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THE SIGNIFICANT EFFECT OF FLOOR SURFACE ROUGHNESS ON SLIP RESISTANCE IN PUBLIC TOILET IN TANAH MERAH, KELANTAN

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ABSTRACT

Surface texture comprises surface roughness, which is frequently represented as roughness. Surface roughness influences by friction. It has been founded that surface roughness has a significant impact on the slip resistance between shoe heels and floor surfaces under various walking scenarios. The slipperiness of the public toilet floor is one of the risk variables that influences how frequently people slip and fall. Slip resistance is now regarded as a key characteristic of footwear. Continuous efforts are being made to decrease slip, trip, and fall accidents by increasing friction between shoes and floor contact. These problems persist because of the heavy traffic volume encountered during holidays. However, all public restrooms must be secure enough for users. Most of the previous study establishes friction measurement in relation to slipperiness evaluation of shoes and floor. Therefore, background increasing the traction of floor surfaces would be desired, but there not enough data to say whether traction properties are linearly connected with topographic features of the floor surfaces or what scales of surface roughness are necessary to successfully limit slipping hazards. This study builds on prior results about how public toilet floor surface finishes affect slip resistance performance for the best slip resistance controls in various surface roughness with varying type of floor. Depending on the type of floor being used to test slip resistance, the roughness of the surface will be measured. The evaluation of slipping hazard exposures that start the chain of events leading to an accident may be all that is needed to measure slipperiness. To prevent a loss of balance and an accident, it is necessary to consider human capacity to foresee slickness and adjust to risky settings. Expecting prediction to identify whether public toilet in Tanah Merah is safe to used or not.

Keywords: surface, texture, roughness, public toilet, friction

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INTRODUCTION

PROBLEM STATEMENT

The primary factor triggering slipping or falling is a lack of contact between the shoes and the floor. The Friction coefficient between shoes and floors is influenced by several variables, including the floor's surface roughness, the floor's substance, the level of floor contamination, and the friction measurement tool. Even floors from the same manufacturer may have various friction coefficient depending on the material. After prolonged use, the wear state of floors may change, and different sections may have distinct geometrical features that ultimately influence the slip resistant.

The enormous impact on public restroom use caused by sharing facilities and heavy traffic in the Tanah Merah area is the study's main problem. Due to this situation, the bathroom floor will always be wet, which may result in user injury. Due to the fact that the floor is constantly wet and splattered with water due to public holidays and weekends, there are more opportunities for accidents due to slips and falls.

PURPOSE OF STUDY

The purpose of this study is to identify the significant effect of the floor surface roughness on slip resistance for public toilet in Tanah Merah area regarding to the safety aspect for the public users.

AIM AND OBJECTIVE

The aims for this study is to identify the type of the floor finishes used for the public toilet are safe to use or not in order to prevent any injuries among the users.

While the objective for this study is :

- i) To identify the best floor finishes for the public toilet which is wet and slippery.
- ii) To prevent any injuries due to the wet floor that can cause slippery among the public toilet users.
- iii) To determine that public toilet in Tanah Merah are safe for the users or not.

SCOPE OF STUDY

The scope of this study is targeted to the public toilet users in Tanah Merah town, Kelantan.

LITERATURE REVIEW

INTRODUCTION



Figure 1: Public toilet signage

This topic will discuss the main relationship between floor surface roughness and slip resistance in public restrooms. In all the work that was done to reach the goals, including research and study. The earlier researchers helped the study accomplish its goals and gave better information on this study.

Type of Public Toilet Floor

According to the dictionary, a public toilet is a room or booth used by the public for urination and defecation, and it must have at least a bowl with or without a seat (for sitting or squatting), as well as a waste pipe and a flushing device. Common sites for public restrooms include inner-city areas, workplaces such as companies and factories, schools and universities, and other places of employment and higher education. Like this, public restrooms are typically available at museums, theatres, bars, restaurants, and entertainment venues. Toilets for general use are typically available in train stations, gas stations, and long-distance public transportation vehicles like trains, ferries, and aeroplanes. Large outdoor events frequently have portable restrooms provided.

