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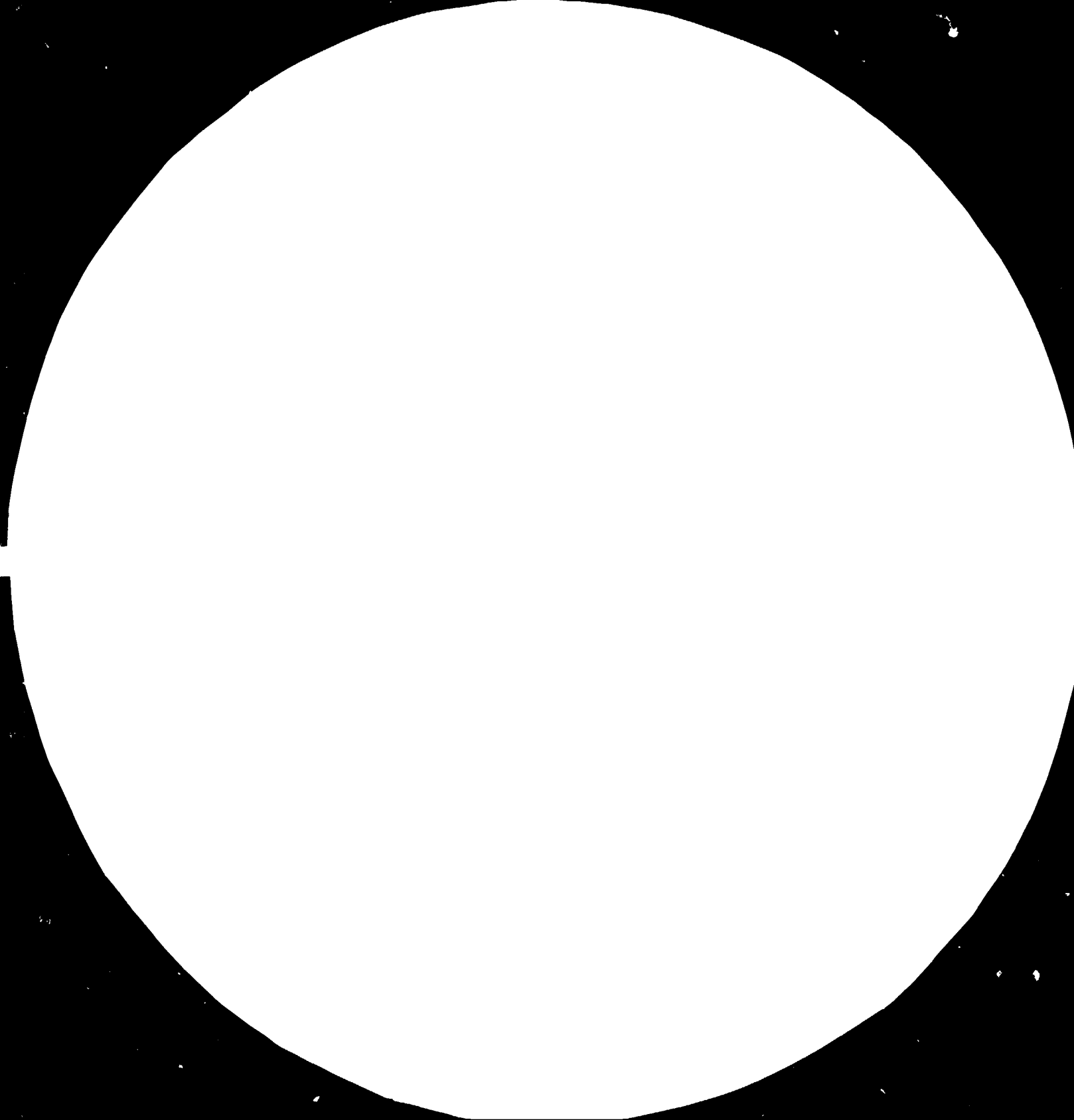
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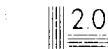
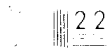
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UNIDO



FINAL REPORT FOR A CONTRACT

between

THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

and

THE TIMBER RESEARCH AND DEVELOPMENT ASSOCIATION

for services relating to the

DEVELOPMENT OF PRE-FABRICATED MODULAR WOODEN BRIDGES

in the

REPUBLIC OF HONDURAS

Based on the work of
C.J. Mettem, H.J. Burgess,
and others.

20 May, 1983.

TRADA,
Hughenden Valley,
High Wycombe,
Buckinghamshire, HP14 4ND,
United Kingdom.

DEVELOPMENT OF PRE-FABRICATED MODULAR WOODEN BRIDGES

in the

REPUBLIC OF HONDURAS

INTRODUCTION

The work described in this report was undertaken for the Government of Honduras, under a contract awarded by the United Nations Development Organisation (UNIDO) to the Timber Research And Development Association (TRADA). UNIDO were acting as executing agency for the United Nations Development Programme.

A preparatory technical assistance mission in the woodworking industry sector was undertaken at the request of the government of the Republic of Honduras from 20 January to 4 February 1981. It resulted in a report and a draft project document. The report, reference DP/ID/SER.A/285, was based on the work of Robert M. Hallett, Industrial Development Officer, Agro-Industries Branch, UNIDO. It proposed further missions, including one by a UNIDO expert, Mr. C. R. Francis.

Mr. Francis was team leader of the UNDP project DP/KEN/77/007 'Development of New Timber Products' in Nairobi, Kenya. He was recruited for a post of one month duration in Honduras. He stayed in Honduras from 24 March to 25 April 1981 and his report, reference DP/ID/SER. A/307 was made available in English and Spanish.

