DESIGN OF A WATER DISTRIBUTION SYSTEM FOR GEDONG RURAL GROWTH CENTER

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Universiti Malaysia Sarawak
2000

Universiti Malaysia Sarawak
Kota Samarahan

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BORANG PENYERAHAN TESIS

Judul: Design of a Water Distribution System for Gedong Rural Growth Centre

SESI PENGAJIAN: 1997 - 2000

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(HURUF BESAR)

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Form of Acceptance

This project entitled "Design of a Water Distribution System for Gedong Rural Growth Center" was written by Nirlawina Binti Mohamad Lazim as a partial fulfillment for degree of Bachelor of Engineering (Hons) Civil Engineering in Unimas is accepted and certified by:

.....

Dr. Nabil Bessaih

(Project Supervisor)

22.05.2005

.....

Date

DESIGN OF A WATER DISTRIBUTION SYSTEM FOR GEDONG RURAL ROWTH CENTER

NIRLAWINA BT. MOHAMAD LAZIM

A proposed design project report in partial fulfillment for degree of Bachelor of Engineering (Hons) Civil Engineering in University of Malaysia Sarawak

Universiti Malaysia Sarawak
2000

To my beloved:

Mom & Dad

ACKNOWLEDGEMENT

I would like to express my grateful to Allah S.W.T. and to Prophet Muhammad S.A.W. for entire blessing all my life. A deepest appreciation to my project supervisor Dr. Nabil Bessaih for the inspiring guidance and encouragement towards completing my final year project. Special thanks to Mr. Hiew Si Tien, for giving the chance to author to do a design and practical recommendations for this project.

I owe a dept of gratitude to my beloved family especially to my father, En. Mohd Lazim b. Abdul, my mom, Pn. Zainab b. Man, my sisters and brothers, Kak, Abang Sham, Kak Ja, Abang Anuar, Boy and Jijie, for their support and spirit.

I am especially grateful to Roslee b. Haris due to his support throughout the duration of project. Last but not least, thanks to all my friends especially to Odie, Gee, Nida, Aida and Norma who always give a hand toward this project.

Nirlawina bt. Mohamad Lazim

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Abstract

Human need water to survive. Therefore, a good planning a water distribution is very important to cater a sufficient quantity quality and pressure to consumers. The distribution consists of gridiron pattern of water mains to deliver water for domestic, commercial, industrial and fire fighting purposes. This dissertation describes the design of a water distribution system for Gedong Rural Growth Centre using waterCAD. The procedures of design are based on Malaysia JKR Standard, Design Criteria and Standard for Water Supply System (1989). In the analysis, three different demand scenarios such as average daily demand, peak demand and critical demand were analyzed in order to see the variation of flow rate and residual pressure. The pipe sizes and elevation of high level tank were setup to meet the requirements of JKR Standard.

Abstrak

Air merupakan salah satu unsur yang penting dalam kehidupan manusia. Pelbagai pendekatan telah digunakan bagi mendapatkan sumber bekalan air untuk kegunaan harian. Fungsi sistem pengagihan air yang utama ialah menyalurkan air bagi keperluan domestik, komersial, industri dan simpanan bagi mengawal kebakaran dan sebagainya. Buku ini memaparkan rekabentuk sistem pembekalan air bagi Pusat Pembangunan Luar Bandar Gedong (Gedong Rural Growth Centre). Rekabentuk sistem ini dianalisa berdasarkan kepada Standard JKR Malaysia (1989). Dalam analisis ini, beberapa jenis keperluan dianalisa seperti purata keperluan harian, keperluan kemuncak dan keperluan kritikal untuk mengetahui kelajuan aliran dan perbezaan tekanan yang dihasilkan. Saiz paip dan ketinggian tangki diselaraskan dan ditetapkan bagi memenuhi standard JKR.

CHAPTER 1

INTRODUCTION

1.1 OBJECTIVE

The objective of this project is to design a water distribution system, which delivers water within the demand area to consumers for Proposed Gedong Rural Growth Center, Sarawak in required quality and quantity and under satisfactory pressure.

1.2 PROJECT BACKGROUND

The proposed Gedung Rural Growth Centre is a project by *'Jabatan Pengairan dan Saliran'* Kuching, Sarawak.

The parties involved in this project are:

Client: JABATAN PENGAIRAN DAN SALIRAN
9th & 10th Floor,
Wisma Saberkas,
Tun Abang Haji Openg Street,
Kuching, Sarawak.

Contractor:	PPES WORK (SARAWAK) SDN. BHD. 1st Floor, Lot 61S-C23, Section 42, Jalan Padungan, 93100 Kuching, Sarawak.
Consultant Engineer	:PERUNDING JHL Civil & Structural Consulting Engineers, Project Management Consultants, 2nd Floor, Lot 284, Section 9, KTLD, Rubber Road, 94300 Kuching, Sarawak.

