Structures II

Arch 324

Name 1 ________________________

Name 2 ________________________

Name 3 ________________________

Wood Beams

Description

This project uses observation and calculation to understand how bracing effects the stability and performance of a wooden beam.

Goals

To observe the bending behavior of a simple span beam through physical modeling.
To see the effects of unbraced length on lateral buckling.
To calculate the effective length for different bracing conditions.

Procedure

1. Set the 1/16"x1/2" basswood stick in the support as shown. This approximately models a 2x12 (1.5" x1.25") at 1:24 scale with a span of 45 FT.
2. First load the unbraced stick (ℓ_u = 45') at the center line with you finger. Observe the lateral buckling failure. Find ℓ_e and calculate R_B from the NDS formula 3.3-5
3. Next brace the stick at the center load point (ℓ_u = 22.5'). Again, observe the lateral failure. Find ℓ_e and calculate R_B from the NDS formula 3.3-5
4. Now brace and load the stick at the 1/3 points (ℓ_u = 15') and observer the lateral failure. Find ℓ_e and calculate R_B from the NDS formula 3.3-5
5. Finally, brace and load the stick at the 1/4 points (ℓ_u = 11.25') and again observer the failure. Find ℓ_e and calculate R_B from the NDS formula 3.3-5
6. Compare the R_B values found for the 4 bracing conditions and note how the bracing effects the slenderness. Note which case comes closest to 50 and which one is the smallest. As R_B decreases, the beam gets more stable and stronger.

Beam Properties: b = 1.5 IN d = 11.25 IN L = 45 FT

ℓ_u	ℓ_e	R_B
45'		
22.5'		
15'		
11.25'		

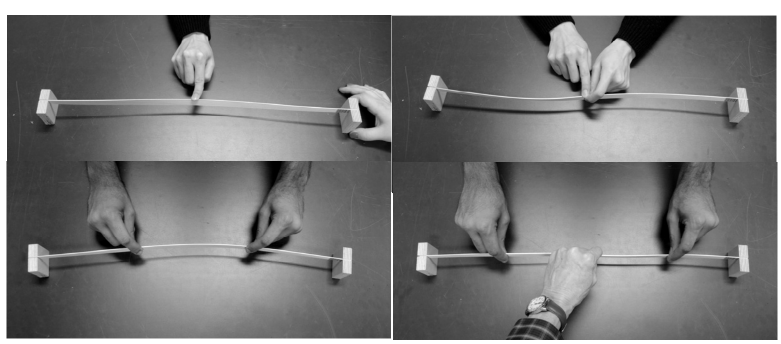

Table 3.3.3 Effective Length, ℓ_e, for Bending Members

Cantilever[1]	where $\ell_u/d < 7$		where $\ell_u/d \geq 7$
Uniformly distributed load	$\ell_e=1.33\ \ell_u$		$\ell_e=0.90\ \ell_u + 3d$
Concentrated load at unsupported end	$\ell_e=1.87\ \ell_u$		$\ell_e=1.44\ \ell_u + 3d$
Single Span Beam[1,2]	where $\ell_u/d < 7$		where $\ell_u/d \geq 7$
Uniformly distributed load	$\ell_e=2.06\ \ell_u$		$\ell_e=1.63\ \ell_u + 3d$
Concentrated load at center with no intermediate lateral support	$\ell_e=1.80\ \ell_u$		$\ell_e=1.37\ \ell_u + 3d$
Concentrated load at center with lateral support at center		$\ell_e=1.11\ \ell_u$	
Two equal concentrated loads at 1/3 points with lateral support at 1/3 points		$\ell_e=1.68\ \ell_u$	
Three equal concentrated loads at 1/4 points with lateral support at 1/4 points		$\ell_e=1.54\ \ell_u$	
Four equal concentrated loads at 1/5 points with lateral support at 1/5 points		$\ell_e=1.68\ \ell_u$	
Five equal concentrated loads at 1/6 points with lateral support at 1/6 points		$\ell_e=1.73\ \ell_u$	
Six equal concentrated loads at 1/7 points with lateral support at 1/7 points		$\ell_e=1.78\ \ell_u$	
Seven or more equal concentrated loads, evenly spaced, with lateral support at points of load application		$\ell_e=1.84\ \ell_u$	
Equal end moments		$\ell_e=1.84\ \ell_u$	

1. For single span or cantilever bending members with loading conditions not specified in Table 3.3.3:
   $\ell_e = 2.06\ \ell_u$ where $\ell_u/d < 7$
   $\ell_e = 1.63\ \ell_u + 3d$ where $7 \leq \ell_u/d \leq 14.3$
   $\ell_e = 1.84\ \ell_u$ where $\ell_u/d > 14.3$
2. Multiple span applications shall be based on table values or engineering analysis.

3.3.3.6 The slenderness ratio, R_B, for bending members shall be calculated as follows:

$$R_B = \sqrt{\frac{\ell_e d}{b^2}} \tag{3.3-5}$$

3.3.3.7 The slenderness ratio for bending members, R_B, shall not exceed 50.