

Midwest Guardrail System with Round Timber Posts

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Introduction

- National Fire Plan after 2000 Fire Season
- Fuel management as fire prevention technique
- Controlled burns consume small-diameter forest thinnings (SDTs)
- Cut SDTs for product use w/ proceeds to offset removal costs
- SDTs for posts in guardrail systems
- Need structural properties of SDTs for round posts in longitudinal barriers





- 24 million ft (4,500 miles) of guardrail is sold in the US per year
- Which translates into 3.8 million post (of some type)
- A lot of thinnings could be utilized if thinning material is shown to perform adequately as guardrail posts
- Round post can be twice the value of rectangular and nine times the value of chips



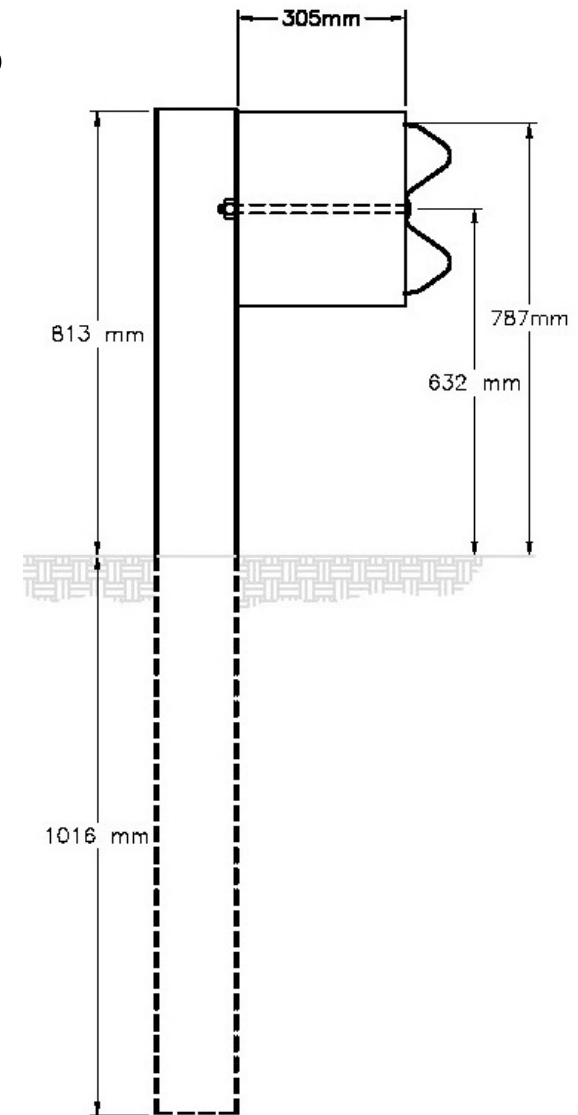
Longitudinal Barriers

- Strong-post, W-beam guardrails
 - 12-gauge rail
 - spacer blocks – wood, steel, & recycled materials
 - evenly spaced posts – wood and steel
- Round wood posts economical
- Large-scale implementation mostly in Texas
 - prior TTI research
- Opportunities for increased round post use in W-beam guardrails
 - options needed for wood species



Midwest Guardrail System (MGS)

- Developed in 2000 & meets TL-3
- 1,905-mm post spacing
- 787-mm mounting height
- Splices at midspan locations



Research Objectives

- Dynamic structural properties for round posts (DF, PP, and SYP)
- Post diameter, embedment depth, and grading specification for each species
- Round wood posts in MGS
- TL-3 evaluations to NCHRP 350
- Installation manual and standard CAD plans



Wood Sampling

- Initial post diameters
 - SYP – 184 mm (7.25”) from TTI testing
 - DF – 190 mm (7.5”) using tabulated strengths
 - PP – 216 mm (8.5”) using tabulated strengths
- Wood highly variable – strength can differ by:
 - species, ring density, knot size, moisture content, & region
- Three control groups using ring density & knots
 - LRD-SKN
 - LRD-BKN



HRD-SKN



Wood Sampling (Cont.)

- Post categorized by ring density, knot frequency, and knots
 - LRD - ≤ 4 rpi
 - HRD - ≥ 6 rpi
 - SKN - < 38 mm (1.5")
 - BKN - > 64 mm (2.5")
- Component testing to evaluate post properties for 3 categories & random population



Post Specimens

- Wood posts acquired from multiple sources
- Graded by experts
- Weighed, measured, documented, and knot mapped
- SWMOE estimation
 - rank and sort posts
- Random selection



Phase I Component Testing

- Target load capacity – 9.5 to 10 kips
- Cantilevered rigid sleeve testing (450 tests)
 - round 1 (initial sizing)
 - 45 dynamic tests
 - 180 static tests
 - round 2 (modified sizing)
 - 45 dynamic tests
 - 180 static tests
- SWMOE, MOR, & Peak Load tabulated
- Post sizes modified for Phase II testing



Phase II Component Testing

- Cantilevered soil testing (18 tests)
- Evaluated 37 and 40 in. embedment depths
- Results showed need to increase post sizes & capacity
- 37-in. embedment depth preferred
- Nominal post sizes at groundline [+0.75"/-0.25"]
 - SYP – 190 mm (7.5")
 - DF – 184 mm (7.25")
 - PP – 203 mm (8.0")



Post Grading Criteria

- Knots & RPI
 - SYP: ≤ 64 mm (2.5") & ≥ 4 rpi
 - DF: ≤ 38 mm (1.5") & ≥ 6 rpi
 - PP: ≤ 89 mm (3.5") & ≥ 6 rpi
 - tight spec. - reduce diameter
 - loose spec. - allow high percentage to qualify
- Additional criteria
 - post manufacture, size, scars, shape & straightness, splits & shakes, decay, holes, slope of grain, compression wood, and preservative treatment



Test Requirements & Plan

- TL-3 of NCHRP Report No. 350
 - 820-kg small car @ 100 kph & 20 degrees
 - 2000-kg pickup truck @ 100 kph & 25 degrees
- Small car test unnecessary
- SYP MGS testing unnecessary
- 2000P crash tests on MGS w/ DF & PP posts



Dynamic System Test



Douglas Fir MGS – Test MGSDf-1



E.D. = 37 in.



**4,450-lb GMC Pickup
62.1 mph & 25.5 degrees
D.D. = 60.2 in.
W.W. = 60.3 in.
7 fractured posts**



Ponderosa Pine MGS – Test MGSP-1





**4,464-lb GMC Pickup
62.3 mph & 25.5 degrees
D.D. = 37.6 in.
W.W. = 48.6 in.
4 fractured posts**

Conclusions and Recommendations

- Round timber posts for MGS
 - two TL-3 pickup truck tests under NCHRP 350 – DF & PP
 - SYP using component testing, similarity, & prior work
 - 37-in. post embedment depth
- Round-Post Option for MGS
 - new market for SDTs
 - reduces risk for forest fires
 - aids U.S. and state timber industries
 - reduces MGS cost
- Grading specification, installation manual, & CAD



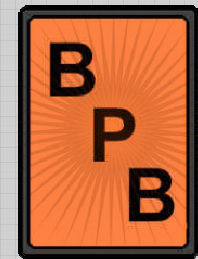
plans



Acknowledgements



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