1.3 BUILDING FACILITIES

The building and facilities provided in this scheme are:

- Government quarters
- Government office
- Community Hall
- Existing resettlement scheme

CHAPTER 2

WATER SUPPLY SYSTEM

2.1 GENERAL

The purpose of water supply system is to deliver water to consumers with appropriate quality, quantity and pressure. The setting requires an extensive system of pipes, storage reservoirs and tanks, pumps and related appurtenances. A water supply system is composed of:

I. The source of water supply

II. Storage facilities

III. Treatment facilities

IV. Transmission (from treatment) and intermediate storage facilities

V. Distribution facilities

This project is only about the design of storage facilities and also the distribution facilities. Those facilities are used to distribute water to individual consumers connected to the system.

2.2 DESIGN PROCEDURES

The procedure used in the design of water distribution system for the proposed Gedong Rural Growth Center is:

I. Population estimate.

- The population estimate is from layout plan, and the project brief to determine the number of people based on the appropriate area.
- From that, the population in each area is added up to get the overall population

II. Water demand.

- The water demand is obtained by using the formula given in MWA Design Guidelines.
- The value obtained represented the capacity of a day storage tank.

III. Water demand to each service area.

- The water demand to each service area is estimated. This is the various amount of water needed by each service area.

IV. Water reticulation network.

- Water reticulation network is designed based on the layout plan. The pipes are mostly placed by the roadside.

V. Detailed information for the reticulation network

- Storage tanks, pump, pipe length & diameter, type of pipe, valve and location of fire hydrants.

VI. Design analysis.

- Flow in the network is analyzed with the software WaterCAD develop by Heastad Method to check the adequacy of the system under various demand scenarios. Analysis is made for three difference cases:

  i. Average Daily Demand.

  ii. Peak Hour Demand.

  iii. Critical Demand.

2.3 INTAKE POPULATION

The total population for the Gedong Rural Growth Center is 4347 persons. Each of the service area is estimated by calculating the area and multiplies with typical population densities from table 2.1 below.

Table 2.1 Typical Population Densities.
(.Linsley R.K & et al, 1992)

Type Of Area	Population Densities	
	Persons/Acre	Persons/Hectare
Residential		
• Single-family dwellings	5 – 30	12 – 75
• Multiple-family dwellings	30 – 100	75 – 250
• Apartments	100 – 1000	250 - 2500
Commercial	15 – 30	40 –75
Industrial	5 - 15	12 – 40

Table 2.1 showed the typical population densities which are not stated in the JKR Standard.

For the government office and community hall population densities are taken as 60 persons/hectare consider under commercial which persons/hectare between 40-70. For government quarters and existing resettlement scheme are fall under category single-family dwellings and persons/hectare are between 12-75. So for government quarters the population densities are taken as 60 persons/hectare.

Table 2.2: Intake Population

Junction	Service Area	Area (Ha)	Population/ Capacity (Service Area X 60)
J1	Government Quarters	1.4245	250
J2	Government Quarters & Existing Resettlement Scheme	3.0433	250
J3	Existing Resettlement Scheme	4.2169	65
J4	Existing Resettlement Scheme	2.1611	69
J5	Existing Resettlement Scheme	1.1858	129
J6	Existing Resettlement Scheme	4.8362	79
J7	Existing Resettlement Scheme	4.1644	86
J8	Existing Resettlement Scheme	4.1644	183
J9	Community Hall & Existing Resettlement Scheme	1.0846	253
J10	Community Hall & Existing Resettlement Scheme	1.1493	71
J11	Government Quarters	2.1409	290
J12	Government Quarters	1.3153	
J13	Government Office & Government Quarters	3.5533	214
J14	Government Office & Government Quarters	5.1478	309
J15	Government Office & Existing Resettlement Scheme	4.2898	257
J16	Existing Resettlement Scheme	2.7722	166
J17	Existing Resettlement Scheme	2.6832	161
J18	Existing Resettlement Scheme	1.4569	88
J19	Existing Resettlement Scheme	1.8819	113
J20	Existing Resettlement Scheme	1.6674	100
J21	Government Office & Existing Resettlement Scheme	2.5253	152
J22	Government Office & Existing Resettlement Scheme	2.3351	140
J23	Government Office & Existing Resettlement Scheme	2.9422	177
J24	Government Office & Existing Resettlement Scheme	4.7349	284
J25	Community Hall & Government Quarters	2.7317	164
J26	Community Hall & Government Quarters	2.7924	167

