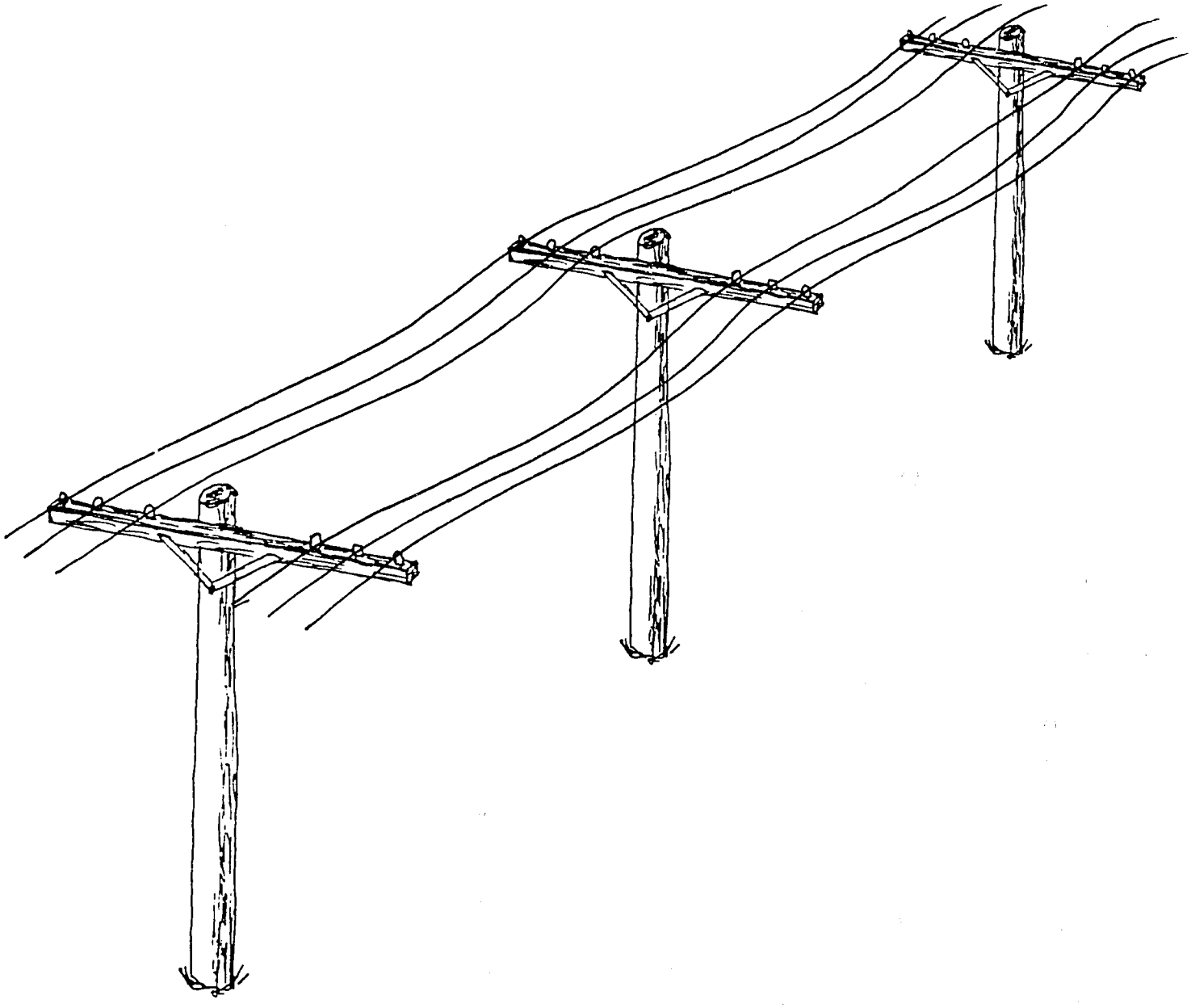
FORESTRY PLANNING & DEVELOPMENT PROJECT
Government of Pakistan-USAID

CROSS-ARMS OF EUCALYPTUS AND POPLAR WOODS



Research Report No.3

March 1992

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CROSS-ARMS OF EUCALYPTUS AND POPLAR WOODS

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The Water and Power Development Authority (WAPDA) of Paksistan has a detailed set of standards and specifications for the purchase and installation of wooden cross-arms. Deodar (Cedrus deodara) is specifically preferred, although allowance and specifications have been drawn for the use of shisham (Dalbergia sissoo).