After Mr. Hallett's mission and project proposals, there was a request from Chief, Purchase and Contract Service, UNIDO, Vienna, dated 31 August 1981, for Timber Research and Development Association (TRADA) to prepare and submit a project proposal to continue the development of prefabricated modular wooden bridges in Honduras. The terms of reference were provided, and a contract was arranged.

A list of the principal individuals and organisations encountered in the project is given in Appendix A, whilst Appendix B lists the project reports and other important references.

INITIAL TRADA VISIT

The objectives of the first TRADA mission, which was undertaken by C. J. Mettem between 5 October and 19 October 1981, were to follow up the work of the first expert Mr. Francis; to establish a central workshop in Tegucigalpa, the capital; to ascertain the situation regarding materials and equipment ordered; to investigate steps taken by the government towards the provision of suitable sites and generally to make contacts to pursue the terms of reference.

Lists of tools and equipment recommended and purchased by the first expert were reviewed and checked. These were given as Appendices to the first visit report. At the time of the visit, most items were available, but some were still on order or held in customs. An undertaking was made by the counterpart to make marks or labels on all the tools and equipment and to record them in an inventory. To our knowledge, this has still not yet been done, and should be followed up by the UNIDO - appointed resident engineer, for project DA/HON/81/002, Ing. J-C. Cano.

Owing to the lack of steel parts and incomplete jigs, it was not possible to use the workshop extensively during the visit, or to implement plans for training. One or two SECOPT staff were identified as forming part of the workshop team, plus a welder who was available at the depot for general duties. The staffing and duties of a workshop team were, however, agreed with the counterparts. This team was based on Mr. Francis's recommendations, but reduced slightly to meet an estimated production level of 5 panels per day, plus an allowance of time for instruction.

The terms of reference required TRADA to check on two bridge sites selected in consultation with the government and to ensure that the abutments and other preparatory works were correct. They also included the requirement for a compilation of potential bridge sites.

At the time of the initial visit, no sites were available with abutments under preparation, and it was not possible to identify any totally firm commitment on the part of the government to commence construction. This seemed likely to cause delays in completing the project. Information was obtained on a number of possible sites, and four were visited. Several of these offered good potential for developing the project, and were described in the first report.

The two most highly recommended bridge sites from a combination of technical considerations and practical needs were identified as follows:-

1. Tegucigalpa, colonias La Campanata, Reforma.
2. Yoro District, Yoro-FIAFSA road, La Guata crossing.

Both needed 15 m spans. It was recommended that the urban site would fulfil a social need and at the same time provide a good location for training and demonstration purposes. The rural site would form part of a planned road improvement scheme, and would serve a sawmill and rural communities.

It was pointed out that since the bridge is a modular prefabricated design, the accurate construction of abutments and setting-out of pier caps and bearing pockets would be very important. At a final project meeting at the end of the first visit, objectives were agreed for work leading up to a second mission. These may be summarised as follows:-

1. Equipment and materials genuinely ready and tested.
2. Workshop complete.
3. Prototype panels made.
4. Sites agreed and a date set for start of construction.

Activities during a second field visit were agreed.

SECOND VISIT

This took place between 15 January and 28 January 1982 and was made by P. Watt. Government changes and operational difficulties for UNDP delayed progress at the time, and the objectives defined at the end of the first mission had not been achieved when Mr. Watt arrived. The trip was useful however in correcting mistakes which had started to occur in the procurement and manufacture of steel parts.

A number of potential suppliers and fabricators had been given parts lists and steel drawings, but these were incomplete and confused. Several steel fabricators were visited and recommendations were made not to place contracts with certain suppliers whose samples of work had been unsatisfactory. It was decided to concentrate orders upon fewer fabricators. Attention was also drawn to the lack of firm arrangements for the supply of bolts, another factor which could delay progress of the project.

Little progress had been made between the first and second TRADA visits in completing the workshop, and recommendations for correcting the jig table had not been followed. These observations should be noted in view of current plans to move the workshop and set up a larger one on the site adjoining the SECOPT offices, as similar problems and delays are likely, unless determined action is taken to prevent them.

Recommendations of the report on the second visit included the following:-

The project was delayed through circumstances beyond control of those technically involved, and a new time-scale was recommended.

Civil engineering work started at a site at Yuscarán was generally satisfactory, although a change in level was recommended. This site could proceed as a suitable one for a prototype. A further 15.0m span bridge site should be prepared. The site in Tegucigalpa would be ideal in many ways.

Financial assistance from U.N. and administrative help from the Field Advisor's office was needed to ensure effective provision of steel and bolts.

Soon after Mr. Watt's return to TRADA lists of sets of bolts and other fastening items were drawn up and preliminary quotations were obtained. These were sent to UNIDO Vienna and to UNDP Tegucigalpa.

THIRD VISIT

Following assurances that all wooden and steel parts for three bridges were available and that abutments were ready for erection at Yuscarán, the third trip, by C. J. Mettem, was made between 22 June and 8 July, 1982.

On arrival it was found that contrary to expectations no complete bridge panels had been made. The Yuscarán bridge site had not been visited since the second field trip in January 1982 and no progress had been made in developing other sites. Many recommendations of the second visit report had been neglected and in particular vital steel parts and fasteners had not been delivered.

A difficult situation had developed with the Chief Counterpart, Alex Bendeck, who had been transferred to other duties by the army and who had apparently spent little time on the project since March. Only one-and-a-half working days were available with the counterpart, who then left the area entirely. TRADA had not been made aware of any such potential difficulties.

In May 1982 a tropical storm named 'Aleta' caused severe damage to areas of Choluteca District, which is on the eastern side of the extreme southern region of the republic. A new emergency reserve programme had been drafted to deal with damaged bridges there, and assistance was given to R. M. Hallett, UNIDO Vienna, in considering this proposed project and visiting the emergency region.