Total Population = 4347 person

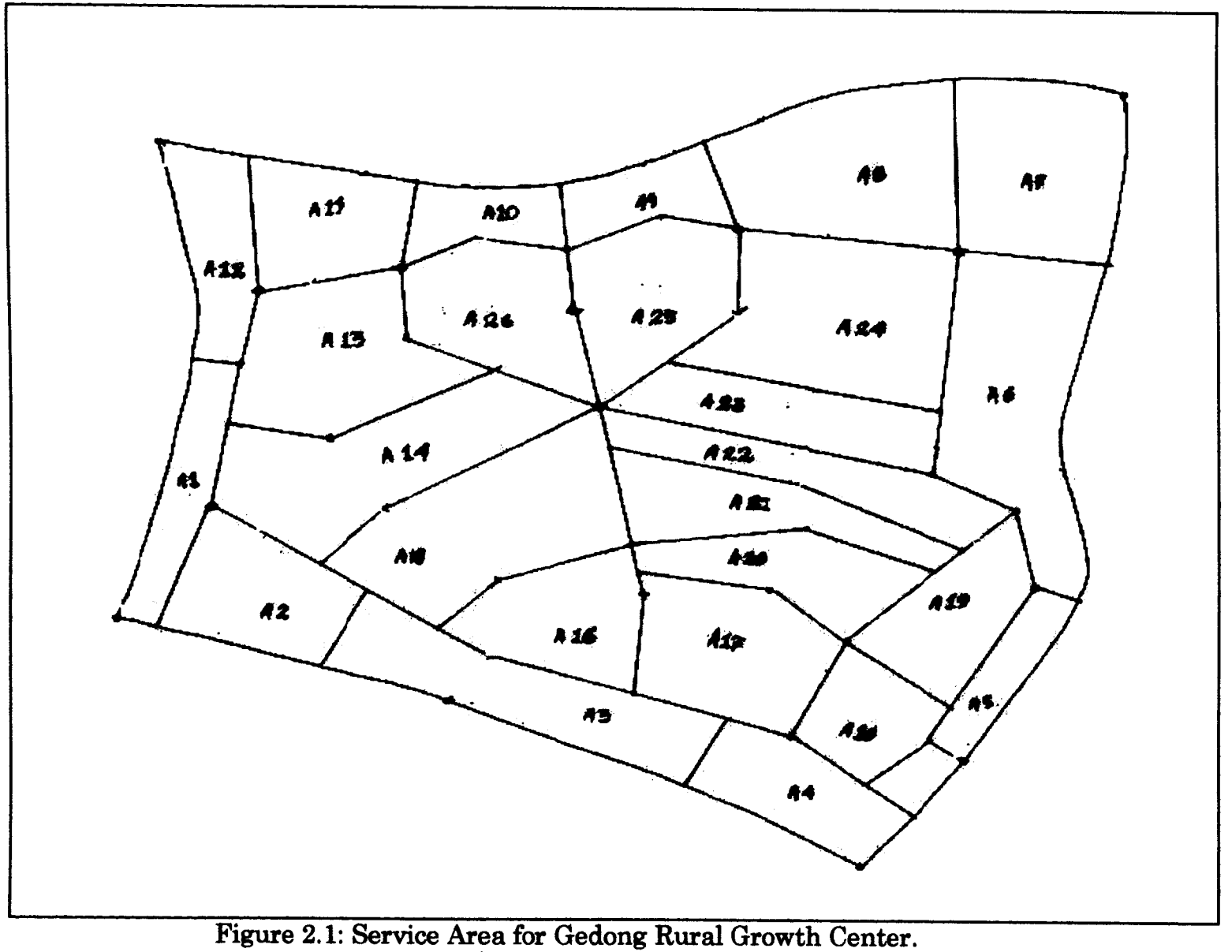

Figure 2.1: Service Area for Gedong Rural Growth Center.

From the layout plan, there are only states that the land is used for government quarter's multi-purpose community hall and government office. For estimation the required persons on the service area, take 60 to multiply with area in hectares.

2.4 WATER DEMAND

Water demand is the amount of water needed for consumers in an area for their needs and activities in a specified period of time. Water usage varies from one place to another, depending on their climate, characteristics of the environment concern, population and other factors. In Gedong Rural Growth Center, water used also varies from time to time. Thus, in the planning of water distribution system, the probable water demand and its variations must be estimated as accurately as possible.

Water demand is obtained by using the formula given in JKR standard.

$$Wdn = (Pn \times C \times F) + Dn$$

Where:

Wdn = water demand at the end of year 'n'
Pn = projected population at the end of year 'n'
C = per capita consumption at the end of year 'n'
F = service factor at the end of year 'n'
Dn = additional demand at the end of year 'n'

2.4.1 Population Projection

Population projection refers to the increase in number of population at a certain area under, a defined period of time. In this project, population projection at 5 year intervals to cover a 20 year period. Population projection formula:

$$P_n = P_o (1 + r) n$$

Where:

P_n = projected population at the end of year 'n'.

P_o = population at the beginning of year zero.

r = assumed population growth rate.

n = number of years.

Table 2.3: Population Growth Rate.

	Upper limit	Lower limit
Mukim A	3.0%	1.5%
Mukim B	2.8%	1.3%
Mukim C	2.5%	1.2%

A 2.5% per annum population growth rate from table 2.3 had been used to project population to the year 2019. The table 2.3 shows the population projection for the scheme up to the year 2019.