DEPARTMENT OF BUILDING

UNIVERSITI TEKNOLOGI MARA

(PERAK)

INTRODUCTION TO EPOXY WATERPROOFING METHOD

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It is recommended that the report of this practical training provided

By

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Entitled

Introduction to Epoxy Waterproofing Method

be accepted in partial fulfillment of the requirement for obtaining the Diploma in Building.

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STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references are stated herein, prepared during a practical training session that I underwent at Jabatan Kerja Raya for a duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. It is submitted as one of the prerequisite requirements of BGN310 and accepted as a partial fulfilment of the requirements for obtaining the Diploma in Building.

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In the name of Allah, all praise is due to Him, the Sustainer of the Heavens and Earth and all that is within it and may His blessings be upon the Prophet Muhammad, peace be upon him. Alhamdulillah, with the grace and blessing for Allah S.W.T, I finally finished in writing my practical report. I am deeply grateful for those who have been around me, helping me with all the research for the past 5 months.

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ABSTRACT

In the construction industry, waterproofing is needed in order to preserve and keep the building stand still for a long time. Waterproofing have a few different method such as Cementitious Waterproofing, Liquid Waterproofing Membrane, Bituminous Waterproofing, and many more. Every methods are needed in different places so there are few factor need to be considered in choosing the right method of waterproofing. But each one of them have the same aim which is to prevent any water leakage inside or on the building. In this report, a new waterproofing method in Malaysia and it applications will be introduced. Epoxy waterproofing method will be conducted on top of the tiles. These method only need to apply some epoxy mixture (Epoxy + Hardener) around the toilet and 4 inches skirting and some flakes also need to be leave for 12 hours straight. Flakes have multiple different colour which provide interesting design and make the toilet look fancy. The most important thing needed in this method is a total cleaness. Dust will make the layer of epoxy mixture broke.

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CHAPTER 1

INTRODUCTION

1.1 Background and Scope of Study

Waterproofing is a main component needed in every building's structure. According to Mishra (n.d.), waterproofing in buildings is the formation of an impervious barrier over surfaces of foundations, roofs, walls and other structural members of building to prevent water penetrations through these surfaces. Commonly used materials for waterproofing in building is cementitious material, bituminous material, liquid waterproofing membrane etc. Waterproofing in buildings and structures are generally required for basement of structure, walls, bathrooms and kitchen, balconies, decks, water tanks and swimming pools etc.

Moreover, according to eddyhrbs (2013), waterproofing is the combination of materials that prevents water intrusion into structural elements of a building or its finished spaces. Basic waterproofing and envelope design incorporate three steps to ensure a watertight and environmentally sound interior. First, understanding water sources likely to be encountered. Water likely to be penetrated inside the building commonly from rainwater on above grade components and groundwater intrusion below-grade. Other sources also should consider as appropriate, such as overspray from cooling towers, landscaping sprinklers, and redirected water from such sources as downspouts and gutters. Next, designing system to prevent leakage from these sources. And last but not least, finalizing the design by properly detailing each individual envelope component into adjacent components. The envelope design must be carefully constructed and reviewed to ensure successful performance of the completed product. To prevent all possible water intrusion causes, a building must be enveloped from top to bottom with barrier or drainage systems, with diverter components added where appropriate to increase performance of the envelope. These systems then must interact integrally to prevent

water infiltration. Should any one of these systems fail or not act integrally with all other envelope components, leakage will occur.

Other than that, waterproofing system are to drain water away from a building located in ground having a surface above which a portion of the building extends. The building has a footer and at least one wall extending vertically from the footer. The system includes a first drain member located in a first trench provided in the ground outside the building. A membrane including a first portion and a second portion is provided. The first portion forms a liner which lines the first trench to form a trough for capturing water. The second portion is affixed to an outer surface of the wall along at least a portion of a height of said wall and extending toward the footer (United State Patent No. US 6,634,144 B1 , 2003) . According to "What is waterproofing" (2012), waterproofing is a method which prevent water from penetrating the house.

