.9	4.6			5.0
0.9	4.6			6.0
0.9	4.6	4.6		
0.9	4.6	4.6	4.7	
0.9	4.6	4.6	4.7	4.0
0.9	4.6	4.6	4.7	6.0

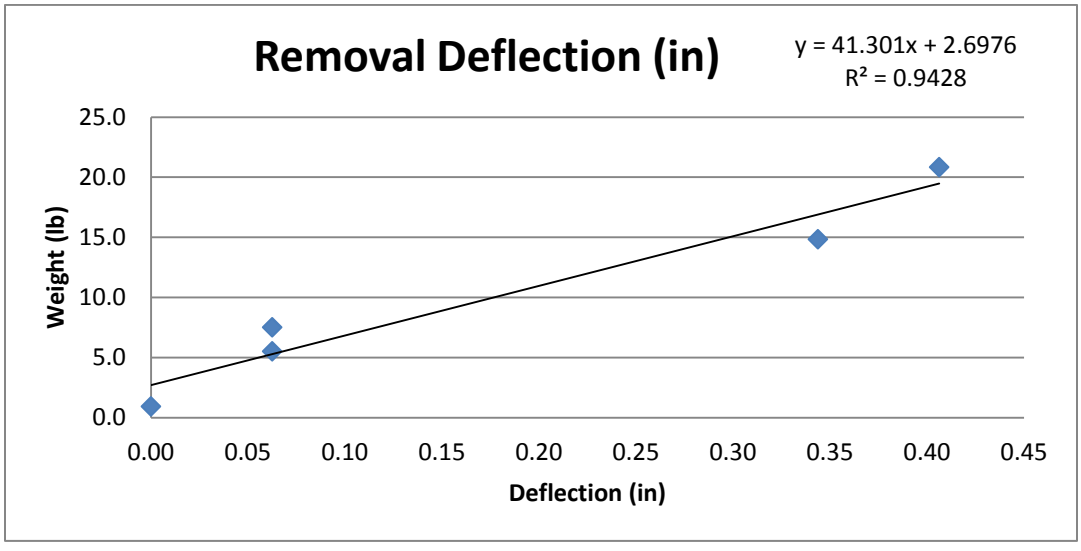

Figure 3: The figure above represents the trend in deflection corresponding to loading as it was taken during the unloading period after the tensile test

3. Post strain Re-test

Since the results in Figure are slightly different from those in Figure 2 another test was conducted using the post-strained wire and yielded the following results:

Length	Weight	Deflection (in)
10.75	0.9	0.00
10.81	5.5	0.06
10.84	10.1	0.09
10.88	14.8	0.13
10.94	18.8	0.19
Actual value undocumented		

Hangar	W1	W2	W3	Db
0.9				
0.9	4.6			
0.9	4.6	4.6		
0.9	4.6	4.6	4.7	
0.9	4.6	4.6	4.7	4.0

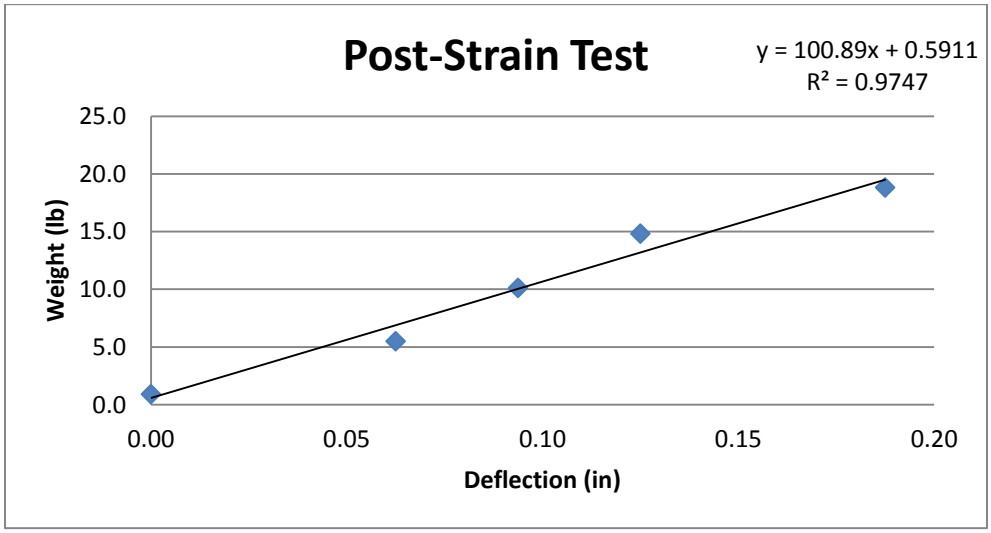

Figure 4: The figure above represents the trend in deflection corresponding to loading as it was taken in a separate test following the maximum strain test

4. Overnight test

The overnight test was conducted using 10.1lbs of weights suspended for over 40hrs. The initial length reading was 10 13.5/16" and the final reading was 10 14/16"

