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SIBE2017

The Third International Conference on Sustainable Infrastructure and Built Environment

Faculty of Civil and Environmental Engineering
Institut Teknologi Bandung

ABSTRACT BOOK

"Sustainable Infrastructure and Built Environment - **Past, Present, and Future**"

In collaboration with:

National Taiwan University, Taiwan

Hokkaido University, Japan

Coordinating Ministry for Maritime Affairs, Indonesia

Ministry of Public Works and Housing, Indonesia

State Ministry of National Development Planning, Indonesia

ABSTRACT

The Third International Conference On Sustainable Infrastructure and Built Environment

*Sustainable Infrastructure and Built Environment – **Past, Present and Future***

BANDUNG – INDONESIA
SEPTEMBER 26th – 27th, 2017

International Conference and Exhibition

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PREFACE

Infrastructure provides the basic needs of human beings, and sustainable infrastructure systems are essential dor the survival, health, and well-being of a society. The civil, environmental, and ocean engineers are at the epicenter in seeking the means to enhace human life through modernization of infrastructure as evidenced by provision of shelter, water, and transport, amongst aothers.

The current fast rate of urbanization and industrialization has caused a rise in environmental issues, involving environmental mismanagement, which has been associated with unforeseen global catastrophes. The problems are further aggravated by the impacts of environmental degradation such as soil erosion, hurricanes, sea-level rise, depletion of water resources, etc. The issues have become the current focus of attention and studies of the world's academicians and professionals in infrastructure aspects such as regulation, instituion, and policy development framework.

To support economic activites and to offer a better quality of life, developing countries need to accelerate sustainable infrastructure provision. In many developing countries, including Indonesia, lack of infrastructre has been the main obstacle of investment and development activities. Besides limited available fund, the acceleration of sustainable infrastructure development still has to face the challanges of, among others, knowledge, human resources management, best practices, and capacity development. On the other hand, developing countries generally possesses abundant local natural resources, sufficient carrying capacity, and local wisdom.

In order to meet these multifaceted challenges, not only proper planning, design, implementation and verification exercises, but also clear policy and strategy direction of sustainable infrastructure development are required, via an integrated, multidisciplinary and holistic approach.

The global momentum for sustainable development must now lead to practical applications of the engineering and science of sustainable – an optimization – which allows an accelerated infrastructure provision with maximum attention on sustainability aspects.

The conference will provide an opportunity for professionals and researchers to learn, share and exchange the latest development and research in civil engineering and environmental engineering. The scope of the conference will be broad, covering all aspects of civil and environmental engineering practices.

Participants of the conference include researchers, academic staffs, students, industries, public and local governments. The keynote presentations during the conference are as follows:

KEYNOTE SPEAKER

1. Minister of Public Works and Housing
2. National Development Planning Agency
3. Indonesian Coordinating Minister for Maritime Affairs
4. Director General of Oil and Gas

INVITED SPEAKER

1. Prof. Shang-Hsien Hsieh (NTU, Taiwan)
2. Prof. Takashi Matsumoto (Hokkaido University, Japan)
3. Prof. Chen Hanbao (Tianjin Reasearch Institute for Water Transport Engineering, M.O.T., China)
4. Prof. Ryo Kohsaka (Graduate School of Environmental Studies, Tohoku University, Japan)
5. DR. Gao Chun Pin (Executive Officer of Singapore's Building and Construction Authoritu, BCA)

The objectives of the conference are:

1. To provide a platform for exchange of ideas and information among academics, researchers, consultants, engineers, manufactures and post graduate scholars in civil, ocean, and environmental engineering
2. To discuss and evaluate the latest approaches, innovative technologies, policies and new directions in infrastructure development, pollution prevention and eco-friendly technologies adapted to developing countries
3. To promote cooperation and networking amongst practitioners and researchers involved in addressing infrastructure and built environment issues.

The oral presentations are subdivided into 8 major sections as following:

1. Structure and materials
2. Transportation system and engineering
3. Water resources engineering and management
4. Water and waste engineering and management
5. Ocean and maritime engineering
6. Construction management
7. Geotechnical engineering
8. Environmental protection and management

There are 120 contributors in oral presentation.

Finally, the organizing committee wishes that the conference is able to provide beneficial scientific information to the participants and other concerned readres.

Bandung, September 2017

Organizing Committee

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TOPIC 1

STRUCTURES AND MATERIALS

The Flexural Strength of Concrete Slabs with Various Reinforcing-Bar Spacing

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Abstract. The study applied the full-scale test on concrete slabs with an overall dimension of 200 x 200 9 cm. It aims at measuring the flexural strength of the slabs with the reinforcing-bar spacing of 15 cm, 20 cm and 25 cm. The fiber percentage of the slabs is 1 %. The slabs was loaded with water that was incrementally increased. The deflection was measured by dial gauges placed underneath the slabs. The result indicated that the cracks at the fibred slabs did not follow the yield line theory. Meanwhile, the normal concrete cracks follow the yield line theory. The flexural rigidity of the fibred concrete slabs was higher than that of normal concrete slabs.