Last but not least, waterproofing is very important as it helps keep the house dry. Plus, it helps reduce humidity inside the house and protect things inside the house from any damage cause due to humidity or water exposure. It is also important for the veracity of the building. The advantages of waterproofing are it has variety of options. Depending on the level of water damage or personal preference, waterproofing system can be installed indoors or outdoors. Also, waterproofing increase the house's value which is the biggest advantage. The system prevents unwanted moisture from getting into the walls thereby allowing the mould to grow. Mould can impact human's health in a negative way. It is also preventing damage caused due to water seepage which can ruin the structural integrity. Moisture also causes metals to rust and wood to decay. Unhealthy living areas and week foundations will affect the property value however, aim of this study is to discover and introduce the new method of waterproofing in Malaysia.

1.2 OBJECTIVES

The objectives of this research are:

- To study thoroughly the application of Epoxy method on washrooms at the "Berek Polis" located at Jalan Muar, Segamat.
- To explore the likelihood the advantages and disadvantages of these method.
- To discover the differences between Epoxy method and cementitious waterproofing method which have been used worldwide.

1.3 SCOPE OF STUDY

The study was carried out to investigate the method used to improve waterproofing at Berek Polis at Jalan Muar, Segamat, Johor which consult by Jabatan Kerja Raya (JKR) Segamat. There are 30 houses are chosen to use this Epoxy method. The observation for this method were carried out a few times per week during the office hour. Consequently, the intent of this survey is to learn more about how to improve waterproofing with convenience method, which is Epoxy Waterproofing Method and problems occurred with the solutions that should have been taken.

1.4 RESEARCH METHODS

1.4.1 Site Investigation

Site investigation about the Epoxy waterproofing method took time for 2 hours on the construction site including discussion with the contractor and some construction work as an example to convince the client on the effectiveness of this method. All the observation results have been recorded in a short note with some photos.

1.4.2 Interviews

Semi-structured interviews done to the contractor and workers who are specialist in Epoxy work from Epoxy Xpert Resources (M) Sdn. Bhd. hired by the Jabatan Kerja Raya (JKR) Segamat for those construction works. During the interview, a set of same questions had been prepared. At the same time, additional questions also been asked during the interviews to clarify or further expand issues. The interview carried out about a few minutes.

1.4.3 Documents Reviews

All the existing documents which is provided by the Epoxy Xpert Resources (M) Sdn. Bhd. and been collected and reviews together by the client and JKR during the short meeting. All the documents such as company profile copies, warranty and method pictures also have been provided as the existing documents. Futher document reviews by JKR have been accomplished.

CHAPTER 2

COMPANY BACKGROUND

2.1 Introduction of Company

Jabatan Kerja Raya (JKR) Daerah Segamat was built in 1959 contains a few sectors such as Building Department, Electrical Department, Administrative Department and many more. Every departments have its own assignment such as Building Department must solve any problems involving the government building such as police department, schools, and houses that registered under the government. Problems that always occur on the building such as roof problems, waterproofing problems piping problems, and many more.

JKR Daerah Segamat also responsible in handling work inside and outside the city which include planning work, build, repair and maintenance work of roads, buildings and also supply clean water for Federal or State construction projects (Portal Rasmi Jabatan Kerja Raya Johor, n.d.)

JKR have receive a few new projects from the client which help many new companies and contractors to join the open tenders by the JKR. Some of the latest projects are located at Pusat Latihan Polis Malaysia (PULAPOL) who ask for JKR's help about their problems which include roof problems that occur at the officers' house, waterproofing problems that affect every house and piping problem. The waterproofing problem is the biggest problem which give the opportunity to a waterproofing company to introduce their waterproofing method to the JKR. Plus, waterproofing problems also occur at Berek Polis Jalan Muar, Segamat which are currently handle by Mr. Abd Malek Bin Sanat.

