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Forest Concepts, LLC

ELWd Systems

Innovative Wood Products from Small Diameter Forest Resources

BLM – Medford District
Agreement No: HAA022001

Wildland Urban Interface Project – Cattle Exclusion Fence

Summary

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Introduction

Under funds from the National Fire Plan, Forest Concepts, LLC led the development of a wildlife-friendly fence to exclude cattle from sensitive areas such as wetlands, springs, and streams. The objectives of the project were to: 1) exclude cattle from sensitive areas, 2) allow wildlife to freely pass in either direction, 3) use materials from forest thinning projects, and 4) use technology appropriate for entrepreneurial forest products businesses in rural communities. This report summarizes the results of a ten-month project.

Background

This project is a result of the convergence of several public policies and stakeholder interests. Tens of millions of acres of forestlands, wildlands and urban/wildland interface are in need of selective thinning to reduce the risk and severity of wildfire. If value-added uses can be developed for previously useless (mostly small diameter) timber then jobs may be created in rural communities and the forest products industry. This project looked at riparian and cattle exclusion fencing as a potential value-added use for thinning materials (smallwood).

Protection of surface water quality and associated aquatic ecosystems is a national priority for the USDA, EPA, Dept. of Interior and other agencies. Our goal was to develop a fencing design that better met the needs of all stakeholders. Current cattle exclusion fence designs are challenged by wildlife-interests because the fences are non-selective in their action. Recreational and wildlife interests prefer that fence designs prevent the target species (cattle) from entering a protected area but let non-target species (humans, small mammals, and large mammal wildlife) free access. Cattle grazing interests are concerned that total cattle exclusion from aquatic areas prevents cattle on the land under grazing permits to access water and forage that have been traditionally freely available. We believe there are innovative ways to address these concerns.

Problem Statement

Fence design necessarily includes the interplay of function, form (design parameters), and constraints. The Medford District of the USDI/BLM chose a spring site within a current grazing allotment to provide context and a proof-of-concept demonstration site for the project. The spring is located on the Ashland Resource Area near Hyatt Lake at approximately 5,000 ft. elevation. We chose the “buck and rail” form as a preferred look for the fence. Buck and rail was chosen over post and rail based on 1) sponsor’s desire to avoid pressure treated posts, and 2) to ease installation across rocky and hard-soil terrain.

As we developed a preferred design solution, we were guided by the following key constraints.

1. We wanted to make it easier for local forest operations contractors to "complete the watershed cycle" by doing fuel reduction thinning, collect the small diameter stems, machine stems into fence components, and finally construct fences back in the watershed. Thus, the fence should be designed around the species and pole diameters being removed during fuel reduction thinning projects in the region.
2. We preferred a design that was all wood (organic) that did not include bolts, tie wire or nails that eventually would become debris as the fence decayed into duff.
3. We preferred a design that had a minimum installed cost. Thus we prefer to use materials that are bark-on and components that can be kitted for rapid installation in the field.
4. The rail locations, fence height, and rail strength should be guided by the scientific literature for wildlife friendly fencing.

After the initial functional requirements and constraints were identified, a literature review was conducted to understand specific requirements needed by wildlife to freely pass from one side of the fence to the other, yet exclude cattle from sensitive areas. Focus species for the project are:

- Large Ungulates – e.g., deer, pronghorn, elk
- Small Animals – e.g., rabbits, beaver, raccoon
- Carnivores – e.g., mountain lion, lynx, bobcat, coyote, wolf, fox, bear
- Cattle – typical range species

Fence Style

We chose the buck and rail style as the preferred design for our fence based on 1) sponsor's desire to avoid pressure treated posts (C14[1]), and 2) to ease installation across rocky and hard-soil terrain.
The buck and rail fence satisfies these constraints.

C8/C33 *Maximize content from small diameter thinning materials* – A buck and rail fence can easily be built from the wood species and diameters available in fuel reduction thinning units.

C9/32 *Manufacture locally* – The fence can be designed to be made by workers and facilities in the area.

C11 *Fence performance should not be affected by frost heave* – Since the fence bucks sit on top of the ground, they are not subject to frost heave. The fence will rise and fall with the ground level.

C12 *Fence performance should not be affected by seasonal changes in soil moisture / soil strength* – The bucks sit on top of the soil. The only design concern is to have enough soil contact area so the weight of the fence and snow accumulations does not sink it into the ground.

C16 *Area near spring is a rocky outcrop with little or no soil depth* – No fence post holes need to be dug.

