DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

TYPE OF PIPE USED AT THE BUILDING

Prepared by:

CHE KU AIMY FARHAM BIN CHE KU MADZLAN

2011960857

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

APRIL 2014

It is recommended that the report of this practical training provided

By

Che Ku Aimy Farham Bin Che Ku Madzlan

2011960857

entitled

Type of Pipe Used at The Building

accepted in partial fulfillment of requirement has for obtaining Diploma In Building.

Report Supervisor	Sr. Siti Jamiah Tun Binti Jamil
Practical Training Coordinator	Sr. Anas Zafirol Bin Abdullah Halim
Faculty Coordinator	Dr. Mohd Rofdzi Bin Abdullah

DEPARTMENT OF BUILDING

FACULTY OF ARCHITECTURE, PLANNING AND SURVEYING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

APRIL 2014

STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references stated herein, prepared during a practical training session that I underwent at WRA Services Sdn Bhd for duration of 5 months starting from 4 November 2013 and ended 23 March 2014. It is submitted as one of the prerequisite requirements of DBN307 and accepted as a partial fulfilment of the requirements for obtaining the Diploma in Building.

Name : Che Ku Aimy Farham Bin Che Ku Madzlan

UiTM ID No : 2011960857

Date : 25 March 2014

ACKNOWLEDGEMENT

Assalamualaikum w.b.t, in the name of Allah, the Most Gracious and the Most Merciful. Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this report entitled the type of pipe and method of to joint that pipe. This is one of the requirements to complete my practical training for 5 months beginning on 4 November 2013 to 23 March 2014. Here I would like to take this opportunity to extend my sincere thanks and appreciation to all the parties involved either directly or indirectly in completing this report. Among those involved in the partnership during my practical training is Mr Abdul Latif Bin Jusof of being agents of the site, Mus Mas Ayu Bt Mustafa as an office clerk, Mr. Zukifly Bin Ismail as the construction manager, Mr. Wan Mohd Faisal Wan Rezali as supervisor M&E, Mr. Hisham Bin Sipit as site supervisor and Mr. Harun Bin Mamat as a quantity surveyor. Thank you also to the lecturers building department consisting of my supervisors Sr. Siti Jamiah Tun Binti Jamil, a visiting lecturer, Mrs. Rafizah Binti Mohamed. Also do not miss my thanks also to my mother and father and members of my family because they give support, encouragement and enthusiasm to my current training practical and successful completion of this report. Thanks again I say, may God bless and bless all our efforts together in preparing this book a useful report.

ABSTRACT

This report consists of a background and the background of the construction project, the place of the practical training at WRA Services Sdn. Bhd and ongoing projects is cadangan membina dan menyiapkan kompleks perniagaan yang mengandungi 4 tingkat podium, 1 tingkat tempat letak kereta bawah tanah, 3 tingkat tempat letak kereta bertingkat 1 blok hotel 18 tingkat dan 1 blok pejabat 18 tingkat di atas Lot PT 3133K dan 4785 serta kerja-kerja berkaitan di Jalan Masjid Abidin, Mukim Kuala Terengganu. The theory in this report will describe in detail the types of pipes used at the building. Pipe is very important as part of a building. To distribute water to the building must use pipe. There are many type of pipe uses to supply the water to the building. The different types of pipe have the different way to joint it. To get the information about the method to joint that pipe is through the observation about jointing all of the pipe. Besides that, the discussions need to improve the knowledge about that pipe. In addition, the mass media and electronic media is one of the ways to get the information about the pipes easily and quickly. There are three type of pipe will be describe. The pipes are PPR pipe, MS pipe and Polysteel pipe. Plumbing works is very important aspect in a building. This is because plumbing system is something should have in every building to make that building function.

CONTENT PAGES

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

LIST OF ABBREVIATION

MS PIPE	Mild Steel Pipe
SATU	*Syarikat Air Terengganu*
SPAN	*Suruhanjaya Perkhidmatan Air Negara*

CHAPTER 1

INTRODUCTION

1.1 PREFACE

This project titled "Cadangan membina dan menyiapkan kompleks perniagaan yang mengandungi 4 tingkat podium perniagaan, 1 tingkat tempat letak kereta bawah tanah, 3 tingkat tempat letak kereta bertingkat, 1 blok hotel 18 tingkat dan 1 blok pejabat 18 tingkat di atas lot pt3133k & 4785 serta kerja-kerja berkaitan di jalan masjid abidin, mukim Bandar, Kuala Terengganu, Terengganu for Perbadanan Memajukan Iktisad Negeri Terengganu, Terengganu Darul Iman.

Photo 1.1 Signboard of the project

1.2 OBJECTIVE OF STUDY

The objective of study is focus at the type and installation of the pipe used for the building as follow:

I. To identify the method of jointing various type of pipe

II. To study the advantages of the pipe

1.3 SCOPE OF STUDY

In ensuring all objective of the study achieved, scope study need to be decided first so that study objective did not lose the way from the original objective. The scope of study is to determine the type of used at the building and to identify the method of jointing various type of pipe. There are many type of pipe in the building. Each of them has its own advantages and has different installation. Each connection works require the proper technique so that the pipe does not leak.