2.2 ORGANIZATION CHARTS

The highest position in this department is held by Mr. Zaid Bin Misran who is a civil engineer grade J41. He receives a help from his two assistant engineer which are Ms. Haryani Binti Mahad and Mr. Mohd. Jalaluddin Bin Abd. Hamid. Both graded JA36 assistant engineer.

Mr. Jalaluddin is responsible in taking care the provisions in the building department. Also, he is the supervisor at every project under the Building Department. Plus, he also receives help from three assistant engineer grade JA29 which are Mr. Mohd. Zafferi Bin Ismail, Mr. Mohd. Nazmi Bin Zainal and finally Mr. Abd. Malek Bin Sanat. They are responsible in taking care new project, dealing with the client as a consultant, and preparing a tender. Currently, Mr. Abd. Malek Bin Sanat is responsible for the new waterproofing method in Segamat. They also got help from the staffs in the department to do some work at the site such as measurement, civil work, and many more.

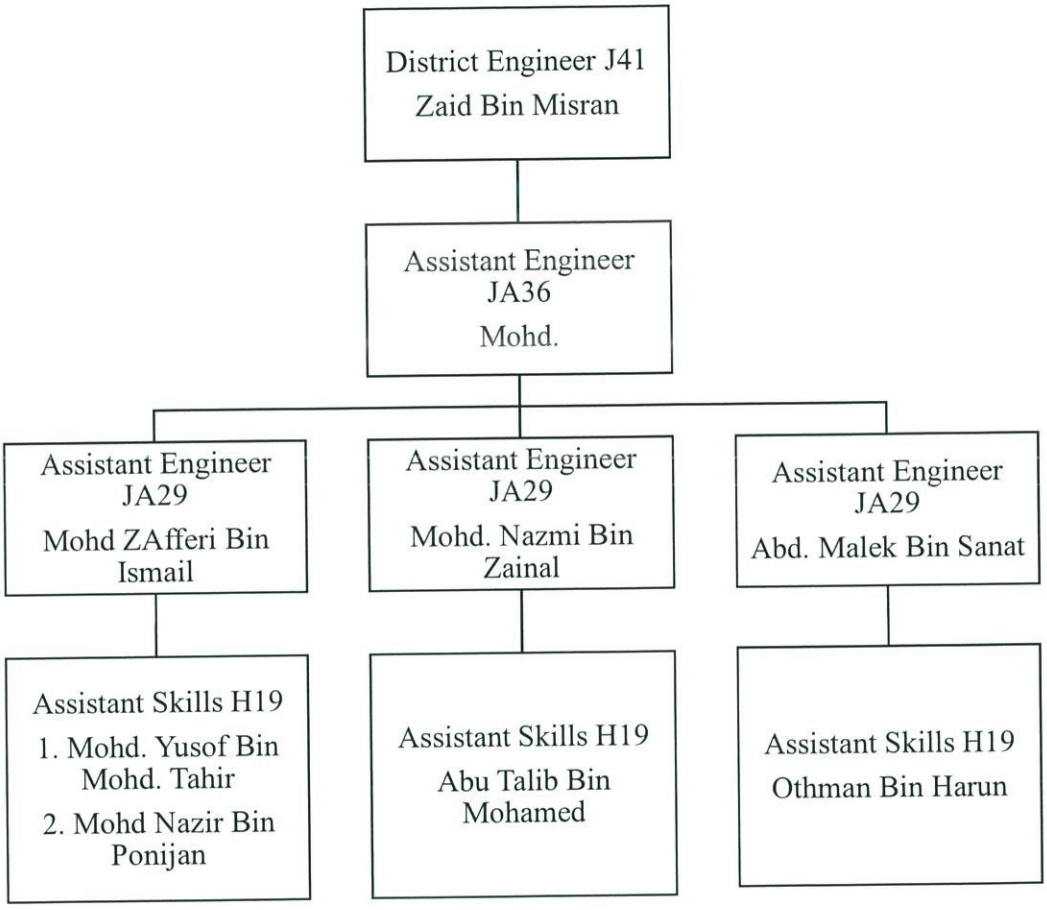

Chart 1 - Organization chart of Building Department

2.3 LIST OF COMPLETE AND ON GOING PROJECTS

Table 1 - Completed Project

BIL.	PROJECTS TITLE	CONTRACTOR AND CONTRACT NO.	CONTRACT ACTUAL PRICE	ADDITIONAL NOTES
1.	Upgrading Jalan Muar-Tangkak-Segamat, Johor (Stage 1: Segamat-Tangkak) Pakej 1B	Contractor: Iswarabena Sdn Bhd Contract no.: JKR/IP/CKUB/152/2011	Contract actual price: RM 150,000,000.00	Site possession date: 1.11.2011 Original date of completion: 4.11.2013 Current finishing date: 30.7.2015
2.	Build a crematorium with (1) cremator at Hindu's cemetery Lot 6256, Sg.Karas, Labis, Segamat.	Contractor: Pembinaan Eng Lee Jaya Sdn Bhd Contract no.: JKR/PERS/J/SG/02/2016	Contract actual price: RM 1,027,973.16	Site possession date: 18.5.2017 Original date of completion: 6.9.2017 Current finishing date: 4.10.2017