It was agreed that possible ways to avoid future difficulties in administering the prefabricated modular wooden bridge project might include recruitment of a Spanish-speaking resident engineer acting for UNIDO, in addition to the further engagement of TRADA.

It was recommended that design details should revert to those shown on the drawings and written instructions provided by TRADA. Changes to take account of supply difficulties or local circumstances could be taken into account provided notice was given. Assistance could be provided by TRADA in planning and detailing new workshops, jigs and tools and a number of recommendations were given in the visit report.

As regards sites, it seemed most likely that the first bridge would be erected at Yuscarán, and arrangements were made with SECOPT and HONDUTEL to set right earlier breaches of communication. It was recommended that pressure should also be maintained to proceed with the city site, which is technically suitable, socially and economically desirable, and a potentially excellent showpiece for the project. Amongst the sites visited in Choluteca region, that at Santa Ana de Yusquare (also known as San Juan), would be ideal for a prototype wet launch.

By the end of the third visit, sufficient panels and bracing members had been manufactured to permit a trial assembly of a complete girder (two trusses side-by-side with accompanying bracing). This was carried out successfully.

The report on the third visit included a list of materials and equipment to be delivered to the Yuscarán site, which was provided in Spanish as well as English; instructions for preparations of components and site details; illustrations and notes on sites visited and drawings and recommendations for a new central workshop at SECOPT Headquarters.

FINAL VISIT

The fourth and final visit of the project to which contract No. T81/61/DG referred was undertaken by C.J. Mettem and H.J. Burgess between 5 October and 28 October, 1982.

Upon arrival it was found that the Yuscarán site was in a reasonably advanced state of preparation, although not so near completion as TRADA had been informed. Time was inefficiently spent during the first part of the visit, as had been the case with previous trips, due to weakness of transport arrangements and inadequate facilities for accommodation on site.

Yuscaran bridge erection

Actual erection work on the 12m prototype bridge took place between 7 and 21 October. A 'launching ceremony', attended by government and UNDP officials, press and visitors from Belize, was held on 19 October. Erection was slower than might be expected in future, due to several factors. These included general lack of familiarity with the system; a very awkward site for a prototype, and a misunderstanding on the part of the SECOPT engineers, which led to anchor bolts for the bridge bearing plates being cast into the pier caps prior to launching.

The difficulties of the site are illustrated in Figure 1 and Figure 2, which show a general view of the area from a hill above, and panels being lifted over the stream and up the rocky track to the assembly area.

Owing to the curve and incline of the road, it was decided that the standard launching technique with twin towers would be impracticable. An alternative had been devised, which was to erect a single, tall derrick on the stream bed. This stood longitudinally in line with the centre of each girder to be launched. A complete girder assembly, consisting of two trusses, each of three panels, was then placed in a single lift. No alternative recommendations for lifting the heavy loads encountered in a dry launch were available in the manuals provided to TRADA, such as those written in the Kenya project. Consequently, this system of a central derrick had been devised in advance of the field visit. Even so, it inevitably took several days to familiarise the Honduran team with this novel idea, especially since they had already learnt the methods shown in the Kenya film and manuals. Once confidence had been gained in the central tower technique however, it proved a quick and safe method for such a difficult site.

The problem of the pre-positioned anchor bolts was reviewed with the SECOPT and HONDUTEL engineers during the visit, and it is unlikely that such a mistake will be repeated. To reinforce the instructions given in the manuals, which clearly state that pockets should be left open until after launching, an axonometric drawing has been provided. This illustrates both in three-dimensional drawings and in text, the correct construction sequence for bridge bearing details.

Further details of day-to-day progress in the Yuscarán bridge construction were provided in the field visit report, which was taken for a de-briefing meeting, held in UNIDO Vienna on 15 November 1982.

Illustrated in Figures 3, 4, 5 and 6 are views of the bridge during the launching ceremony with decking incomplete; the decking being fixed and parapet construction underway, and the completed bridge.



Figure 1. General view of Yuscaran bridge site area.

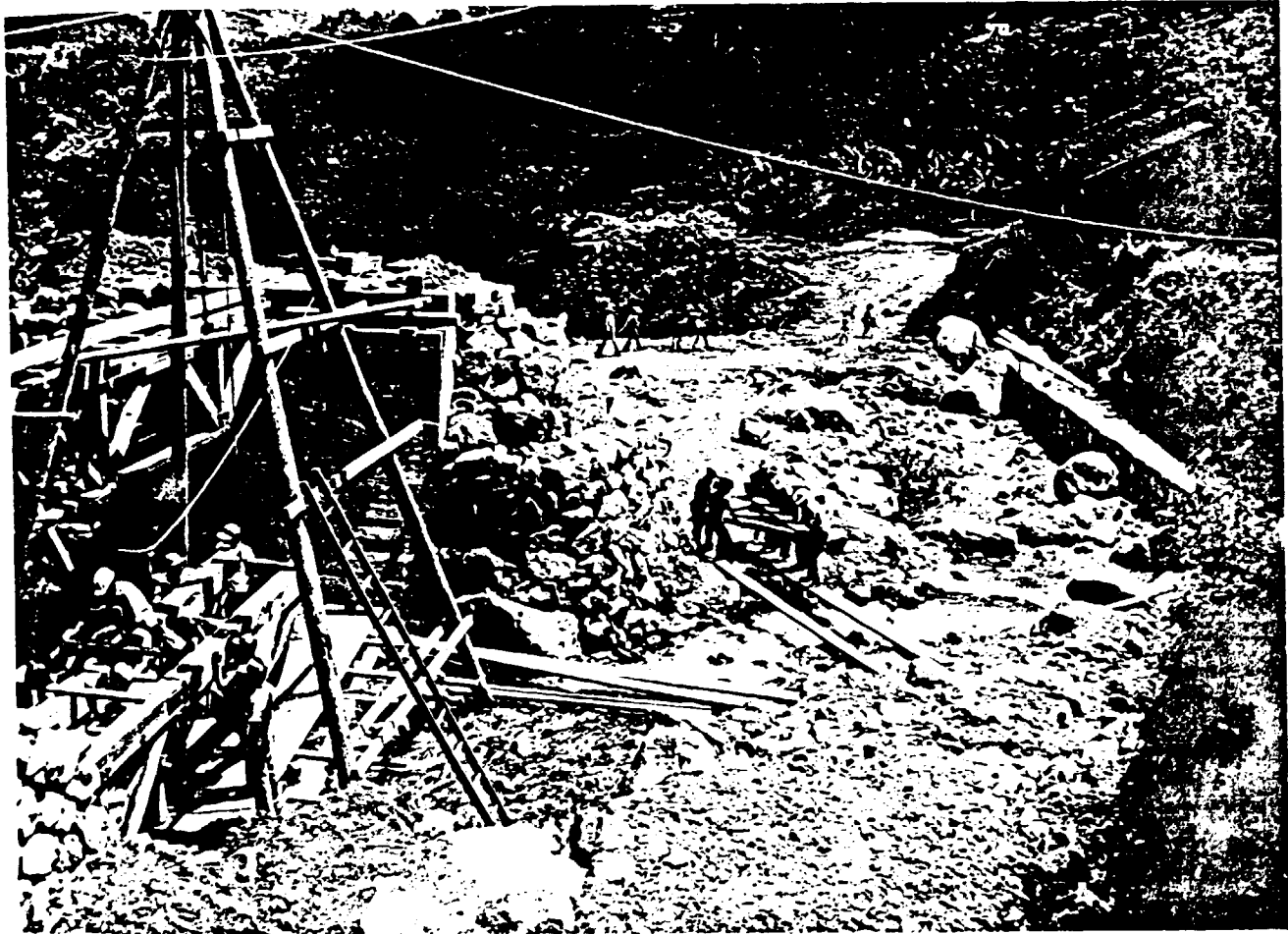


Figure 2. Modular bridge panel being lifted over stream to truss assembly area. Note also central derrick on stream bed and rear girder in position on pier caps.



Figure 3. Partially completed bridge during launching ceremony.

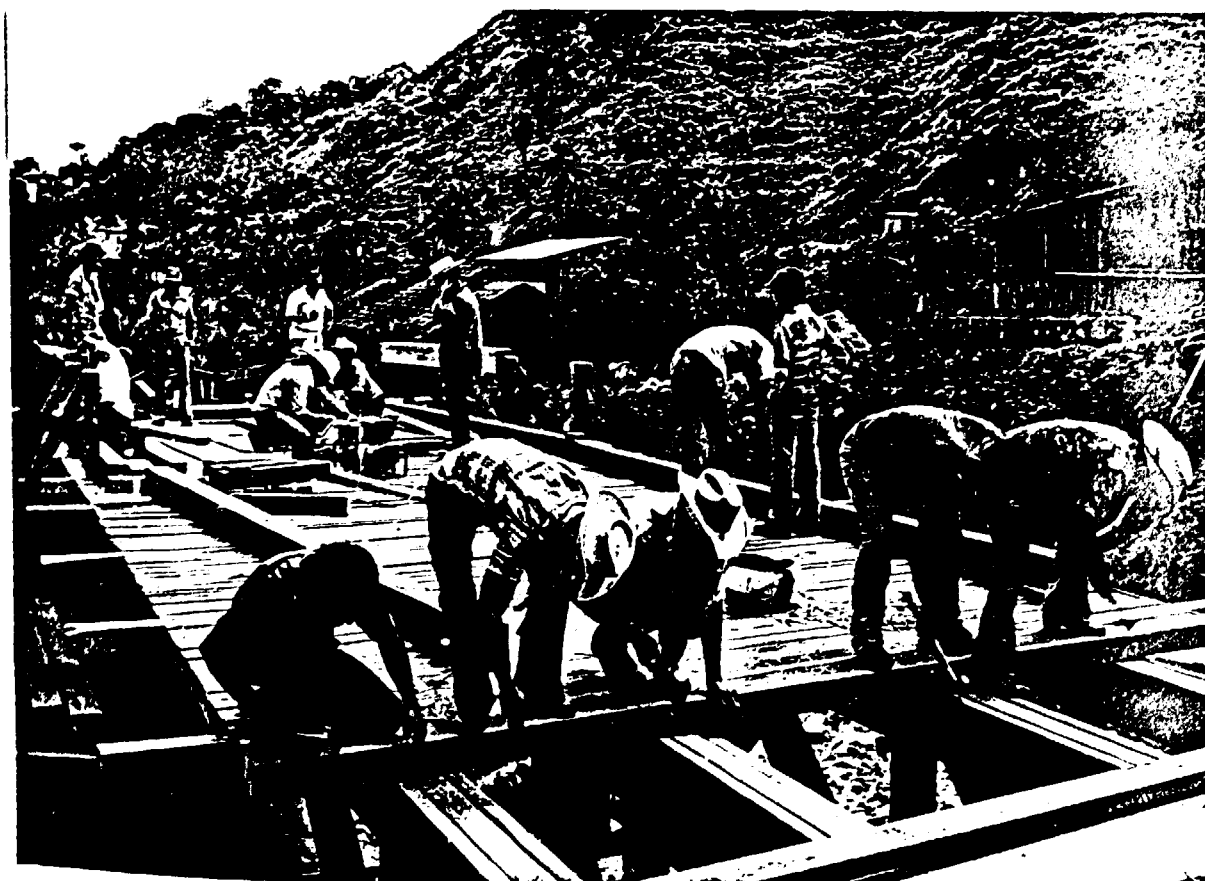


Figure 4. Fixing deck, curbs and handrails.

