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DEVELOPMENT OF PREFABRICATED MODULAR WOODEN BRIDGES

SI/PER/84/801/11-51

PERU

Technical report: Advice on extending the
bridge system within Peru *

Prepared for the Government of Peru
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of a UNIDO staff member

Backstopping officer: R.M. Hallett, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

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I. INTRODUCTION

This project was first approved as UC/PER/84/182 for funding from UNIDO's UNIDF resources in September 1984. Then it was considered for cancellation owing to shortages of these funds, but reinstated as SI/PER/84/801 in mid-December 1984. It arose out of the need to repair the road network following the serious flooding in late 1983 which caused losses estimated at \$US 702 million.

The counterpart agency was the National Development Institute (INADE) created in June 1983 to co-ordinate hydraulic and special projects in the highlands and forest areas as well as to co-ordinate the work of departmental development corporations and public sector agencies to reconstruct and rehabilitate the zones affected by these natural disasters.

Because the Piura Department was especially affected by flooding, this project was intended to assist in the introduction of UNIDO's Wooden Bridge System to that region. Although there have been many delays in building the first, demonstration bridge in Piura, it is expected that it will be built in the first half of 1987. However, it was decided to extend the application of the system to one of the special project areas in the forest, in particular the area covered by the special project Pichis Palcazu. This project aims at integral rural development in Pichis, Palcazu, Oxapampa and Satipo-Chanchamayo.

It was with this expansion in mind that the Government, through telex 1870 from UNDP, Lima, dated 5 July 1986, requested a one-week mission by a Headquarters staff member which resulted in a budget revision to cover his travel as a consultant on budget line 11-50. The mission of Mr. Robert Hallett, Agro-based Industries Branch, took place between 23 and 30 November 1986. Annex 1 is the Job Description.

II. BACKGROUND

During 1986, several reports were prepared by Mr. J.C. Cano (National expert) and counterpart staff, principally Mr. Jorge Llosa Montagne, of the office of technical assistance and finance, INADE (refer to report no. 003-86-INADE/3401-J.L.M. "Visit to Perene and Palcazu, 16-18 July 1986"

Other relevant reports are:

- No. 001-86-INADE/3401 of 22 January 1986 by Mr. Llosa M.;
- No. 004-86-INADE/3401-J.L.M, with Mr. Cano to the Microregion of Yauyos within the Lima Development Department;
- Report by Mr. Cano dated 31 March 1986 regarding the use of UNIDO's bridge in the Lima department at Rio Chillón;
- Report by cover of memorandum no. 02-86-INADE/3401 dated 8 August 1986 by Mr. Eduardo Guerra Castillo, covering the expansion of the UNIDO/INADE agreement to include CORDELIMA.

In general, these reports served to inform both the staff and management working in these special development regions of the potential of UNIDO's Wooden Bridge System for meeting some of their bridge needs. The visits described by these reports also made provisional identification of possible bridge sites, of sources of supply for sawnwood and other inputs as well as possible workshop locations.

III. PROGRAMME

Throughout his mission Mr. Hallett was accompanied by Mr. Cano without whose assistance the mission would have been much less useful. A list of the people met forms Annex 2.

The programme began on Monday, 24 November, with a visit to UNDP and UNIDO offices. This was followed in the afternoon by visits to the INADE Headquarters to meet Mr. Rodolfo Solano H., Deputy Director, INADE, and Special Project Pichis Palcazu, and Mr. Alfonso Vega Maguina, the main practical counterpart of Mr. Cano who was also nominated to go on a study tour to other countries already using the bridge system.

On Tuesday 25 November 1986, plans were made to travel to the Pichis Palcazu area but actual departure was delayed until 15.00 hours. Wednesday, 26 November, was devoted to meeting the staff of the special project at La Merced (see list in Annex 1) and the objectives and characteristics of the bridge system and the special development project, respectively, were explained and discussed. Arrangements were made to travel to Iscozacín by small aircraft to inspect facilities there and gather information on local availability of timber species. The intention was to return by road past several potential bridge sites and especially the sawmill at Shiringa-Mazu and the wood processing complex La Raya, as well as the town Villa Rica.

Unfortunately this was not possible owing to heavy rains which not only delayed departure from Iscozacín but also prevented a visit to Pichinaki in the Chanchamayo Satipo project area where several bridge sites and possible workshop had been identified.

Thursday, 27 November 1986, was spent at Iscozacín and involved Mr. Cano studying, with project staff, the characteristics of available species whilst Mr. Hallett met other staff, in particular Michael Krones who was responsible for setting up a small woodworking shop.

Following a very late return to Lima Thursday night, Friday, 28 November, was spent reviewing the discussions to date with Mr. Cano and drafting the outlines of further project activities. A meeting arranged at 16.00 hours with Mr. Juan Sarmiento, Vice Minister of Construction, Ministry of Housing and Construction, was cancelled at the last moment but Mr. Cano was able to meet with him the following week after the departure of Mr. Hallett.

Other activities included a visit to a small private sawmill near Iscozacín (at Fundo La Union), owned by Juan Frantzen W., which had a capacity of about 4500 bf/day and which apparently could produce acceptable sawnwood for bridges to be fabricated at Iscozacín; a meeting was held with engineers

of an agricultural (rice) project who were confident that the UNIDO bridges would be suitable and useful for their work: another meeting was held with Mr. Dimas A. Pinto Rojas, Subprefect of Chanchamayo who was very anxious to assist private enterprise to build these bridges for the area.

IV. OBSERVATIONS

A. Demand for UNIDO's Bridge System

There is clearly a lot of interest in using UNIDO's wooden bridge system in Peru, especially in the Pichis Palcazu project area and in the Department of Lima (to the north-east near Canta and to the south-east inland from San Vicente de Canete near Yauyos and Huangascar).

Although timber is not firmly established as a general construction material, the engineers and directors of INADE seem convinced of the system and that it will be cost effective. In fact, the directors of the development programmes within the special project were competing for the first bridge workshop to be established in their areas. Sufficient bridge sites have been identified during earlier missions to estimate that between 40 and 50 UNIDO type bridges could be built in the above-mentioned areas over the next few years if suitable facilities were established.

During the visit to Iscozacín, Mr. Cano worked out a cost estimate sheet in Intis based on his experience with the system in other countries together with his local knowledge, which argued persuasively in favour of the UNIDO system.

B. Supply of Materials

There are apparently several sawmills in the Special Project region which are capable of producing acceptable sawnwood for UNIDO bridges, although stress grading to the required standards would have to be introduced. The physical and mechanical properties of some 1,200 local species are being studied at Iscozacín and a considerable collection/reference base is being assembled. A sufficient number were identified as suitable and abundant enough for construction purposes. Annex lists 10 of these with their strength class and durability shown.

Aside from timber, the main materials needed for the bridges are mild steel (in plates, flats, bars), bolts with nuts and washers, nails, reinforcing rods and cement. All would have to be brought in from Lima. The mild steel could be worked into the necessary types of plates (by cutting to size, drilling and welding) in either Lima or in the region. The rest should be delivered 'ready to use'. Consumable items such as welding rods, drill bits (for steel and wood) would also have to be delivered.

C. Framework of Cooperation

The lines of responsibility must be clearly established before any technical assistance should begin in the Special Project Region or other parts of Peru. Experience in other countries has shown that the logistics of coordination and communications between Government Departments or Ministries is the greatest obstacle to successful implementation of this type of project.

It has been found useful to agree and have signed conventions ('convenios') between organizations and even have special accounts opened to ensure steady access to the budgeted funds so as not to delay related activities through unforeseen difficulties in releasing such funds. Also, staff assigned to work on such projects have, to the frustration of those anxious to transfer the technology, been transferred themselves to other duties either during the project or soon after its end.

Should the Government and Counterpart Agency find the results of the demonstration stage positive, every effort should be made to continue the activities by encouraging users - whether Regional Development Corporations, Special or Technical Assistance Projects, using Bilateral Aid, World Bank loans or domestic funds - to order bridges and incorporate them as appropriate into their programmes. In this way the costs will decrease, the local economies will be stimulated, private enterprise may be attracted to do more and more of the supply, fabrication and assembly operations - up to and including offering tenders for complete bridges.

Thus the role of the original counterpart agency should be reduced to that of coordination and control plus transmission of any modifications or improvements developed in other countries. It should also contemplate introduction of industrial buildings and sheds using the same basic technology, first by producing and costing timber roof systems, then by introducing wall panels and other standard components. Eventually, whole buildings may be found to be competitive.

D. Sites for Bridges and Workshops

There are many possible combinations of arrangements that would permit extensive fabrication and erection of UNIDO's wooden bridge system in Peru. Depending on the official Government policy, the trend to private sector production of components is most natural.

The activities can either be centralized or dispersed, but it has become apparent during UNIDO's experience in several countries that users and producers of bridges should ultimately become separated. The initial stages of introduction of the system into a country should be done by a technically-oriented department of the Ministry or Department responsible for bridge design at the national level. Sufficient experience should be gained so that once production becomes widespread, the engineers and officials of that agency can maintain control of quality and future modifications.

From this stage users, whether public or private, should be able to "order" a bridge from one of several building contractors whose tenders are based on quotations from various suppliers and who would have the option of a) buying in complete bridge 'kits' for erection at the site, or b) buying in the components (semi-fabricated), assembling the panels or fabricating the braces or tension members and then controlling the dispatch of the 'kit' to the site for subsequent erection once the approaches and abutments are finished.

It appeared from the mission that several options could be suitable for Peru and that within a few years a balance would be found for normal supply of these bridges depending on the region and distance from developed centres, especially Lima.

Finally, it must be considered that a workshop equipped to produce bridge components could also make a variety of timber structural components, especially for roof systems (e.g. portal frames) to serve the local area and to balance the product mix and use its physical resources better.

V. RECOMMENDATIONS

A. Counterpart Agency

Owing to the strong role played by the Regional Development Corporations, especially in rural areas, it is recommended that the Ministry of the Presidency act as counterpart agency to any further assistance. The Ministry of Housing and Construction should be associated since spin-off activities should be expected in these fields.

For particular responsibilities in project areas, INADE or other special organizations may contribute resources. Bilateral aid programmes should be tapped for contributions to specific bridge works, especially for on-site activities (approaches, abutments and labour during erection), but also for material costs.

B. Technical Assistance

It has been found in other countries that, although a few engineers have absorbed the technology, additional international inputs are needed to disseminate the concept of the bridge system throughout the country and to implant the related wood technologies and timber design abilities into the mainstream activities of Ministries and builders. This can either be on a national basis or linked with international (regional) efforts to focus attention on the broader aspects of modern timber construction.

If assistance is on the national level, periodic inputs in the form of short missions by specialists to solve specific problems ad hoc and to organize and run short technical seminars on various related subjects (such as stress grading and timber selection, kiln drying, hazard in use and appropriate preservation methods, design and costing of structures) are recommended.

If on the regional level, the international expert(s) would monitor progress, solve problems ad hoc and contribute as above by organizing short seminars to keep the momentum generated by the first project(s), and to broaden the appreciation amongst engineers and architects of timber construction.

In any case, until a 'critical mass' is reached, of engineers and officials who are convinced of the virtues of timber construction for bridges and for other civil works, continued, periodic technical assistance is recommended.

If further UNIDO technical assistance is contemplated, it should be a pre-requisite for counterpart Government inputs to be covered by funds in trust in a separate account under the responsibility of the UNDP office to ensure that materials are bought and salaries paid to the agreed extent.

Location of Activities and Workshops

The first point to be made is that investment in equipment is relatively small since standard woodworking machinery serves the purpose and other items such as welding set, compressor or portable generator and metal-working machines are normally on hand somewhere. Therefore, the problem is reduced mainly to one of logistics, organization and deployment of existing resources.

The second point is that in any new region the first one or two bridges can be made by "buying-in" components from well-established, larger firms in Lima and bringing them to a local workshop for assembly into panels, control and dispatch to the bridge sites. This enables familiarity to be gained by local engineers and gives a chance for them to get the feel of the concept and to choose better how to set up local facilities.

In the case of the Pichis Palcazú region, it is recommended to have 2 sets of steel parts (for 30 metres of 4-truss bridges) made in Lima by SIMA (Servicio Industrial de la Marina) or other large works. Two extra sets but comprising only one example of each type of plate, should also be made by SIMA to particularly exact specifications to serve as samples for others to follow. The next sets should be made at Villa Rica under the supervision of the SPPP-PDR Oxapampa (or another well-established metal workshop in the development region) and in the southern part of the Province of Lima to provide for bridges in the region of San Vicente de Canete.

Bridge component assembly workshops should be established near where bridges are needed, but more importantly, where basic woodworking facilities already exist. These would be at 'Campamento de La Raya' and at Pichinaki (under the supervision of the SPPP-PDR Chanchamayo Satipo) using sawnwood cut nearby at any number of sawmills wishing and able to provide the required quality. The workshop of Iscozacín could be used, provided adequate supervision was given but this would better be kept to later stages of development or else it could convert some of the locally produced sawnwood, once dried, to cut-to-size pieces for delivery to the assembly workshop - thus spreading the work and also reducing transport costs.

The species chosen should be from the 10 selected by Mr. Cano during the visit 26/27 November 1986. Preservative treatment is necessary for some of these but it would be best to use naturally durable species at first. Other supplies such as bolts, nuts, washers, nails and consumables should be bought on the open market as required.

V. CONCLUSIONS

1. There is a great deal of interest in using UNIDO's bridge system more widely in the country.
2. Indications are that costs will be competitive.
3. Private enterprise should be involved in fabrication and assembly of components and eventually in erection of the bridges.
4. Several assembly workshops could be planned.

5. Steel parts should initially be made at a well-equipped, modern workshop in Lima.
6. Technical assistance should be continued on a periodic basis to ensure proper use of the system and to spread the proper use of timber in construction.

GROUPING FOR UNIDO'S MODULAR WOODEN BRIDGES

N o.		N A M E S		STRENGTH GROUPING	NATURAL DURABILITY
		COMMON	BOTANICAL		
1	10	CAIMITO COLORADO	POUTERIA ZAPOTACEA	S4	B
2	1	COMESEBO EBANO VERDE TAHUARI	TABEBUIA SERRATIFOLIA	S2	A
3	4	CHONTAQUIRO NEGRO " COLORADO " AMARILLO	DIPLotropis	S2	B
4	6	CHANCACA	MESILABRUS ITAUBA	S3	A
5	5	PALO PERUANO AZUCAR HUAYO	HYMENAEA COURBARIL	S3	A
6	8	HUACAPU AMARILLO DE ALTURA TAHUARI	TABEBUIA SERRATIFOLIA	S3	B
7	3	MACHONASTE TULPAY	CLARICIA RACEMOSA	S2	B
8	2	QUILLOBORDON	ASPIDOSPERMA SP	S2	B
9	7	TACHO AMARILLO " NEGRO " BLANCO YACUSHAPANA	TERMINALIA AMAZONIA	S3	A
10	9	SHIHUAHUACO	DIPTERIS ODORATA	S4	B

List of Persons met

Dr. Rodolfo Solano Hernández	Deputy Director, Special Project Pichis Palcazu (SPPP)
Ing. Alfonso Vega Maguina	Office of International Affairs INADE (counterpart to SI/PER/84/801)
Ing. Uberto Fuentes Valdivia	Director Rural Development Project Chanchamayo-Satipo
Ing. Jorge Bacilio Rios	Chief of Works, Rural Development Project Chanchamayo-Satipo
Ing. Moisés Ahumada Cortez	Chief Sub-Unit, Studies and Projects
Ing. Witsen Barreto Moreno	Director Rural Development Project Oxapampa
Manual Martinez R.	Chief Communications Unit
Ing. Jaime Esteves	I/C sites
Michael Krones	US/AID. Iscozacín (SPPP).