4.	Proposed of upgrading Jalan Tumang Fasa 2, Segamat district, Johor.	Contractor: Anjung Perkasa Sdn Bhd Contract no.: JKR/NEG/J/03/2012	Contract actual price: RM 26,000,000.00	Site possession date: 16.10.2012 Original date of completion: 18.8.2014 Current finishing date: 1.8.2015

Table 2 - Ongoing Projects

BIL.	PROJECTS TITLE	CONTRACTOR	CONTRACT ACTUAL PRICE	ADDITIONAL NOTES
1.	Kerja-kerja membaiki kerosakan bagi kuarters Polis Jalan Muar, 85000 Segamat, Johor.	Contractor: Tenang Makmur Enterprise	Contract actual price: RM 190,400.00 Additional price: RM 9,599.00 Total price: RM 199,999.00	Duration: 12 weeks Start date: 13.8.2019 End date: 5.11.2019
2.	Kerja-kerja naiktaraf Pondok Polis Felda Palong Timur, Segamat, Johor.	Contractor: Bedara Jaya	Contract actual price: RM 27,590.00 Additional price: RM 300.00 Total: RM 27,890.00	Duration: 6 weeks Start date: 15.9.2019 End date: 26.10.2019
3.	Kerja-kerja membina pagar luar, bilik stor, mengecat, tukar kerangka dan atap garaj serta lain-lain kerja yang berkaitan di Pejabat Penerangan Daerah Segamat, Johor.	Contractor: Berkat Hikmah Enterprise	Contract actual price: RM 103,000.00 Additional price: RM 6,262.24 Total: RM 109,262,24	Duration: 8 weeks Start date: 15.9.2019 End date: 9.11.2019
4.	Kerja-kerja membaikpulih serta menaiktaraf bangunan tempat belajar/bilik kelas tambahan pelajar Sekolah Agama Gemereh Segamat, Johor.	Contractor: Saga Murni Enterprise	Contract actual price: RM 46,190.00 Total: RM 46,190.00	Duration: 12 weeks Start date: 15.9.2019 End date: 7.12.2019

CHAPTER 3

CASE STUDY

3.1 Application of Epoxy Method

This project is about waterproofing work at "Berek Polis" at Jalan Muar, Segamat, Johor. The method apply in this project is Epoxy method which have been introduced in Malaysia for the past three years and this is the first Epoxy work in Segamat, Johor. Furthermore, this project involves 30 houses and 52 toilets. Other than that, some of the maintenance work need to be done at the Police Quarters are gutter changing, piping maintenance and many more.