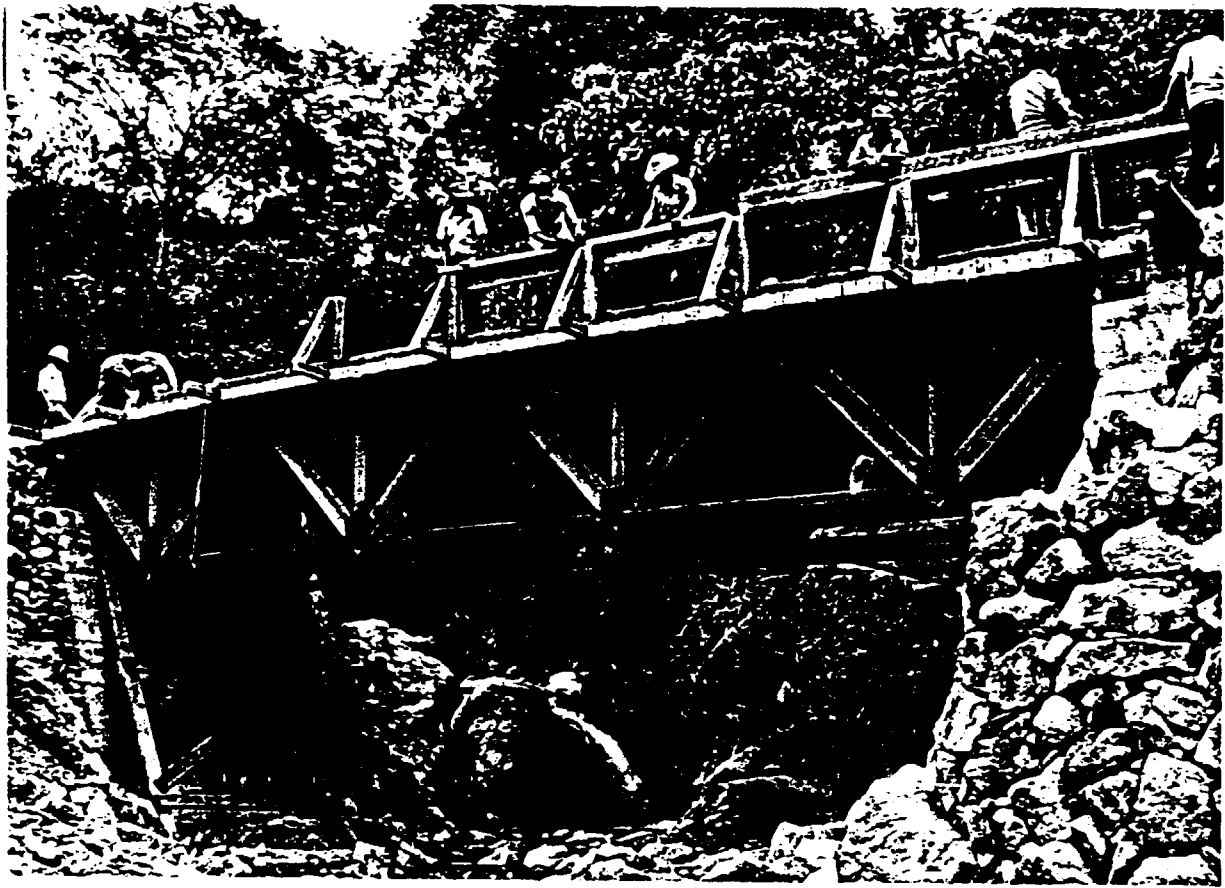


Figure 5. Permanent deck bracing installed.

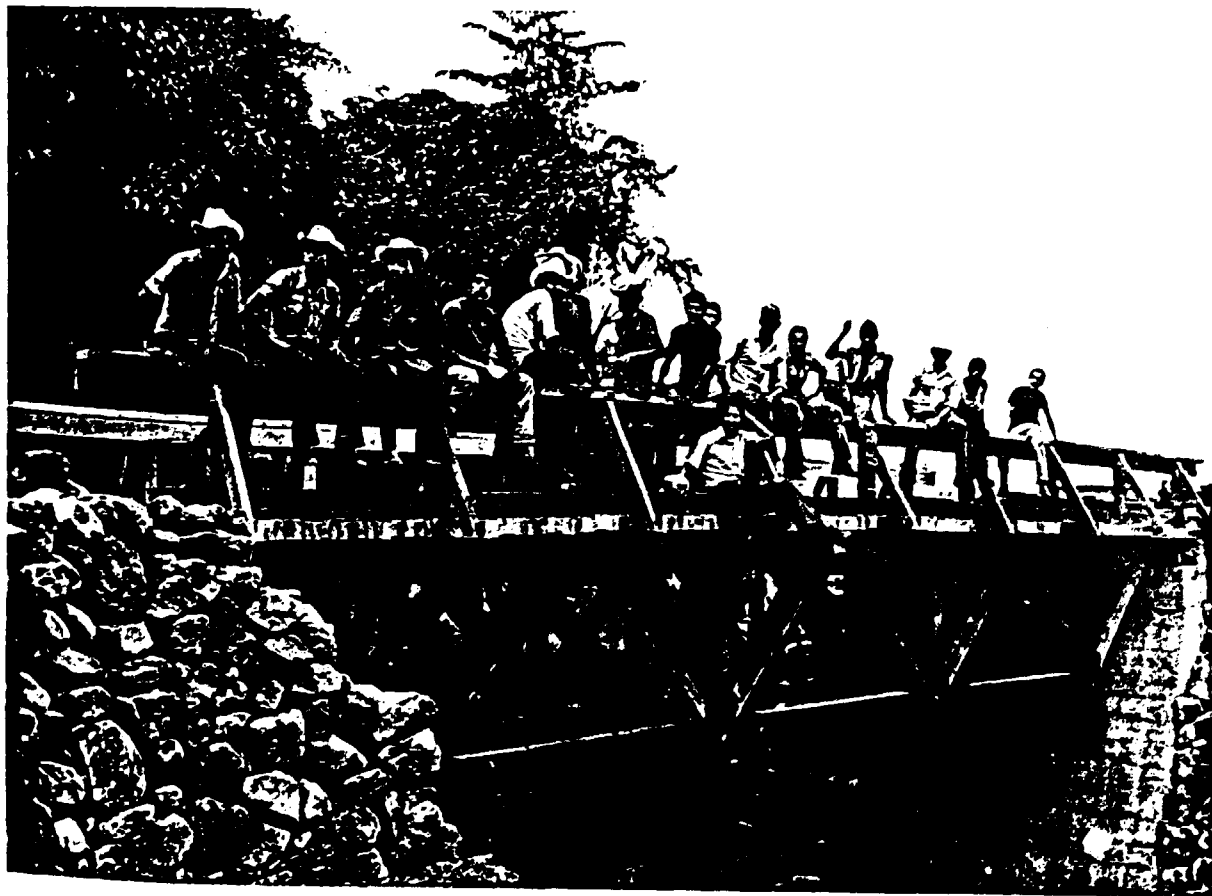


Figure 6. Complete 12m span, 4-truss, light-chord bridge.

Project planning meeting

A project planning meeting was held at the UNDP offices on 20 October 1982, chaired by Mr. A. Kruidrink, the Resident Representative, and attended by the Field Advisor's staff, the project team and Ing. J-C. Cano, who was the likely candidate for the post of UNIDO-appointed resident engineer. The following is a brief summary of the discussion:

Mr. Kruidrink said UNDP wished to concentrate efforts firstly on the bridges required in the Choluteca region. It was undesirable to become involved in other regions at this stage. For the first ten bridges planned in the south, sites requiring moderate spans and not needing multiple spans should be chosen. Donors and potential donors of funds must be shown one region in which a fair number of bridges have been completed in order to be convinced that money has been well spent and should be augmented. An important aspect in the original project description was that it was intended to provide bridges for rural roads. Large multi-span bridge projects did not fit in with this concept.

Ing. Abadie referred to a list of eight bridges in Choluteca region, five of which were of moderate span, and it was agreed that this list could form the basis of investigations into suitable sites. A list of information required for each proposed site had been prepared in Spanish by TRADA and this was passed to Ing. Abadie at the meeting. It was agreed that TRADA would accompany SECOPT engineers to begin the survey on 25 October.

Training was discussed, and Ing. Abadie said that this would be required in several centres, for example the Choluteca SECOPT depot, as well as in Tegucigalpa. During the first part of Ing. Cano's stay, training would be developed in the capital, but the need to extend to other regions would be kept in view.

A request for training at a managerial level was made informally at the meeting. This subsequently gave rise to a contract from UNIDO Training Section for a special twelve day training programme for Ing. Abadie at TRADA, which took place between 17 November and 10 December 1982 (these dates are longer than 12 days because of an intervening visit to Germany by Ing. Abadie).

Choluteca site visits

Sites in Choluteca District were visited by H. J. Burgess, in company with SECOPT engineers, between 25 and 27 October 1982.

The purpose of the visit was to secure details of the sites short-listed by S. OPT in the plans discussed above. Eight sites had been nominated by the government, but three of these had estimated spans in excess of 35m, and were not visited for measurement of profiles. The remaining five, together with San Juan (span 12m) discussed in the visit report of June-July 1982, plus a site in a slightly different region of Choluteca named San Bernardo (west of Choluteca), were measured for profiles.

Drafts of these profiles were given in the visit report, and further work upon them was carried out during Ing. Abadie's visit to TRADA.

To assess the suitability of various spans and abutment heights, standard bridge diagrams were prepared, ranging from 6m to 21m. These diagrams were drawn on transparent material so that they could be laid over the profiles to illustrate the effects of positioning the abutments and the amounts of cut and fill required.

Profiles for the following sites, prepared in the manner described above, were sent to Honduras at the end of Ing. Abadie's visit:

Quebrada Seca, 18m and 21m span.

San Benito Viejo, 12m and 15m span.

San Benito Nuevo, 12m span.

Santa Rosa, 18m and 21m span.

Rio Platanar, 15m and 18m span.

Guapinol, 6m span.

Recommendations were also made for further preparatory work on profiles, alignments and cut and fill calculations for these sites.

Preliminary discussions with UNIDO appointee

It was fortunate, and extremely helpful to the project, that it was possible for UNIDO to arrange for Ing. J-C. Cano to make a short visit to Honduras at the same time that the TRADA engineers were completing the first project. Ing. Cano was present throughout the erection of the Yuscaran bridge, and visited the site of the new workshop. Recommended procedures for project development given as Appendix C, were agreed between Ing. Cano and TRADA.

CONCLUSIONS AND RECOMMENDATIONS

Four visits to the Republic of Honduras were made during this project, involving three members of TRADA's Engineering Department in overseas work. In addition, headquarters backup services were provided. These gave rise to a thorough review of the modular wooden bridge design originally described in DP/ID/SER.A/201; a draft set of manuals especially for Honduras; and a full set of working drawings for a prototype bridge.

This prototype was successfully launched at Yuscarán, Dept. El Paraiso, between 7 and 21 October 1982. Construction was a collaborative venture between SECOPT (Secretaría de Comunicaciones, Obras Públicas y Transporte) and HONDUTEL (Empresa Hondureña de Telecomunicaciones). TRADA would like to thank the directors and staff of these two organisations for their utmost co-operation at all times during the project, and especially for the hard work undertaken during the bridge launching. The friendliness and appreciation of the townspeople of Yuscaran was also noteworthy.

The difficulties encountered during the early stages of this project are not unusual and should not be allowed to deter a resolute team of advisors. The problems of weak counterpart support have already been mentioned, and it is hoped that the steps already being taken will be sufficient to overcome these.

Assistance was given to UNIDO in drawing up recommendations for project DA/HON/81/002 which resulted from a request for assistance following damage caused by tropical storm 'Aleta' to Choluteca District in May 1982. An outcome of this was the award of contract 82/75/MK, whose terms of reference may be regarded separately. From a practical point of view however, TRADA took advantage of this last visit for the old contract to lay plans for a new one, and in this respect, it was particularly useful to have Ing. Cano present in the field at the same time.

During the early stages of Mr. Cano's presence on a full-time basis in 1983, TRADA would recommend that he should attend immediately to the essentials of getting the new workshop operating, but he should hand the task of detailed commissioning back to Sra. Cuadra of SECOPT as quickly as possible. Ing. Cuadra's preliminary work has been very satisfactory and SECOPT have adequate facilities to commission the workshop, provided a UNIDO representative is on the spot to ensure liaison and to help to avoid delays. Once free of full concern for the workshop, Ing. Cano should concentrate on arranging for preparation and organisation of site work, concentrating on the Choluteca

District in the first instance. Lack of sufficient satisfactory and well-prepared sites is likely to hamper progress of the new project for some time to come unless there is considerable effort in this. Final decisions by SECOPT on sites, and work on full surveys, will obviously have to be discussed by Ing. Cano, Ing. Abadie, and others such as the Inter-American Development Bank (IDB) and INA officials.

The status of equipment and material requisitions was reviewed at the de-briefing meeting with Sra. Savarain and Mr. Hallett. TRADA would express the hope that these are progressing satisfactorily. Lack of new steel parts together with nuts and bolts, are likely to cause further delays unless these are now provided, whilst absence of properly installed woodworking machines, particularly the planer thicknesser, will delay the time at which the new workshop can produce efficiently engineered bridge components.

It is pointed out that according to the schedules and time-scale planned during the October 1982 visit and discussed at the subsequent de-briefing meeting with the SIDFA and Mr. Hallett, materials, machinery and transport should all now be available in Tegucigalpa.

An important concept in the original terms of reference, which were formulated after the first visit of Mr. Hallett, was the possibility of establishing one or more additional workshops in regions with a strong necessity for bridges.

The Consejo Superior de Planificación Económica (CONSUPLANE) indicated in its National Transport Sectoral objectives should include support for various socio-economic sectors; amongst others these include access roads for regions with prospects of improved agricultural production.

It was perhaps inevitable that the initial development of the project was in Tegucigalpa and that the first bridge workshop was located there. Had it been possible to foresee the emergency programme, it would have been better to locate the prototype workshop in Choluteca, the county town of the Department in which ten bridges were planned for the second phase of the project.

In future, for the integration of the national territory into a single political and socio-economic entity, thousands of small bridges for rural access roads will be required, and regional workshops should be planned which will enable this objective to be achieved on a self-help basis. This decentralisation of the workshops will have the further beneficial effect of stimulating regular employment in the rural areas.



APPENDIX A

Principal Honduran organisations and individuals
encountered in the project

Secretaría de Comunicaciones, Obras Publicas y
Transporte
(SECOPT)

Ing. Jack Arévalo - Vice Ministro
Ing. Roberto Abadie - Director, Planificacion Sectorial
Ing. Rodolfo García - Director General de Caminos
Ing. Alex Z. Bendeck - Former counterpart
Ing. Miguel Angel Matute - Dept. Direccion General de Caminos
Ing. Ismael Gutierrez - Counterpart, Erection
Ing. Francisco Cubas - Counterpart, Engineering
Ing. Benigna de Cuadra - Counterpart Workshop Manager
Sr. Miguel Hernández - Workshop Foreman

Corporación Hondureña de Desarrollo Forestal
(COHDEFOR)

Ing. Manuel Hernández Paz - Coordinator, External Aid

Forestal Industrial Agua Fría, S.A. de C.V.
(FIAFSA)

Dr. Julio E. Barahona - General Manager
Ing. Emil Pagoaga - Logging engineer

Canadian International Development Agency
(CIDA)

Mr. John Willson - Co-ordinator
Mr. John Roper - Advisor

Empresa Hondureña de Telecomunicaciones
(HONDUTEL)

Ing. Julio R. García - Head, Design Office, Civil Works
Ing. Eneique Rivera

Universitaria Nacional Autonoma de Honduras.
(UNAH)

Sr. Leonardo Raudales - Chief Technician, Civil Engineering
Department.

Banco Internacional Latino Americano Para el Desarrollo
(BID)

Ing. Francisco Navas,
Srta. Miroslava Errazuriz,
Ing. Rubio

Regional development and co-operative agencies:

CMDC

Lic. Elmer Enamorado - Vice Presidente

Arq. Mario Hepburn - Director de Planificación

Ing. Raúl Corona - Diseño de la Unidad Ejecutora

Sr. Wilfredo Andino - Unidad Ejecutora.

INA

Ing. Abodora Arriaga Iraeta - Director

Ing. Raul Mendizábal - Dept. Técnico

Ing. Fausto Gómez

Ing. Emyl Falk.

APPENDIX B

Project Reports and other relevant references

A comparative study of highway bridge loadings in different countries, P.K. Thomas, Transport and Road Research Laboratory of U.K., Supplementary Report 135 UC, 1975.

Technical Report: Low-cost modular prefabricated wooden bridges, J. E. Collins, UNIDO expert, DP/ID/SER.A/201, 19 October, 1978.