1.4 METHODOLOGY OF STUDY

To produce a practical report, there are four main methods used to achieve the study, as follow:

I. Observation

Based on all the information collected are recorded. Through this approach, it helps to focus on the means of connection piping systems inside and outside the building. Besides that, observation is an important method to get an overview of the types of pipe and extension methods. The approach is important for data collection, such as obtaining relevant pictures.

II. Interview and discussion

In addition, interviews were conducted on the workers, the supervisor M&E and the construction manager to find out more about plumbing. This method was carried out to obtain more detailed information related to the types and methods of connection pipes for the building.

III. Mass media and electronic media

Beside the above stated methods, the mass media and electronic media is one of the methodology of study. It is the way to find the information with easy and fast.

CHAPTER 2

COMPANY BACKGROUND

2.1 INTRODUCTION

WRA Services Sdn. Bhd. is a Bumiputera construction company which actively involved in construction of building and civil engineering works. WRA is registered with Pusat Khidmat Kontraktor and Construction Industry Development Board. Since it's establishment in 1993, WRA has successfully complete many building project, stadium, road and installation of water supply pipes. WRA also has experience in managing and constructing projects under 'Design and Build' concept whereby WRA is responsible for appointment of a team of consultant for preparing a building design complete with all necessary electrical and mechanical services that meet client and constructing the same in accordance with the agreed design.

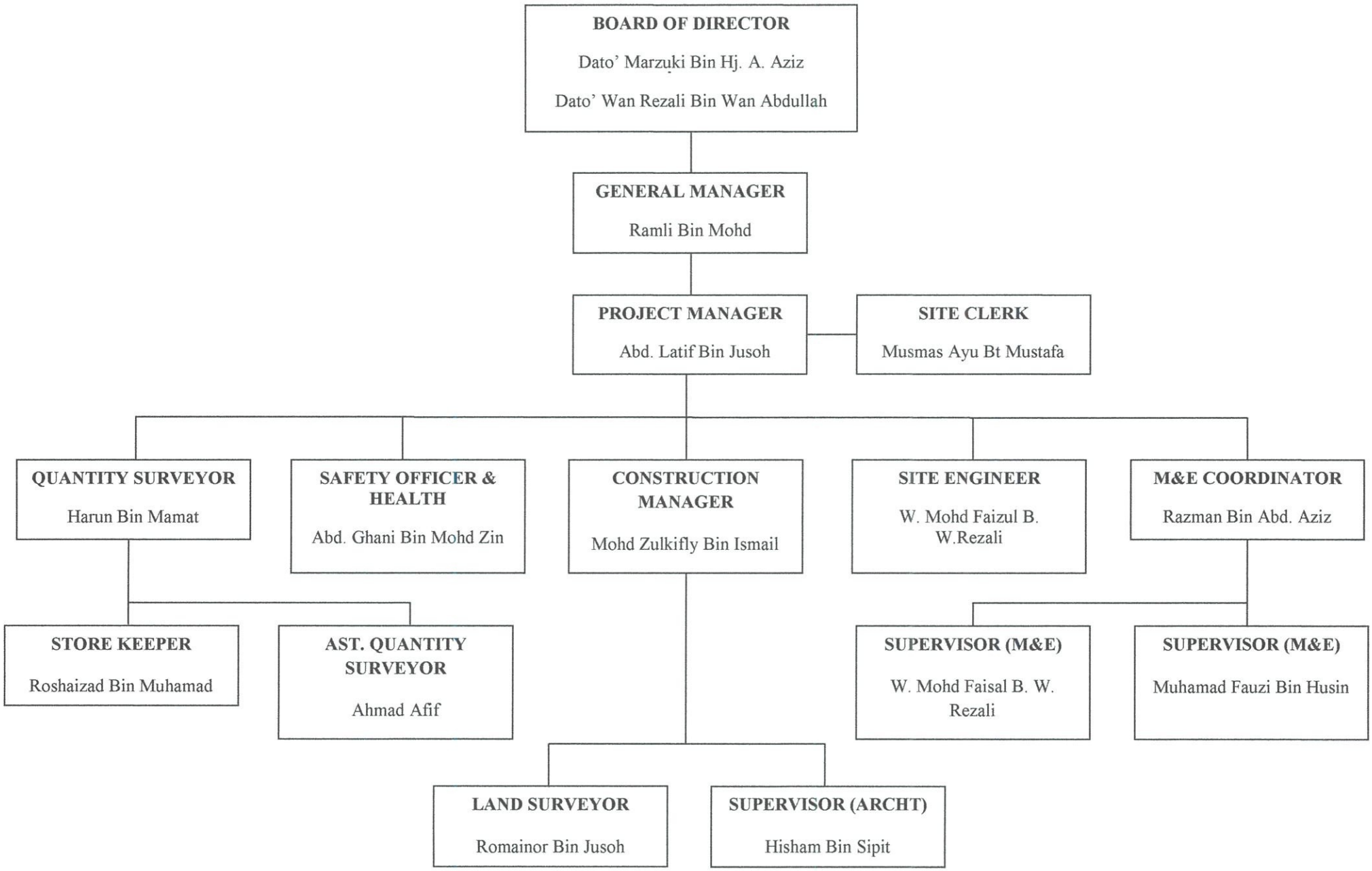
The success of WRA in discharging it's obligations to the clients, to a great extent, is due to a team of dedicated and committed management staff who are ever ready to accept any challenge. Solid support from bankers, suppliers and specialist sub-contractors is also an important factor which help WRA in successfully completing it's undertakings and give confident to WRA to advance to a higher level of success.

WRA's main aim is to become a resilient Bumiputera construction company which is capable to deliver quality projects that meet clients needs.

2.2 COMPANY PROFAIL

Name of Company	:	WRA Services SDN. BHD
Registration No.	:	264479H
Registration Address	:	No. 51A Tingkat 1 Jalan Tok Lam 20100 Kuala Terangganu
Telephone	:	
Fax	:	09-6240564
Date of Establish	:	18th May 1993
Company Secretary & Auditor	:	Zuki & Rashid Tax Accountants
Address of Company Secretary	:	66/23, 1st Floor, Taman Sri Intan, Jalan Sultan Omar, 20300 Kuala Terangganu.
Authorised Capital	:	RM 5,000,000.00
Paid-up Capital	:	RM 4,000,000.00
Banker	:	Bank CIMB Berhad

2.3 ORGANISATIONAL CHART



2.4 LIST OF PROJECT

2.4.1 LIST OF COMPLETED JOBS

Table 2.1 List of WRA Services completed project

No	Project	Construction Cost	Completion Date
1.	Kerja-kerja dalaman serta membekal dan memasang perabot bagi bangunan Tenaga Nasional Research And Development Centre (Peringkat 1A) di Bangi, Selangor Darul Ehsan	RM 6,826,343.00	21.8.1998
2.	Cadangan membina dan menyiapkan sebuah stadium hoki di Lembah Pantai, Kuala Lumpur	RM 18,082,306.00	24.9.1998
3.	Membekal dan memasang paip keluli 600mm, 400mm, paip HDPE 315mm, 250mm dan 180mm g.p di Pendalaman, Klang,Selangor Darul Ehsan	RM 7,971,905.00	9.12.1998
4.	Cadangan membina satu blok bangunan 4 (empat) tingkat untuk Jabatan Farmasi dan Jabatan Sains Sekutu, Universiti Malaya, Lembah Pantai, Kuala Lumpur	RM 15,002,028.20	2.8.1999

No	Project	Construction Cost	Completion Date
5.	Cadangan merekabentuk, membina dan menyiapkan Sekolah Menengah Kebangsaan Ketengah Jaya 2, Dungun, Terengganu	RM 13,000,000.00	28.12.2002
6.	Membina dan menyiapkan sebuah pusat latihan RELA Wilayah Timur, Hulu Terengganu, Terengganu Darul Iman	RM 7,498,000.00	12.5.2002
7.	Membina dan menyiapkan system perparitan Bandar MBKT kontrak DC3 (Pakej 2 & 3), Kuala Terengganu	RM 8,106,344.00	31.8.2002
8.	Membina dan menyiapkan jalan baru (Premix) dari Pelung, Setiu ke Kuala Jeneris, Hulu Terengganu – Fasa II	RM 16,609,000.00	26.7.2003
9.	The design, construction, equipping and commissioning of ambulatory care centre, Hospital Tengku Ampuan Afzan, Kuantan, Pahang Darul Makmur	RM 56,805,750.00	20.12.2004

No	Project	Construction Cost	Completion Date
10.	Projek bekalan air kuala Terengganu peringkat IV pakej C – membekal, memasang dan menguji system bekalan air untuk zon utara. Kuala Terengganu	RM 19,998,000.00	21.8.2005
11.	Redevelopment of Kuala Terengganu airport project package II – Terminal Building	RM 123,168,685	20.4.2008
12.	Membekal dan menanam cerucuk termasuk tukup cerucuk bagi pembinaan kompleks perniagaan yang mengandungi 4 tingkat podium, 1 blok hotel 18 tingkat dan 1 blok pejabat 18 tingkat di atas Lot PT 3133K, di Jalan Masjid Abidin, Mukim Bandar Kuala Terengganu, Terengganu Darul Iman	RM 10,469,152.10	28.6.2009
13.	Pembinaan kompleks perniagaan yang mengandungi 4 tingkat podium, 1 tingkat tempat letak kereta bawah tanah, 3 tingkat tempat letak kereta bertingkat 1 blok hotel 18 tingkat dan 1 blok pejabat 18 tingkat di atas Lot PT 3133K dan 4785. serta kerja-kerja berkaitan di Jalan Masjid Abidin, Mukim Kuala Terengganu -membina dan menyiapkan kerja-kerja "work below ground floor finish (WBGFF)"	RM 7,959,199.80	12.1.2010

Source: WRA Company Profile

Photo 2.1 Cadangan membina satu blok bangunan 4 (empat) tingkat untuk Jabatan Farmasi dan Jabatan Sains Sekutu, Universiti Malaya, Lembah Pantai, KualaLumpur

Source: WRA Services (2014)

Photo 2.2 Cadangan membina dan menyiapkan sebuah stadium hoki di Lembah Pantai, Kuala Lumpur

Source: WRA Services (2014)