According to Rodriguez (2018), an epoxy coating requires a clean and slightly porous surface to adhere properly. Epoxy may not bond to sealed or polished concrete. The concrete also must be fully cured. Before apply an epoxy floor coating, it is important to patch and repair all major cracks and chips in the concrete surface and to remove all grease. If the concrete is old, test the surface for previous layers of epoxy or other products that might have been applied over the years. To test for adhesive, pour a small amount of water onto the floor. It should soak in. If the water beads on the surface rather than soaking in, it likely has been sealed and may not be suitable for an epoxy coating. Before applying an epoxy coating, ensure that the temperature is suitable, and follow all manufacturer's recommendations. Unfavourable temperatures can cause the epoxy to bubble and peel. Epoxy is a two-part liquid that need to be mix before application. Once the product is mixed, time are limited to apply the epoxy coating before it starts to harden.

Table 3 in the next page is the method statement form for Epoxy Waterproofing method which include equipment used in this Epoxy Waterproofing Method, duration, labour and output.

Table 3 - Method Statement Form.

NO.	EQUIPMENT USED	DURATION	LABOUR	OUTPUT
1.	Broom. 	10 – 20 minutes	1 person	Used to ensure the toilet is clean before staring the waterproofing process. Also used to spread the flakes all over the toilet after the design process.
2.	Blower. 	30 minutes.		It is used to ensure the toilet are dry after the cleaning process and after the grinding process.
3.	Chisel and hammer. 	15 minutes		This equipment are important in this method process. It is because needed to take the trap off.

NO.	EQUIPMENT USED	DURATION	LABOUR	OUTPUT
4.	Grinder.  	15 minutes	1 person	Grinding the whole area in the toilet including 4 inches of skirting.
5.	Tape 	5 – 10 minutes		For design stage and to close any open area or unwanted open area which can occur problems in this method. Also to cover the trap.

In this project, it started with cleaning the toilet and take all the toiletries out. This is to ensure that surface preparation work are going smoothly and to ensure that the toilet is clean from any dust can interrupt the entire process. Wash the toilet using water to decrease the fine dust in the air during the grinding process.

Figure 1 - Cleaning process begin.

Figure 2 - Toilet's flooring need to be wash for the next step.

Next, carefully take out the trap and break the cement using an iron chisel and a hammer around it so that the trap are fit enough. Make sure that the trap is still good to use again after the waterproofing work is complete. Other opinion is to change the trap with a new one.

Figure 3 - Take out the trap using an iron chisel.

Figure 4 - Cement around the trap also need to be break.

Figure 5 - New traps are also provided by the contractor.

Moreover, use a wet towel and blower to blow the leftover cement dust. Also, blow and wipe in between the tiles to ensure that no dust a left which can affect the epoxy method it is including every corner in the toilet to provide a better surface without dusts.

Figure 6 - Using a blower to ensure no dust left.

Figure 7 - Every corner need to be blow.

After that, use a Diamond Wheel grinder to roughen the surfaces including skirting 4 inches so that the bond between epoxy and the surface are strong. Don't forget to wear Personal Protective Equipment such as ear muffs, safety shoes, and nose protection to ensure safety during surfaces processes. Grinding increase the dusts inside the toilet so mask is an important thing needed to prevent the dust from affecting the body condition.

Figure 8 - Grinding process include 4 inches skirting.

Figure 9 - Surface condition after the grinding process.

Wash the toilet once again to reduce the amount of dusts from the grinding process and dry it using towels, blowers and a heat gun before continue the next stage.

Figure 10 - Toilet are clean to provide a better epoxy condition.

Moreover, replace the trap with a new one which can be perfectly fit into it place with epoxy cement. If there is a small hole or a broken tiles on the floor, use the epoxy cement to prevent water leakage. The epoxy cement are a mixture of epoxy and chemical reaction of M5 to make it harden.