Strain Summary

In order for these results to be processed it must be realized that the deflection is proportional to the initial length of the fishing wire. The readings from the ruler were slightly short of the actual length of the string but it may be assumed equal for practical purposes. For the initial loading test the strain reached approximately %5 at its

maximum recorded value. The plot of the post strain test is shown below with the deflection non-dimensionalized:

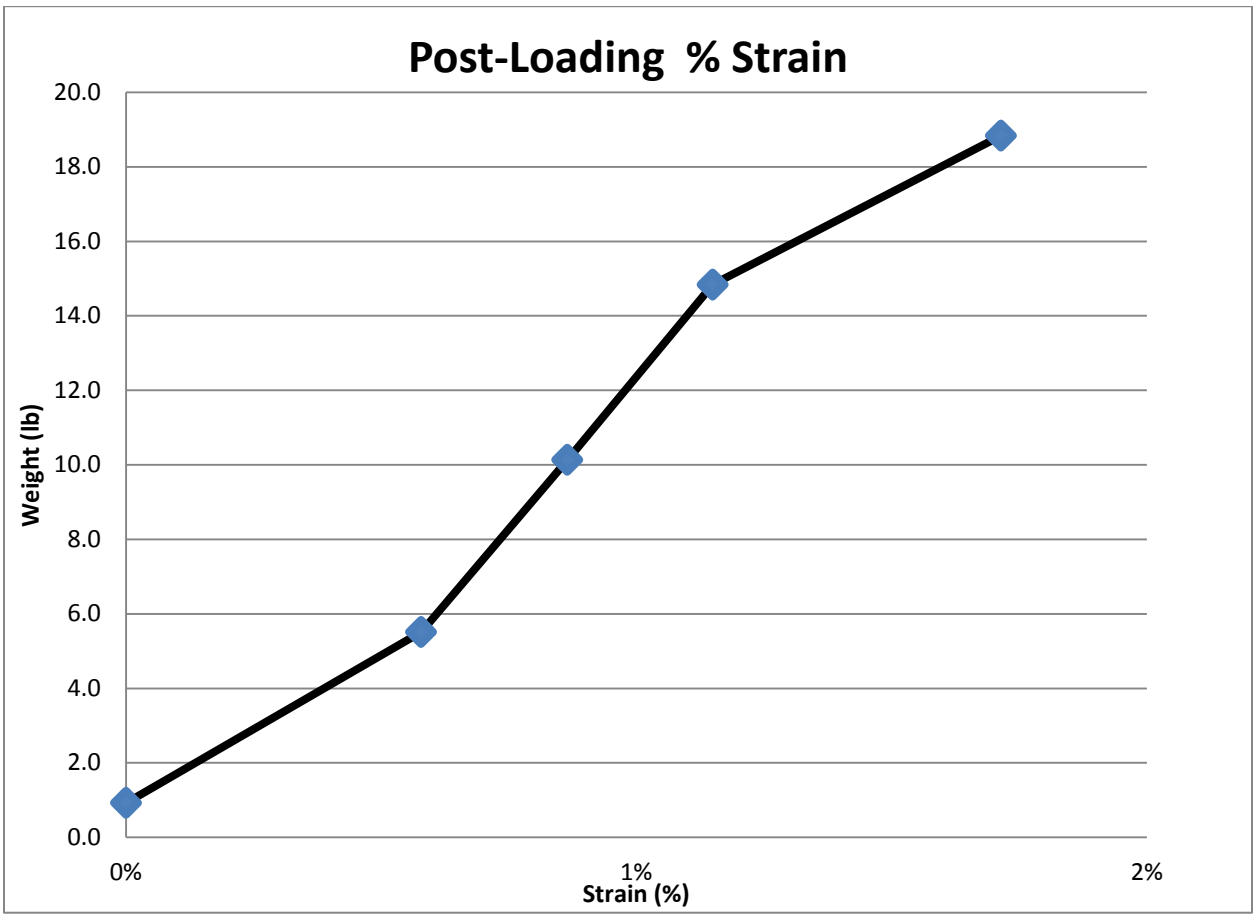

Figure 5: The figure above represents the percent of deflection in pre-stretched fishing line following the maximum strain test (Same as Figure 4 but in % strain)

Conclusion:

a) The green 60lb fishing wire far outperformed the transparent 8lb line which broke under less than 5.6lbs of weight. The 60lb line did not even break under 20lb of weights plus downward bodyweight force.

b) The deflection absorbed by the elasticity of the fishing line was found to vary with loading and fishing wire length. For approximately 10.5" of fishing line at 10.1lbs, the deflection was measured to be less than 1% strain or 0.09"

It is recommended that the fishing wire be pre-stretched in order to reduce initial deformation if strain is a serious concern in later phases.

Next Steps:

1) Determine if fishing wire will be used in AFO attachment, if so use 60lb green fishing line.

2) Use the weight/strain curve to estimate how much strain to expect from a given length of fishing wire for muscle optimization purposes.

Appendix: