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Faculty of Civil Engineering

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Preface

This Conference Proceedings volume contains the written version of the presentations from participants in the first International Conference on Advances in Civil and Environmental Engineering (ACEE 2015) held on the 28-30 July 2015 in Penang Island, Malaysia. The Conference aims to provide a platform for scholars, researchers, practitioners, and professionals from all around the world to present the state-of-the-art reviews of rapidly-developing and exciting areas, report the latest significant findings and developments in all the major fields of Civil Engineering and Environmental Engineering.

The Editorial Committee members have been working hard to meet the deadline of review and editing. The conference proceedings consists of 79 papers and divided into five sessions. All accepted papers covered a wide variety of discipline in civil and environmental engineering that covered Structural and Earthquake Engineering, Geotechnical and Geology Engineering, Construction Management and Building Technology, Water Resources and Environmental Engineering, Materials Engineering, and Highway and Transportation Engineering.

We would like to express our sincere appreciation to all the reviewers for their hard works, precious times and endeavour in reviewing the manuscripts. Also, we would like to thank the authors, participants and speakers for their great contributions to the success of ACEE 2015.

Dr. Kuan Woei Keong

Editor-in-chief of ACEE 2015

July 2015

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Table of Contents

PREFACE

TABLE OF CONTENTS

Keynote Speakers

1	REVIEW OF DESIGN CODES FOR PILES WITH NSF ALLOWING FOR PILE/SOIL INTERACTION <i>S.A. TAN</i>	1
2	SIMPLE AND ADVANCED MODELS FOR CONNECTION DESIGN IN STEEL STRUCTURES <i>F. WALD, M. KUREJKOVÁ, L. GÖDRICH, M. KOČKA, K. MARTÍNEK, L. ŠABATKA, J. KABELÁČ</i>	14
3	SUSTAINABILITY: ROLE OF ENGINEERS IN PROMOTING EQUITABLE RESOURCES UTILIZATION <i>S. ABDUL-TALIB</i>	24

A. Structural and Earthquake Engineering

1	VALIDATION BETWEEN EXPERIMENTAL WORK AND MODELING OF AN INTERIOR BEAM-COLUMN JOINT WITH FUSE-BARS USING HYSTERES PROGRAM <i>N.H. HAMID, M.F. HUSSIN, N.D. HADI, M. MOHAMAD</i>	A-1
2	LATERAL-TORSIONAL BUCKLING RESPONSE OF PULTRUDED GFRP LAMINATED BEAMS WITH BEARING STIFFENERS <i>S. B. SINGH, HIMANSHU CHAWLA</i>	A-15
3	SEISMIC FRAGILITY CURVES OF UNREINFORCED MASONRY STRUCTURES <i>F. DJAALALI, M. BENZAIBI</i>	A-31
4	STRUCTURAL BEHAVIOUR OF PRECAST SELF-COMPACTING CONCRETE SANDWICH WALL PANELS (PSCC) SUBJECTED TO IN PLANE SHEAR FORCE DUE SEISMIC LOAD: AN OVERVIEW <i>ANAS A., NORIDAH M., SAMAD A.A.A., SHAHIRON S</i>	A-41
5	AF-RA VALUE FOR CRACK CLASSIFICATION OF CONCRETE BEAM STRENGTHENED WITH CARBON FIBRE SHEET USING ACOUSTIC EMISSION TECHNIQUE (PRELIMINARY STUDY) <i>NOORSUHADA M.N. , SOFFIAN NOOR M.S., AMIRAH R.</i>	A-52
6	PROPERTIES OF CIRCULAR HOLLOW SECTION UNDER COMBINED BENDING AND TORSION <i>HASAN D., MARZUKI N. A., AHMAD H., IMRAN N. F.</i>	A-60