Difficulties with public toilet flooring include water, dampness, and increase risk activity. A particular set of qualities must be present in the materials used in a public restroom. Materials used for flooring must be able to withstand heavy traffic in a secure environment. There is some type of flooring for public toilet.

Concrete Flooring



Figure 2: Concrete flooring

This is an excellent, affordable option for any public toilet floor in a busy area. Under surface covers, there is already a subfloor made of concrete. It can be painted over it with a paintbrush or sealed to use as flooring. Concrete flooring is simple to maintain and do not require frequent sealing. It is easy to clean and maintain, water resistant like tile, and highly durable. Once finished, disinfecting the floor usually just requires a quick clean with warm water. With a variety of polishes, stains, and other decorative treatments, it may be glammed up for comparatively little money.

However, if done incorrectly, it will either be overly harsh and uncomfortable on the bottoms of user feet or too slippery and hazardous when wet. For internal use, it is best left with a semi-smooth finish. Like tile, concrete feels cold to the touch and takes a while to heat up or cool down. Concrete needs to be sealed since it can stain like tile can. As a result, concrete surfaces might vary depending on how they are finished. Because of the friction, this also influences slip resistance.

Tiles Flooring



Figure 3: Tiles flooring

Clay and other natural sediments are used to make tiles, which are then burned in a kiln to a stone-like hardness. After that, a melted glass coating is applied to make them stain and water resistant. Tiles are adaptable and excellent for heavy traffic public toilet settings because it extremely resilient and do not easily crack. They often have strong defenses against several types of irreparable harm and come in a variety of patterns, shapes, and styles. When installing tiles, there may be instances of water absorption through the grout joints. Bacteria and other liquids can enter through the grouting as well. Although it is simple to maintain, a mop is typically used for cleaning. This is because such undesirable materials can be quickly removed by sweeping, wiping, or vacuuming by placing them on top of the tiles. Virtually any commercial or easy DIY cleaner works without harm on more difficult stains. Tiles made of more porous materials frequently have a coating or other barrier to stop bacteria from growing on them. The glaze has a shining surface that you can quickly wipe, making it even simpler to clean.

Unfortunately, tiles are so slippery. Tile floors can be very slippery, which makes sense given their glossy, cleanable surface. Slipper socks and shoes can be dangerous for people with balance disorders or for people who trip and lose their balance. Additionally, there is the spillage issue. If you spill water on tiles, it will be challenging to locate the liquid and effectively clean it up. That only makes the chance of slipping worse. Without a proper finish, low-quality tiles will not be durable.

Epoxy Flooring



Figure 4: Epoxy flooring

Epoxy resin is the ideal material for a public restroom floor since it is resistant to water, chemicals, and bacteria. Since epoxy is non-porous, the floor won't absorb the moisture found in a public restroom. It also doesn't require waxing. The removal of dirt, filth, cleaning agents, and production waste is a breeze. Epoxy floors also have the benefit of having less odor due to bacterial decomposition. Additional antimicrobial component is blended throughout the epoxy, providing protection on the inside, and providing some level of ongoing protection for the floors. It can be kept clean by simply using a brush and clean water to rinse the floor. Another choice is pressure washing, which eliminates any concerns about water escaping underneath the flooring. A floor will typically become more slippery under certain circumstances the glossier it is. Epoxy flooring gets quite near to being ideal, despite not being ideal for all uses. Chips, cracks, and slipperiness are typical issues with this material.

Factor In Selecting Floor Finishes For Public Toilet

Public toilet spaces can influence the entire aesthetic value in the specific spaces, it's too important to consider the factor to select the best type of floor finishes in the public toilet. Materials that are used to create or cover a floor, such as wood tiles, have been referred to as flooring (Rundell &Gusyneth 2002). Finish refers to how a surface look. Therefore, materials are used to finish flooring. By utilizing a variety of materials at a reasonable cost while guaranteeing durability, aesthetics, and others these materials provide taste, comfort, and aesthetics. Durability, costing, smoothness, slipperiness and cleanliness is the elements should be taken into account when choosing a flooring material.

