DESIGN OF A WATER DISTRIBUTION SYSTEM FOR PROPOSED BDC
HOUSING DEVELOPMENT SCHEME AT BLOCK 8 KLAUH LAND
DISTRICT, SRI AMAN DIVISION

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A proposed design project report submitted in partial fulfillment for
Degree of Bachelor of Engineering (Hons) Civil Engineering in
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1999/2000
Dedicated to my Beloved Family and Friends

Thanks for everything...
ACKNOWLEDGEMENT

The student wishes to express her highest gratitude and thanks to her lecturer and supervisor Dr. Nabil Bessaih, for the project. He had guided and helped the student a lot throughout the project and provided many useful advice and suggestions. Special thanks to PU Engineering Sdn. Bhd., especially to Mr. Monirul Islam, for giving a chance to the student to do a design on that project. The engineer of PU Engineering Sdn. Bhd., Cik Sharifah Raha bte Wan Abdul Rahman for assistance in providing information, advice and materials needed for the project.

Gracie Chong Shih Chin
ABSTRACT

Water affects the life of every human on Earth. A water distribution system is needed to transport water from a source to a user. Therefore, the system has to be designed to consistently provide water in sufficient quantity to users at an acceptable pressure as economically as possible. This dissertation is about the design of the system for the proposed BDC Housing Development Scheme at Block 8 Kluah Land District, Sri Aman Division. The design is based on Malaysia Jabatan Kerja Raya (JKR) Standards, which was adapted to MWA Design Guidelines for Water Supply Systems. The size and type of pipes were determined to meet the requirement of the Standards. The WaterCAD software that developed by Haestad Method Inc. was used to perform the analysis of the system. Several demand scenarios were analyzed for the system such as average daily demand, peak hour demand and critical demand at junction.
ABSTRAK

Air mempunyai peranan yang sangat penting di dalam kehidupan manusia. Untuk membeikan air kepada pengguna-pengguna, satu sistem pembekalan air yang ekonomi dan sesuai dengan jumlah kuantiti yang mencukupi dan tekanan yang memenuhi syarat perlu direkabentukkan. Tesis ini menerangkan proses rekabentuk sistem pembekalan air bagi projek "BDC Housing Development Scheme at Block 8 Klauh Land District, Sri Aman Division." Rekabentuk tersebut berdasarkan syarat-syarat atau paduan-padaun Jabatan Kerja Raya Malaysia (JKR). Saiz dan jenis-jenis paip yang perlu digunakan dipilih berdasarkan peraturan-peraturan JKR tersebut. Perisian WaterCAD yang dihakcipta oleh Haestad Method Inc. di Amerika Syarikat digunakan untuk menganalisis rekabentuk system tersebut. Keputusan analisis boleh diperolehi daripada perisian ini dalam tiga jenis senario iaitu keperluan harian purata, kegunaan puncak sehari dan perminataan genting dengan system pencegahan bakaran.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPROVAL SHEET</td>
<td>i</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>iii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>v</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>x</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>xii</td>
</tr>
</tbody>
</table>

## CHAPTER 1: INTRODUCTION

1.1 Project Background

1.2 Shopping and Housing Area

1.3 Objective

## CHAPTER 2: WATER SUPPLY SYSTEM

2.1 Introduction

2.2 Design Procedures

2.3 The source of supply

2.4 Estimation of Housing Units

2.5 Water Demand
CHAPTER 3: WATER DISTRIBUTION SYSTEM

3.1 Introduction 13

3.2 Type of distribution system 13

3.3 Reticulation pipeline design 14

3.4 Pipes 15

3.4.1 Pipe materials 15

3.4.2 Pipe diameter selection 22

3.5 Recommended residual pressure 24

3.6 Flow velocity 25

3.7 Demand fluctuation 25

3.8 Head loss calculation 25

3.8.1 Major friction losses 25
3.8.2 Minor friction losses
3.9 Reticulation network
3.10 Valves and Fittings

CHAPTER 4: METHOD OF ANALYSIS

4.1 Introduction of WaterCAD
4.2 Types of analysis
4.2.1 Steady state analysis
4.2.2 Extended period analysis
4.3 Input Data
4.4 Result of Analysis