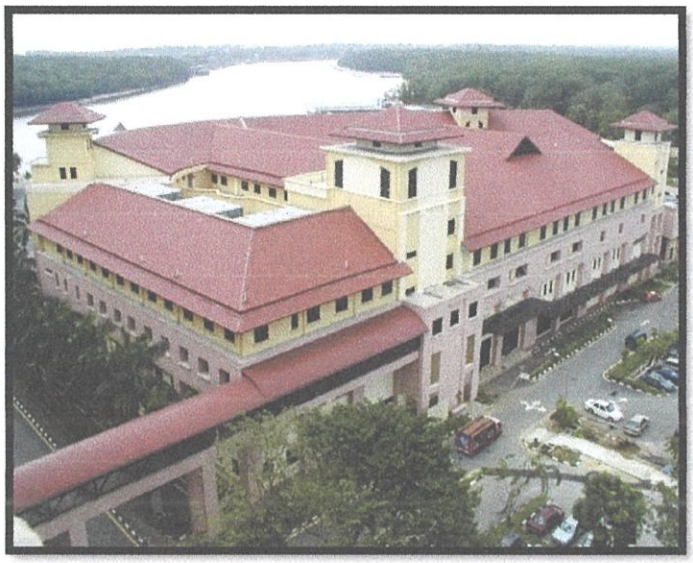


Photo 2.3 The design, construction, equipping and commissioning of ambulatory care centre, Hospital Tengku Ampuan Afzan, Kuantan, Pahang Darul Makmur

Source: WRA Services (2014)

Photo 2.4 Redevelopment of Kuala Terengganu airport project package II –Terminal Building

Source: WRA Services (2014)

2.4.1 LIST OF ON GOING PROJECT

Table 2.2 List of WRA Services ongoing project

No	Project	Construction Cost	Implementation Agency
1.	Membina dan menyiapkan kompleks perniagaan yang mengandungi 4 tingkat podium, 1 tingkat tempat letak kereta bawah tanah, 3 tingkat tempat letak kereta bertingkat 1 blok hotel 18 tingkat dan 1 blok pejabat 18 tingkat di atas Lot PT 3133K dan 4785 serta kerja-kerja berkaitan di Jalan Masjid Abidin, Mukim Kuala Terengganu	RM 95,000,000.00	Perbadanan Memajukan Iktisad Negeri Terengganu
2.	Cadangan Pembinaan Institiut Latihan UiTM di Nilai, di Sebahagian Lot 34546 bandar baru enstek daerah seremban, Negeri Sembilan Darul Khusus	RM 101,000,000	MARA

Source: WRA Company Profile

CHAPTER 3

TYPE OF PIPE USED IN BUILDING

3.1 INTRODUCTION

Plumbing is very important as part of a building. The main function of the pipe system to distribute water for drinking, cooking, cleaning and washing to the building occupants. The size of pipe should be used according to the correct specification to select adequate water pressure. Therefore, for high-rise buildings, the system should be used to pump water will reach the top floor and able to provide adequate pressure.

3.2 PROJECT BACKGROUND

The title of the project is Cadangan membina kompleks perniagaan yang mengandungi 4 tingkat podium, 1 tingkat tempat letak kereta bawah tanah, 3 tingkat tempat letak kereta bertingkat 1 blok hotel 18 tingkat dan 1 blok pejabat 18 tingkat di atas Lot PT 3133K dan 4785. serta kerja-kerja berkaitan di Jalan Masjid Abidin, Mukim Kuala Terengganu. The project was led by Mr. Abdul Latif bin Jusof as a project manager.

3.3 CASE STUDY: TYPE OF PIPE USED IN THE BUILDING

3.3.1 POLYPROPYLENE RANDOM COPOLYMER (PPR PIPE)

All BE PP-R pipes & fittings are manufactured in accordance with DIN 8077 (Pipes in polypropylene, PP, Dimensions), DIN 8078 (PP quality requirements) and DIN 16962 (Quality requirements tests for fittings).

PPR pipe and fitting are manufactured from high quality and it can be used for range applications in different industries. For example hospitals, apartment, condominium, and factory.

The PPR pipes have two types, for cold water and hot water. The difference of the cold water pipe and hot water pipe is the wall thickness of pipe. For hot water pipe, the wall thickness is thicker compared the cold water pipe. Beside that, the strip at the pipe was also able to distinguish whether the pipe is to use hot water or cold water. For example, the red strip is use for hot water, and blue strip use for cold water.

The advantages for pipe PPR used in the building is it not detrimental to human health and not rust and corrosion It because the raw material for PPR pipe is Polypropylene Random, and manufactured from high quality. Besides that, the surface of PPR pipe is smooth and no scaling. The PPR pipe also easy to install and it can saving time.

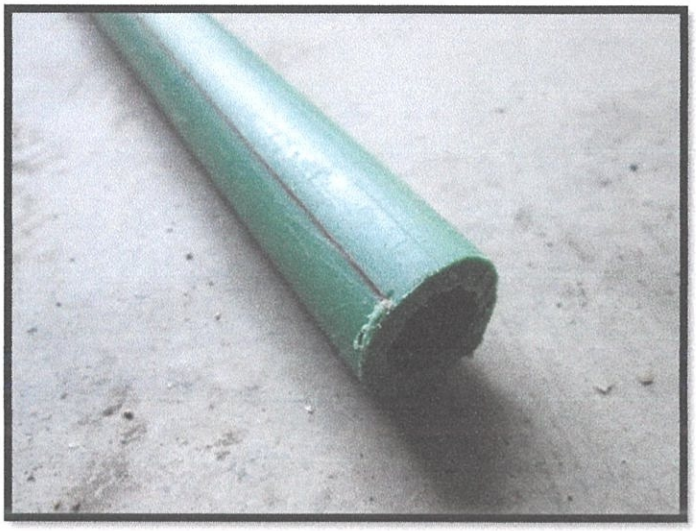


Photo 3.1 PPR pipe for hot water

Photo 3.2 PPR pipe for cold water

3.3.1.1 METHOD TO JOINTING PPR PIPE

Firstly a mark is made on the PPR pipe by using the measuring tape based on the length of pipe required. Before the process of cutting is made, the mark is made must be accurate in order to avoid waste.