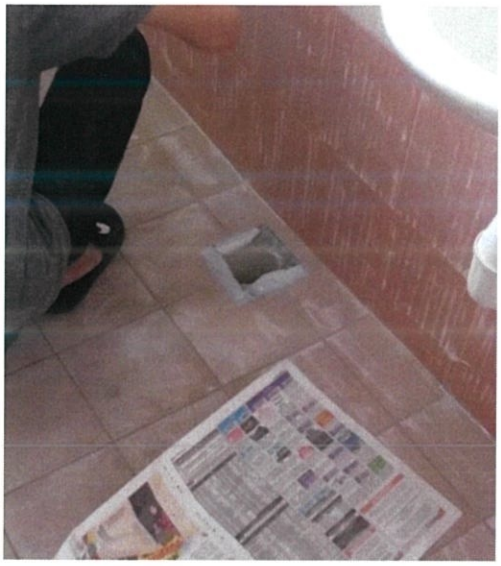

Figure 11 - Epoxy cement around the hole to fit the new trap.

Before starting the design stage, use a tape on top of the 4 inches of skirting. It work as a border and a mark to apply the epoxy hardener for epoxy work.

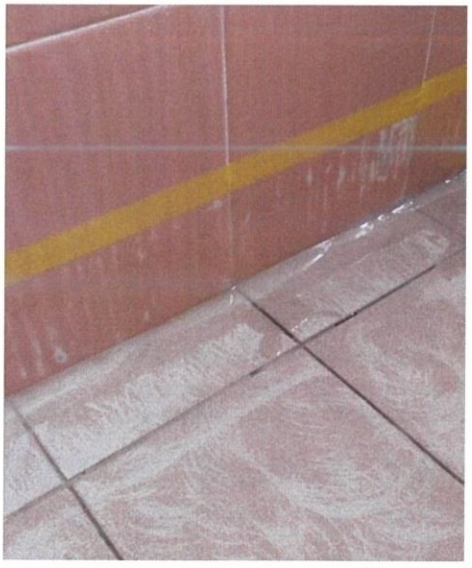

Figure 12 - Tape on top of 4 inches of skirting.

Figure 13 - tape around the toilet.

Also, cover on top of the trap with tape to prevent water from entering the water hole. It is also to prevent the flakes and epoxy hardener from blocking the water hole. Do not remove the tape until the entire process is done.

Figure 14 - Apply the tape on the trap.

Figure 15 - Trap that have been cover.

Figure 16 - Tape is use to seal the trap.

Start to measure for design stage. It is important to have a precise measure according to the toilet area so that the design is fit perfectly. Use a marker pen and a ruler to have a precise measure.

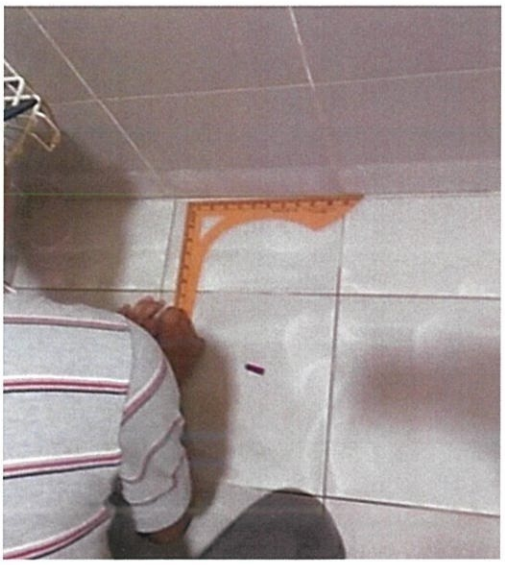

Figure 17 – Measure stage as a beginning of design stage.