Durability

The chosen flooring material must be sturdy and long-lasting enough to withstand loads, various weathering effects, decaying, etc. It is ideal for flooring

materials to last about if other structural elements. Among other materials, flooring made of marble, concrete, and mosaic have the best durability. The floor's resilience for public restrooms allows it to sustain heavy foot traffic without deteriorating.

Costing

Price ranges for various floor materials vary. The price may rise together with the level of quality and durability. However, the choice of flooring material is made based on several variables, including the estimated total cost of the project, the style of building, how the floor will be used, etc. As a result, these considerations should be used to determine the initial cost.

Slipperiness



Figure 5: Wet Area Sinage

The top surface of flooring shouldn't be slippery because of its smoothness, especially when it's wet. When a floor material is over polished, it becomes slippery. Public toilet floor tiles should be treated with an anti-slip substance. Public restrooms frequently have humid settings, which can result in floors that are mucky and full of bacteria, making the floors slick. Cleaning experts must take extra precautions to ensure that the floors they maintain are secure and slip-resistant because slip-and-fall accidents are a growing concern today. However, it can occasionally be challenging to pinpoint the precise cause of a slick surface.

According to the previous research, there are more than 70 devices that have been developed to evaluate slip resistance (Strandberg1985), but none of them perfectly mimics the action of a human foot, and there is currently no method that is widely accepted for determining slipperiness. A method for assessing slipperiness may prove to be impossible to develop due to the complexity of the forces involved in human locomotion and the infinite variation of shoe/floor/contaminant interfaces. The study of surface roughness opens yet another route for the creation of slip-resistant shoes and floors. Instead of measuring the coefficient of friction, it might one day be able to rate slip resistance in terms of the characteristics and extent of surface roughness coefficient of friction.

Surface Roughness Slip Resistance In Relation To Floor Cleaning

Although surface roughness tests are becoming more and more widespread, the TRRL pendulum tester is still the most widely used to evaluate floor slip resistance in the UK. Recent research at BRE has shown a connection between flooring material cleaning abilities and sub-millimetres surface profile characteristics. To characterize the floor cleaning requirements, the push toward roughness assessments to evaluate slip resistance may thus prove to have additional benefits.

Slip resistance can be challenging to assess because there are so many variables that might have an impact on a surface. Slip resistance ratings require controlled testing facilities, a standard rating, appropriate evaluation, and defined testing procedures in order to produce accurate findings. After prolonged use, the wear condition of floors may change, and different sections may have distinct geometrical features that ultimately influence the coefficient of friction.

It's crucial to realize that the flooring industry does not consistently test or label the slip resistance of its products. This frequently results in facility users making bad and inaccurate decisions about what kind of floor is best for their particular location. Rarely do flooring manufacturers give their clients instructions on how to care after their goods. The chemical cleaning business is left to provide the consumer with direction in this situation, however these chemical makers don't always test or label their products' influence on slide resistance. It is reasonable to imagine that any floor cleansers used in facilities might similarly leave a slick film behind.

RESEARCH METHOD

In this research, the method has been conducted and its process will be made clear in order to collect the research data.

Introduction

The methodology that will be used in this study is qualitative method which involves research, questionnaire to public toilet users and observation. In this study, literature review used to acquire information regarding the main topic in this research that conducting in Tanah Merah area by collecting data from related studies of articles, journals and research.

All the information and data has been gathered. Next, all the collected information and data will be analysed, synthesized and reviewed. This is because the main reason is to identify the significant effect of floor roughness towards slip resistance in order to prevent injuries for the users. All those collected data is crucial since it can be used as a proof for this research.

Research Approach, Method and Techniques

The approach for this topical study is qualitative method. This method more focus on the reading to gain information through the literature review findings, doing survey that targeted to the public toilet users around the 4 selected public toilet in Tanah Merah and lastly observation to identify the best floor finishes that proven efficient as anti-slip resistance.

Literature review findings, is about collected data from the first tier sources from articles, journal and websites to get the better information regarding the floor finishes for the public toilet. There is evidential research that had been conducted before about the relation floor finishes with the shoe sole. This study proof that the significant of friction to avoid slippery on floor.

