WORKSHOP ON DESIGN OF CIVIL AND HYDRAULIC STRUCTURES FOR MICRO-HYDROPOWER PLANTS 20-24 November 1995*

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SOPAC Secretariat

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*held at the Forum Secretariat Headquarters
Suva

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INTRODUCTION

As part of the Energy Counselling Project the German government is providing to the South Pacific through its agency GTZ, a workshop was held at the Forum Secretariat on the design of civil and hydraulic structures for Micro-Hydropower (MHP) plants.

The course was presented by Hubert Hildebrand, a consultant from the firm, Fichtner, who have been assigned to the Energy Counselling Project. Thirteen participants from four countries (Solomon Islands, Vanuatu, Papua New Guinea and Fiji) attended the workshop. A list of participants is attached as Appendix 1.

MICRO HYDROPOWER

The term micro hydropower refers to the smallest generating units producing power utilising natural running water, generally in streams. Various definitions of the term 'small hydropower' and the sub-terms 'micro' and 'mini' are given in Figure 1.

The size of communities, particularly the more rural ones, and available catchment sizes in Pacific Islands countries is conducive to the use of micro hydropower schemes with a few minor exceptions on the larger islands such as Viti Levu in Fiji and Upolu in Western Samoa.

Country reports presented for the four nations represented indicated the availability of hydropower and the present level of development. The design and operation of micro hydropower schemes contain many elements, each of which can contribute to failure in terms of the plant not achieving its potential, and in the worst cases, failure to be commissioned.

The country reports also demonstrated the range of hydropower schemes operating in the South Pacific from a small 3.5 kW village lighting scheme in the Western Province of Solomon islands to the 72 MW Monasavu Hydro Scheme in Fiji.

The course, however, was confined to the designing of structures for the smallest range of hydropower schemes, several of which are being planned, designed or built at the present moment.

PROGRAMME AND WORKING ARRANGEMENTS

The workshop consisted of a general introduction to small hydropower utilisation, followed by a series of design calculations for the various components of a micro hydropower scheme. The general programme is attached as Appendix 2. These components were:-

- Intake structures
- Sandtraps
- Low dams and weirs
- Headrace Canals
- Forebays
- Penstocks
- Power Houses

For each component a series of options were presented, and a number of practical exercises set. As a final exercise, a number of examples were given of site details for which the participants were required to design all structures. These were taken from real life locations. A typical problem is shown on Figure 2.

It should be noted that the design calculations did not involve the civil engineering, (static), calculations or any geotechnical analysis.

The economics of microhydropower were considered where alternative dimensioning of a structure, or choice of materials were possible from the calculations and design options.

FIELD TRIP

A field trip was arranged for Friday 24 November to the Bukuya micro hydro power site. This is a project funded by an $8.5 million interest-free loan from the People's Republic of China for 4 projects.

The scheme is currently not operating because there are insufficient houses connected to the generation plant. Householders are unable to pay their contribution to the L.V. Line cost, the connection fee or the cost of house wiring.

COURSE EVALUATION

The course organises and presenters arranged a formal and informal evaluation of the course and of the needs for future workshops on the subject of microhydropower.

It was clear that the course had been well received and covered the areas of expertise required by many of the participants for future schemes or scheme proposals within country.