C18 *Wet areas are boggy with little soil strength* - The only design concern is to have enough soil contact area so the weight of the fence and snow accumulations does not sink it into the ground.

C31 *Ensure the aesthetics of the cattle exclusion fit with the landscape scene* – Buck and rail fences are widely associated with western outdoors scenes. They evoke a sense of Ponderosa country and open spaces.

Fence Characteristics

The proposed fence design also takes into account all of the parameters and design variables for the species groups. The following is the preferred design for a general cattle exclusion fence:

- 41cm (16in) from the ground to the bottom rail
- 1.2m (47in) to the top of every other top rails
- That the fence be less than 1.42m (56in) wide

[1] Constraint identifiers (e.g. C14) denote constraints enumerated in the full report. Not all constraints are listed in this summary document.

Our solution to achieve a strong all wood fence was to mount one rail on the outside of the buck and its mating rail on the inside of the buck, using one ELWd® spar for each run of rails. The angle of the buck makes the rail height lower on the back-mounted rail. Other design features that were included in the prototype and recommended fence include:

1. A "knee and brace" design for the buck. The rear buck-post is tenoned into the front post and held in place by a wood dowel. This design is proven in Montana to be long lasting and to be resistant to ice damage. The knee brace tenon and mortise are relatively easy to make with low-tech tools.

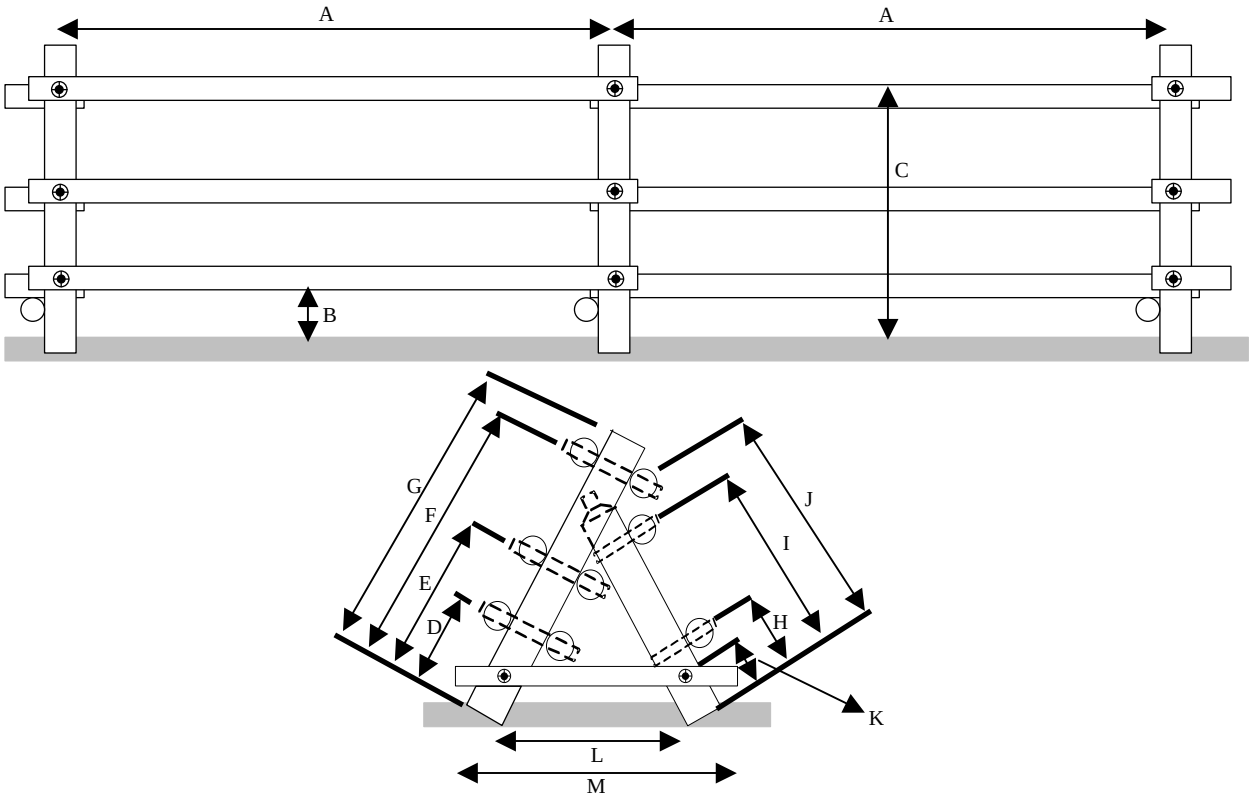
2. Rails are ten feet long and single span. Forest Concepts' original design called for 21-foot rails that were to be installed double-span. Long rails provide more rigidity to the fence and are commonly used in the interior West. The rationale for changing to shorter rails was to make it easier to collect and transport both fuel reduction thinnings and resulting fence materials. Additionally, with the preferred designs shown above, single-span rails make the fence more flexible to follow uneven terrain.

