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Wood and bamboo in water conveyance

INTRODUCTION

Modern Water Engineers and Scientists have higher advanced and sound knowhow on the use of conventional materials e.g. plastics concrete - steel etc. in building water conveyance system. These materials are technically known and learned upto University level.

Some Developing countries are faced with severe scarce of local and foreign funds to meet their targets of implementing water supply and irrigation schemes due to explosive cost rise of construction materials upon which are often imported.

Wood and Bamboo forests are abudant and climatecaly many developing countries can grow these forests within a short time and become substitute to conventional materials.

The technology of Wood and Bamboo is appropriate Technology, cost saving and the use of local labour.

THE TECHNOLOGY OF BAMBOO PIPING MATERIAL

Bamboo pipes, are made out from bamboo stems which are cut from our forests. Bamboo is a tropical plant. These Bamboo are two types in Tanzania, Bambusa Vulgaris and Arundinaria Alpina. All growing between altitude 0-1500 metres and 1500 to over 2000 metres respectively. One nactre can contain about 5,000 bamboos and can fully mature after 4 years. The length of uniform section is about 4 metres. The inner tube varies in diameter for each stem of bamboo, size ranging from 38mm, 50mm, 63mm, 80mm, 100mm and 125mm recently some 250mm and 300mm bamboo have been reported grown in India, Burma and China respectively. The bamboo specie is Dondroca/amus giganters and Dendrocalamus sinicus.

Manufacture of Pipes. The bamboo pipe is made out by hollowing the internodes which are maturally pluged at interval of every 100cm and 50cm.

This drilling operations is done manually by special drilling tool of orga design attached to a long steel bar which operates half way and then turned the other side for the same. Bamboo pipes are reinforced by Galvanised wire about 3mm thick spaced about egery 50mm interval in a form of knot provides a cross sectional support for pressure sustain.

Pressure. Bamboo pipes have the following capacity:-

(a) Arundinaria Alupina non reinforced with wire outside spacing 5cm 1.5 atmospheres all working pressures.

(b) Bambusa Vulgaris non reinforced with wire 4.0 atmosphere. Reinforced with wire outside spacing 5 cm, 6.0 atmospheres, conventional plastic pipes class "B" its working pressure is 6.0 atmosphere. Bamboos pipes are sensitive to water hammer impact. The correct location of impacts are determined during first trial of running water in the pipe. In this portions stronger materials e.g. plastic are used.

Hydraulic 'Properties'. Discharge pressure measurements were conducted by the hydraulic laboratory, University of Dar es Salaam. The average value of Manning's (n) and Hazen - William's (c) roughness coefficient were determined and found to vary between 0.013 - 0.016 and 75 - 90 respectively.

The lower (n) value and the higher (c) value correspond to good node removal. For design purposes the Division adopts a value of (c) between 70-75. This is because presently pipes are not centrally precessed which makes control of quality unreliable. In future some bamboo pipes might be lined with tar inside which will improve the flow efficiency as well as might provide interior protection against decay.

Construction of Pipe Lines. In construction bamboo pipeline the following stages of activities are performed stage by stage:-

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(a) a four metre bamboo pipe are cut at the forest.

(b) They are transported to construction site and stored under running water. While the internode opened to enable bamboos sink in water as a pipe. This cleans the pipe from unpleasant smell (desapping) washing is done for six to eight weeks.

(c) Bamboo are reinforced with wire and ends shapened to adopt a polythene joint.

(d) Bamboo pipes are (dried seasoned for at least a week at air tight place to prevent craking followed with hot or cold tar coating to prevent rotting. For those pipes which requires copper sulphate treatment before tar coating bamboo pipes are first submerged in a pool of copper sulphate solution for number of weeks prior coating tar inside and outside.

(e) Bamboo pipes must be barried in the ground to prevent cracks and damage. Therefore excuvation of trenches of width 60 cm and depth 100 cm is required. Solution of aldrin and deildrin 0.5% is applied in the trench surface.

