SUSTAINABLE WATER MANAGEMENT IN URBAN AREAS

Thamer Ahmad Mohammad

Department of Civil Engineering
Faculty of Engineering
Universiti Purta Malaysia

CONTENTS

- Introduction
- Methodology
- Results and Discussion
- Conclusions

INTRODUCTION

- Rainwater harvesting techniques is appropriate in many countries such as United Kingdom, Germany, China, Japan, Thailand, Sri Lanka, India, Australia, Brazil, South Korea and United States of America.

- The technique is relevant in areas with sufficient rainfall for collection but experiencing water shortage due to either limited availability of conventional water resources or due to high water demand. It can also be used in arid regions to overcome water shortage.

INTRODUCTION

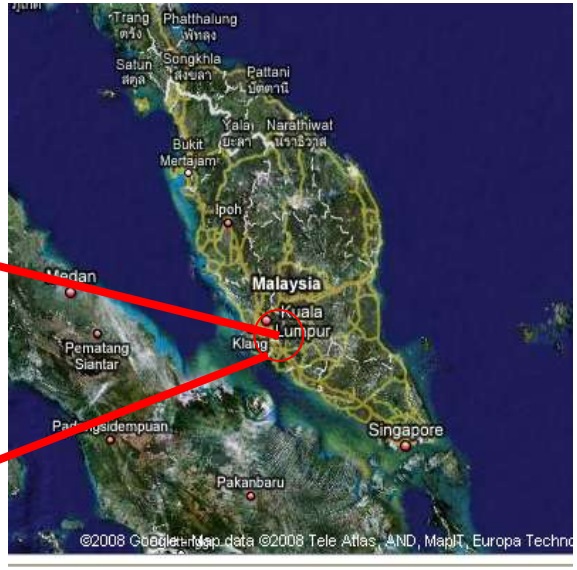
- In urban areas, at a household, rainwater can be used for flushing toilets, watering gardens and washing floor. These uses are known as non-potable and can increase the efficiency of water usage at household level.

- In rural areas, rainwater harvesting can become the main source of potable uses if the areas are not served by water supply distribution network. So, it can be used for drinking, bathing and cooking. It is recommended to treat the collected rainwater prior to use.

SYSTEM DESCRIPTION AND METHODOLOGY

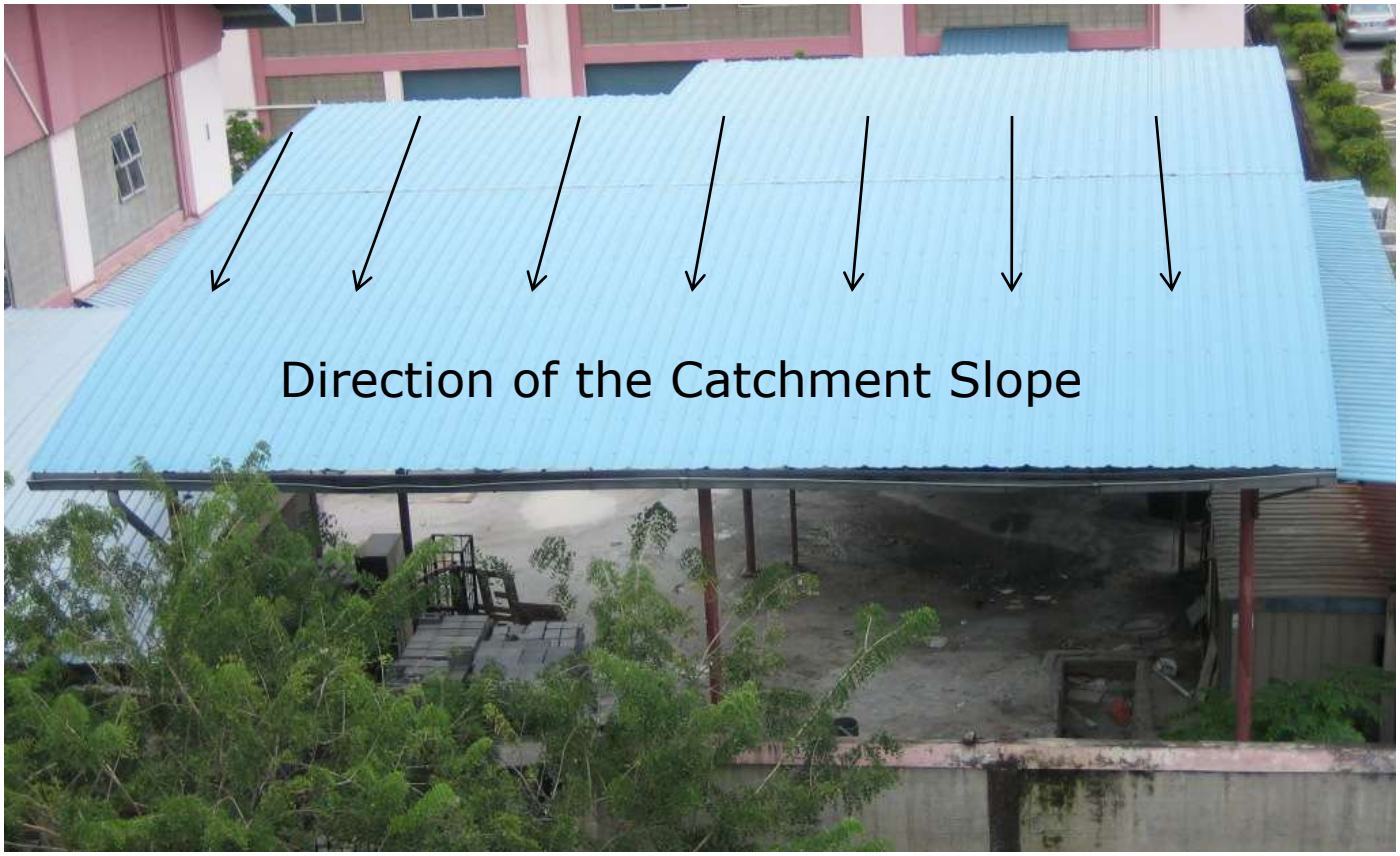
- The system installed ant the Department of Civil Engineering, Faculty of Engineering, University, Putra Malaysia
- The system composed of:
- Roof catchment (made of corrugated metal sheets with a total area of 150 m^2)
- Gutter (made of steel with cross section of 15 x 15 cm)
- Down pipe (made of PVC and it is 100 mm diameter)
- Collection tank (made of steel and it is 0.85 m wide, 4.0 m long and 1.2 m deep)

The Site

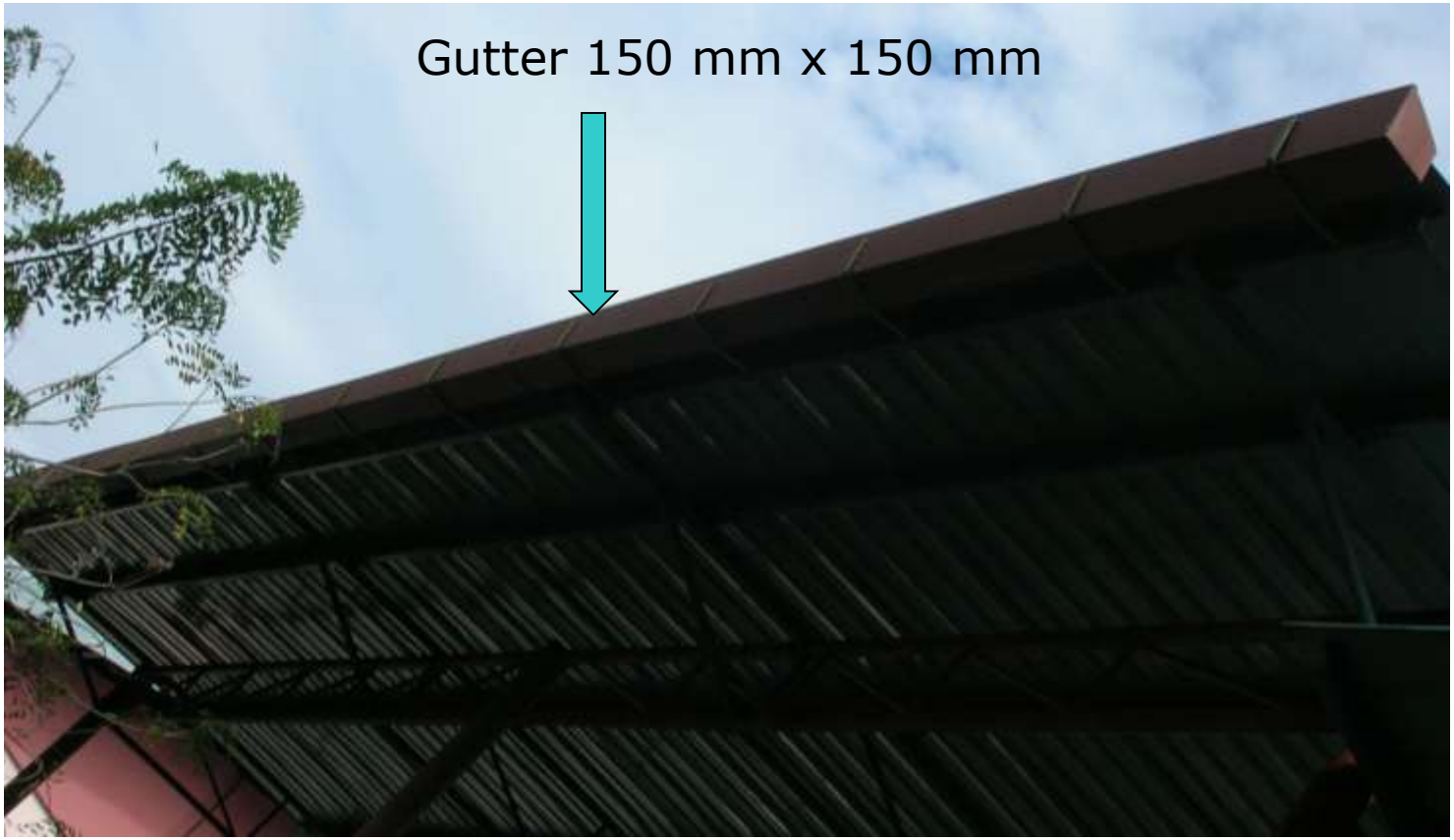


The system is installed at the Faculty of Engineering, Universiti Putra Malaysia

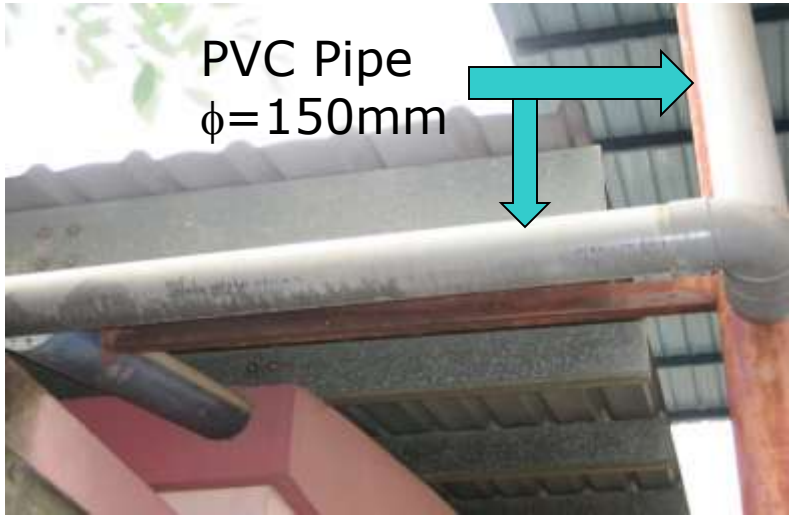
Roof Catchment



The Gutter



Down Pipe

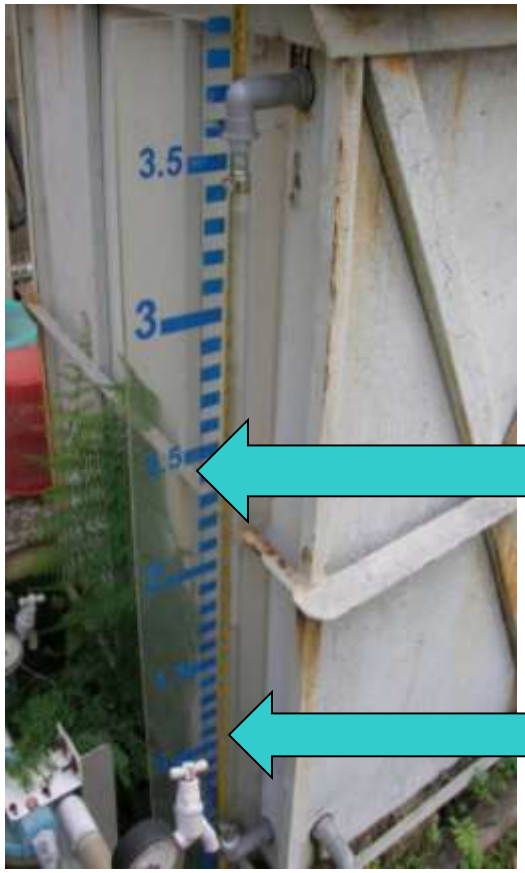


Collection Tank

Collected Data

- Collected rainwater volume from the roof (volume of rainwater in the tank)
- Rainwater depth (rainwater gauge installed about 10 m away from the catchment)
- Duration of the Rain in minutes
- Daily water consumption (a meter installed in a selected students toilet)

Volume of Rainwater



- Volume of rainwater is collected for each rain event

the variation of the rainwater volume With the time is also recorded

Meter for rainwater volume

Piezometer to monitor rainwater depth

Location of Rain Gauge and Datalogging System

Location of rain gauge

Rainwater depth and rainwater duration are recorded from January to March 2008 using the raingauge installed near the rainwater harvesting system

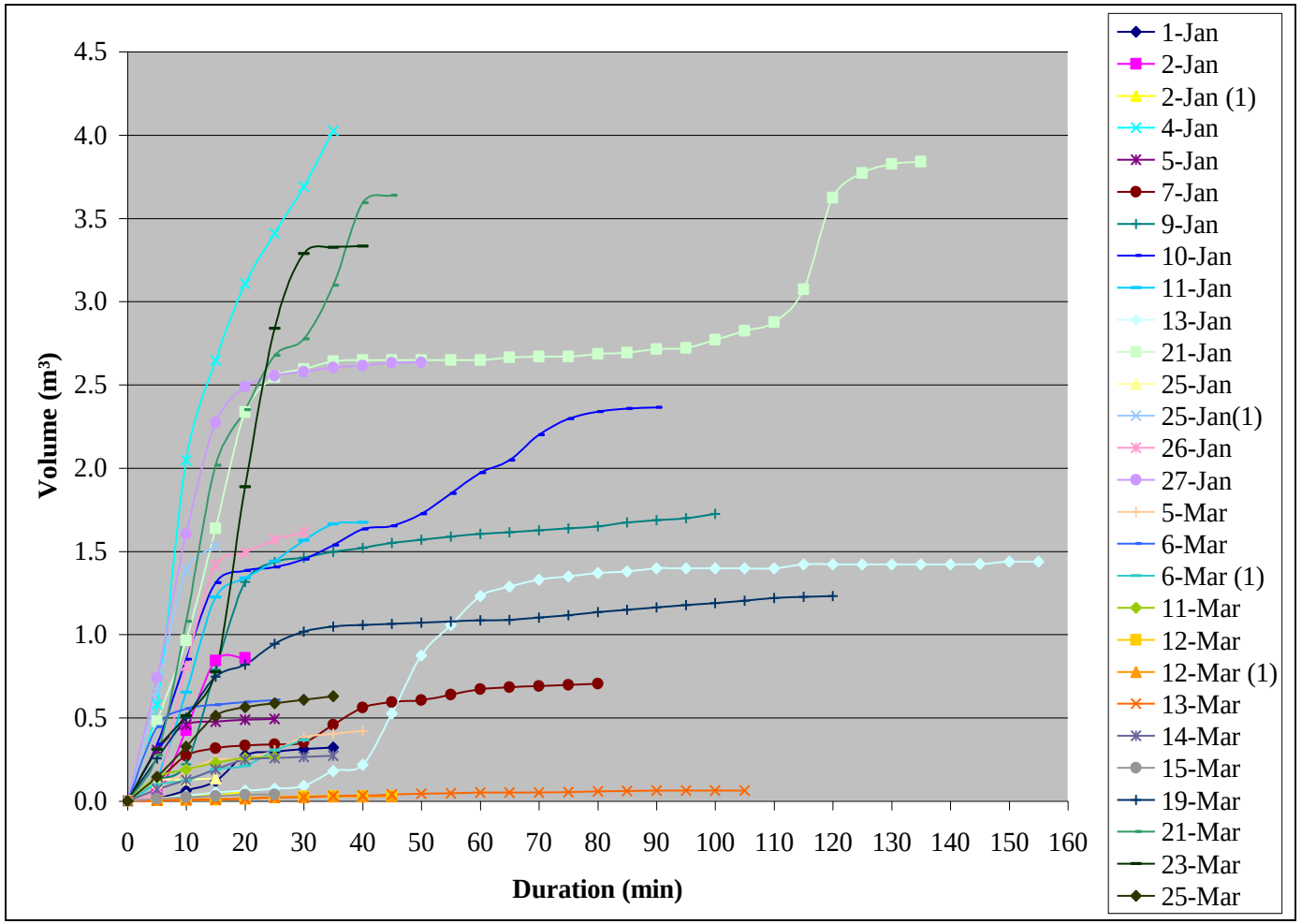
Data Logger

Measurements of Water Consumption

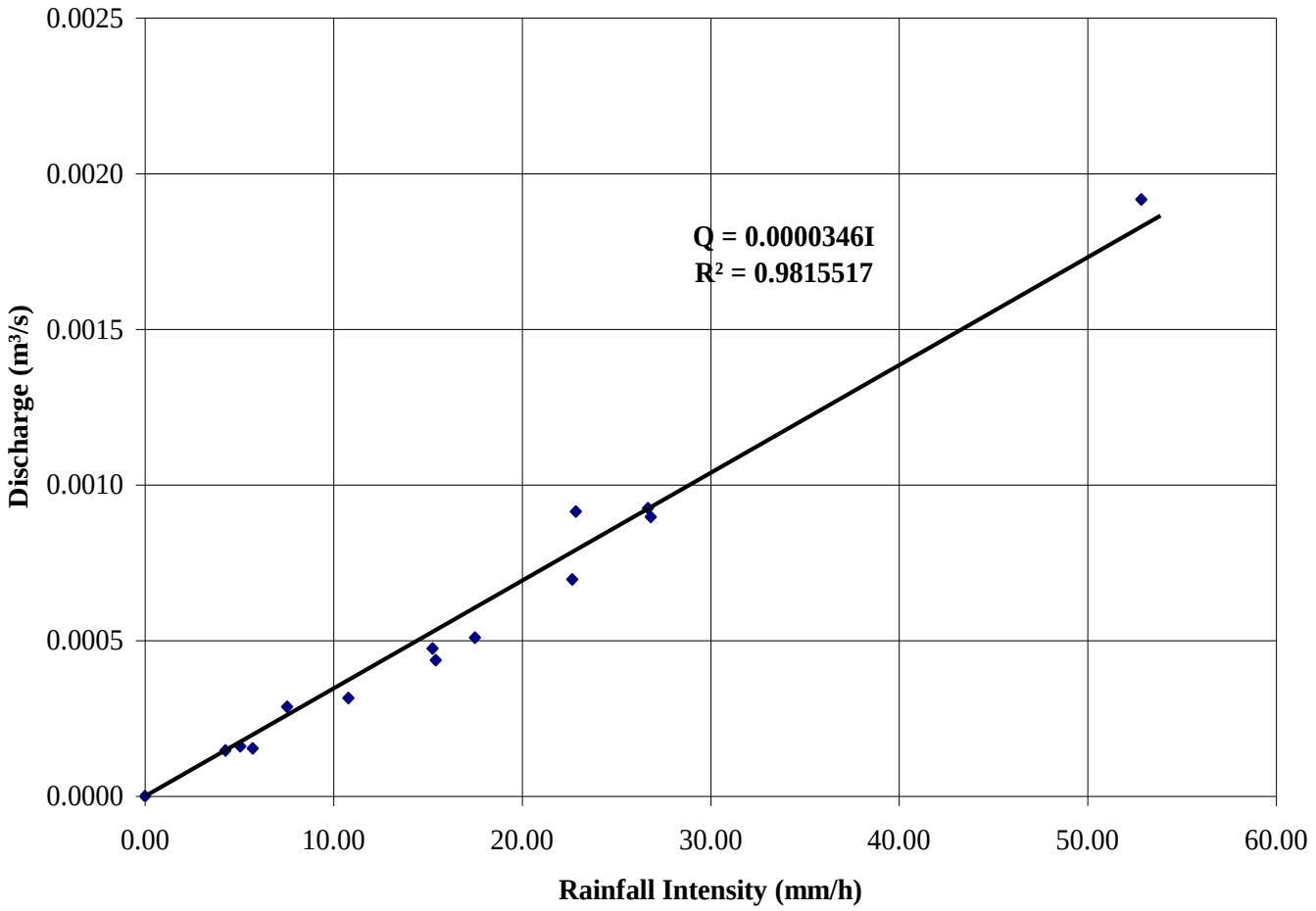
Water Meter

Daily water consumption and number of users are recorded from January to March 2008

RESULTS AND DISCUSSION



RESULTS AND DISCUSSION



RESULTS AND DISCUSSION

The rational formula can be converted to:

$Q=CIA/360$

$Q=KI$

From the relationship

$Q=0.0000346 *I$

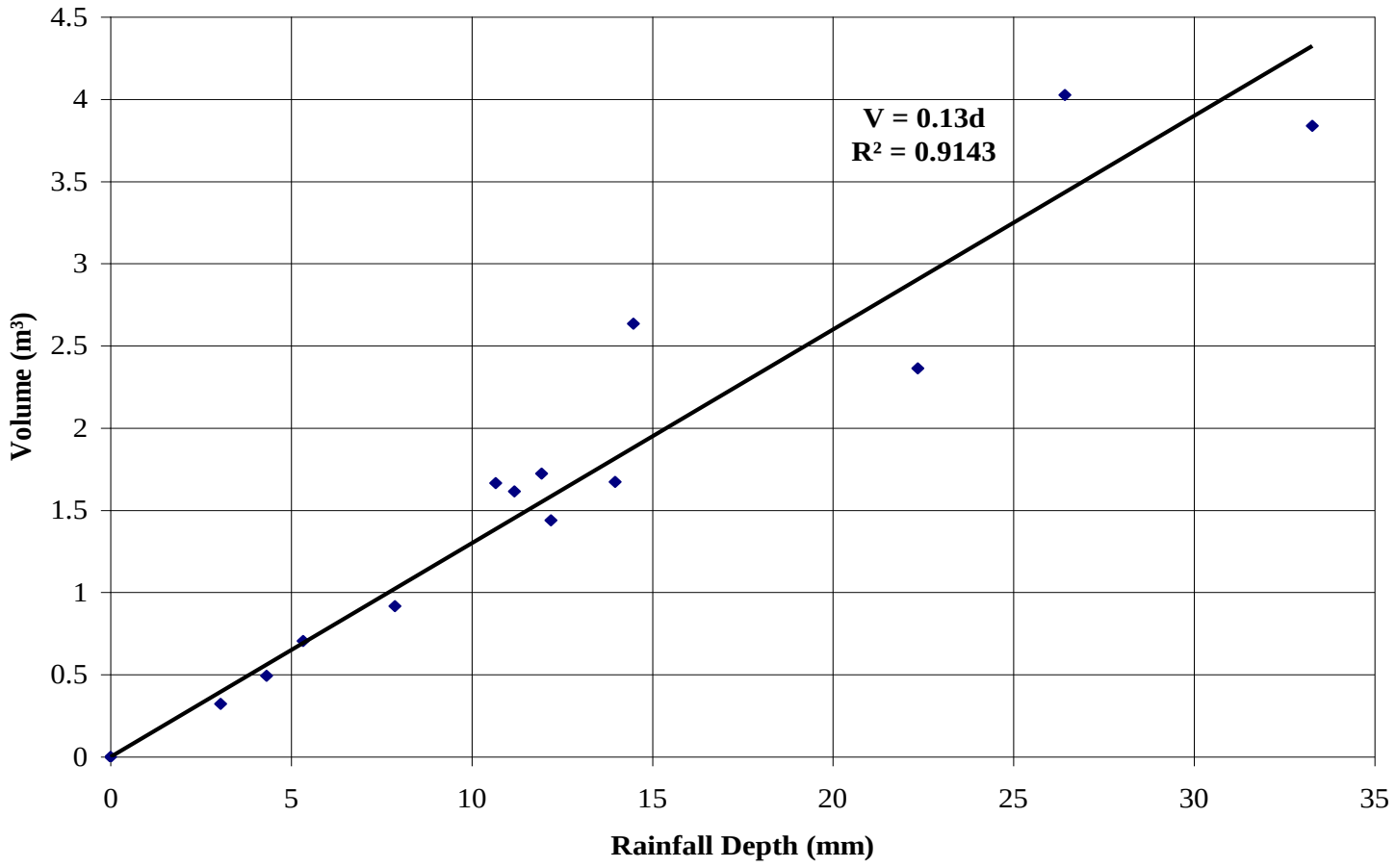
$K=CA/360$

RESULTS AND DISCUSSION

- CA/360=0.0000346
- K=0.83
- value of K is found within the values given by Zhu and Liu (1998) for Corrugated metal sheets

- The relationship between the collected rainwater volume (V_R) and the rainwater depth (d) can be written as
- $V_R = \phi d$
- $V_R = 0.13d$

RESULTS AND DISCUSSION

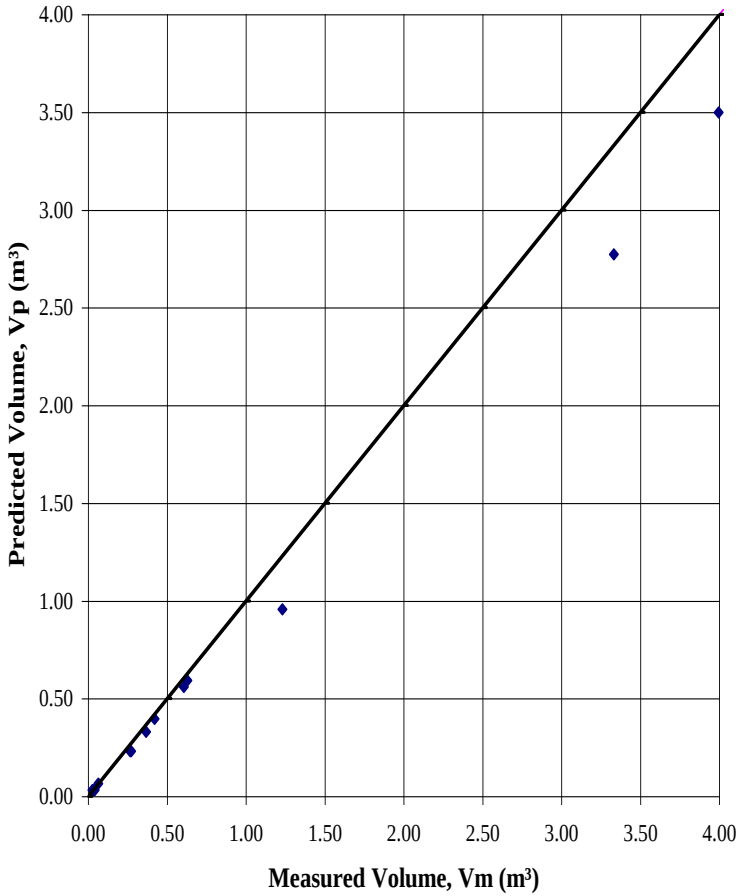


RESULTS AND DISCUSSION

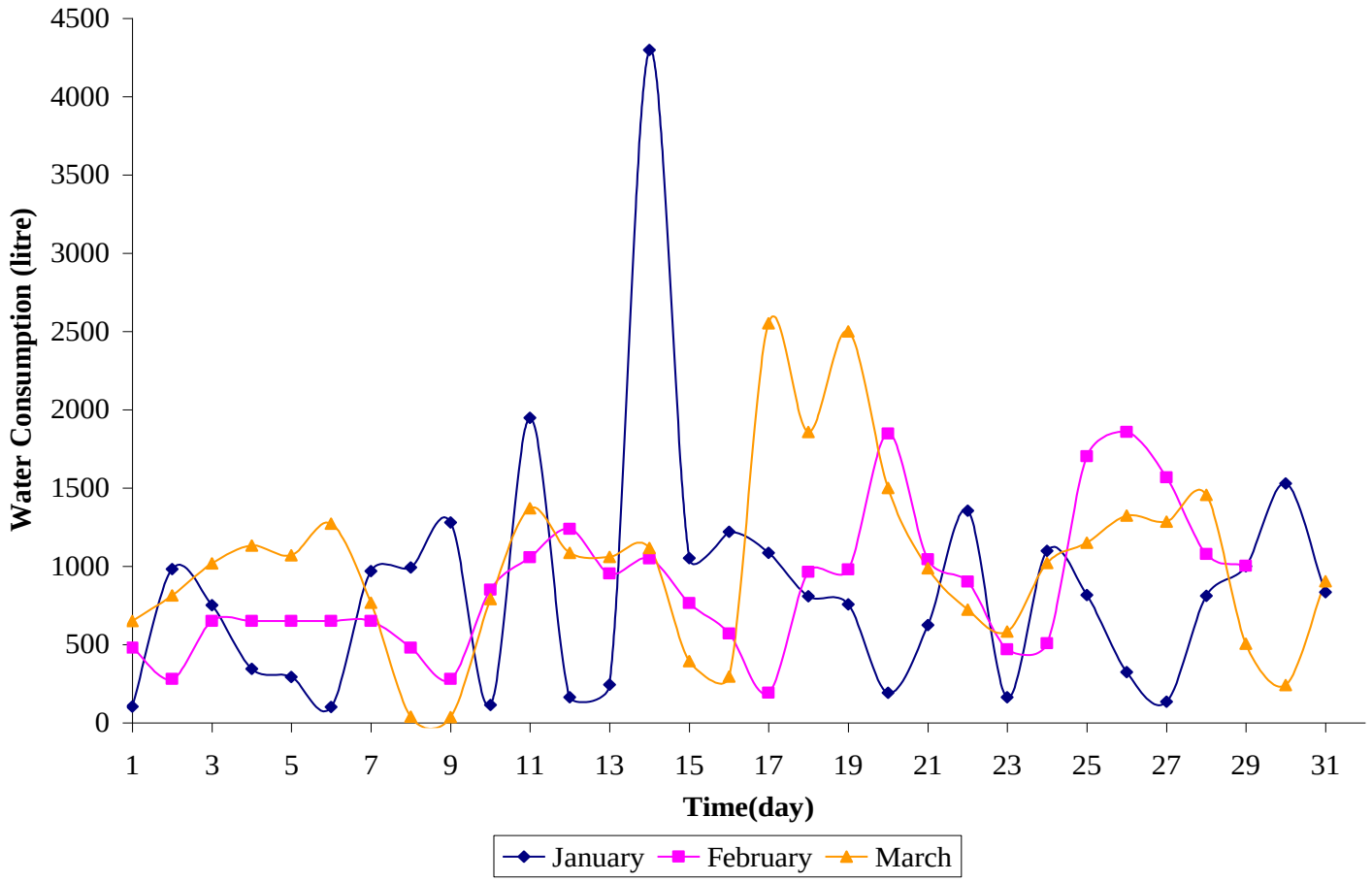
$E_A = V_p - V_m$

Minimum $E_A = 0.0014\ m^3$

Maximum $E_A = 0.56\ m^3$



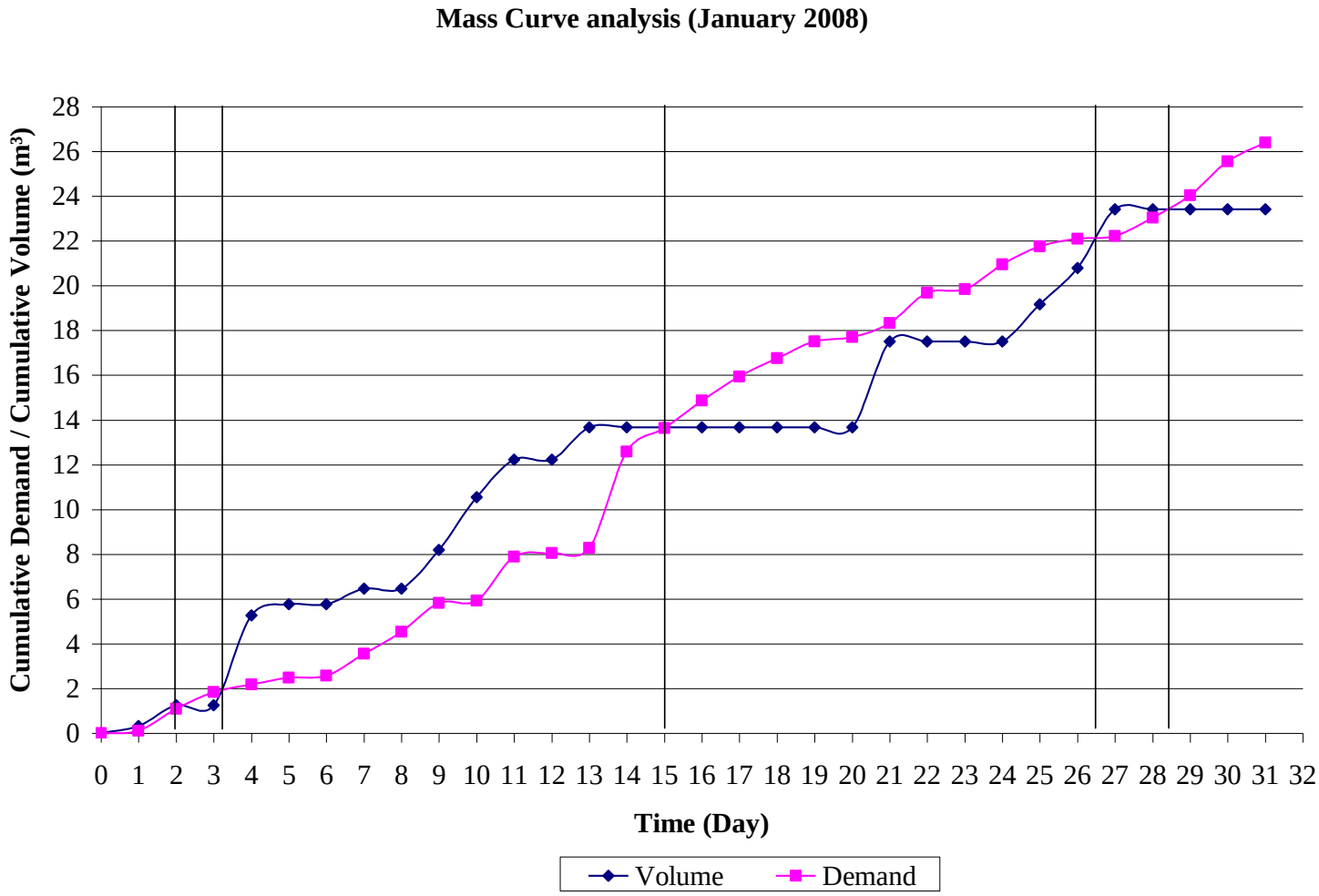
RESULTS AND DISCUSSION



RESULTS AND DISCUSSION

- Maximum daily water consumption = 4.3 m^3
- Average daily water consumption in January 2008 = 0.85 m^3
- Average daily water consumption in February 2008 = 0.88 m^3
- Average daily water consumption in March 2008 = 1.02 m^3

RESULTS AND DISCUSSION

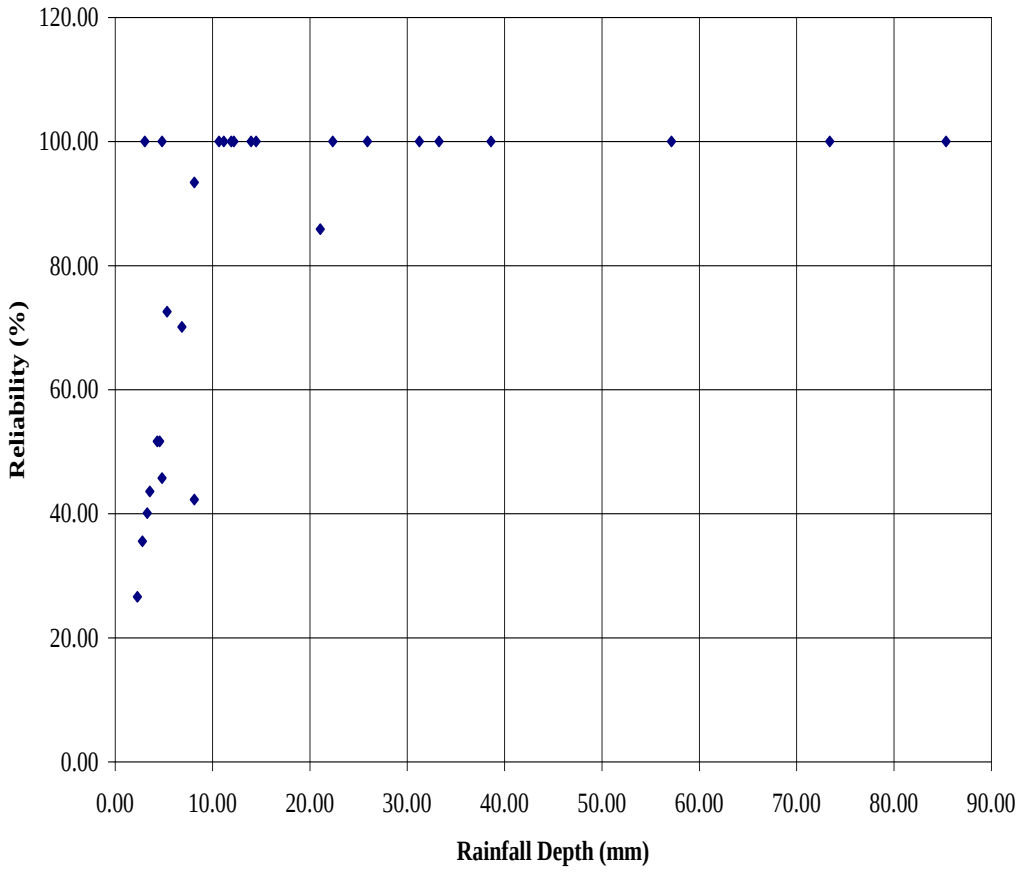


RESULTS AND DISCUSSION

Reliability (R) $= V_a/V_d \times 100$

V_a = daily collected rainwater volume

V_d = water consumption for flushing toilet



CONCLUSIONS

- The proposed model can be used for predicting the rainwater volume from rainwater depth with reasonable accuracy.
- The installed rainwater harvesting system proven that collected rainwater volume can successfully meet the water demand for non-potable uses.

CONCLUSIONS

- Reliability of the system mainly depends on the rainfall intensity or rainfall depth and the system showed that in some events it is 100% reliable.

Thank you