Manufacture of Ready-to-Assemble Fence Kits

Components for the 150-foot demonstration fence were built in Federal Way, WA at the Forest Concepts facility from Douglas fir small diameter timber. The original plan was to build the fence in Medford from fuel reduction thinning wood and using local labor. However, due to extreme fire conditions, and requirements for local forest workers to support fire suppression in the region, it was impractical to do the fabrication in Medford.

Fabrication of bucks requires the use of a tenon cutter to taper and cut the tenon on the end of the brace, and an angle-head drill press to drill the post. Drilling poles for the rails and back-brace is done on a drill press with a special tapered drill bit. Forest Concepts has developed two versions of the necessary machinery. One version is transportable, but designed for use in a manufacturing shop environment. The other version is hydraulically powered and intended for highly portable field and work-yard applications.

The expectation is that a local contractor, or economic development non-profit would purchase and maintain appropriate equipment to make prefabricated fence kits. The kits can be manufactured year-around and placed in inventory for installation as needed. Due the highly transportable nature of the equipment, fabrication may take place at almost any location under stewardship contracts. In the stewardship contract model, fence materials would come from thinning units and be redeployed as cattle exclusion or riparian fences in the same watershed.



Letter	Description	Length
A	Distance Between Bucks	10 Feet
B	Height to Bottom Front Rail	16 Inches
C	Height to Back Top Rail	47 Inches
D	Distance to Center of Bottom Rail Spar Hole	17 Inches
E	Distance to Center of Middle Rail Spar Hole	29.5 Inches
F	Distance to Center of Top Rail Spar Hole	46 Inches
G	Length of Post	50.5 Inches
H	Distance to Center of Bottom Diagonal Brace Spar Hole	10.5 Inches
I	Distance to Center of Top Diagonal Brace Spar Hole	34.5 Inches (rev Jul 03)
J	Length of Jackleg Brace	45.5 Inches (rev Jul 03)
K	Distance to Center of Buck Tie Spar Hole (same on each side)	5 Inches
L	Center to Center Distance of Buck Tie Spar Holes	38.5 Inches
M	Width of Fence	48.5 Inches

Schematic of ELWd® buck and rail fence design and table of dimensions.

Discussion

The ELWd® buck and rail fence demonstrated that an all-wood fence can be prefabricated from small diameter poles such as those common to fuel reduction thinning projects. Costs for complete component kits are estimated to be in the range of $6.00 to $11.00 per foot. A significant portion of the cost is related to using wood connectors rather than nails to attach the rails to the bucks. We believe that the advantages of kit prefabrication can be obtained with a nailed design as well as with the all-wood design. If the rails and braces are nailed into predrilled holes, we estimate that cost would be reduced to a range of $4.00 to $7.05 per foot. Field installation and assembly costs would be similar for each construction method. In order to switch to a nailed design, the stakeholders would need to relax constraints C8, C37, and C38.

Several persons expressed concern that bark-on poles will decay in a fraction of the time of debarked poles. Although we were not able to find any scientific evidence that the concern is valid, we heard it from enough experienced fence-owners to include it as an open issue. Debarking rails and bucks would add approximately $1.00 per foot to the cost of the fence.

Another point of continuing discussion is the merit and risk associated with preservative treatment of fence components. A number of new, more "environmentally safe" wood treatment are now available. At the moment, insufficient data and experience exist to make informed decisions about the choice of materials, and the fence components to be treated.

The demonstration fence included back-braces on every fence section to simplify the training and supervision required for installation. In many buck and rail fences, there is a back brace only at corners and every fifth section on straight runs. With experienced contractors doing the installation, it may be possible to reduce the cost by eliminating many of the back-braces.

Demonstrations in Diverse Climates and Applications

Additional demonstrations are encouraged in riparian and upland sites across the Western U.S. Of particular interest would be interior dry sites where buck and rail fences have been in use for a century or more. Experienced fence builders and contractors may discover design improvements that would substantially reduce the cost of manufacture and installation.

Acknowledgments

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