(f) Pipes are laid one after another joined by means of polythene (P.E) tube about 15 cm long by slightly warming the tube. The end of pipes are placed tight in the tube, as the pollythene cools it contracts and hardens to fit the bamboo pipes. The pipe are kept far away in contract with preservative by placing unpreserved soil around the pipe. The trench is finally backfilled. C.C.A. treated sawdust can be glued in the surface of bamboo to prevent termites attack as well. The use of insecticides is taken as a temporary solution only.

Life time. A well preserved bamboo pipe can last 10 to 20 years.

Fittings. All fittings e.g. Elbow - tees - Water points are made out of wood blocks.

Results of Operating Schemes. We have about 30 gravity operating schemes of which are performing well, after studing and resolving some of the problems encountered e.g. termites attack, fungi rot, material handling during construction of schemes. Solutions:-

(a) Termites problem has been resolved by soil treatment;

(b) Fungi rot has been resolved by providing constant water saturation, constant and intermitent chlorine application and tar coatings outside, also impregnation of copper sulphate in bamboo culm, followed with tar coatings outside and inside.

(c) Cracking of bamboo between forest to construction site and during construction this hage been resolved by protecting bamboos by submerging them under water, keeping them under shade and coating them with tar.

Some schemes have given constant water supply to the village population of each 2,500 people for a period of nine years and eight years respectively and are still functioning. The used preservative is tar coating outside and constant water saturation with intermintent chlorine dose to prevent fung rot and soil treatment (insecticide) for termites.

Some few schemes operated for five years only and failed. The treatment adopted was soil treatment (insecticide) against termite and constant water saturation inside the pipe. The tar was not applied on outer surface thereby making direct contact with ground.

Transportation System - This is done by lorries for long jorneys and hand carts at the village.

Maintanance of Operating Schemes. Daily maintanance work is done by two villagers selected among the villagers during construction time one seven ton lorry can carry three hundred bamboos which is enough for small pipe extension and maintanance in the village for five years, maximum burst repairs one pipe a month. Spare bamboos pipes are stored in river or sterilized water pond. They are kept safe against cracking and insect attack.

The village system is logged by a performance return sheet indicating monthly bursts, leaks, insects attacks and stock of spares and chlorine. The report is submitted to headquarters monthly for monitoring.

HEALTH ASPECTS

In nature bamboo used are non toxic materials. Fungis are prevented by water contact and chlorine destruction. Care is required when preservative are incorporated in the system. If insecticides is used to treat pipe line trenches all preservatives are fixed to the ground where there is no chemical movement. The pipes are kept far off from direct contant with preservative. The water quality is excellent. Water analysis conducted in Tanzania and Abroad had shown the acceptable water quality within "WHO" limits. The acceptable drinking water tar / Bituminous lining in the intirior of bamboo pipes is:-

(a) P.F. 4
(b) Aqualseal
(c) Bittuos. All are products of Great Britain.

ECONOMICS OF BAMBOO PIPES

The 63 mm diameter pipes are about 4 times cheaper to compare with local plastic pipes with the same diameter. The cost factor in determining bamboo economy is adoptability of suitable preservative, since this has been found the most dominant factor. According to independent STDA Evaluation Mission June 1983, on Wood/Bamboo Project in Tanzania, the cost of manufacture purchase, installation and transport per metre of 63mm bamboo pipe diameter is $2.3 while plastic is $5.1 with the same diameter. The bamboo pipe is assumed to have been treated with preservative copper chrome Arsenate.