In this study, a quantitative research method had been done to collect the data. 20 questionnaire had been distributed to the 20 public toilet users to rate and give their opinion regarding the selected public toilet each in Tanah Merah area. By conducting this method, its show the users satisfaction rate towards the selected public toilet.

Lastly, site visit to observe the reality public toilet in Tanah Merah. Not just that, by visiting the site, is to identify the type of the floor finishes used to collect the data for this study. All the data will be compare with 4 selected public toilet to propose the best anti slip floor resistance that can used for the public toilet and safe for the users.

All the information obtained from this approach indicate the data that influence the result from this study. Not just that, all the data also have some information about the methods and solutions to prevent all the nightmares injuries that cause by the slippery floor.

Method Analysis

The method analysis is the way to keep on track regarding the flow of progress for this study based on used method.

For the literature review method is consist of collected information from the sources like articles, journal and website. All the information result will let more understanding towards the study and also as a guidance for this study. The selected information had been compiled and quoted in this study as a guideline reference.

Regarding the questionnaire, the only one format that ask the users to rate and select the floor condition level based on selected public toilet in Tanah Merah. They also required to comment even critique or give their recommendation in the

notes section. This questionnaire had been distributed to 20 users at each public toilet. All the responses will used as the findings result for this study.

Site visit is the one of the method to identify the type of the floor finishes based on selected public toilet to collect the data by observing to compare it. When the expected outcome is to identify the factor that should be consider to ensure that public toilet are safe for the users.

Compilation all the data is the proof and evidence for this study for the better environment to all the public toilet users.

Research Scope and Limitations



Figure 6: Map Tanah Merah, Kelantan

The scope for this study is focusing 4 selected public toilet in Tanah Merah area which is Ismail Petra Mosque that located at the heart of Tanah Merah, Saidina Osman Mosque, located at Jalan Lubuk, McDonald's and Petronas Tanah Merah DT the one of the focal point in Tanah Merah and Surau Nik Daud Al-Fathani located nearby the playground Pechong.

For this study is targeted 80 public toilet users to give their response via google form each based on the selected public toilet. Reponses consist of 20 responses that usually used the public toilet.

Summary

This study basically consist of 3 method which is literature review through the reading from the journal, articles and website, users opinions collected via questionnaire that distributed for 80person and 20 for each selected public toilet and observation method through site visit to identify the type of the floor finishes used at the public toilet in Tanah Merah.

All the collected data will be analysed, synthesized and reviewed as a research evidence.

DATA ANALYSIS AND FINDING

In this research, the method has been conducted and its process will be made clear in order to collect the research data.

Introduction

The methods for conducting this research study to identify the safety level to prevent any injuries that will be caused by the slickness.

Finding from Articles

Public restrooms in Malaysia do not exactly have a good reputation. In Malaysia, there is still a relatively low degree of awareness regarding the cleanliness of public restrooms. Statistics from 2013 show that only 61 percent of the 10,257 public restrooms are deemed to be in satisfactory condition. Human rights include the right to utilise sanitary facilities. So that more public restrooms in Malaysia can receive a three-star certification, agencies like the Housing and Urban Wellbeing and Local Government Ministry must step up their initiatives. To make sure that public restrooms are in good shape and are safe, local authorities should also regularly supervise the public cleaning contractors who have been hired.

Responses from Questionnaires

The majority of public restrooms in Malaysia are filthy. Use those found in hotels or retail centres or mosque if possible. In a survey, 90% of respondents said they thought it was extremely or very necessary that the condition of public restrooms be dry in order to prevent slipperiness. Some people prefer using a water wash instead of a toilet paper wipe, but they are unaware of how to use the water hose safely or they don't consider the users who will come after them. The toilets that don't have water hoses instead have a little pipe in the toilet bowl that shoots water up to the butt are known as dry toilets. Additionally, some people fail to turn that off after using it, wasting water. Bathroom manners are terrible. Because even the walls get wet, may suppose some people also take showers in the restrooms.

Response Regarding The Floor Condition

All respondents are people who have used the public restrooms in the Tanah Merah region. Those respondents between the ages of 20 and 45 expressed satisfaction with using public restrooms, however respondents 45 and older expressed dissatisfaction due to difficulties caused by the wet conditions in public

restrooms. However, these respondents respond regarding the floor public toilet condition whenever they use around Tanah Merah area.

The pie charts and bar chart illustrate the state of the floors in McDonald's, the Petronas Pump Station, and mosque restrooms. The public restroom on the ground was the subject of the query. The third portion asks respondents if they were satisfied or not after utilising those public restrooms. This question also indicated whether the floor was damp, extremely damp, or dry before another user utilised it.

Toilet at Ismail Petra Mosque

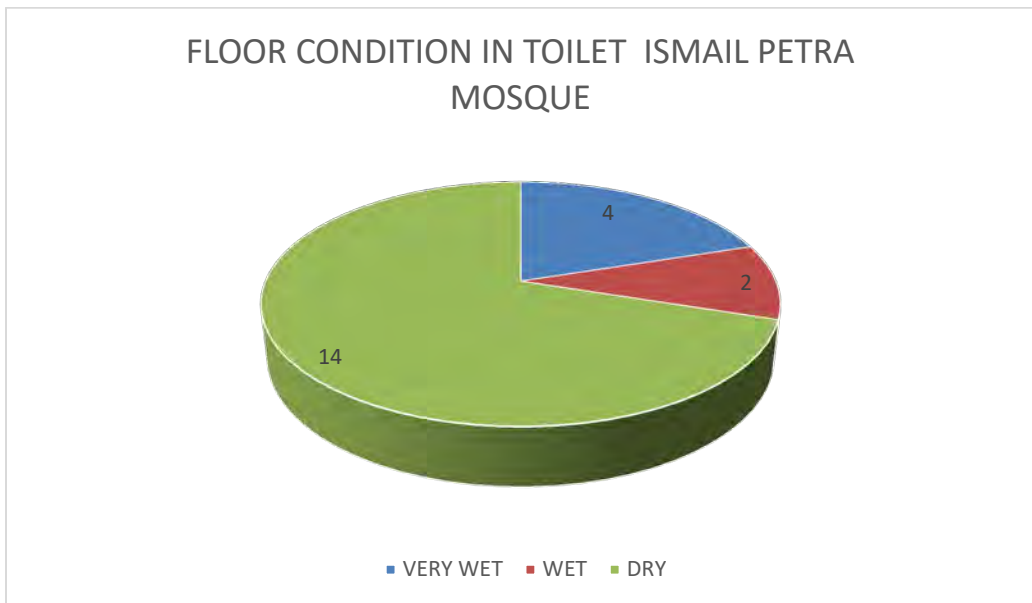


Figure 7: Floor Condition In Toilet Ismail Petra Mosque

The pie chart makes it evident that the majority of users mentioned that the Ismail Petra Mosque's floor condition was dry, with 14 percent representing 14 people. However, 4% of respondents claimed that the floor is really wet, and 2% reported that the floor is wet. The floor's condition while it's dry will have less of an impact on slip resistance because water particles won't alter the surface's roughness, which can improve the grip between shoes and the floor.