- 7 ACOUSTIC EMISSION MONITORING ON BEAM-COLUMN JOINT STRENGTHEN BY CARBON FIBRE SHEET: A REVIEW
MUHAMMAD ZAKARIA MOHAMAD, NOORSUHADA MD NOR A-72
- 8 REVIEW ON DAMAGE EVALUATION OF RC STRUCTURE WRAPPED BY CFS USING AE SIGNALS
NOORSUHADA MD NOR, WAN NUR ASYIQEEN WAN AHMAD A-87
- 9 INTENSITY OF CONCRETE BEAM STRENGTHENED WITH CARBON FIBRE SHEET USING ACOUSTIC EMISSION TECHNIQUE: PRELIMINARY STUDY
M.N. NOORSUHADA, M.S. SOFFIAN NOOR, S. SYAHIRAH A-99
- 10 SUSTAINABILITY OF HOUSING CONSTRUCTION USING BLOCK DAMPER
A. ADNAN, P. P. ONG A-109
- 11 STUDY ON STRUCTURAL BEHAVIOUR OF HALF-SCALED PRECAST LIGHTWEIGHT FOAMED CONCRETE SANDWICH PANEL SUBJECTED TO AXIAL LOAD
N. MOHAMAD, A. A. A. SAMAD, W. I. GOH, F. TALIB, S. SHAHIDAN, R. ABDULLAH A-122
- 12 ULTIMATE MOMENT CAPACITY OF THIN-WALLED COMPOSITE FILLED BEAMS AT INTERNAL SUPPORT
F. M. AZRIZAL, SULAIMAN H., GHAZALI E. A-130
- 13 BUCKLING AND POSTBUCKLING ANALYSIS OF THIN PLATES UNDER IN-PLANE SHEAR AND COMPRESSION
M.K SINGHA, MEHNAZ RASOOL A-145
- 14 NEED FOR FATIGUE ASSESSMENT OF STEEL BRIDGES
A.Q. AYILARA, M. S. LIEW, T. WEE A-153
- 15 STRUCTURAL BEHAVIOUR OF PRECAST CONCRETE SANDWICH PANEL USING RECYCLED AGGREGATE CONCRETE UNDER TRANSVERSE LOAD
M. NORIDAH, K. HAMZA, A.A.A. SAMAD, N. JAMALUDDIN, S. SHAHIRON A-166
- 16 VULNERABILITY OF PUBLIC BUILDINGS IN PULAU PINANG SUBJECTED TO ACHEH EARTHQUAKE EVENT
ROZAINA ISMAIL, AZMI IBRAHIM, AZLAN ADNAN A-174
- 17 STRUCTURAL STRENGTHENING TO RC COLUMNS BY MEANS OF CONFINEMENT EFFECT USING CARBON FIBRE REINFORCED POLYMERS (CFRP)
STEVEN NG, DAVID VAZQUEZ A-185
- 18 SEISMIC ENERGY DISSIPATION OF INSULATED SANDWICH WALL PANEL UNDER REVERSIBLE CYCLIC LOAD
MOHAMAD SAKDUN N. S., ABDUL HAMID N. H., JAMARI N. A. A-196
- 19 AXIAL CAPACITY OF FOAMED CONCRETE FILLED STEEL TUBES
N. A. AHMAD ZAMRI, C. PETRUS, H. ABDUL HAMID, A. IBRAHIM A-209

B. Geotechnical and Geological Engineering

- | | | |
|---|--|------|
| 1 | ESTIMATING MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT OF COMPACTED SOILS
<i>NG K.S., CHEW Y.M., OSMAN M.H., MOHAMAD GHAZALI S.K.</i> | B-1 |
| 2 | USING MICRO-POROSITY DATA FOR THE CHARACTERISATION OF FAULT ROCKS (CATACLASITES AND MYLONITES)
<i>PAOLA GATTINONI, LAURA SCESI</i> | B-9 |
| 3 | FINITE ELEMENT METHOD IN DRAWDOWN ANALYSES OF EARTH DAM WITH SEEPAGE BARRIER
<i>S. S. ATHANI, C. H. SOLANKI, G. R. DODAGOUDAR</i> | B-19 |
| 4 | SHEAR WAVE ARRIVAL TIME ANALYSIS USING WAVELET TRANSFORM METHOD
<i>A. IBRAHIM, M. N. IBRAHIM, E.J. TAHA, D. JAMALLUDIN</i> | B-33 |
| 5 | INVESTIGATION ON DURABILITY AND SOUNDNESS CHARACTERISTICS OF CHUPING DOLOMITE AS SUBBASE LAYER DUE TO WEATHERING PROCESS
<i>JULIANA, I., KHAIRUL AFINAWATI, H., NUR SHAFIEZA, A., NURJUHANAH, J., KHAIRUNNISA, I.</i> | B-40 |
| 6 | EVALUATION ON THE GEOTECHNICAL BEHAVIOUR OF KAOLIN COMPACTED WITH SHREDDED TIRE FOR LANDFILL LINER APPLICATION
<i>N.H.H. ABDULLAH, A. IBRAHIM, N.Q.F. SAIDI, R. KERIA, R.N.H. RAJA MOHD NOOR, N.H. HASHIM</i> | B-48 |
| 7 | THE DYNAMIC CONE PENETRATION TEST: A REVIEW OF ITS CORRELATIONS AND APPLICATIONS
<i>ABDULRAHMAN M. HAMID</i> | B-63 |
| 8 | APPLICATION OF REMOTE SENSING AND GIS IN EROSION HAZARD MODELING OF A CATCHMENT
<i>R. LODH, S. BISWAS</i> | B-79 |
| 9 | RELATIONSHIP OF COMPRESSION INDEX AND INITIAL VOID RATIO FOR REMOULDED PENANG MARINE CLAY
<i>OSMAN M.H., ALBAR A., MD. HASAN A.S., OSMAN M.</i> | B-91 |