Keywords: *flexural strength, slabs, fiber.*

Physical, chemical, and mineralogical characteristics of blast furnace slag on durability of concrete

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Abstract. A partial replacement of Portland cement (PC) by ground granulated blast furnace slag (GGBFS) is an effective method to improve the durability of concrete due to its lower diffusivity and higher chemical resistance compared to PC. Further, the microstructure of GGBFS blended cementitious materials controls the physicochemical properties and performance of the materials in concrete. Therefore, understanding of cement hydration and cementing behavior of GGBFS is essential to establish microstructure property relationship for predicting performance. In this study, hydration, microstructure development, and chloride ingress into GGBFS-blended cement have been investigated. Solid-phase assemblage and pore solution chemistry of hydrating PC and cement blended with GGBFS were predicted using thermodynamic model and compared with experimental data. A mathematical model integrating PC hydration, GGBFS reaction, thermodynamic equilibrium between hydration products and pore solution, ionic adsorption on C-S-H, multi-component diffusion, and microstructural changes was developed to predict chloride ingress into GGBFS blended cementitious materials. The simulation results on chloride profiles for hydrated slag cement paste, which was prepared with 50% of replacement of PC with GGBFS, were compared with experimental results. The model quantitively predicts the states of chloride such as free, adsorbed on C-S-H, and chemically bound as Friedel's salt.

Keywords: *Calcium Silicate Hydrate (C–S–H); Hydration products; Pore solution; Ionic ingress; Modelling; Porosity*

On the Accuracy and Convergence of the Hybrid FE-meshfree Q4-CNS Element in Surface Fitting Problems

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Abstract. In the last decade, several hybrid methods combining the finite element and meshfree methods have been proposed for solving elasticity problems. Among these methods, a novel quadrilateral four-node element with continuous nodal stress (Q4-CNS) is of our interest. In this method, the shape functions are constructed using the combination of the 'non-conforming' shape functions for the Kirchhoff's plate rectangular element and the shape functions obtained using an orthonormalized and constrained least-squares method. The key advantage of the Q4-CNS element is that it provides the continuity of the gradients at the element nodes so that the global gradient fields are smooth and highly accurate. This paper presents a numerical study on the accuracy and convergence of the Q4-CNS interpolation and its gradients in surface fitting problems. Several functions of two variables were employed to examine the accuracy and convergence. Furthermore, the consistency property of the Q4-CNS interpolation was also examined. The results show that the Q4-CNS interpolation possess a bi-linier order of consistency even in a distorted mesh. The Q4-CNS gives highly accurate surface fittings and possess excellent convergence characteristics. The accuracy and convergence rates are better than those of the standard Q4 element.

Keywords: *continuous nodal stress; finite element; meshfree; Q4-CNS; quadrilateral four-node element; surface fitting.*

U-phase characterization for performance evaluation of cement systems in sodium sulfate radioactive waste environment

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Abstract. Cementitious materials are extensively used for several purposes including deep geological repository for long-lived radioactive wastes. The low- level waste generated from boiling water reactor (BWR) power plant consists of very high concentration of sodium sulfate, higher than 25 mass % of Na2SO4. It is well known that sodium sulfate ions cause a serious chemical deterioration to cement matrix through either forming expansive products of ettringite and gypsum or sodium sulfate crystallization. In addition, a very high concentration of sodium sulfate solution could induce to form U-phase [(CaO)4(Al2O3)0.9(SO3)1.1 (Na2O)0.5:16H2O] and this may cause deterioration to cement. But the condition for U-phase formation and its stability in cement environments have not been understood due lack of studies. In this study, a pure U-phase was synthesized and characterized by various experimental techniques to propose its structure. The equilibrium constant was determined by analyzing equilibrated liquid composition. A chemical thermodynamic calculation for co-hydrating slag-blended cement with25 mass% of Na2SO4 was performed to predict phase assemblage. The simulation results on the formation of U-phase were compared with experimental results. The model could not show the presence of U-Phase in the slag blended cement system though it is observed in the experiment.

Keywords: *low-level radioactive waste; slag-blended cement; U-phase; XRD; ^{27}Al MAS NMR; PHREEQC*

Seismic Behavior of Steel-Plate Composite Walls

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Abstract. This paper summarizes the results of in-plane cyclic tests of three steel-plate composite (SC) walls with boundary elements. The tests were executed in the laboratory of National Center for Research on Earthquake Engineering (NCREE) in Taiwan. Thick steel plates were used as boundary elements of the three specimens. To study two kinds of failure modes, we included in the test 1) two shear-critical walls with an aspect ratio of 0.75 and a thickness of 3 cm for boundary elements; and 2) one flexure-critical wall with an aspect ratio of 1.22 and a thickness of 2 cm for boundary elements. The failure mode and cyclic behavior of each specimen are reported. The test results are compared with the recommendations of AISC N690s1 and predictions of selected literatures. The impact of wall aspect ratio on in-plane shear strength of SC walls with boundary elements is discussed.