Toilet at Saidina Osman Mosque

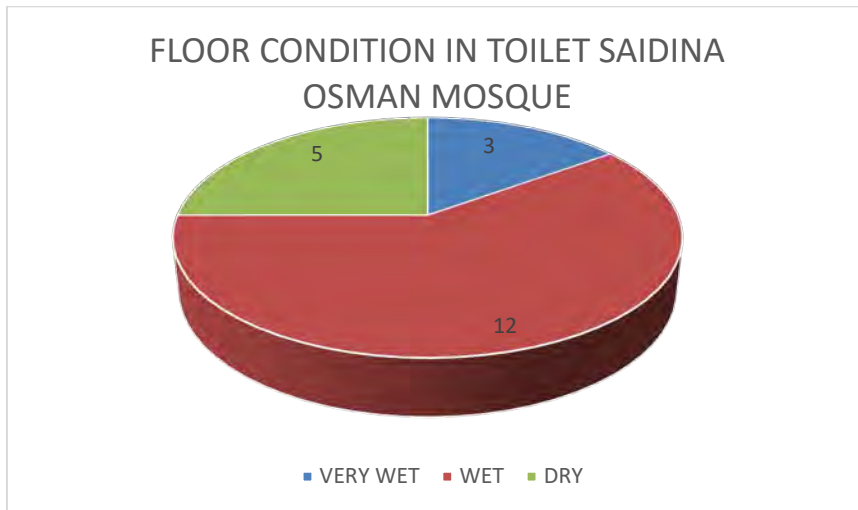


Figure 8: Floor Condition In Toilet Saidina Osman Mosque

This pie chart displays the percentage of the floor's condition in various restroom settings at the Saidina Osman Mosque. Twelve percent of users reported that the floor was moist. Water splashes during "wuduk," or cleaning time, may therefore be the reason. However, just 5% of respondents said that the toilet was dry, while another 3% said it was really moist.

Toilet at Surau Nik Daud Al-Fathani

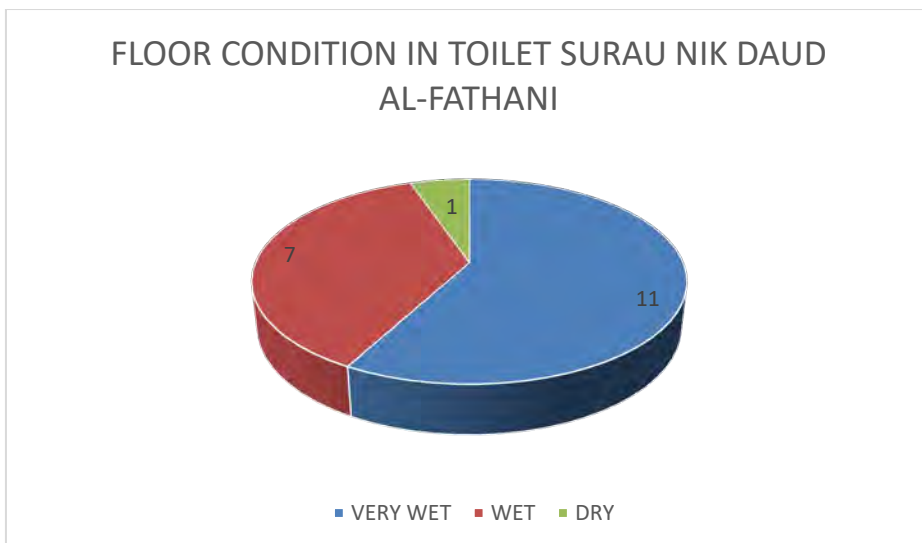


Figure 9: Floor Condition In Toilet Surau Nik Daud Al-Fathani

The Surau Nik Daud Al- Fathani restroom's floor condition is depicted in the pie chart. The floor was divided into three sections with very wet, wet, and dry conditions. The majority of users, or 11 percent, said that the floor is really damp. In addition, 7 percent of the time indicates that the situation is damp, while only 1% indicates that the floor is dry. It demonstrates that the floor at Surau Nik Daud Al-Fathani is in poor condition, which could result in slip resistance. The fact that the water cannot flow properly and is constantly moist could potentially be due to the tiles that were used.