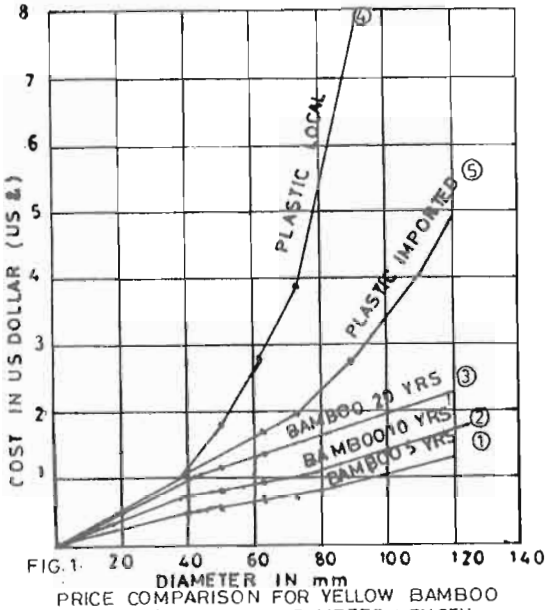

FIG. 1 PRICE COMPARISON FOR YELLOW BAMBOO AND PLASTIC PIPES PER METER LENGTH PRICE 1985

WOODEN PIPES AND TANKS

The present woodstave technology started developing in the United states of America in the 1860's. In Canada, Sweden and Norway this technology is still applied to day. Although Tanzania Wood/Bamboo division adopted this technology it has negertheless carried out investigations to ascertain actual carrying capacity for the locally manufactured staves and safety of water carried through or stored in woodstave structures treated with the toxic wood preservative C.C.A.

In Tanzania pine timber is mainly used as a result of its chemical retention. This technics in Tanzania has been succesful. Pipe lines up to 60 cm have been constructed and village water

tanks up to 45 m3 have been also constructed. All these schemes are operating very satisfactory.

Hydraulic Properties. According to Scobey (1976) the C - valve indetermining flow characteristic in wooden pipes is Hazen Williams formule C - Value 120. Also tests conducted at University of Dar es Salaam hydraulic Laboratory recommended the use of C - valves of Hazen William 70 to 115. The tested pipes were given laboratory approvel of 6 bar pressure carrying capacity.

Manufacture of pipes and tanks (Pipes sizes 5cm to 5m and tanks from 22.5m3 to 1,500m^3).

Timber staves are milled to the true Inner and outer circle of the true radius of the pipe to be made. Tongue and grooves are also milled aleng the edge.

The manufactured staves are preserved with water born preservatives e.g. C.C.A. (Copper Cromium Arsenate). This treatment guarantees the life span of about 30 years in ground contact. The water quality of preserved wooden materials is perfectly good. Water analysis was conducted in Tanzania and University of Delft Netherlands.

Construction of Pipe Lines. In building up the pipes continous stages are laid side by side, each stave is butted against the one immediately preceeding it. Thus making the stave contious without any joint in the pipe. Staves are held firmly on place by steel bands. Tanks are constructed similiary but in vertical way.

Economics of Wooden Pipes and tanks
Both pipes and tanks are cheaper to compare with conventional material e.g. steel and plastic pipes. In Tanzania a recently constructed Irrigation pipeline of 60cm diameter and 365 in length costed 420,000 TAS where as the same would have costed 630,000 TAS and 1,125,000 TAS had it been constructed of respectively concrete or steel.

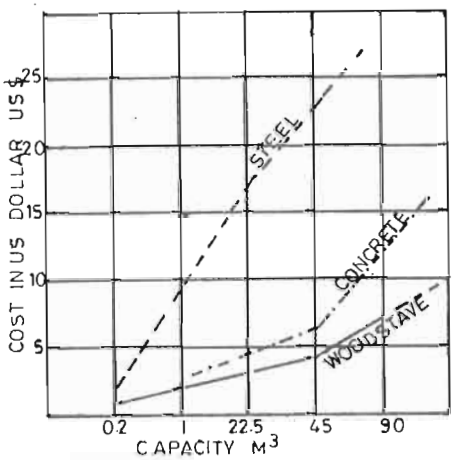

FIG. 1 CONSTRUCTION COST FOR GROUND LEVEL WATER TANKS

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