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## WATER AND SEWERAGE IN HOUSING DEVELOPMENT

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### INTRODUCTION

Water borne sewage disposal was initiated in Bulawayo in 1931. Prior to that date sanitary facilities had consisted of earth closets or a bucket system.

However it was not until 1956 that there was instituted a policy of providing all new high density housing with individual water connections and flush toilets. At that date there were 12 000 high density houses with communal water supplies and communal toilet blocks or individual aqua privies. In 1959 a programme was begun to provide all existing houses with individual water connections and flush toilets and this was virtually complete in 1982.

Between 1956 and 1975 an additional 17 000 high density houses or flats were built but with an estimated back log of housing in excess of 10 000 units it was decided in 1975 to speed up the housing programme and between 1975 and 1982 a further 24 000 houses have been built.

### WATER SUPPLY

All individual water connections are metered as this is considered necessary to avoid excessive use of water. Each household is entitled to either 9 or 14 m<sup>3</sup> per month depending on whether the occupier is a Council tenant or private owner and the cost of this allowance is included in the monthly rent or service charge respectively.

Additional consumption as recorded on the meter is charged for at the standard tariff.

Actual domestic consumptions range between 8 and 16 m<sup>3</sup> per month but mains are designed for an average use of 1 m<sup>3</sup>/day. (Total use averages 22 m<sup>3</sup> per house per month).

To limit the cost of meter installation water meters are fitted to an outside wall and general use is made of the Kent PSM water meter which has proved least liable to wilful damage.

### WATER MAINS

Water mains consist of asbestos cement Class 18 piping in diameters 50 mm and above which are manufactured to CAS 113 : 1974 and are supplied in 4 metre lengths. Below 50 mm diameter galvanised steel piping is used.

Pipes are laid on a bedding of 75 mm of decomposed granite or similar selected suitable material with a gap of 450 mm length left at each joint which is maintained until the pipelines have been successfully tested under pressure.

Jointing is generally by means of "Fluid - title" sleeve joints but cast iron short collar detachable joints are used for the installation of fittings. Pipes are laid with a cover of 900 mm but this is increased to 1 200 mm under roadways.

Backfilling to a height of 300 mm above the crown of the pipe is carried out with selected material placed in 100 mm layers and well and carefully rammed around the pipe. The remainder of the back filling is carried out in 300 mm layers with boulder free material. Where possible water mains are installed in a 2 m servitude at the rear of the stand with control valves fitted at convenient places. Fire hydrants of the standard screw down type pattern are installed only in the vicinity of important buildings such as schools. Connections are made by fitting a malleable iron saddle to the main and drilling and tapping for a 20 mm galvanised pipe to supply one house or a 25 mm pipe with branches to supply up to four houses.

### SEWERS

Sewers are designed for an average daily flow of 0,3 m<sup>3</sup>/house and a peak flow of 1,5 m<sup>3</sup>/house/day.

Sewer pipes of 100 mm and 150 mm diameter are manufactured of earthenware in accordance with C.A.S. A16/1973. Pipes are supplied in 1 m and 1,5 m lengths with lipseal rubber sleeve joints.

Sewer pipes of 225 mm diameter and above are manufactured of concrete made from dolomitic aggregate and a 12 mm thick sacrificial layer in accordance with C.A.S. No. A17. Pipes are supplied in 2,44 m lengths with rolling rubber ring O-joints.

#### LAYING OF SEWERS

Sewers are laid in a 2 m servitude at the rear of the stand and trenches are excavated to grade and level using profiles at manholes and to a depth 75 mm below the invert of the pipe.

Pipelaying is commenced from the lower end of the section and proceeds up hill with each socket being supported at its correct level on a heap of selected material sieved through a 25 mm screen.

Bedding is carried out immediately behind the pipelaying by filling beneath the barrel height with selected material thoroughly compacted by well ramming on either side of the pipe. When laying and bedding of the sections is completed it is tested by air. Thereafter the section is backfilled to a depth of 300 mm above the crown of the pipe with selected material placed in 100 mm layers and well and carefully, tamped around and over the pipe. The remainder of the backfilling is carried out in 300 mm layers with boulder free material after which the testing is repeated.

Sewers having less than 300 mm cover over the socket within stands and sewers having less than 900 mm cover in road ways are protected by encasing in concrete 100 mm thick.

#### MANHOLES

Manholes are located at 80 m maximum distance and at each junction and bend and are constructed of precast reinforced concrete rings manufactured to comply with C.A.S. A17/1973 for Class 'S' - Standard Reinforced Pipes. Rings are made in 610 and 305 mm lengths with ogee type joints.

Gradients are continuous through the manhole and a smooth flow is ensured by constructing the channels of half round earthenware supported by concrete benching.

Manholes are of 675 mm minimum diameter. Within stands covers are of precast reinforced concrete but in roadways cast iron covers and frames are used.