Toilet at McDonald's and Petronas Tanah Merah Dt

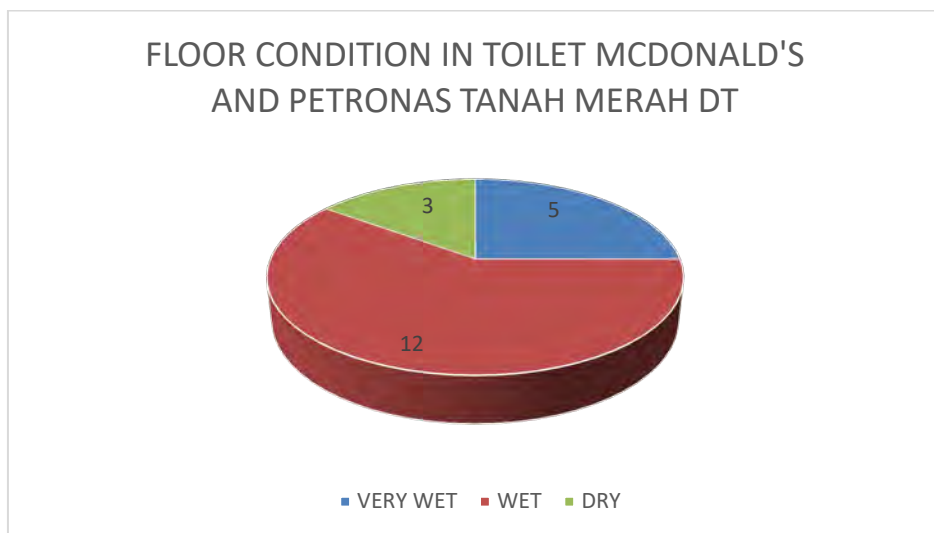


Figure 10: Floor Condition In Toilet McDonald's and Petronas Tanah Merah DT

This graph shows the state of the floors of the McDonald's restrooms and the Petronas Tanah Merah pump station. The pie chart has three sectors, as can be seen. 12 percent of floors are reported as being damp, with 5 percent reporting that the floor is really wet. However, just 3% of respondents indicated that the flooring is dry. Dry conditions have lower user ratings than rainy and extremely wet conditions. Because they arrive to refuel the automobile while they are relaxing or eating fast food, we can see that this restroom is always being used by the user.

User Satisfaction Rate Regarding Floor Condition

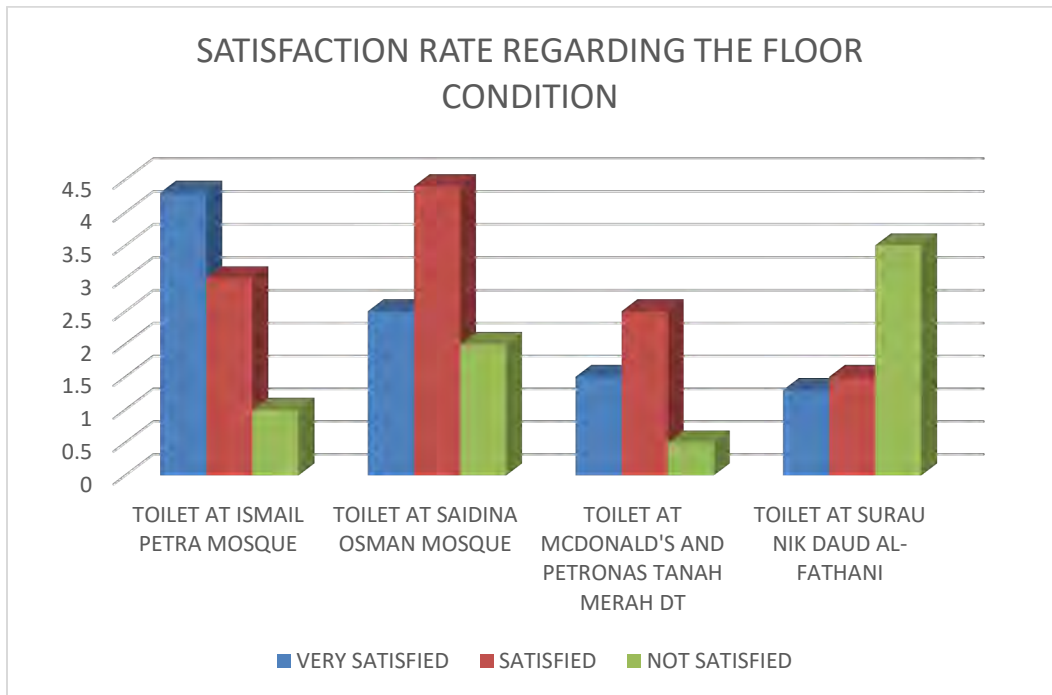


Figure 11: Satisfaction Rate Regarding The Floor Condition

The user satisfaction rate with reference to floor condition is displayed in a bar graph. As we can see, the restrooms at the Ismail Petra Mosque received high marks since the floor is consistently dry despite the fact that a lot of people visit the mosque to pray. Additionally, the restrooms at the Saidina Osman mosque, McDonald's, and the Petronas Tanah Merah DT pump station are rarely satisfied because the floor is typically wet or extremely wet. These indicate that no one is in charge of overseeing toilet cleaning. Due to a possible reduction in the traction between bare feet or footwear and the floor, this may speed up the pace of slickness. However, for toilet at Surau Nik Daud Al Fathani show most of the used not satisfied with condition of the floor. They being paranoid because the floor is always in a very wet condition.