Both of these species have been of significant economic importance to Pakistan in the past, and the current demand for these species is increasing much more rapidly than the supply. It has, therefore, been of keen interest to the forestry community and to the Pakistan Forest Institute to attempt to conserve these species through improved utilization techniques and the application of the philosophy of "highest and best use" for these species because of their superior wood quality characteristics.

A large number of studies have been conducted at PFI to determine the suitability of eucalyptus (Eucalyptus camaldulensis) and poplar (Populus sp.) woods for various end-uses. The results of these studies indicate that woods of both species have high strength, comparable to deodar, and should be suitable for construction material, cross-arms, transmission poles, etc.

1. EUCALYPTUS CROSS-ARMS:

The field testing of cross-arms of eucalyptus wood was started in 1980-81 when 38 cross-arms were installed on an 11 KV line on Jamrud Road, Peshawar, in cooperation with local WAPDA authorities. These cross-arms were treated with 50:50 mixture of creosote and diesel oil to protect them from insect and fungal attack. They were inspected in 1983, 1985 and 1991. Only one cross-arm of the 38 viewed on final inspection was found to be defective. It had developed deep lateral cracks which could lead to compression failure under heavy wind load, and was not acceptable for further service under WAPDA specifications. When this problem was first discovered during the 1985 inspection, WAPDA was notified and asked to replace it as a matter of precaution. The defective piece is still in service six years later. Although technically defective, this unit still serves its purpose under the existing load circumstances.

2. POPLAR CROSS-ARMS:

Field testing of 27 treated poplar cross-arms was started in February 1984. The first 6 of these were treated with a 50:50 mixture of creosote and diesel oil. But, unlike the eucalyptus, the wood absorbed excessive amounts of the chemical, causing them to be very heavy and difficult to handle, and making the treatment cost very expensive. The remaining 21 cross-arms in this batch were given alternative treatment with 4% CCB (Wolmanite) solution. All 27 pieces were installed on the 11 KV line in WAPDA Colony, Shami Road, Peshawar.

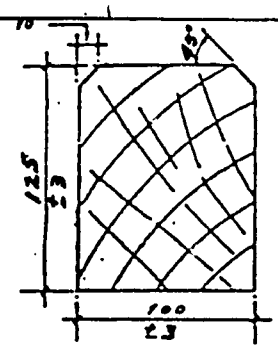
These 27 poplar cross-arms were inspected in December 1985 and again in July 1991. Two of these were classified as defective during the 1985 inspection and were reported to WAPDA. However, both were still in service at the end of July 1991. Although technically defective, they were still serviceable under the existing field conditions.

3. DISCUSSION - PERFORMANCE OF CROSS-ARMS:

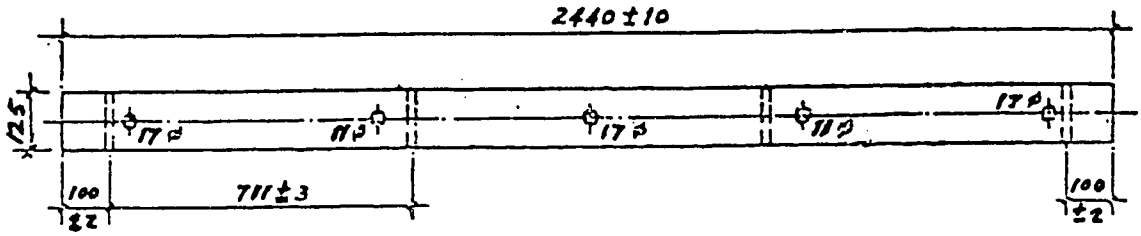
It is apparent from these very favorable field trials that the eucalyptus and poplar cross-arms make suitable substitutes for deodar cross-arms. In the case of the three technical failures noted out of the combined total of 65 cross-arms tested, none were replaced by WAPDA because they are, in fact, still performing their function of holding up the wires and insulators, and preventing the wires from contacting each other.

The technical specifications for cross-arms (see figure 1) include considerable detail on the sawing, drilling, and shaping of the cross-arms in an attempt to take the greatest mechanical advantage from the natural characteristics of the wood. For example, the top edges of the finished cross-arm are to be bevelled in such a way as to discourage the surface accumulation of water, and as a quick-check way for the lineman to know if the cross-arm is being mounted in the proper position.