Case 1: Average daily demand
Case 2: Peak Consumption
Case 3: Critical Demand at Junction J-2
Case 3: Critical Demand at Junction J-6
Case 3: Critical Demand at Junction J-7
Case 3: Critical Demand at Junction J-8
Case 3: Critical Demand at Junction J-9
Case 3: Critical Demand at Junction J-10
Case 3: Critical Demand at Junction J-11
Case 3: Critical Demand at Junction J-12
Case 3: Critical Demand at Junction J-13
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Fire Flow Requirement (Table 14.18 – JKR Standards)</td>
<td>9</td>
</tr>
<tr>
<td>3.1</td>
<td>Principal advantages and limitations of selected water supply pipe materials (Table 14.2 – JKR Standards)</td>
<td>15</td>
</tr>
<tr>
<td>3.2</td>
<td>Pipes and their recommended use (Table 14.10 – JKR Standards)</td>
<td>20</td>
</tr>
<tr>
<td>3.3</td>
<td>Maximum permissible working pressure for DI pipe (Table 14.9 – JKR Standards)</td>
<td>21</td>
</tr>
<tr>
<td>3.4</td>
<td>Recommended maximum working pressure for HDPE pipes</td>
<td>22</td>
</tr>
<tr>
<td>3.5</td>
<td>Thickness and diameter of ductile iron (DI) pipe (Table 14.4 – JKR Standards)</td>
<td>23</td>
</tr>
<tr>
<td>3.6</td>
<td>Roughness values and coefficients (Table 14.14 – JKR Standards)</td>
<td>26</td>
</tr>
<tr>
<td>3.7</td>
<td>Minor pipeline losses (Table 14.15 – JKR Standards)</td>
<td>27</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Site layout plan</td>
<td>3</td>
</tr>
<tr>
<td>3.1</td>
<td>Gravity system</td>
<td>14</td>
</tr>
<tr>
<td>3.2</td>
<td>Reticulation network</td>
<td>29</td>
</tr>
<tr>
<td>4.1</td>
<td>Layout of the reticulation network in WaterCad</td>
<td>33</td>
</tr>
</tbody>
</table>
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Pressure head of Existing Water Main</td>
<td>69</td>
</tr>
<tr>
<td>B</td>
<td>Diameter and wall thickness of PE80</td>
<td>70</td>
</tr>
<tr>
<td>C</td>
<td>Survey Plan</td>
<td>71</td>
</tr>
</tbody>
</table>
CHAPTER 1: INTRODUCTION

1.1 PROJECT BACKGROUND

This is a design project of a water distribution system for BDC Housing Development Scheme at Sri Aman Division. The project consists of a shopping area and a housing area.

The parties involved in the project are:

**Client:** Borneo Development Corporation (Sarawak) Sdn. Bhd.
Top Floor, Electra House, Power Street, P.O. Box 342, 93704 Kuching.

**C & S Engineer:** PU Engineering Sdn. Bhd.
Civil & Structural Consulting Engineers
Lot 349 & 350, 1st & 2nd Floor, Rubber Road,
P.O. Box B39, 93860 Kuching.

1.2 SHOPPING AND HOUSING AREA

The project consists of the following buildings: - (Figure 1.1)

a) 10 units of one storey shop houses
b) 52 units of double storey shop houses
c) 262 units of low cost houses
d) 64 units of double storey terrace houses
1.3 **OBJECTIVE**

The objective of this project is to design a suitable and economical water distribution system for the project that delivers water to consumers in the area in the required quantity and under a satisfactory pressure. The design is based on JKR Sarawak Standards and Malaysia Jabatan Kerja Raya (JKR) Standards, which was adapted to MWA Design Guidelines for Water Supply Systems.
Figure 1.1: Site layout plan
2.1 INTRODUCTION

A water supply system is designed to deliver water to the consumers with appropriate quantity and pressure. The elements that make up water supply system include:

a) The sources of supply
b) Storage facilities
c) Transmission (to treatment) facilities
d) Treatment facilities
e) Transmission (from treatment) and intermediate storage facilities (to service area)
f) Distribution facilities

In this project, the distribution facilities are designed and analyzed.

2.2 DESIGN PROCEDURES

The procedures used in the design of water supply system for the proposed project are as follows:

a) Source of supply

In the project, the water is supplied by a tapping off point from the water main that lay along the main road, which is Jalan Serian Simanggang.
b) Calculate the number of type of housing units

- The number of type of housing unit set out in the estate site layout plan is used to estimate the water demand.

c) Water demand

- The basic formula for water demand estimation for housing estates is obtained in the Malaysian JKR Standards.
- The value is giving the water demand for one day.

d) Water distribution and reticulation network

- The water distribution network is designed based on the site layout plan. Most of the pipes are laid adjacent to roads so as provide easy access for maintenance, and dead ends shall be avoided.

e) Detail information for the distribution network

- Some of the detail information for the network can be obtained in the Malaysian JKR Standards such as pipes material, classification and type of pipes, joints, fittings, valves, pipe diameter selection, design factors in pipe sizing and fire flow requirement.

f) Methodology for the network analysis

- The network will be analyzed by using computer software *WaterCAD* that developed by Haestad Methods Inc. (USA).

The analysis will be done for three different demand scenarios
to check the adequacy of the system for these three different conditions. The three demand scenarios are as below:

1. Average daily demand
2. Peak hour demand
3. Critical demand.

### 2.3 THE SOURCE OF SUPPLY

The water main lay along Jalan Serian Simanggang with 29.97m level is the sources of water supply for the project. From the test data that obtained from Sri Aman Water Board (Appendix A), the minimum available pressure head of the existing water main is 32 m.