Furthermore, use a tape to design according to the design choose by the client. A few designs are provided by the contractor so that the client can choose which are interested. Plus, client can also create their own design such as animals, flowers, and many more also they need to choose the colour for the design.

Figure 18 - Apply the tape according to the design.

Figure 19 - Design stage almost done.

Figure 20 - Design stage have complete.

Apply a mixture of epoxy + hardener (M5) on the inside of the design of certain part, on the skirting and the border. These mixture help to attach the flakes onto the floor for a long time. Do not apply a thick layer of the mixture on the floor because it will take a long time to dry before the flakes can be apply.

Figure 21 - The mixture are being apply on skirting.

Figure 22 - The mixture apply on the floor for the first layer are done.

Next, pour the flakes onto the floor for the first layer. In this case study, the colour chosen by the client and consultants for the first layer is white and blue for the second layer of epoxy flooring.

Figure 23 - Close up on the white flakes used in this method.

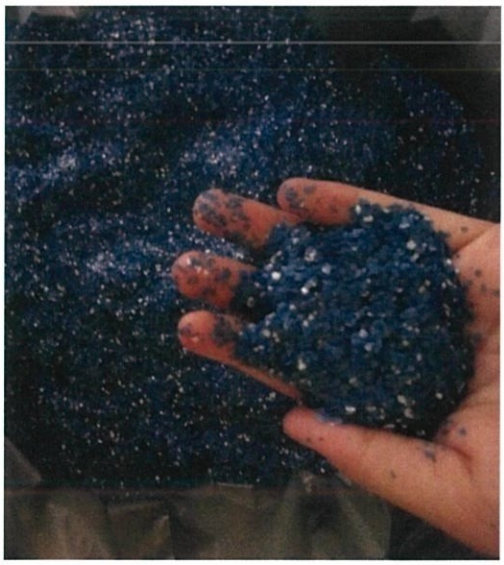

Figure 24 - Close up on the blue flakes used in this method.

Figure 25 - The white flakes were poured on the floor.

Figure 26 - White flakes for the skirting around the toilet.

Furthermore, used a broom to spread the flakes all over the floor including the 4 inches of skirting. The mixture of epoxy and hardener will help the flakes to attach on the floor like a glue.

Figure 27 - Using broom to spread the flakes nicely.

Figure 28 - Final result for the first layer.

After finished with the first layer, in need to by dry for 1 hour before continue with the second layer. Then, wipe the extra white flakes on the floor which do not attach with the mixture. Make sure that there are no dust or white flakes left on the floor before starting the second layer.

As for the second layer, the order of processes are the same as applying the first layer. Last but not least, it need to be left for 12 hours for dry process before the toilet can be used again so that no problems occur during the time limit.

3.2 Method's Advantages and Disadvantages

According to Blue & Green Tomorrow (2016), one of the advantages is the appearance. Compared to an average garage floor, epoxy floors are bright and professional. Their appearance alone makes them entice to use. The smooth and even surface is also very easy to sweep and maintain. Since not much sticks to this type of flooring, cleaning up a mess a very easy. Epoxy method also allow the client to choose different designs according to the preference and colours. The normal colours that have been chosen by the clients are white, grey, dark grey, black, sky blue, dark blue, red, green, dark green, yellow, cream, brown and dark brown.

Figure 29 - Epoxy flooring finishing look.

Moreover, this method are affordable to use. Compared to other types of flooring, the per-square foot cost of epoxy floors are much affordable than other method. The price are normally based on amount of color chosen by the client. Since it can be installed directly over concrete and other flooring types such as tiles and masonry, the installation costs are quite a bit lower than the others. Pricing remains one of the biggest and the most immediate advantages on epoxy flooring. Plus, the price also depending on the number of colour used.

Last but not least, the advantages of epoxy is the flakes can be attach with just a thin layer of the mixture of epoxy and hardener. This method does not need a thick of layer used to attach the flakes.