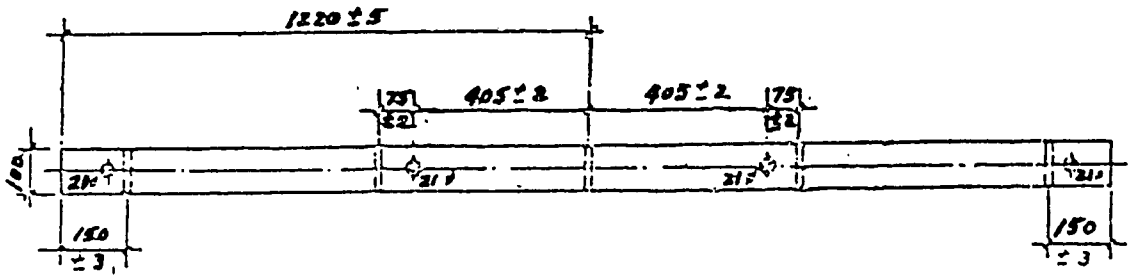
The treatment with water soluble CCB made it possible for PFI to mark these cross-arms prior to their installation, so that they would be easier to spot-check during the study. A three-inch tall "PFI" was stencilled on each cross-arm with white paint, so that the letters would be properly oriented when the cross-arm was properly installed. In spite of this extra precaution, 10 of the 21 were still mounted upside-down. However, there was no significant difference in the performance as a result of the incorrect mounting.



END VIEW



ELEVATION



PLAN

ALL DIMENSIONS IN MILLIMETRES

WEST PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY	DESIGN DEPARTMENT
STANDARD WOOD CROSSARM FOR 11 KV. LINES TYPE X-11	
DRN. A.S.	DATE:- 22.1.76
DWG. NO. PDM/DF-185	

BEST AVAILABLE DOCUMENT

4. ECONOMIC EVALUATION:

In spite of the fact that the high market price and short supply of deodar seems to indicate the need for an alternative material, the cost per year of service life is an important consideration when selecting any material for any purpose. Ideally, the best long-term investment should come from the material which will give the least cost per service year.

The standard approach for this kind of comparison is to do a "sinking fund" analysis which shows how many rupees must be set aside each year to accumulate the necessary fund to replace the item at the end of its service life. In the following analysis, the assumptions are:

1. Standard service life for cross-arms (WAPDA) is 7 years;

2. Nominal interest rate is 12% per year.

SPECIES	INITIAL COST (EACH -1984)	COST PER YEAR (7 YEARS)
eucalyptus	Rs. 73	Rs. 7.2
poplar	92	9.2
deodar	200	19.8

Data unavailable for this analysis include the actual service life experienced for deodar under field conditions, as well as the actual service life which may be attained from the eucalyptus and poplar alternatives. But, the eucalyptus performance over a full 11 years, as compared to the 7 year standard, seems impressive in itself. When viewed as a comparison of cost per year of service life in the above table, eucalyptus has a benefit/cost ratio of 2.75 : 1.00 over deodar.

6. CONCLUSIONS AND RECOMMENDATIONS

Strength properties of cross-arms are hardly affected when the seasoning defects are not severe, especially since WAPDA specifications are based on a safety factor of 5. Of the cross-arms in this study, 100% of the eucalyptus and poplar are still in service after 11 and 7 years respectively. Technical failure has amounted to only 3 out of 65 (4.6%).

Perhaps the most important finding is that, of 65 cross-arms tested of the two species combined, there have been a total of 634 service years without a failure requiring replacement.

It is hoped that WAPDA will continue to show interest in the use of these two alternative species for transmission line materials. Eucalyptus is in especially increasing supply as a utility wood; poplar is currently in competitive market for higher value uses as match stock, plywood, and specialty products; and deodar is in very low supply and high demand as cabinet wood. On the basis of judicious use of resources and least-cost performance, eucalyptus appears to be the wood of choice for cross-arms.

APPENDIX

Production costs of cross-arms of eucalypt & poplar treated with CCB/Wolmanite (waterborne preservative) by diffusion method:

Price of cross-arm of deodar purchased by WAPDA = Rs.200.00.

1.Euc:	Round volume 193.60 cft @ Rs.25/cft	Rs.	4,840.00
	Sawing charges.		606.40
	Total:		5,446.40

Total cross-arms recovered = 89		
Cost of timber & sawing/cross-arm	Rs.	61.20
Cost of drilling @ Rs.0.25/hole		2.25
Cost of chemical (preservative)		6.00
Miscellaneous charges		3.00
Cost per cross-arm		72.45

2.Poplar:	Round volume = 280.70 Cft @ Rs.25/cft	7,017.50
	Sawing charges	731.28
	Total:	7,748.48

Total cross-arms recovered = 103		
Cost of timber & sawing/cross-arm	Rs.	75.23
Cost of drilling @ Rs.0.25/hole		2.25
Cost of chemical (preservative)		11.00
Miscellaneous charges		3.00
Cost per cross-arm		91.48