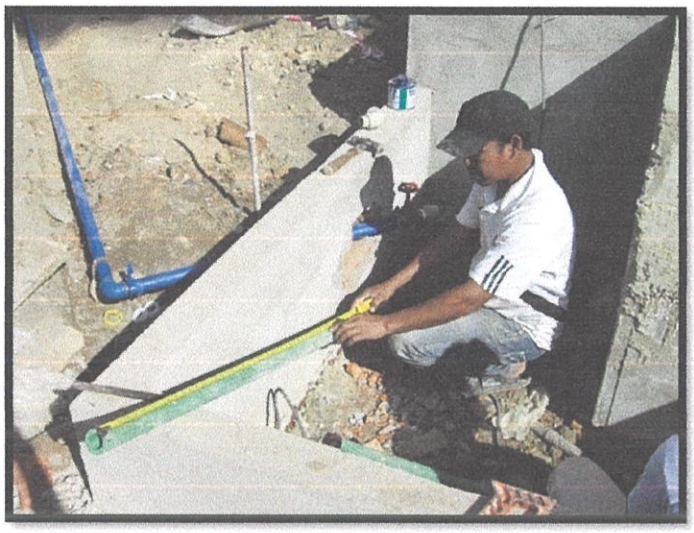


Photo 3.3 Measure and mark the pipe

After the marking work had completed, the PPR pipe will be cut by using a cutter. There are three type of cutter. The different type use of the cutter is depending on the thickness of the PPR pipe. Use the suitable cutter to ease cutting works.

Photo 3.4 Cutting process

Then, using welding machines to heat the inside surface of the pipe. Before that, make sure the temperature of the welding machine is up to 270 °C, for example 278 °C.

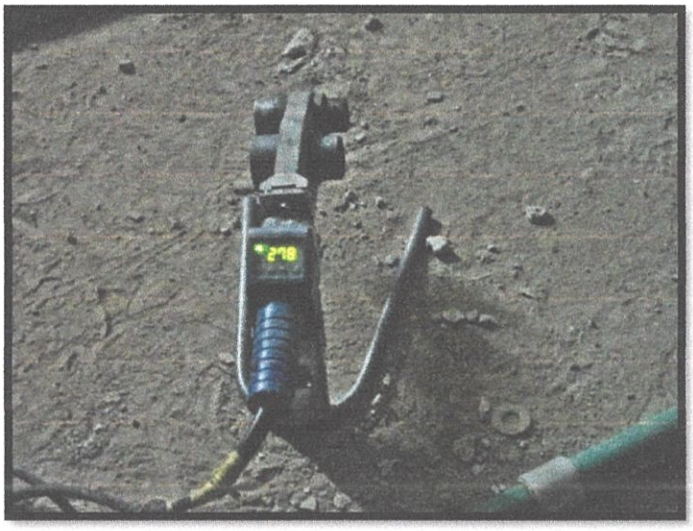


Photo 3.5 The welding machine is ready to use at the temperature 278 °C

After the temperature reached at 278 °C, push the pipe and fitting into the welding adaptors, and do not twist or turn the pipe and fitting while pushing. After that, wait until heating time is reached.

Photo 3.6 The pipe is pushed and fitting into the welding adaptors

When the welding heating time is reached, remove both pipe and fittings together, again without twisting or turning while pulling out of the welding adaptor. Almost immediately, push both pipe and fitting together until the depth is reached

Photo 3.7 The pipe is fitting together until the depth is reached

Table 3.1 Welding depth, heating, welding and cooling time

Pipe Diameter (mm)	Welding Depth (mm)	Heating Time (sec.)	Welding Time (sec.)	Cooling Time (min.)
20	14.0	5	4	2
25	15.0	7	4	2
32	16.5	8	6	4
40	18.0	12	6	4
50	20.0	18	6	4
63	24.0	24	8	6
75	26.0	30	8	8
90	29.0	40	8	8
110	32.5	50	10	8

Source: http://www.beppr.com

3.3.2 MILD STEEL PIPE (MS PIPE)

The MS pipe is the steel pipe and to joint the pipe must be use the welding. This pipe is installed outside the building. second layer consists of mild steel, while the third layer comprises a layer of cement. The bitumen at the first layer at the MS pipe to protect the mild steel from rusting. Then, the cement at the third layer to avoid the mild steel from rusting from inside the pipe. so, the advantages for using the MS pipe is it can provide the clean water and safe to use.