The Kenyan Low Cost Modular Timber Bridge. J. D. Parry, Transport and Road Research Laboratory of U.K., Lab. Report No. 970, 1981.

Initial visit concerning the development of Prefabricated Modular Wooden Bridges. Field visit 20 January - 4 February, 1981. C. J. Mettem, TRADA.

Technical Report: Proposed Assistance to the Development of Prefabricated Modular Wooden Bridges. R. M. Hallett, UNIDO, DP/ID/SER.A/285, 3 March, 1981.

Technical Report: Assistance to the Development of Prefabricated Modular Wooden Bridges, C. R. Francis, UNIDO expert, DP/ID/SER.A/307, 28 July, 1981.

Progress Report: Engineering field visit concerning the development of prefabricated Modular Wooden Bridges. 15 January - 28 January, 1982. P. Watt, TRADA.

Prefabricated Modular Wooden Bridges, Field Visit 22 June - 8 July 1982, based on field work of C.J. Mettem, TRADA.

Prefabricated Modular Wooden Bridges, Field Visit 5 October - 28 October, 1982. C. J. Mettem and H. J. Burgess, TRADA.

APPENDIX C

Recommended guidelines for further development of project management plans, agreed with Ing. J-C. Cano.1. Factors when drawing up schedules of bridge sites

These all require decisions both at administrative government and at technical government and aid agency levels; they are listed in approximate descending order of detail.

- a) Priority of area of site:
 - District,
 - Precise location.
- b) Importance of service provided by road using bridge.
- c) Capacity; frequency; tonnage and axle types of traffic.
- d) Accessibility of site; condition of road or scheduled improvement date.
- e) Availability of roadmaking equipment and labour for road and bridge.
- f) Nature of gap to be bridged- spans, profile of valley, depth of stream, flood levels; soil and rock types; cut and fill.
- g) Span, design capacity and number of bridge trusses likely to be required; special considerations regarding abutments, piers, approach spans.

2. Stages in management of a modular wooden bridge construction

- a) Take decision to locate bridge at a particular site and investigate use of the modular wooden bridge system.
- b) Prepare preliminary profiles using simple measuring equipment and standard transparent overlays and span tables, according to the TRADA recommendations.
- c) Perform general design process using standard tables etc. to estimate whether light or heavy chord design needed, number of trusses and panels required.

Consider any special launching difficulties.

- d) Reach final agreement with government and involved agencies on schedules for site and workshop activities and draw up in agreed form - e.g. as Gantt charts.
- e) Complete design; produce drawings of the particular bridge to supplement the standard drawings, if necessary.

Carry out design and detailing of abutments, piers, pier caps, approach spans if required.

Prepare any necessary non-standard details - e.g. for deck, parapet, changes due to development of the system.

- f) Liaise with workshop management on preparation of bills of materials, quantities, workshop orders, requisitions for panels, plates and loose bridge parts, timber for deck and superstructure, bolts, nails and other fastenings.

Requisition launching equipment and arrange for its secure storage on site, together with small tools for the construction work.

- g) Carry out erection and launching; complete bracing and superstructure; arrange final inspection of construction and provide for maintenance inspections; hand over.

3. Workshop management tasks

- a) Estimate volume of production for start-up:
 - i. Number of modules and loose parts.
 - ii. Quantities of fasteners and weights of nails.
 - iii. Check initial supply and fabrication of steel plates and chords.
 - iv. Timber quantities- revise supply arrangements; check on grading and preservation treatments and means of ensuring them.
- b) Review and finalise layout scheme for workshop, considering material and parts flows, assembly line. Locate machines and jigs, carrying out in priority order if not all available. Check provision of conveyors, stands, benches, storage bins. Arrange completion of power supplies.
- c) Complete commissioning of workshop and ancillary buildings- material and finished part stores, offices.
- d) Make recommendations for project development with special reference to workshop:
 - i. Training programme- programme content; training personnel; timetable.
 - ii. Materials management- purchasing procedures; requisitions; materials control; quality control.
 - iii. Maintenance management- plan maintenance and make provision for machinery repairs; sharpening service; cleaning, inspection and maintenance of erection equipment; inventory control.
 - iv. Production management- planning and scheduling; cost estimation and control; achievement of manufacturing quality and dimensions; liaison with materials control; inspection of production.

4. Site management tasks

a) Civil works and abutments:

- i. Investigate participation of local community and co-ordinate if required.
- ii. Participate in selection of contractors and site team, engineers, supervisors.
- iii. Complete surveys, produce final profiles, agree abutment and pier detail drawings.
- iv. Collaborate with contractors or construction team who are building abutments and piers, checking for correct engineering details throughout.

b) Prepare for erection and launching:

- i. Finalize launching method.
- ii. Prepare timetable.
- iii. List equipment and loose parts needed.
- iv. Liaise with workshop on supply of panels, chords, decking etc., agreeing delivery dates.

c) Logistics:

- i. Arrange transport for bridge parts, equipment and temporary materials.
- ii. Arrange secure storage on site for above.
- iii. Arrange any necessary diversions of river and/or road and clear stream bed and launching area of obstacles, fallen trees, rocks etc. if necessary.
- iv. Agree commencement dates for construction team, supervisor, labourers, carpenters.
- v. Obtain agreement in advance on overtime payment, banking and wage packet arrangements etc.
- vi. Arrange accomodation on site for engineers and supervisors and make daily transport arrangements for workers if required.
- vii. Canteens and latrines.

d) Launching:

Assembly and erection of launching equipment and assembly and launching of bridge should be under the direct control of a single, previously appointed supervisor. This should not normally be the site manager, design engineers or visiting experts, but an experienced road building or construction foreman who can give decisive orders and make quick decisions.