Keywords: *steel-plate composite wall; boundary element; cyclic loading test; aspect ratio*

Quantification of Hydrated Cement Matrix Pore Connectivity through Tortuosity and Fractal Dimension

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Abstract. The chloride-induced corrosion of reinforcement embedded in concrete structures exposed to marine environments is one of serious threats to service-life of the structures. Diffusion is the dominant transport mechanism of chloride ingress into concrete. Therefore, clear understanding of chloride transport mechanism, particular the diffusion path, is important for designing the durability performance of reinforced concrete structures. The purpose of thi study is to determine tortuosity of cement materials and threshold pore radius which controls chloride ion transport. The pore-structure model to obtain capillary pore was expanded by introducing fractal dimension which represents microstructural complexity. The fractal dimension was determined by fitting experimental data to simulation results considering two types of C-S-Hs (low and high density) or two types of products (inner and outer), and it was used as tortuosity to determine effective diffusion coefficient of chlorides in the reactive transport model. The chloride ingress was simulated using the transport model and verified with experimental data for hydrated cement having different water to cement (W/C) ratio. A good agreement between experimental data and simulated chloride profiles demonstrate that critical pore radius exists in inner product of C-S-H. Furthermore, diffusion path is influenced by W/C and the pore in inner product controls diffusion of chloride ions in each case.

Keywords: *fractal dimension, tortuosity, calcium silicate hydrate (C-S-H), chloride ion, transport*

A Study of Cement Made from Recycled-Garbage Materials Compared with Portland Cement

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Abstract. Garbage waste is a worldwide environmental problem. Various ways have been implemented for these recycled-garbage materials to be useful in order to save the environment. One of the ways to recycle the garbage into cementitious materials is by combining organic garbage (household garbage, bagasse and rice husks) with mediteran soil. Hereinafter the recycled garbage material is called organic cement. The results of this research is aimed as a movement to save the environment. The test result of chemical compounds, through laboratory test method showed the indication of organic cement resembling the portland cement chemical compounds in the form of: CaO of 65,36%, SiO_2 18,84%, Al_2O_3 6,33%, Fe_2O_3 2,29%, SO_3 3,64%, MgO 1,35%, C_3S 66,72%, C_2S 3,98%, C_3A 12,9%, C4Af 6,97%. The density of organic cement was discovered trough physical examination with the amount of 3,01 g/cm^3, lower than the density of portland cement which was 3,16 g/cm^3. The fine cement grain which passes the 200 mesh sieving was as much as 59 %, more than the portland cement which was 33 %. The solidity of organic cement was 1224 kg/m^3, 3,52% lighter than the solidity of portland cement which was 1267 kg/m^3. The testing of initial and final setting time using normal consistency water content with 37 % for organic cement, more than the normal consistency of portland cement of 25 %. The initial setting time of organic cement was 105 minutes, longer than the initial setting time of portland cement which reached the 90 minutes mark. The final setting time of organic cement was on 330 minutes mark, longer than the final setting of portland cement which reached 180 minutes mark. Organic cement concrete possesses cohesive and adhesive properties as such in portland cement concrete. In the same design and age mix, the strengths of organic cement concrete were lower than portland cement concrete, caused by the slow setting time. The evaluation of recycled-garbage materials composition is needed for the faster setting time. Although the results of organic cement concrete strengths test are below than that of the portland cement concrete, organic cement concrete can still be utilized for lightweight construction and hot regions.

Key words: *organic cement, portland cement, organic garbage, bagasse garbage, rice husk garbage, setting time.*

Comparison Variation Cement Against Properties Masonry Concrete Brick CLC

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Abstract. One of the ways to reduce the weight of its own construction is by reducing the weight of the wall, especially the wall of a building. In case, the wall that is composed of red brick has a volume weight 1,500 kg/m^3 to 2,000 kg/m^3, and cement brick has a volume weight of 950 kg/m^3 to 1,000 kg/m^3. Whereas the concrete masonry brick has a volume weight 400 kg/m^3 to 900 kg/m^3, so if we compare, the weight volume of concrete masonry bricks has a volume weight ≤ 50% of the weight of red brick or cement brick. In the manufacture of concrete masonry bricks it is known a methods CLC (Cellular Lightweight Concrete) in which uses a mixture of cement, sand, chemical admixture and water with the filler material in the form of air generated the micro scale soap bubbles (micro bubble). In the manufacture of concrete masonry bricks CLC, the cement as a binder material certainly affects thephysical and mechanical properties of concrete masonry bricks CLC that produced. The compositions are covering 200 kg/m^3, 250 kg/m^3, 300 kg/m^3, 350 kg/m^3 and 400 kg/m^3 of cement

Keywords: *red brick, cement brick, masonry bricks CLC, cement compositions, physical and mechanical properties.*

Experimental Study of Manufacture of Lightweight Coarse Aggregate Made of Kaolin Soil, Ball Clay, Fly Ash and Boiler Ash

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Abstract. In a concrete mixture, coarse Aggregate composition provides the most influence on the weight of concrete (about 60%). Therefore, for the purposes of lightweight concrete is required the lightweight coarse aggregates. The artificial lightweight coarse aggregate is an alternative solution to produce lightweight concrete. A laboratory test have been conducted to the material characteristics (physical and chemical) that shown the ball clay has the best physical and chemical properties as the main ingredient in the manufacture of light weight coarse Aggregates if compared with kaolin, fly ash and boiler ash. Which lightweight coarse Aggregates that formed with 19 different variations of composition is burned at a temperature of 1000^{o}C, obtained uniform round shape coarse aggregates with a size ∅10 mm - ∅25 mm. From physical and mechanical properties testing of all the variations, it has shown that the variations that fulfill the qualification in terms weight / volume unit and wear are variations based on the rule of SNI and CEB / FIB is a mixture of 80% ball clay + 20% boiler ash, 80% ball clay + 20 % kaolin, 100% and 90% ball clay + 10% kaolin which suitable to be a lightweight coarse Aggregates to substitute stone.

Keywords: *Artificial coarse aggregate, ballclay, kaolin, boiler ash, fly ash.*

Comparison of Physical and Mechanical Properties Lightweight Concrete Brick CLC (Cellular Lightweight Concrete) With Gradient Variation of Sand

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Abstract. In lightweight construction in clay (soft) and peat would require an innovation in reducing the weight of its own of the building construction. One to reduce the construction weight is reducing the wall weight, especially the walls are made of red brick that has a weight of 1,500 kg / m^3 to 2,000 kg/m^3 and cement brick which has a weight of 950 kg/m^3 to 1000 kg/m^3. Then comes innovation to make lightweight concrete brick CLC, because the technology is simple and can be performed by small to medium-scale industries.in addition to the raw materials are relatively easy to obtain and also the technology is more environmentally friendly. CLC (Cellular Lightweight Concrete) is produced by mixing cement, sand, chemicals admixture and water with fillers in the form of air generated as micro bubbles or also called foamagent. From research carried out on the sand gradation which includes gradation of coarse sand, quite coarse, quite smooth and smooth we can conclude that there is an influence of graded sand against the physical and mechanical properties of lightweight foam concrete brick that resulted which is quite smooth gradations (zone III) of having good sand fineness modulus 3,030.

Keywords: *red brick, cement brick, lightweight concrete brick CLC, fineness modulus sand, physical and mechanical properties.*

Lock-brick System for environmentally friendly building infrastructure

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Abstract. Infrastructure development for raw water, livable housing, and roads are very urgent. It is spearheading to the development of backward village to get to the prosperous. Programs have been launched, such as stimulant funding for unlivable housing. The community participation is expected to realize the livable housing. But the community's financial condition does not support, so that appropriate housing only could be half-constructed, which eventually jammed. Lock-brick construction system could be an alternative solution for this problem. It also could be implemented for water infrastructure such as small ponds. Lock-bricks are made from the main ingredients soil, which be added a little cement, thoroughly mixed in dry conditions, and be dampened with water to a level sufficiently moist. Then, poured to the pressing machine until 60% pressed, forming interlocked bricks when arranged to form the walls of the livable house. Columns, beams, could be constructed by this system. Lock-brick systems are used for a wide range of building infrastructure but still considering the strength of the structure, according to standards. Some examples of usability have been done for the simple building livable housing, student dormitories building, rain water ponds, runoff water-trap canals and other construction. This lock-brick system could support the development of sustainable infrastructure and built environment because of simple, easy to make, cheap and multifunction of the usability

Keywords: *lock-brick; sustainable-infrastructure; livable-housing; simple-made*

Verification on Seismic Rapid Evaluation Using the Building Data of the 2016 Meinong Taiwan Earthquake

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Abstract. A feasible strategy on evaluating the seismic capacity for a huge volume of existing buildings is to carry out a rapid screening at beginning. Then, those buildings labeled with safety concern by rapid evaluation can be further examined by a detailed evaluation to confirm the seismic resistance. The existing seismic rapid screen methods, such as Hassan and Sozen (1997), adopted the column and wall indexes to represent the seismic vulnerability of the existing buildings. In this study, an alternative seismic rapid evaluation method proposed by National Center for Research on Earthquake Engineering (NCREE) is presented. NCREE adopted the seismic detailed evaluation data bank of the school buildings in Taiwan to establish an empirical formula of the performance ground acceleration and the column-to-floor area ratio of the existing low-rise RC buildings. In the other words, the performance ground acceleration of a low-rise RC building can be rapidly accessed by the column-to-floor area ratio of the building. The seismic rapid evaluation method had been verified by the data bank of damaged buildings from the 2016 Meinong Taiwan Earthquake. Comparison shows that the predictions of the rapid evaluation correlates well with the damaged status of buildings caused by earthquake. However, the rapid evaluation method is conservative but without losing the capability on screening seismic capacity of the existing low-rise RC buildings. In this paper, the proposed rapid evaluation, the data bank of damaged buildings and the verification results are reported.