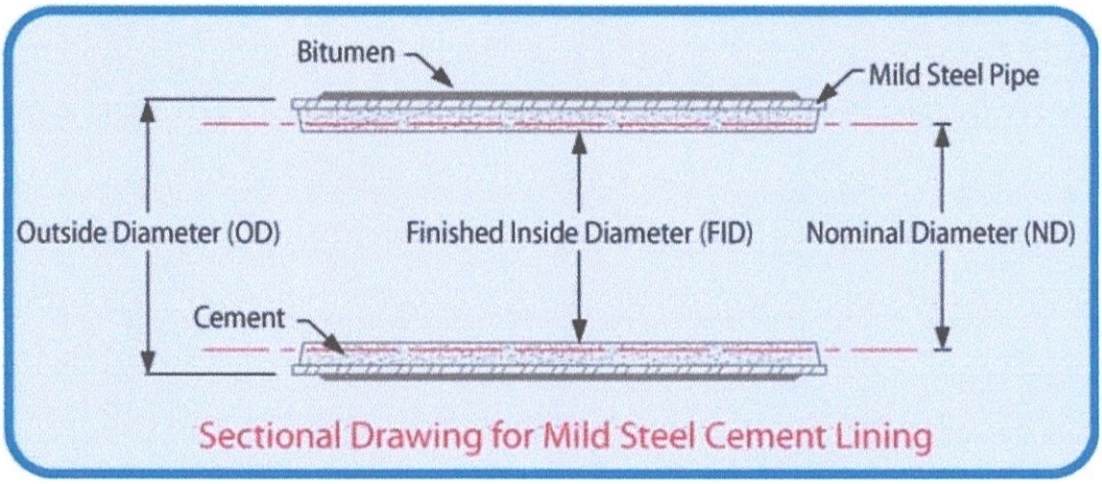


Figure 3.1 Cross section of mild steel pipe

Source: http://www.lbhbro.com.my/products

3.3.2.1 METHOD TO JOINTING MS PIPE

There is many type of connection for mild steel pipe. For example flanged joint, collar joint, socket joint and flange adaptor. each connection has its own functions and advantages. For example flange adaptor, it suitable use for jointing a plain ended pipe to a flanged pipe or fitting special such as a valve.

Firstly, adjust the flange on the MS pipe before welding the flange to the pipe. The size of flange must match to the MS pipe and the flange must be positioned outside the pipe wall.

Photo 3.8 The flange must be positioned

Before the pipe is welded, turn on the machine generator to produce electricity to use the welding machine. After that, welding that pipe with flange. Welding process requires the right process to get a solid connection and to prevent leakage. Conducted during the welding process, the welding process should stop for a moment to remove the excess sheet metal or metal with a taper hammer. After that, use a steel brush to clean the surfaces to be welded. Sheet metal has to be removed to create a new connection for welding and give it a stronger weld.

Photo 3.9 Welding the flange

Photo 3.10 Remove the excess sheet metal

After that, close the flange with blink flange. Blind Flange is an accessories of mild steel pipe end of the pipe. The connections that blink flange to flange are using the bolt and nut. Gasket must be placed at between the blink flange and flange to fit the connection and to prevent leakage.

Photo 3.11 Blink flange, gasket and flange

Then, connect that pipe to the existing pipe with collar joint. This connection requires a weld at the external side of the collar.

Photo 3.12 Welding the collar to jointing that pipe

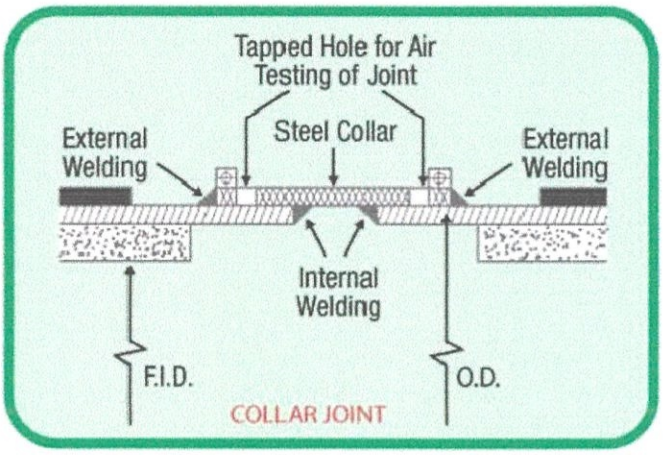


Figure 3.2 Detail of collar joint

Source: http://www.lbhbro.com.my/products

3.3.3 POLY STEEL PIPE

"Poly Steel Pipe" is composite pipe made of steel at the middle pipe and covered with Polyethylene (HDPE), both as the external and internal linings. The connections of poly steel pipe by making the screw threads at the pipe and connected to the poly steel accessories. The number of threads and screw rotation is dependent on the diameter of the pipe. The large diameter of pipe, the more the number of threads that need to be made. The size poly steel pipe and accessories are available in the diameter range of 15mm to 100 mm. For connection straight and long, the pipe should be connected directly to minimize usage of accessories. For each change in pipe direction, must use appropriate accessories such as a tee and elbow.

"Poly Steel Fitting" are made of Malleable Cast Iron boodles with Epoxy Coating and PolyPropylene (PP) lining with the rubber Sealling Ring (O-ring) Inserted at the joints, it prevent water leakage on the thread joints. The PP Internal lining prevents contact of transported substance with the Malleable Cast Iron underneath, resulting in lasting durability and high resistance to deterioration, even in the most extreme environment.