### 2.4 ESTIMATION OF HOUSING UNITS

From the site layout plan, the number and type of housing units is set out, and for designing purposes, the following water demand or per unit consumption have been agreed to as being reasonable by all the State Water Authorities in Malaysia:

- **Low Cost Houses** - 910 liters/unit/day
- **Single storey terrace houses** - 1360 liters/unit/day
- **Semi-detached/double storey terrace houses** - 1590 liters/unit/day
- **Shop houses (2 storey)** - 2730 liters/unit/day
- **Shop houses (3 storey)** - 4090 liters/unit/day
- **Shop houses (4 storey)** - 4550 liters/unit/day
- **Bungalows/shop houses (single storey)** - 2270 liters/unit/day
2.5 WATER DEMAND

Water demand is the total amount of water needed by the consumers in the area of their needs and activities in a specified period of time. The amount of water demand varies from season to season, day to day and hour to hour, depending on climate, topographic, characteristics of the environmental concern, population, industrialization and other factors.

2.5.1 WATER DEMAND ESTIMATION

Based on Malaysian JKR Standards, the water demand formula for housing estate is as follows:

\[ W = \sum (N \times C) \times F + D_a \]

Where:
- \( W \) = Average daily water demand
- \( N \) = Number of type of house
- \( C \) = Per unit consumption
- \( F \) = Service factor
- \( D_a \) = Additional water demand

2.5.2 SERVICE FACTOR

The service factor is the potential percentage of population served. For instance, the water distribution system cover 90% of the area will give a service factor equal to 0.90, but it does not necessarily mean that 90% of the populations in the area have service connections. Service factor vary from state to state and also district to district. For the project, service
factor of 1.0 is used means that water is supplied to all the houses/buildings.

2.5.3 PROVISIONAL FOR ADDITIONAL WATER DEMAND

With reference to Malaysian JKR Standards, the additional water shall be providing for new developments such as industrial estate, resettlement scheme or a new town or housing developments. For this project, as the number of type of housing units is calculated for the future developments, thus there are no additional demand required. However, fire flow requirement must be considered for the design purpose. Refer to Table 2.1 that outline in the JKR Standards as Table 14.18, the recommended risk category of fire flow requirement is Class D with average total flow 1140 liter/min and the maximum number of hydrant outlets used simultaneously is one unit. Moreover, The JKR Sarawak Standards recommends that the water of fire flow requirement is discharge in 50 minutes duration with average flow 15 liter/second.
<table>
<thead>
<tr>
<th>Class</th>
<th>Average Total Flow (l/min)</th>
<th>Spanning (m)</th>
<th>Maximum No. Of Hydrant Outlets Used Simultaneously</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A Risk</td>
<td>4100</td>
<td>90</td>
<td>3 @ 1370 l/min</td>
</tr>
<tr>
<td>Large buildings, shopping complexes, high-rise buildings, large industrial estates, warehouse and ports.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class B Risk</td>
<td>2700</td>
<td>90</td>
<td>2 @ 1370 l/min</td>
</tr>
<tr>
<td>Congested areas with buildings up to 5 storey</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class C Risk</td>
<td>1370</td>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>Shop house up to 3 storey, light industry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class D Risk</td>
<td>1140</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td>Residential terrace house, detached, semi detached.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class E Risk</td>
<td>680</td>
<td>180</td>
<td>1</td>
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<tr>
<td>Others</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
2.5.4 WATER DEMAND CALCULATION

The calculation of water demand without providing any fire demand based on the formula above is as follows:

<table>
<thead>
<tr>
<th>Type of Houses</th>
<th>Per unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit</td>
<td>consumption liters/unit/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low cost houses</td>
<td>262</td>
<td>910</td>
</tr>
<tr>
<td>Double storey terrace houses</td>
<td>64</td>
<td>1590</td>
</tr>
<tr>
<td>Semi-detached houses</td>
<td>22</td>
<td>1590</td>
</tr>
<tr>
<td>Detached houses</td>
<td>5</td>
<td>2270</td>
</tr>
<tr>
<td>Single storey shop houses</td>
<td>10</td>
<td>2270</td>
</tr>
<tr>
<td>Double storey shop houses</td>
<td>52</td>
<td>2730</td>
</tr>
<tr>
<td>Petrol station</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>Surau</td>
<td>1</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Total water demand without additional water demand (liters/day) 556,670

2.5.5 TOTAL WATER DEMAND WITH ADDITIONAL DEMAND

The total water demand that shall be supplied is as follows:

\[
\text{Total Water demand} = \text{Water demand in housing estate} + \text{Fire flow requirement}
\]

\[
= 556,670 \text{ l/day} + (15 \text{ l/s} \times 60\text{s/min} \times 50 \text{ min/day})
\]

\[
= 556,670 \text{ l/day} + 45,000 \text{ l/day}
\]

\[
= 601,670 \text{ l/day}
\]