Keywords: *column index; low-rise RC buildings; seismic rapid evaluation; seismic vulnerability; wall index.*

Shear Stress Distribution in the Opening Chords of Hybrid R/C T-Beams with Opening

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Abstract. This study is carried out to evaluate the potential of three hybrid T-beams with web openings theoretical shear stresses distribution. The shear stresses at the opening edges were plotted at the working stage, yielding stage and collapse stage for these three tested beams. The available experimental results from the previous research was compared to the finite element results as well as the developed analytical. The shear stress distribution at the middle of the top and bottom chords of the opening in pure bending region are zero. At the upper and lower corners of the opening occurs the maximum shear stresses. The maximum shear stress occurs at the right lower corner chord at the high moment edge and at the left upper corner chord at the low moment edge in beams with openings at high shear and high flexural – shear region. Furthermore, an extensive parametric study is performed on these beams to find the distributing ratio of the shear force between the opening chords. The shear force at an opening in hybrid R/C T-beam is carried by the top and bottom chords of the opening according to the area – moment of inertia root ratio with the correction factor 0.70.

Keywords: *hybrid R/C; opening chord; shear stress distribution; web opening.*

Prestressed I-Girder Optimization via Genetic Algorithm

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Abstract. Prestressed concrete has been gaining popularity in the construction industry because of its many advantages, including reduced dead load due to less material used and overall cost saving. Nonetheless, a single prestressed I-girder as a structural element in highway bridges is still significantly costly and massive, thus optimization can yield a significant amount of saving as well as reduced material consumption. In this paper, genetic algorithm (GA) is the method of choice for the optimization process, a method inspired by nature's evolution and natural selection. This study evaluates many aspects of genetic algorithm applied for optimizing material cost of prestressed I-girder design. Basic operations of genetic algorithm are presented, as well as the introduction of novel methods to achieve better result and overall performance, which are later verified. The process of seeking the best optimization parameters is also undertaken. As a result of the optimization process, the best solution is presented, defined by being the least costly solution while still maintaining compliance with AASHTO LRFD 2007 design code, including ultimate strength, service stresses and deflection, detailing requirements, geometrical feasibility, etc. Lastly, sensitivity analysis is carried out, discussing the influence of starting conditions to the output of the optimization process.

Keywords: *Genetic algorithm; Highway bridges; I-girder; Optimization; Prestressed concrete.*

An autogenous shrinkage behaviour of internally cured high strength mortar developed from local artificial lightweight aggregate (lalwa)

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Abstract. This research provided an overview of an alternative techniques for curing concrete in Indonesia especially preventing for shrinkage. Internally curing requires some of water storage that can supply water to cement mortar during hydration and cementitious reactions caused by increased of fly ash and silica fume. The use of lalwa as internal curing agent on High Strength Mortar (HSM) due to obstacle of autogenous shrinkage expected workings properly compare with shrinkage prediction of CEB-MC 90-99 model. The test was conducted on HSM mixture with water to cementicious materials ratios of 0.27, 0.30 and 0.35 to investigated the effect of using lalwa which made from pure expanded shale as a partially replacement of fines aggregate. We found that the lower the w/cm paste, the more effectively the use of alwa towards autogenous shrinkage reduction.

Keywords: *HSM, Mortar, lalwa, internal curing, autogenous, shrinkage*

Fire Behavior on the Burning Structure

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Abstract. A property destruction is an impact of uncontrolled fire. A strategy to tackle this situation is by using passive fire protection system. This system is embedded in building materials to safe and protect people from fire. It is a built in a building system and does not need special operation in fire. This system will be conducted by making a new fire resistance material. The purpose of it is to tackle the deficiency of current fire resistant materials. At the moment, fire resistant materials are gypsum, brick, stucco, concrete, and intumescent paint. Geopolymer, which is a new fire resistance material method, is based on a method to make brick. This study consists literature regarding fire, structure and geopolymer in fire. The purpose of this study is to analyse the behaviour of fire, structure and fire resistance material in fire condition. The main results and the finding of this study are the impact of fire behavior on structure and material in fire condition.

Keywords: *passive, fire, protection, resistance, behaviour, structure, material, geopolymer.*

Numerical Analysis of Viscous Wall Damping on Steel Frame

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Abstract. In its service life, the building structure should be able to subject all the environmental loads. Therefore, the structure is designed to minimize component damaged, by using a damping system. Viscous Wall Damping is one of the damping systems, using high viscosity liquids as dampers. The viscous wall damping is represented by an Exponential Maxwell Damper model. Much of the literature shows the ability of damping wall by experimental studies (Reinhorn AM, Karunarathne, et al), but few of them had discussed numerically. This article will present an analytical model of the viscous damping wall, add viscous wall damping elemet to an existing frame and numerical analysis. The analysis displayed the ability of the damper due to a relative intense earthquake load. The analysis was performed by a computer application on a steel space frame that excitated a combination of three earthquake types. The influence of VWD showed that a significant decrement of displacement u_1 at the structure with VWD in X & Y direction (50,78%) and with VWD in Y direction (23,96%). The decrement displacement happened at all structure. At the end of the analysis shows the reduce of the structure periods, the structure response (displacement, velocity and acceleration). All these results concluse that the structural components damaged due to loads can be greatly reduced.