Observation Results

Type of floor toilet represent the surface roughness that affect on slip resistance. Those show all the different type of floor tiles in toilet at 4 area which are Toilet at Surau Ismail Petra Mosque, Toilet at the Saidina Osman mosque, McDonald's and Petronas Tanah Merah DT pump station and last one is Surau Nik Daud Al Fathani.

Toilet At Ismail Petra Mosque



Figure 12: Floor Finishes At Ismail Petra Mosque

Linoleum Floor tiles is the one of the materials that works nicely in a toilet. These tiles can keep their colour and texture while fending against dust and filth. It's simple to apply, and when used properly and neatly, this stuff looks fantastic. The pros of these tiles is very durable, easy to install, biodegradable and low maintenance.

Toilet At Saidina Osman Mosque



Figure 13: Floor Finishes At Saidina Osman Mosque

Porcelain is a great material for toilet tiles. It is tougher, more resilient, less prone to scratches, absorbs less water, and is more stain resistant than conventional ceramic. Despite being a member of the "ceramic family," porcelain tile is distinct from ceramic tile. Because porcelain clay is kiln baked at temperatures higher than ceramic clay, it performs better as bathroom floor tile than ceramic tile.

Toilet At McDonalad's and Petronas Tanah Merah DT



Figure 14: Floor Finishes At McDonalad's and Petronas Tanah Merah DT

Granite tiles are incredibly sturdy and resilient. However, the granite tiles could make the area more slick where the water gets stuck.

Toilet At Surau Nik Daud Al-Fathani



Figure 15: Floor Finishes At Surau Nik Daud Al-Fathani

Stone tiles, which are constructed of marble, granite, limestone, and slate, are growing in popularity nowadays. Additionally, there are many textures on the market, such as sandblasted, etched, cleft, and tumbled. The range of colours includes creams, blues, reds, and greens. Stone tiles, however, cost more to maintain than other types of tiles since they need to be cleaned more frequently. However, these floor always in a very wet condition that may cause of slipperiness. As we can see that the surface roughness is might rough that can increase the grip of the footwear. Unfortunately, those because of the water flow system is not in a good condition might make the floor always in a very wet state.

Summary of Data Analysis

The test findings highlighted the effect of floor surface roughness on the effectiveness of slip resistance in all wet conditions. The shoe-type effect on slip resistance performance against the highly contaminated environments was modest in comparison to the floor-type effect. The study's findings also showed that at their lower boundary ranges of floor surface roughness, the slick environment required rougher surface finishes than the wet and soapy ones.

CONCLUSION AND RECOMMENDATIONS

Conclusion

In conclusion, based on what was hypothesized at the beginning for this study, which the floor finishes influence the highest factor that effected the significate impact for the users in safety context. All the selected floor finishes used at the 4 selected public toilet in Tanah Merah prove that the roughness surface is safer for the users.

All this result from this study proves that public toilet at Ismail Petra Mosque is the better execution when the management used grass carpet as their floor finishes to avoid slippery and ensure the safety for the users.

This evidence should be the significant impact for the factor to select the best floor finishes for the public toilet and should consider the main purpose for the public toilet.

Lastly, I really hope the outcome from this topical study could make a huge impact and can bring the awareness to the future development for the public toilet especially at the Tanah Merah area in order to ensure the safety for the users.

Recommendations

However, for community context, public user highly unrecommended wet floor that will cause slippery for them. All the data show that the highest unsatisfaction rate for the public toilet at Surau Nik Daud Al-Fathani while the highest satisfaction rate for the public toilet at Ismail Petra Mosque.

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Surat kami : 700-KPK (PRP.UP.1/20/1)

Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak



Tuan,

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Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

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Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
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27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
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