C. Construction Management and Building Technology

- | | | |
|---|---|------|
| 1 | PRELIMINARY STUDY ON THE CURRENT PRACTICE OF CONSTRUCTION WASTE MANAGEMENT IN MALAYSIA: A QUALITATIVE APPROACH
<i>R. N. H. RAJA MOHD NOOR, I. R. EN DUT, A R. MOHD RIDZUAN, N. J. TAMMY, A. H. JAMALUDIN, N. H. H. ABDULLAH, S. R. ROSELLI, N. TUTUR, C. K. I. CHE IBRAHIM</i> | C-1 |
| 2 | AUTOMATED SYSTEM FOR QUALITY CONTROL IN MALAYSIA CONSTRUCTION PROJECTS : A REVIEW OF LITERATURE
<i>NUR NABIHAH ABD RAZAK, INTAN ROHANI ENDUT, ASSRUL REEDZA ZULKIFLI' AHMAD RUSLAN MOHD RIDZUAN</i> | C-20 |

3	RISK IDENTIFICATION FOR HIGH-RISE BUILDING IN MALAYSIA <i>SABIHAH SAAIDIN, INTAN ROHANI ENDUT, SITI AKMAR ABU SAMAH, NURUL ELMA KORDI</i>	C-35
4	RISK ASSESSMENT ON CONTRACTOR'S TENDER FIGURE IN BUILDING PROJECTS <i>SABIHAH SAAIDIN, INTAN ROHANI ENDUT SITI AKMAR ABU SAMAH, NURUL ELMA KORDI</i>	C-46
5	ANTECEDENTS AND CONSEQUENCES OF TRUST AND SATISFACTION IN MAIN CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS <i>SITI HAMIDAH ABDULL RAHMAN, INTAN ROHANI ENDUT, NASRUDDIN FAISOL</i>	C-57
6	A NEW PROCUREMENT METHOD FOR HOUSING PROJECTS IMPLEMENTING IBS MODULAR SYSTEM <i>A.J. AHMAD, R.N. AZLAN, J. MASTURA AND O.M. MD AZREE</i>	C-70
7	A REVIEW OF ACCIDENT CAUSATION FACTORS IN THE CONSTRUCTION INDUSTRY <i>A. AMRAN AND A. ZAINAL ABIDIN</i>	C-79
8	IDENTIFYING ROOT CAUSES CONTRIBUTING TO BUILDING CONSTRUCTION SITE ACCIDENTS <i>A. AMRAN AND A. ZAINAL ABIDIN</i>	C-90
9	KEY SAFETY FACTORS FOR CONSTRUCTION WORKERS IN NORTHERN REGION OF MALAYSIA <i>NURUL AISHAH ABD RAHMAN , MUHAMAD SOLIHIN IDRIS , MUHAMMAD ISHA ISMAIL , FARID EZANEE MOHAMED GHAZALI</i>	C-104
10	IDENTIFYING FACTORS LEADING TO COST OVERRUN IN CONSTRUCTION PROJECTS IN JORDAN <i>GHANIM A. BEKR</i>	C-114

D. Water Resources and Environmental Engineering

1	TREND ANALYSIS OF OZONE AND TEMPERATURE IN TROPICAL CLIMATE REGION OF MALAYSIA <i>A.N NAZIF, I. MOHAMMED, A. MALAKAHMAD</i>	D-1
2	PERFORMANCE OF RICE HUSK AND KAPOK FIBER AS ALTERNATIVE BARRIER TO REDUCE LEACHATE INTRUSION INTO GROUNDWATER <i>N. A. MUHAMAD BASHAR, N. H. H. ABDULLAH, R. RAMLI, A.H. ABDULLAH</i>	D-11
3	CHARACTERIZATION OF WASTE COOKING OIL AS A POTENTIAL GREEN SOLVENT FOR LIQUID-LIQUID EXTRACTION <i>ALIF AZWAN ABDUL WAHAB, SIU HUA CHANG, AYUB MD SOM</i>	D-20
4	CHEMICAL PHOSPHORUS RECOVERY FROM WASTE FISH BONES ASH BY ACIDIC LEACHING <i>MOHAMAD DARWISH, AZMI ARIS, MOHD HAFIZ PUTEH</i>	D-29

5	THE POTENTIAL OF MAIZES AS COAGULANT AID IN WATER PURIFICATION <i>N.S. AZIZAN, W.A.W.AZIZ, J. IDRUS</i>	D-37
6	ANALYSIS OF RAINFALL INFILTRATION INTO SOIL USING ELECTRICAL CAPACITANCE VOLUME-TOMOGRAPHY (ECVT) <i>ANIZA IBRAHIM, MUHAMMAD MUKHLISIN, OTHMAN JAAFAR, MOHD. RAIHAN TAHA</i>	B-46
7	REMEDICATION OF PHENANTHRENE CONTAMINATED SOIL BY HYBRID <i>SPHINGOBACTERIUM SPIRITOVORUM</i> AND ZERO-VALENT IRON <i>SALINA ALIAS, MEGAWATI OMAR, AFIZAH AYO B, SUHAIMI ABDUL-TALIB</i>	D-60
8	COPPER REMOVAL FROM WASTEWATER USING RECYCLED HYBRID ADSORBENT (RHA) IN ACTIVATED SLUDGE SYSTEM <i>S. R. M. KUTTY, E.H. EZECHI, S. G. KHAW, C. L. LAI, M. H. ISAM, M. A. M. ROSLI</i>	D-69
9	THE POTENTIAL OF TEA WASTE AS AN ALTERNATIVE ADSORBENT FOR REMOVAL OF HEAVY METALS IN INDUSTRIAL WASTEWATER <i>BADREALAM, S, ZAKARIA, A</i>	D-82
10	THE CALIBRATION OF A RAINFALL-RUNOFF MODEL <i>L. LLOYD, Y. ZULKIFLI</i>	D-90
11	DETERMINATION OF OPEN CHANNEL ROUGHNESS COEFFICIENT <i>ROSSELI S.R., MOHAMMAD RAZI M.A. , FAUZI, M.A. TUTUR, N. , MARZUKI N.A. , RAJA MOHD NOR R.N.H.</i>	D-98
12	NUMERICAL SIMULATION ON THE INTEGRATED SHALLOW WATER FLOW MODEL <i>NOR A. ALIAS, LARIYAH MOHD SIDEK</i>	D-105
13	AN INVESTIGATION OF DYNAMIC RESPONSES FOR A SPAR PLATFORM BY USING MORISON EQUATION AND DIFFRACTION THEORY: NUMERICAL PREDICTIONS AND EXPERIMENTAL STUDIES <i>C.Y. NG, V.J. KURIAN, M.S. LIEW</i>	D-116
14	JET EROSION DEVICE FOR BANK ERODIBILITY MEASUREMENT <i>JUNAIDAH ARIFFIN, SAERAHANY LEGORI IBRAHIM</i>	D-128
<i>E. Materials Engineering</i>		
1	CONCRETE DURABILITY IMPROVEMENT IN THE PRESENCE OF CHLORIDES USING SILANE BASED HYDROPHOBIC IMPREGNATING AGENTS <i>MICHEL DONADIO, HEINZ SCHUERCH, STEVEN NG</i>	E-1
2	THE RESEARCH OF DETERIORATION DIAGNOSTIC PROCEDURE FOR AGED BUILDING EXTERNAL WALL TILES IN TAIWAN <i>LI-WEI CHIANG, SY-JYE GUO</i>	E-11

3	<p>PERFORMANCE OF SPENT MUSHROOM FARMING WASTE (SMFW) ACTIVATED CARBON FOR NI(II) REMOVAL <i>N.S. MD-DESA, Z. A. GHANI, S. ABDUL-TALIB, C.C TAY</i></p>	E-23
4	<p>COMPRESSIVE STRENGTH OF KENAF FIBER REINFORCED CONCRETE (KFRC) <i>A.G. KAY DORA., H.M. YEE, N.A.A. FAZLINA</i></p>	E-32
5	<p>DAMAGE EVALUATION OF STEEL FIBRE REINFORCED CONCRETE BEAMS STRENGTHENED WITH CARBON FIBRE SHEET USING ACOUSTIC EMISSION: A REVIEW <i>A.H. ZULKIFLI, N. MD NOR, A. IBRAHIM</i></p>	E-38
6	<p>FLEXURAL BEHAVIOUR OF HPC WITH DIFFERENT FORM OF STEEL FIBRES <i>NIK FARHANIM IMRAN, NURUL NADIA MOHD SAID, HAZRINA AHMAD, NUROL HUDA DAHALAN, DALIAH HASAN</i></p>	E-48
7	<p>A STUDY ON KENAF FIBER REINFORCED CONCRETE BLOCK WITH QUARRY DUST AS FINE AGGREGATE REPLACEMENT <i>AZRIZAL, M.F., KAY DORA, A.G. , SULAIMAN, H. , AZILA, N.W.B.</i></p>	E-57
8	<p>EXPERIMENTAL INVESTIGATION IN STRENGTH OF SUSTAINABLE CONCRETE MATERIALS WITH PARTIAL REPLACEMENT OF WASTE PAPER SLUDGE ASH (WPSA) <i>AZMI, A.N, F.M., AZRIZAL, ROSSELI, S.R. , SULAIMAN, H. , YAHYA, M.I</i></p>	E-67
9	<p>PERFORMANCE OF CONCRETE GRADE 35 CONTAINING COMBINATIONS OF RICE HUSK ASH AND QUARRY DUST ASH AS PARTIAL CEMENT REPLACEMENT <i>N. TUTUR, N.ASRI, R. N. H. RAJA MOHD NOOR, N.S. SAKDUN, S.R. ROSSELI, M. RAZALI</i></p>	E-75
10	<p>FLEXURAL STRENGTHENING OF REINFORCED CONCRETE (RC) BEAMS USING NEAR SURFACE MOUNTED (NSM) GLASS FIBRE REINFORCED POLYMER (GFRP) BARS AND nsm ANCHOR MILD STEEL BARS <i>MARZUKI N.A., HAMID H.A., HASAN D., ROSSELI S.R., HAMZAH N., ALBAR A.</i></p>	E-84
11	<p>MECHANICAL PROPERTIES OF RUBBERIZED CONCRETE INCORPORATED WITH WASTE TYRE CRUMB RUBBER (WTCR) AS FINE AGGREGATE REPLACEMENT <i>JALILLUDDIN, A. M., JELANI, N.</i></p>	E-96
12	<p>THE INFLUENCE OF FIBRE ASPECT RATIO ON THE FRACTURE TOUGHNESS OF SFRC <i>N. N. SARBINI, S. WAN AHMAD, K. MUTUSAMY, I. S. IBRAHIM, A. A. SAIM</i></p>	E-105
13	<p>THE EFFECT OF HIGH-TEMPERATURE ON THE STRENGTH AND PERFORMANCE OF HYBRID FIBRE CONCRETE <i>H. A. AZHAR, C. PETRUS, L. D. GOH, R. ISMAIL, N. H. HASHIM, F. A. A. ZAKWAN, N. A. MARZUKI.</i></p>	E-118

14	COMPRESSIVE AND TORSIONAL STRENGTH OF SELF COMPACTING CONCRETE <i>MOOSA MAZLOOM, MORTEZA MEHRVAND</i>	E-129
15	DETERMINATION OF DREDGED MARINE SEDIMENT CHARACTERISTICS AS A POTENTIAL BRICK MATERIAL <i>W. S. WAN SALIM, N. A. MOHD NOOR, S. F. SADIKON, M. F. ARSHAD, N. WAHID, S. MOHD SALLEH</i>	E-140
16	EFFECT OF HYDROCARBON EXPLOSION ON OFFSHORE BLAST WALLS <i>RAHMAN SHAIKH ATIKUR, TEO WEE, ZUBAIR IMAM SYED, DO KYUN KIM, KURIAN V. JOHN</i>	E-151

F. Highway and Transportation Engineering

1	AN ANALYSIS OF ELEMENTS OF GREEN HIGHWAY ASSESSMENT SYSTEM <i>N. I. HUSIN, A. CHE AHMAD</i>	F-1
2	SOIL – CEMENT STABILISATION FOR LOW VOLUME ROADS <i>AHMAD KAMIL ARSHAD, SYAHIRAH MASOR MOHAMAD, YULINAR ISMAIL</i>	F-17
3	CHARACTERISATION OF NANOSILICA MODIFIED ASPHALT BINDER <i>AHMAD KAMIL ARSHAD, MOHAMAD SAIFULLAH SAMSUDIN, JURAI DAH AHMAD</i>	F-27
4	CONTRIBUTION OF HOT-MIX ASPHALT PAVEMENT LAYERS TOWARDS RUTTING-A CASE STUDY <i>N. A. QURESHI</i>	F-37
5	NEW DIMENSION OF BUS SERVICE QUALITY PERFORMANCE MEASURE <i>SURIA HARON, SARINA MUHAMAD NOOR, AHMAD FARHAN SADULLAH</i>	F-54
6	FACTORS AFFECTING SERVICE QUALITY OF RAPID PENANG BUS OPERATION AND PASSENGER SATISFACTION <i>SURIA HARON, NOR IZZAH ZAINUDDIN, SAMSIA AZMAN</i>	F-64
7	MODIFICATION OF BITUMINOUS PAVEMENT MIXTURES INCORPORATED ADDITIONAL COCONUT FIBRE <i>MOHD-NORDIN M.M., ZAINUDDIN N.I.</i>	F-78
8	EFFECT OF HUMAN FACTOR ON VARIABILITY OF PAVEMENT CONDITION DATA <i>TURKI I. AL – SULEIMAN (OBAIDAT)</i>	F-86

NEW DIMENSION OF BUS SERVICE QUALITY PERFORMANCE MEASURE

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Abstract

In Penang, bus transportation is one of the main public transportations used by communities. Therefore, the study on bus transportation is important to offer improved quality services and choices for the public. Most of the previous studies on bus transportation were focused on the conventional methods of bus capacity, bus frequency and bus efficiency. As these researchers ignored the marketing aspect of customers' needs and demand, this study attempts to delineate the customers' perspectives in evaluating the quality services that are offered by bus agencies. Adapting service quality instrument from the retail industries, this study investigates the service quality offered by public bus companies. There were 429 respondents inclusive of bus users, non-users, bus driver and bus operations management in Penang, Malaysia. The result indicates that environment and image are two distinctive variables in addition to reliability, safety and security, responsiveness, accessibility and physical facilities. This service quality indicator called TRANSQUAL is more comprehensive and can be used as an aid to all agencies involved in this industry. It will also serve as a benchmark for evaluating the performance of public transport by the Land Public Transport Commission.

Keywords: Service quality, Public transport, Customers' perspective, Multi-method, TRANSQUAL.

1. Introduction

Penang is one of the top destinations for tourists. Many tourists and publics depend on public transportation. As such, the existence of efficient public transportation is important as it raises the country's image. In addition, Penang has been declared as the leader of local public transportation since 1886 [1].

Most of the private cars from mainland travel to Penang Island through the Penang Bridge. There are two bridges that connect the mainland and the island. The most recent bridge was completed in 2014 while the earlier one was completed in 1985. The situation encourages more private cars entering Penang thus endangering the environment. There will be an increased production of carbon dioxide unless all cars use green technology. In order to mitigate the negative effect of having too many private cars on the road, various efforts need to be taken to encourage public transportation. Therefore, public awareness and government role towards an efficient public transportation, especially in the urban areas, will help to realize a better city.

However, recent cancellation of bus operations in 2010 has raised multiple questions, mainly on the lack of community support of the public bus service. Thus, a detailed research and insights into the leading causes and weaknesses is in need for immediate action.

Although research on performance indicator in transportation exists in Malaysia, the progress is very slow. Earlier study by Haron et al. [2] found that uninterrupted services increase public interest to use public transportation. The study suggests a smooth flow of schedule improve customers' satisfaction in using public buses. Therefore, the importance of building a mechanism to measure the performance of the existing public transportation system through the user perception in quality is very important.

However, past researches focused only on a conventional method in measuring service quality. They relied on the capacity indicator, number of passengers, frequency and reliability [3]. As they did not take into account the service ability and quality to fulfil the users' needs, this research helps to provide a better understanding on the reasons for lack of community support towards public transportation. This can only be achieved through the findings of important variables that serve as a potential form of interest to the bus users.

Thus, this study attempts to measure the service quality of bus transportation and suggest an appropriate indicator for bus service quality. This study will contribute in several ways. It helps to delineate factors that contribute to the satisfaction of bus users through the service quality indicators pertinent to the industry. At the same time, it will encourage the use of public transportation that leads to greener earth.

2. Service Quality

Service quality serves as the most important information to upgrade performance as it rouses the interest of many users and simultaneously encourages the continuity of services [4-6]. Tyrinopoulos and Antoniou [7] suggest three approaches to define and evaluate service quality in public transport. They are:

a) *Customers' satisfaction in public transportation.* In this approach, the level of the overall achievement of customers' expectation is assessed through the percentage of expectation on the customers' required needs.

b) *Customers' loyalty.* This approach looks at the reaction that combines customers' attitude and actions. It is usually drawn from customers' satisfaction and the commitment involved with the customers to invest in the durability of public transportation services.

c) *Benchmark.* This approach uses a benchmark to differentiate the quality, different routes or the difference between public transportation agencies or providers.

The approaches are applied to different levels of needs in various countries especially in Europe and North America. As a result, several manuals and handbooks were produced. Some of them are the manual of Service Quality Definition, Targeting and Measurement [8], Transit Capacity and Quality Service [9] and Measuring Customer Satisfaction and Service Quality Handbook [10]. However, the public transportation party did not apply the manuals comprehensively. They chose clues that are suitable to their needs which are equivalent to the existing conventional measurement.

SERVQUAL has become a popular quality standard to evaluate the quality of a service [11]. SERVQUAL which was introduced by Parasuraman, Zeithaml and Berry in 1985 received numerous positive and negative critics from researchers all over the globe, turning it into an all-time effective model.

In order to use SERVQUAL in different industries, scholars [12-14] agreed that changes should be made. Furthermore, few [15, 16] are of the opinion that there is an existing need to handle a different dimensional aspect in the service quality. This issue has been explored by plenty of researchers and they have adapted it according to a variety of industries to meet their research objectives. Among them is the PARKSERV Model in the banking sector [17], E-S-QUAL Model – internet purchasing service [16], Malaysian Private Education Quality: Application of SERVQUAL Model [18], SITEQUAL Model [19], and PERVAL Model – retail shopping [20].

Thus, the initial concept in this study is based on the SERVQUAL concept as its credibility is proven by numerous early researchers. The model is found useful in evaluating service quality and determining the level of performance in many industries.

3. Method

The study was conducted through several phases. Initially, several factors were taken into consideration before the data was collected. The first step was to determine the company that offers the public bus services. Among all providers, Rapid Penang was chosen as the bus company as it has gone through a massive change to accommodate their customers. Then, the suitable route was selected to reflect the studied variables. The route chosen for this study was the most patronized by the tourists and the locals. Finally, validity and reliability tests were conducted to test on the instruments based on a self administered survey of 429 Rapid Penang respondents. The samples were chosen randomly by focusing on a

few groups of respondents, namely the bus users, the non-users, the bus driver and the bus operations management.

4. Reliability and Validity

The data analysis started with a pilot study [21] which further refines the findings of the dimensions. The following paragraph describes each stage.

The results from the pilot study indicate a different dimension as compared to the initial dimension as suggested in SERVQUAL [21]. Originally, there were ten general SERVQUAL dimensions which consist of accessibility, reliability, responsiveness, competence, access, courtesy, communication, credibility, security, understanding and tangibles [14]. The pilot study, however, produced different dimensions which are accessibility, reliability, responsiveness, physical facilities, safety and security, understanding, environment, image, time and fare. These revised new dimensions are shown in Table 1. Only those that are marked with asterisks are similar to the original SERVQUAL model.

Dimension	Details
Accessibility*	Ease and impart of communication
Reliability*	Ability to comply with the agreement accurately and trustworthily
Responsiveness*	Desire to help and provide immediate feedback
Physical Facilities	Physical facilities/facility at bus stops and terminal and ticketing system
Safety & Security*	Protection and security from disturbance, accident risk and criminal danger
Understanding*	Desire to understand the needs and wants of the users
Environment	Free from pollution caused by traffic congestion
Image	Current bus performance and image
Time	Time used for waiting and journeying in the bus
Fare	One way fare imposed on each journey

Early analysis result shown in Table 2 indicates a Cronbach's Alpha that equals to 0.960. This value is most satisfactory considering that no items need to be eliminated from the research. This is due to the correlation value and research instrument index that carries a high level of uniformity. As suggested, the value that exceeds 0.9 is the best. However, 0.8 has already fulfilled the acceptable needed value [22]

Table 2. Reliability Scale during pilot study.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based On Standardized Item	N from Item
0.960	0.961	39
Scale Statistics		
Mean	Variance	Standard Deviation
137.50	528.302	22.985

Using the newly discovered dimension, the data were analysed further using factor analysis. Based on the analysis, it is found that the Kaiser-Meyer-Olkin (KMO) value for this research data equals to 0.907 which is “superb” as it exceeds the best defined value which is 0.90 [23]. The Barlett’s test shows the value of $p < 0.001$ as most significant. Thus, the research data were appropriate to proceed using the factor analysis application. Table 3 shows the Kaiser-Meyer-Olkin (KMO) and Bartlett’s tests where each evaluates the adequacy and sphericity of the instrument.

Table 3. KMO and Barlett’s Tests.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.907
Bartlett's Test of Sphericity	Approx. Chi-Square	12081.7
	Df	50
	Sig.	741
		0.000

Based on the application of factor analysis, the items were rearranged. The first step of the Principle Component analysis was conducted using Varimax rotation with Kaiser Normalization. The second step was also followed by a Varimax rotation with Kaiser Normalization, which produced a more robust arrangement with 7 dimensions and 34 items. Two items were removed because they were dubious and the load factor was less than 0.5.

Finally, the items were factor analyzed for the third time. During this stage, there was no removal of the items. Therefore, the operations analysis and Principle Component rotation with Kaiser Normalization and Varimax rotation confirm the final dimensions. Ten early dimensions were modified into seven new dimensions consisting of 34 items that could potentially be justified as factors of bus service quality.

After the construct validity was established through factor analysis, a reliability test was used on the identified performance indicator. Table 4 shows the Cronbach’s Alpha final test for each dimension scale. The alpha values for all dimensions range from 0.837 to 0.931 which is good.

Table 4. Final Test Cronbach's Alpha for Each Reliability Scale.

Dimension	Cronbach's Alpha	Mean	Varian	SD	Item No.
Physical Facilities	0.931	23.070	22.889	4.784	6
Responsiveness	0.923	20.980	20.252	4.500	6
Image	0.921	11.680	5.627	2.372	3
Safety & Security	0.907	19.930	23.471	4.845	6
Reliability	0.887	13.160	11.525	3.354	4
Environment	0.845	17.37	14.301	3.782	5
Accessibility	0.837	14.060	8.672	2.945	4

Table 5 shows the final Cronbach's Alpha Reliability scale analysis on the whole data. The Cronbach's Alpha value equals to 0.956 that indicates a high internal consistency on the overall scale. It is also found near the previous value even though five items have been eliminated from the overall factor.