Keywords: *Viscous wall damping, Model Analysis, Exponential Maxwell Damper model.*

Structural Integrity Management System for Fixed Offshore Platform

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Abstract. The main objective of Structural Integrity Management System (SIMS) is to ensure that structure is fit for purpose and maintain the integrity of facility throughout its life cycle. SIMS is a part of PHE WMO Asset Integrity Management Framework. The structural component covered in SIMS for fixed offshore platform including substructure (jacket, including vertical, horizontal, and diagonal bracing) and upper structure/topside (deck girder, deck leg, trusses, and other personnel safety structure). SIMS managed in a centralized online database management system to make sure that the assets are registered and program including inspection, assessment, maintenance and repair activities are monitored and completed on schedule. SIMS fundamental process as per API RP2SIM consists of 4 primary elements: data, evaluation, strategy, and program. This process is developed into integrity management cycle: Plan, Do, Check, Action (PDCA) cycle as basis to establish structure integrity program. The Plan cycle include Inspection, Maintenance, and Repair (IMR) Strategy and Program Plan, Risk-Based Underwater Inspection. The Do cycle consist of procedure and execution of Above Water and Under Water Inspection, structural identification and component numbering. The Check cycle contains anomaly assessment report, produce recommendation for anomaly findings, integrity status methodology and determination for each platform. The Action cycle covered further detailed inspection, execution of maintenance and repair. All of the cycle monitored, maintained, and recorded in database management system. In conclusion, SIMS is a continuous process to ensure that structural asset is fit to operate safely, reliably, and effectively from FEED until decommissioning. Further development and improvement shall be done along the implementation of SIMS to escalate integrity performance.

Keywords: *asset integrity management system, fixed offshore platform, structural integrity management system*

Compressive strength of fly ash-based geopolymer Concrete with a variable of sodium hydroxide (NaOH) solution molarity

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Abstract. Geopolymer concrete is a new material made by activating the raw materials which contains many elements of silica and alumina. The Compressive strength of the concrete produced is influenced by the concentration of the activator solution. This paper presents an experimental investigation of geopolymer concrete based on fly ash of Suralaya Power Plant. In this case Portland cement is not used. The objective of the studies was to investigate the effects of alkaline activator solution (AAS) molarity on the compressive strength of concrete. The test parameters were a solution of sodium hydroxide was chosen as the activator solution. The concentration of sodium hydroxide solution used was 10 M, 12 M and 14 M. The specimen is made of concrete cylinder with diameter 10 cm and height 20 cm as many as 15 pieces each variable. Total of specimen is 60 pieces. The test of compressive strength is performed when the concrete is 7, 14, and 28 days old. The ambient curing of the specimen is carried out. The test results is indicate that the increasing of sodium hydroxide (NaOH) solution concentration leads to improve the compressive strength of geopolymer concrete. The optimal compressive strength of geopolymer concrete was achieved at a concentration of sodium hydroxide solution (NaOH) of 12 M. The achievement of the compressive strength of geopolymer concrete only around 50-60% of the planned compressive strength.

Keywords: *geopolymer concrete, compressive strength, fly ash, alkaline activator Solution (AAS), NaOH molarity*

Heat Treatments Optimisation of Reactive Powder Concrete based on the Compressive Strength

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Abstract. This paper presents the corresponding compressive strength of RPC with variable pressure combined with heating rate, heating duration, and starting time of heating. The treatments applied were 8 MPa static pressure on fresh RPC prims and heat curing at 240 °C in an oven. The compressive strength test was conducted at 7-d and 28-d. The images of RPC morphology were captured on the surface of a fractured specimen using Scanning Electron Microscopy in Secondary Electron detector mode to describe pore filing mechanism after treatments. The results show that a heating rate at 50 °C/hr resulted in the highest compressive strength; c. 40 % more than those at 10 or 100 °C/hr. A heating duration of 48 hours led to the maximum compressive strength. Heat curing applied 2 days after casting resulted in the maximum compressive. Heat curing had a signicant effect on the compresssive strength due to the acceleration of both reactions (hydration and pozzolanic) and the degree of transformation from tobermorite to xonotlite. It is concluded that the optimum condition of treatments is both pressure and heat curing at 2-day after casting with a rate of 50 °C/hr for 48 hours.

Keywords: *compressive; crystal; heating; pressure; RPC; treatment; transformation*

Study on Damage Status and Seismic Assessment of Mid- to High-rise Buildings in the 2016 Meinong Earthquake in Taiwan

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Abstract. Since the population is dense and the basement is not considered as floor area, deep excavation is very common for mid to high-rise buildings. The basement is usually used for parking cars. In order to maximize the number of cars to be parked and to provide enough space for the mobility of the cars, the number of columns is minimized and the span between columns is maximized. Due to lack of redundancy, once one of the columns is damaged, the rest of columns will be damaged sequentially. Mid to high-rise buildings, of at least seven stories high and composed of several units, are often lined up in a row along the street. 16 mid to high-rise buildings in Tainan City, which were constructed before 1999, were investigated in the first-stage evaluation after the earthquake. The mid to high-rise building reconnaissance includes commercial/residential buildings and residential buildings. These mid to high-rise building damage modes can be summarized as follows: (1) presence of soft and weak first story, (2) lack of redundancy, and (3) lack of lateral reinforcement. The reconnaissance results of two representatives mid to high-rise buildings during the earthquake are introduced in this paper. This study also uses the seismic assessment method with pushover analysis and nonlinear response history analysis to understand the seismic capacity with those collapsed buildings in this earthquake. The fruitful results of this research could provide a well contribution for the prevention of collapse of mid- to high-rise buildings in the next big disaster.