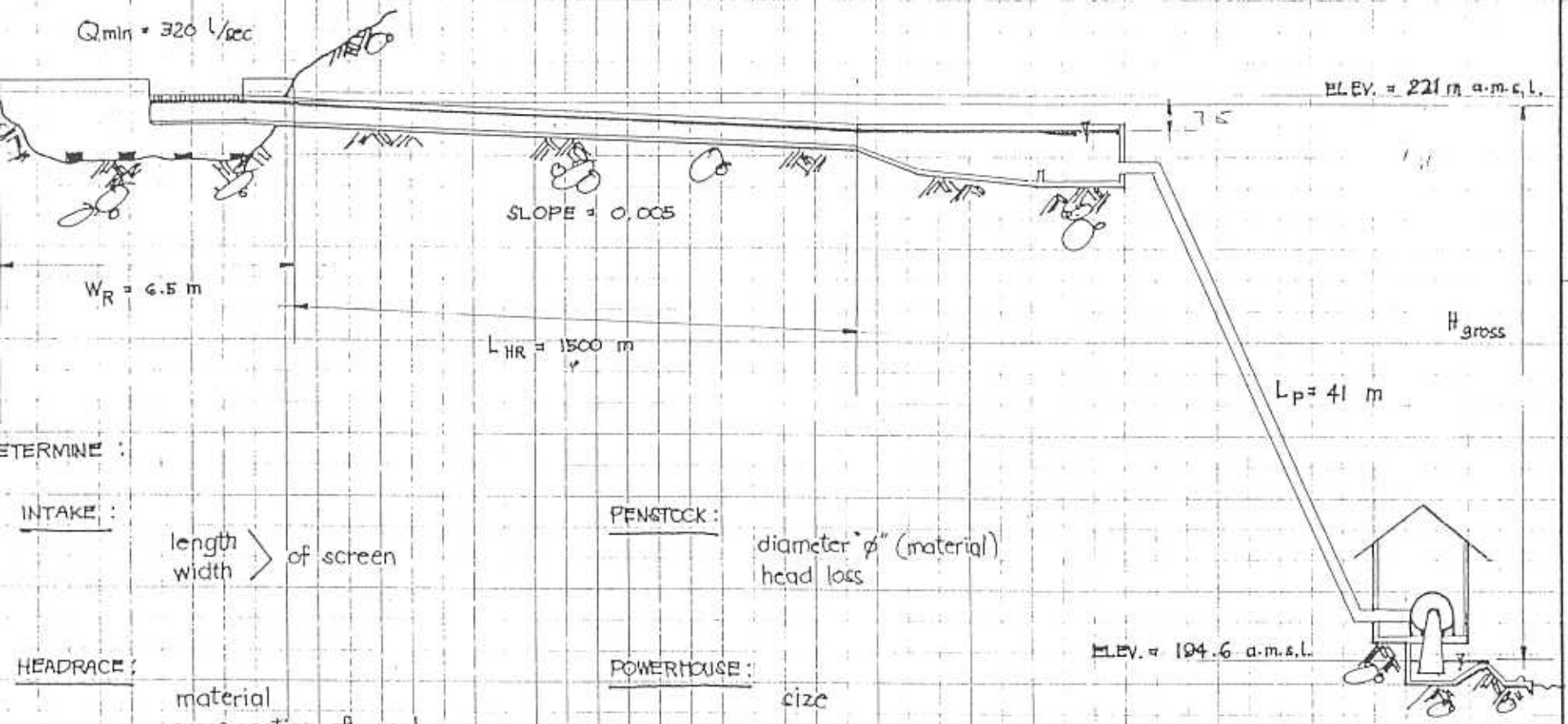
It should be noted that the Energy Counselling Project of GTZ includes assistance with establishing one micro hydropower station in both Vanuatu and the Solomon Islands. The 150kw Buala scheme in the island of San Cristobel in the Solomons is presently under construction and a scheme on the Ebau River on Efate, Vanuatu should commence construction in mid-1996.

From a SOPAC Water and Sanitation aspect, the involvement in this aspect of water use, for hydropower, the continuing links with the Energy Section of the Forum Secretariat, and the collaboration with member country staff, both known and previously unknown, were the major benefits.

The Course Manual is located in the Water and Sanitation Section for future reference.

Fig. 1 Different definitions of the term "small hydropower"

GROUP # 1



DETERMINE :

INTAKE :

length
width
of screen

PENSTOCK :

diameter "ϕ" (material)
head loss

HEADRACE :

material
cross section of canal
or low pressure pipe (head loss)

POWERHOUSE :

size

FOREBAY :

width
length
submergance
particle diameter to be removed = 0.5 mm
water level

FICHTNER

Projekt:
Auftrags-Nr.:
Bearbeiter:
Datum:
Blatt-Nr.:

FORUM SECRETARIAT

WORKSHOP ON DESIGN OF CIVIL & HYDRAULIC STRUCTURES FOR MICRO HYDROPOWER SCHEMES

Forum Secretariat Headquarters
Suva
20-24 November 1995

LIST OF PARTICIPANTS

FIJI

Mr Bipin Patel
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Civil Engineer
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VANUATU

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Rural Energy Officer
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FORUM SECRETARIAT

WORKSHOP ON DESIGN OF CIVIL AND HYDRAULIC STRUCTURES FOR MICRO-HYDROPOWER PLANTS

Forum Secretariat Headquarters , Suva
20-24 November 1995

PROGRAMME & WORKING ARRANGEMENTS

Course Presenter: Hubert Hilderbrand, Project Manager
GTZECP, FICHTNER

DAY ONE: Monday, 20 November (bus pick up from hotel 08.30)

Session I	09.15 - 09.30	Official Opening
	09.30-10.00	*Morning Tea*
Session II	10.00-10.15	Organisation Matters
	10.15-10.30	Introduction of Participants
	10.30-11.00	Introduction to and Overview of the Workshop
	11:00-12.30	Presentation of Country Papers by Workshop Participants
	12.30 - 13.30	*Lunch*
Session III	13.30 - 15.30	Presentation of Country Papers by Workshop Participants (continued)
	15.30 - 15.45	*Afternoon Tea*
Session IV	15.45 - 16.45	Introduction to Types and Classifications of Hydropower Stations (High head and low head developments; run-of river, reservoir and pumped storage plants; large, small, mini and micro schemes; general layouts of hydropower schemes)

DAY TWO: Tuesday, 21 November (bus pick up from hotel 08.15)

Session I	8:30 - 10:15	Civil and Hydraulic Structures of Micro-Hydropower Plants (Types of weir, intake, sandtrap, forebay, power house, water conveyance structures, considerations for site selection)
	10.15-10.45	*Morning Tea (Photograph)*
Session II	10:45 - 13:00	Hydraulic Calculations and Design of Hydraulic Structures (Calculation of flow in open channels: determination of channel gradient and cross section; calculation of flow in pipes; determination of pipe diameter and head loss; calculation of free flow in rivers; determination of discharge and water level in natural streams; examples of weir and intake design; examples of sandtrap and forebay design; example of penstock design; determination of hydraulic losses; entrance losses; screen losses).
	13.00-14.00	*Lunch*
Session III	14:00 - 15:15	Civil and Hydraulic Structures of Micro-Hydropower Plants (continued)
	15:15 -15.30	*Afternoon Tea*
Session IV	15.30-16.30	Hydraulic Calculations and Design of Hydraulic Structures (continued)

DAY THREE: Wednesday, 22 November (bus pick up from hotel at 08.15am)

Session I	8:30 - 10:15	Civil and Hydraulic Structures of Micro-Hydropower Plants (continued)
	10:15 - 10:30	*Morning Tea*
Session II	10.30 - 13.00	Hydraulic Calculations and Design of Hydraulic Structures (continued)
	13.00 - 14.00	*Lunch*
Session III	14.00-15.15	Civil and Hydraulic Structures of Micro-Hydropower Plants (continued)
	15.15-15.30	*Afternoon Tea*
Session IV	15.30-16.30	Hydraulic Calculations and Design of Hydraulic Structures (continued)

DAY FOUR: Thursday, 23 November (bus pick up from hotel at 08.15)

Session I	08.30-10.15	Civil and Hydraulic Structures of Micro-Hydropower Plants (conceptuallayout)
	10.15-10.30	*Morning Tea*
Session II	10.30-13.00	Hydraulic Calculations and Design of Hydraulic Structures (conceptual layout)
	13:00-14.00	*Lunch*
Session III	14.00-15.00	Review of the week: Comments from participants and General Discussion
	15.00-15.15	*AfternoonTea*
Session IV	15.15-16.15	Evaluation and Future Workshops
	16.15-16.30	Closing Ceremony and Presentation of Certificates
	19.00	Workshop Dinner (pick up 19.00 hrs, venue to be advised)

DAY FIVE: Friday, 24 November

Site visit to micro hydro power site at Bukuya