Table 5. Final Test for Cronbach's Alpha of Overall Scale.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based On Standardized Item	N from Item
0.956	0.957	34
Scale Statistics		
Mean	Variance	Standard Deviation
120.25	406.779	20.169

In this current study, a more detailed dimension has been discovered as compared to a previous study by Haron, Noor, Sadullah and Vien [2]. The concept of public transportation performance measures resulted in an average load factor for each dimension as shown in Table 6. Overall, there are 7 factors and 34 items were lying in the factor analysis. Each item has a factor loading of more than 0.6 which is acceptable. There are Image (0.823), Physical Facilities (0.784), Reliability (0.751), Accessibility (0.729), Safety and Security (0.713), Responsiveness (0.700) and Environment (0.675). Hence, it is labelled as TRANSQUAL in order to reflect the dimensions that are suitable for bus transportation.

Table 6. TRANSQUAL Model with 7 Dimensions and 34 Items.

Dimension	Item	Factor Loading
Image (0.823)	Image of the bus company	0.837
	Level of foreign language mastery among driver/company staff	0.832
	Bus image improvement through advertisement and promotion	0.801
Physical Facilities (0.784)	Facilities at the bus terminal	0.864
	Facilities at bus stops	0.844
	Safe and easy to recognize/identify bus stops	0.838
	Bus design that is easy to board and comfortable	0.750
	Bus design that provides comfort and easy access for the disabled	0.714
	Easy access ticketing system	0.694
Reliability (0.751)	The bus arrives right on schedule	0.833
	Bus departs right on schedule	0.816
	Dependable bus schedule	0.777
	Bus driver that abides by the law, is patient and courteous	0.578
Accessibility (0.729)	Site/situation for bus transfer before arriving to the destination	0.851
	Bus transfer timing	0.790
	Distance between the first arrival and the actual destination	0.643
	Distance from home to the bus stop	0.631
Safety & Security (0.713)	The risk of harassment from other passengers	0.787
	Appropriate lighting to prevent crimes at the designated area	0.787
	Presence of police and security force in the designated area	0.706
	Individual safety from criminal dangers at the bus terminal and bus stops	0.702
	Risk of accidents during the journey	0.658
	Well-trained and competent driver	0.635
Responsiveness (0.700)	Providing immediate response on required information of the users	0.747
	Willingness of driver/company to provide assistance when needed	0.740
	Willingness of driver/company to understand the users' needs.	0.739
	Willingness to handle users' complaints	
	Easily accessed information (fares, schedule and maps)	
	Ease of language used	
Environment (0.675)	Level of air pollution from bus fumes	0.838
	Level of noise pollution from bus	0.814
	Level of traffic congestion along the bus routes	0.753
	Level of cleanliness of the bus terminal and bus stops	0.508
	Level of temperature in the bus	0.461

5. Conclusion and Recommendations

Quality of service is usually defined as an organization's ability to meet or exceed customer expectations. It is the result of the comparison that customers make between their expectations about the service and their perception of the way the service has been performed [24]. If expectations are greater than performance, then it is considered as poor quality and hence customer dissatisfaction occurs [25]. For each pair of statements, there is a gap between the different perceptions. The idea is that if the service meets or exceeds expectations, it indicates a good perception of the service. However, the service is problematic if perceptions fall below expectations.

The study starts with the development process where only five items were removed from the 39 items, leaving 34 items. The removal of a small number is due to the selection of items that have undergone screening process in the early stages of the pilot study. Eventually, seven dimensions with 34 reorganization and restructuring items were produced as a set of performance indicators. This performance measurement mechanism offers a new concept in the field of public transportation. The authors labelled this concept as "TRANSQUAL" in accordance with the functions; to measure the performance of public transport.

This finding provides early information to be used as a reference performance of public transport. The absence of this information makes it difficult to make changes in improving the public transport, and to determine the level of performance of public transport. This finding can be used as a yardstick for the Penang Municipal Council to measure the existing public transportation system, and make plans and strategies for future improvement. In addition, it can provide benefits to public transportation agencies in improving their operations and improve the image of public transport in the eyes of society, as well as indirectly foster interests as well as promote the laying of public buses.

The results from this research are hoped to contribute in expanding the service quality research especially its relations with the public transportation performance in Malaysia. Aside from that, this research procedure can be used by other researchers in the same field for further research. The research findings can also become a concrete source of information that can be used as a model or applied as good practice by all related agencies.

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