Keywords: *damage investigation; Meinong earthquake; mid to high-rise buildings; nonlinear response history analysis; pushover analysis.*

The Use of Hazardous Sludge Solidification and Green-lipped Mussel Shells in Cementitious Material: A Case Study of NGCC Power Plant of Priok

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Abstract. This paper aims to introduce the utilization of hazardous sludge with green-lipped mussel shells as concrete mixture components. The hazardous sludge is a side product of wastewater treatment plant operated in NGCC Priok, while green-lipped mussel shells are side product of community activity in Kalibaru, North Jakarta, Indonesia. Utilization is dedicated to preserve the environment, reducing both hazardous sludge generations from wastewater treatment plant and potential waste from social activities in the coastal area. Three different groups of concretes were prepared. The first group contains normal concretes with W/C ratio of 0.5. Subsequently, the second group contains concretes with dry sludge and mussel as a replacement of fine aggregate at different contents, 5% (C1), 10% (C2), and 15% (C3), with W/C ratio of 0.5. Finally, the last group contains concretes with dry sludge as cement replacement and the green-lipped mussel as fine aggregate replacement at different contents of 5% (C4), 10% (C5), and 15% (C6). The results show that dry sludge and green-lipped mussel provide better results when used as a substitute for fine aggregate rather than as cement replacement. In addition, the rate of strength development of concretes containing waste additions are slow compared to normal concretes.

Keywords: *hazardous sludge; green-lipped; mussel shells; NGCC Priok; oven dried sludge; compressive strength*

Restoration of Damaged Offshore Structure by Nano Material Concrete

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Abstract. Deterioration of a material or system often is initiated or accelerated by the presence of a defect or the introduction of a catalyst. Sea water is the most significant catalyst to the failure mechanism of offshore structures. Corrosion of steel due to incompatibility factors such as chloride attack or physical interactions may lead to the joints and elements loss or degradation of stresses, reducing the strength or stability of the structure system. Deterioration of the offshore structures stem from overstress condition owing to under design, overload, unanticipated eccentric loads, fatigue or improper use factors. Proper treatment by nano material concrete may reduce or prevent the occurrence of the deterioration, improves and ensures the substructure stability, particularly jacket legs and joints.

Keywords: *deterioration, defect, joints, structure system, restoration, nano material concrete*.

Implementation of Highly-Flowable Strain Hardening Fiber Reinforced Concrete in New RC Beam-Column Joints

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Abstract. The purpose of New RC project was aimed to reduce the member sections and increase the available space of high rise buildings by using high strength concrete (f'c > 70 MPa) and high strength rebars (fy > 685 MPa). Material consumptions and member sections can be further reduced owing to the upgrade of strength. However, the nature of brittleness of high strength may also cause early cover spalling and other ductility issues. Addition of steel fibers is an alternative as transverse reinforcement. Highly flowable strain hardening fiber reinforced concrete (HF-SHFRC) has excellent workability in the fresh state and exhibits the strain-hardening and multiple cracking characteristics of high performance fiber reinforced cementitious composites (HPFRCC) in their hardened state. The objective of this study is to investigate the feasibility of implementing HF-SHFRC in New RC building systems, such as beam-column joints and base columns as an alternative of transverse reinforcements. Four full-scale exterior beam-column joints, including two specimens with intensive transverse reinforcements and two specimens made of HF-SHFRC without any stirrup, are tested. Test results show that the HF-SHFRC specimens perform as well as specimens with intensive transverse reinforcements regarding failure mode, ductility, energy dissipation and crack width control. Integration of New RC building systems and HF-SHFRC can assuring construction qualities and further diminish labor work and give infrastructure longer service life, and eventually lower the life-cycle cost.

Keywords: *High strength concrete, fiber reinforced concrete, beam-column joints, cyclic behavior, strain hardening.*

TOPIC 2

TRANSPORTATION SYSTEM AND ENGINEERING

Model Petri Net of Adaptive Traffic Lights and Its Collaboration with Special Events

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Abstract. Traffic lights have an important role as the system control of vehicles flow on the urban network. Commonly, most countries still using fixed time strategy. Our research proposes the adaptive traffic lights model to response the traffic demand. It uses basic Petri net as a general modeling framework. For actuating method of minimum and maximum green signal time interval, the green traffic lights have three-time extension units. Next, we collaborate to a case of the existence of railways that crosses on the southern arm of an intersection. We introduce both of collaboration model design of traffic lights and the railway's gate which always closes while a train passing. Verification and validation of the model is based on the simulation result of vehicles queue. The collaboration model design of traffic lights has excellent performance, and it can resolve the congestion problem better than conventional schedule.