The advantages of using the Poly Steel Pipe at the building is the pipes are resistant to corrosion. These pipes are lined with the polyolefin, and the workability of pipe is long. So the pipe is enable to be resistant to acid, alkaline, and chemicals. Besides that, that pipe is clean and healthy. it was designed to provide the clean water and safe to drink that water. The internal plastic pipe is corrosion resistant. So, this pipe can maintain the quality of water and avoid some of the problems of odor, color and taste is not good at water.

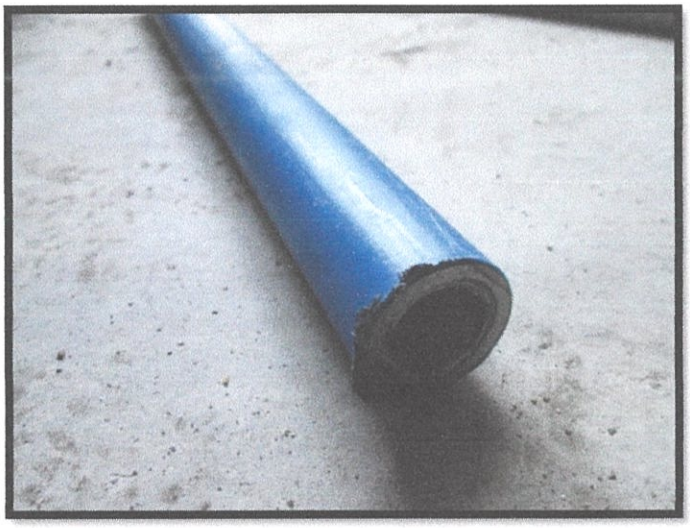


Photo 3.13 The Poly Steel Pipe

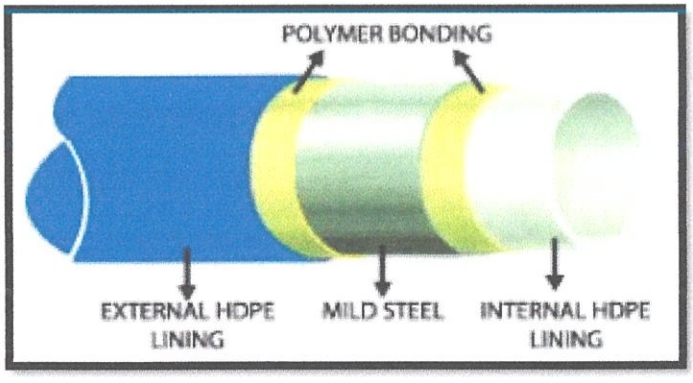


Figure 3.3 Poly Steel Pipe diagram

Source: http://www.pspsb.com.my

Table 3.2 Number of thread and screw twisting based on the diameter of pipe

Nominal Diameter (mm)	Length of Screw Twisting (mm)	Number of Tooth Count Thread (no)
15	10 - 11	5.5 - 5.6
20	12 - 13	5.5 - 6.5
25	14 - 15	6.0 - 7.0
32	16 - 17	6.5 - 7.5
40	17 - 18	6.5 - 7.5
50	19 - 20	8.5 - 9.5
65	22 - 23	9.5 - 10.5
80	26 - 27	11.0 - 12.0
100	32 - 33	13.0 - 14.0

Source: http://www.pspsb.com.my

3.3.3.1 METHOD TO JOINTING POLY STEEL PIPE

Firstly, measure the pipe using the measuring tape and cut the pipe using the cutter with the length required. The time required to cut the pipe that is dependent on the size of the pipe. The larger the diameter of pipe, the longer the time required to cut the pipe.

Photo 3.14 The poly steel pipe has been cut

The next process is threading process. This process to make a thread on polysteel pipe and allow the pipe is connected to pipe accessories such as 90 elbow. Firstly, setting the PSP clamp in sequence set. Fixed the PSP Clam according to specified sequence of numbers on the threading machine. When the mechine is aready to use, insert the pipe into the threading machine and hold the poly steel pipe with PSP clamp. After that, turn on the machine and the machine will turn the pipe over and over again. After the treading process, the threads should be cleaned by using a brush to clean the oil and waste from the pipe threads.