Figure 30 - Epoxy flooring. (Source: epoxyxpert.com)

Just like other method used in waterproofing, there will be disadvantages in epoxy waterproofing method. In this case, epoxy might cracks and chips can be develop. Though the chips start out as a small annoyance, eventually they can lead to a large area of the coat peeling off the floor. The floor has to be repaired when it happen.

Lastly, these epoxy method is quite sensitive. In needed to be installed exactly according to the directions. Plus, the surrounding and the floor need to be clean even without fine dust to begin the work. If it did not done properly, the flooring will not last as long as it should be. The coating also should be applied only during the time of the year when the humidity are low. This is because moisture can affect the durability of these floors.

3.3 Differences between Epoxy Method and the Usual Method of Waterproofing

First of all, cementitious waterproofing coating are widely used in the construction industry. Generally, it is used as waterproofing and protecting surfaces such as masonry, concrete and tile from penetrating water or other environmental influences. It is protecting the structure by coating with slurry-type waterproofing compositions that after hydration and hardening from membranes. The resulting membranes protect the underlying structures and prevent the penetration of water. Furthermore, based on (Patent No. WO2016142339A1, 2016), cementitious slurry-type waterproofing membranes are also used beneath tiles and slabs of stone or other materials for example on balconies or terraces. In such cases the cementitious slurry-type waterproofing membranes functions not only as a waterproofing membrane, but also as a crack bridging layer.

Basically, cementitious slurry-type waterproofing membranes are products based on fine cement mortars with specific proportions of elastifying components. The products are applied in one or more layers. In many cases, two layers between 0.5 and 10 mm are applied. The final waterproofing membranes have a thickness of more than 1 mm, particularly more than 2 mm.

Different from the epoxy method, Epoxy Waterproofing Method have been used worldwide in the construction industry from all over the world such as United States, German, and many more but still there are some country which still uncommon with this method such as Malaysia. According to May (1988), Epoxy resins made their significant commercial debut around 1947 in the United States. The first product was made by the Deyoe-Raynolds Company. It was essentially considered as a polyol for the preparation of synthetic drying oils and correspond to the approximate chemical structure. The term epoxy is a prefix referring to a bridge consisting of an oxygen atom bonded to two or other atoms already united in some way. Epoxy resins define as any molecule containing one or more, 1-2 epoxy groups.

CHAPTER 4

4.1 Conclusion

Waterproofing in buildings is the formation of an impervious barrier over surfaces of foundations, roofs, walls, and other structural members of building to prevent water penetrations through these surfaces. The building surfaces are made water-resistant and sometimes waterproof. Commonly used materials for waterproofing in building is cementitious material, bituminous material, liquid waterproofing membrane and many more. Waterproofing in buildings and structures are generally required for basement of structure, walls, bathrooms and kitchen, balconies, decks, terrace or roofs, green roofs, water tanks and swimming pools and so on. In this report, Epoxy Waterproofing is being introduce it method statement and advantages.

Many existing options can successfully in providing waterproofing to a structure. The successful application of Epoxy Waterproofing Method can come into many advantages towards the construction. One of the advantages for the application epoxy method is much affordable for all to apply it. Plus, it does provide a better look to certain places. Normally, this Epoxy Waterproofing Method does apply at the toilet because most of the leaking problem occur in the toilet. Sometimes, it does not because of the waterproofing but it is because of the piping inside the structure which also led to improvement in waterproofing are needed. Different of other waterproofing method, epoxy waterproofing method does provide a better appearance than the other which also give a better performance and more satisfying than the other.

Despite that, Epoxy Waterproofing have some problems during applications such as dust will affect the layer of epoxy mixture. This is why the toilet need to be clean before starting the epoxy waterproofing method. Even a fine dust could led to a broken layer of epoxy mixture and improper performance of epoxy waterproofing method. The major problem which always occur is it need 12 hours to dry and cannot be used for the time being. There will be a foot step and unattached flakes because of the water.

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