#### SEWER CONNECTIONS

Connections are made to junction pipes installed when the sewer is laid. Both the outlet from the lavatory pan, through an 'S' trap, and the gulley which receives the discharge from the kitchen sink and the shower drain are connected by 100 mm diameter, earthenware piping in which an inspection eye is installed. A vent pipe is fitted to the connection at the last house at the head of each sewer branch line.

#### MATERIALS

Asbestos cement water pipes are manufactured in Bulawayo using locally produced asbestos fibre and cement.

Earthenware pipes are manufactured in Bulawayo using locally excavated clay.

Concrete pipes are manufactured in Bulawayo using locally produced dolomite and cement.

Rubber rings for pipe joints are manufactured in Bulawayo but imported rubber is used.

#### SEWAGE PUMPING STATIONS

An undesirable feature of recent high density housing schemes has been the need for reasons of topography to provide a considerable number of sewage pumping stations - approximately one station for every 1 500 houses. These have been constructed mainly to avoid expensive outfalls and although they add only \$20,00 approximately per stand to the costs of sewerage they are not favoured as the pumping machinery has to be imported and they are subject to breakdown due to mechanical or electrical faults with the subsequent nuisance of sewage overspill.

To keep down costs the design has been standardised using electrically driven submersible pumps with screening, balancing chamber and pumps in duplicate. The rising main is constructed of asbestos cement piping and terminates in a velocity reducing chamber.

#### COSTS

Experience showed that the greatest opportunity for saving in the cost of services existed in the cost of installing sewers and ways were investigated of making savings on this item. The following measures have been adopted in consequence :-

1. Manholes at the head of sewers have been replaced by rodding ways.
2. Depth of sewers were reduced to a minimum of 800 mm.
3. 100 mm diameter pipes were used at the head of sewers for the first 50 houses.
4. Gradients were reduced to a minimum of 1 in 100 for 100 mm pipes and of 1 in 200 for 150 mm pipes.
5. Manholes were reduced to 675 mm diameter and step irons eliminated.
6. Cast iron covers for manholes within stands were replaced by precast concrete covers.

As a result of these economies the latest cost of providing sewerage for a house on a 200 m<sup>2</sup> stand is \$210 per stand.

#### IMPROVING EXISTING HOUSES

In many cases where houses had been provided with aqua privies their replacement eventually became a necessity.

The ground on which they were built was not permeable and through time the water table rose to the extent that the houses were surrounded by springs of sewage effluent. When eventually excavation for the installation of sewers was carried out it was under the most unpleasant conditions.

Initially it was intended to retain the privy structures and dispose of the liquid only via the sewers but the residents complained and new detached toilets were built.

Communal toilet blocks were generally unsatisfactory. Cleanliness was difficult to maintain particularly as the toilets served as public conveniences. Also their use at night was hazardous and many legitimate users were assaulted.

Water consumption was high as automatic flushing devices operated day and night and manual flushing cisterns were repeatedly vandalised.

Individual detached toilets are still being built and one doubts the mentality of the architect who designs an outside toilet with shower facilities and no changing room.

Communal water supplies through a stand pipe with a "waste - not" self closing tap were unpopular.

Apart from disputes over priority in queuing, water had to be carried in containers and most householders were unable to carry out cultivation around their properties.

However some enterprising people who lived near the standpipe devised irrigation schemes by tying back the handle of the tap and delivering through a hose to their property.

An individual water supply including water meter costs \$50 and for the benefits derived therefrom not least the beautification of the housing surrounds by the cultivation of fruit trees etc. it is a worth while expenditure.

#### SEWAGE TREATMENT WORKS

Three types of sewage treatment works have been constructed and are in operation in Bulawayo - oxidation ponds, biological filtration plants and more recently extended aeration activated sludge plants. From a capital cost point of view oxidation ponds are the ideal solution for the treatment of sewage if plenty of ground is available for their location and construction. We have had the unfortunate experience that a works which was built in isolation in 1963 was surrounded by housing in 1978/1979 and is now a subject of complaint when it malfunctions.

The biological filtration plants produce a good quality effluent and cause little nuisance. The effluent does not meet pollution control regulations standards for river discharge in respect of nitrogen and phosphorus but it is used for irrigation of pastures and crop lands and with tertiary treatment for the irrigation of sportsfields and public openspaces.

Our first extended aeration activated sludge plant was completed in August 1982, so there is little experience of its operation but it is hoped that it will produce an effluent fit for river discharge.

Following the gazetting of the Water (Effluent and Waste Water Standards) Regulations 1977 the Ministry of Water Development issued a publication "Guidelines for the disposal of sewage and sewage effluent during wet weather".

Regrettably most engineers responsible for sewage disposal in Zimbabwe took fright at these regulations and considered that the only way to comply was to construct "extended aeration activated sludge plants".

These works are very expensive to construct, have a very high import content and require skilled and sophisticated operation.

The unfortunate position has now been reached where such a works is to be built at a growth point in the communal areas where space is no problem and the nitrogen and phosphorus removed from the effluent could be used profitably in farming

operations. The effluent may yet be used for irrigation but the nitrogen wasted to atmosphere will have to be replaced by expensive fertiliser probably imported.