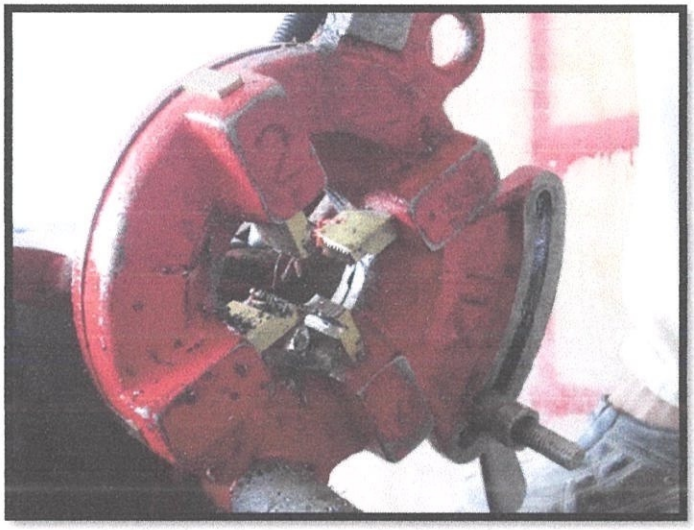


Photo 3.15 Threading mechine

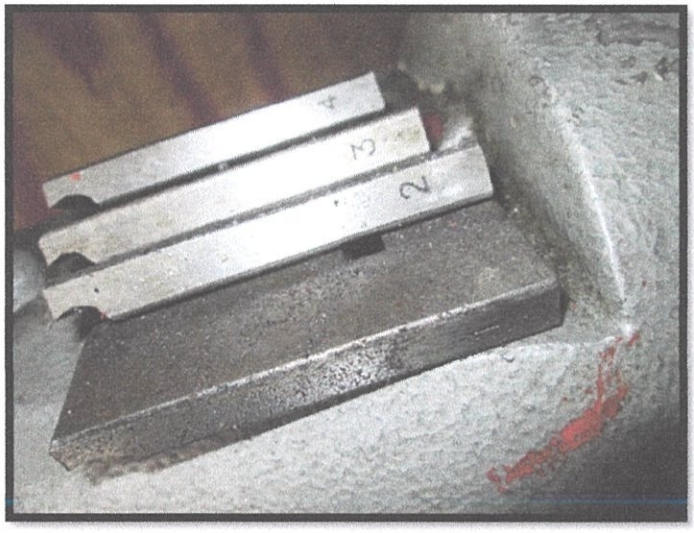


Photo 3.16 PSP Clamp

Photo 3.17 Threading Process

After that, to join the pipe with accessories, use the thread to be placed in the thread line at the Poly Steel Pipe. then use the upvc glue to give sticking to the thread. The next process is wrap that threads at pipe with white tape. Use white tape is intended to fit and tighten the pipe with a pipe fitting accessories. After that, use the upvc glue again to stiking that white tape.

Photo 3.18 Use the thread to be placed in the thread line

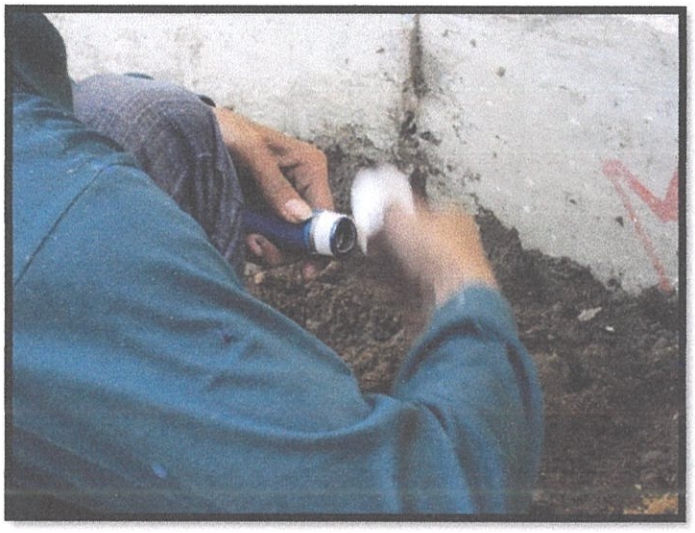


Photo 3.19 The thread of poly steel pipe was wrap by using white tape

Photo 3.20 use the upvc glue again to stiking that white tape

The next step is to connect pipes with accessories. This connection must use pipe wrench to strengthen and tighten the pipe installation.

Photo 3.21 Use pipe wrench to strengthen and tighten the pipe installation

CHAPTER 4

CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

Plumbing works is very important aspect in a building. This is because plumbing system is something should have in every building to make that building function. In addition, the plumbing system also has a important function for a building, that is for fire fighting.

There are many advantages when using the high quality of pipe. For example, the pipe is able to supply clean water to the users of the building, as well as the proper use of the material in the manufacture of pipes and proper installation of the pipe to prevent the corrosion and leaks.

In conclusion, the selection of quality pipe to prevent the pipe from leaking and erosion that can affect the health of consumers. In addition, the work of installation and pipe connection requires high skills to get the perfect and there are no problem at pipe system after pipe installation work is completed. The efficiency of employee work is very important in the process of connecting the plumbing system. In fact, the different types of pipes have the different fittings and connections.

4.2 RECOMMENDATION

Based on observations done at the construction site for 5 months practical training in building construction site, in terms of ms pipe installation done by the contractor has experienced some trouble from Syarikat Air Terengganu (SATU). The changes in pipeline to be approved by the SATU, and at the same time, it should always make and a discussion for plumbing system before it was installed. In addition, the use of pipes and accessories should be got approval from Suruhanjaya Perkhidmatan Air Negara (SPAN) dan SIRIM.

REFERENCES

Company Profile. (1993). WRA Services Sdn. Bhd.

Bute Engineering (M) Sdn. Bhd. (2011). *Hot & Cold Water Piping System.* Retrieved 25 January 2014, from http://www.beppr.com

Poly Steel Pipe Sdn. Bhd. (2002). *Plumbing System.* Retrieved 19 February 2014, from http://www.pspsb.com.my

Lbh Brother Industries Sdn. Bhd. (2008). *Pipe Specification.* Retrieved 7 March 2014, from http://www.lbhbro.com.my/products.htm

Lbh Brother Industries Sdn. Bhd. (2008). *Joint Details.* Retrieved 7 March 2014, from http://www.lbhbro.com.my/products.htm