Keywords: *adaptive traffic lights, Petri net, railway's gate, urban network*

Regression Analysis of Trip Attraction and Parking Evaluation with Tariff on Office Building in Samarinda, East Kalimantan

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Abstract. The purpose of this research is to determine of causative factors and how strong these influence trip attraction at Samarinda Province Government Center and to analysis the charactheristics of parking and tariff that would be applied. The results showed that the model of trip attraction that occurs after the regression analysis is $Y = 0.451 + 0.503\ X_1 + 0.395\ X_5$ with the most influential factors of car users and revenues of 50.1%, which is considered to have a fairly strong relationship. When an increase in the intensity of activity, then the office building with an area of 1 ha able to attract 240 motorcycles and 390 cars / day. With the accumulation of parking at peak hours of 86 cars and 200 motorcycles with the highest parking duration 120-180 minutes (2-3 hours), with the number of vehicles 103 vehicles cars and 176 motorcycles parked vehicles. Applied rates are the rates that may be progressive with the rate of Rp 2000, - for the first two hours and a maximum rate of Rp 4000, - for the automobile. And Rp 1500, - for the first two hours and a maximum rate of Rp 3500,- to a maximum tariff for motorcycle.

Keywords: *trip attraction; parking; parking rates, regression analysis.*

The Life Cycle Cost Analysis of Concrete and Asphalt Pavements of Taiwan Freeway System

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Abstract. The 9.25 km (5.8 mile) Daxi-Longtan section of National Freeway No. 3 was the first large scale concrete pavement of major highway in Taiwan. Based on the maintenance data for the past 22 years since its opening, concrete pavement has shown much lower frequency of maintenance and consequently lower maintenance costs than that of asphalt pavement. The major maintenance works involve diamond grinding, full depth and partial depth patch, joints resealing, and a few slab replacements. This study conducted life cycle cost analysis (LCCA) on the concrete pavement and two conjunctive sections of asphalt pavement with the same length, one at each end of the concrete pavement section. The LCCA approach considers not only direct agency costs (initial construction costs and maintenance costs) but also extra user costs induced by congestion at maintenance work zone. The results show that for the first 22 years, the ratio of life cycle costs of concrete pavement over that of asphalt pavement is 1.11. Since a relatively large portion of the user costs of concrete pavement are caused by traffic congestion during maintenance, it is believed that the extra user costs can be reduced significantly if the fast-track concrete pavement maintenance method can be adopted.

Keywords: *asphalt pavement, concrete pavement, life cycle cost analysis*

Determining the Priority of Urban Roads Maintenance and Rehabilitation System

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Abstract. Due to the limited budget of pavement maintenance and rehabilitation, prioritization of maintenance and rehabilitation is inevitable. Many models have been developed to solve these problems. The aims of this study are to determine the indices weighted of the rank prioritization criteria using fuzzy logic, and to create pavement maintenance and rehabilitation prioritization system using a simple algorithm. The prioritization will be taken into account the effect of important criteria such as: road condition, traffic volume, budget processing and land use. 30 stakeholders were asked to fill in the questionnaires interviewed. To evaluate these priority system as many as 188 pavement sections of Ponorogo urban roads was used as a case study. The Surface Distress Index (SDI) data, traffic volume, budget processing and land use of these road sections were collected. Based on the system, the weights of the criteria were: road condition (W1) = 0,411; traffic volume (W2) = 0,122; budget processing (W3) = 0,363 and land use (W4) = 0,105. The result of this study concluded that the roads which get the first priority for road maintenance and rehabilitation activity was Nyi Ageng Serang street. The second up to fifth priority respectively, were Larasti street, Delima street, Letjen MT Haryono VI street and Veteran street.

Keywords: *Fuzzy logic, pavement maintenance and rehabilitation, pavement maintenance system*.

Performance Level Analyses of Public Transportation Using Importance-Performance Analysis Method

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Abstract. Yogyakarta, one of the middle cities in Indonesia, has been developing BRT system named Trans Jogja to reduce growth of motorization. However, the performance tends to decrease year by year, therefore the system and management upgrading must be carried out continuously to restore public trust. This research tries to investigate public satisfaction, their expectation, and some attributes considered important based on public's perspective using IPA method that can be used as useful information systems to evaluate service quality by prioritizing or focusing on areas where improvement is needed. The results reveal that decision maker must focus and allocate their resources to improve Trans Jogja system on the following attributes: a) keep punctuality, b) shorten waiting time in the bus stop, c) improve bus comfort, d) provide safety for child passenger, e) improve bus stop comfort, f) create new bus route to enlarge accessibility, and g) shorten bus travel time.

Keywords: *Public Transportation, Bus, Reduce Motorization, Importance-Performance Analysis*

Is It Possible the Traditional Mode to be Use as a Sustainable Urban Transportation Option in Indonesia? A Review

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Abstract. In Indonesia, the use of motorized vehicles dominated than non- motorized vehicles. However, non-motorized vehicles are used by community to activities. In fact, there are non-motorized vehicle modifications using motorized machines such as motor tricycles. Non-motorized vehicles are not engine modifications called traditional modes in the paper. Traditional modes are widely used in Indonesia such as bicycles, tricycles and horse carts (andong). Some parts of Indonesia, the existence of traditional modes are become a tourist icon and unique than to other areas. However, in facts of facilities and infrastructure not supported yet. Some examples of the problems are not lane of the availability, if there is used motorized parking. The purpose of the paper is to review the possible used of traditional mode in urban area by the study of literature. The methods is used literature review on view of regulatory and users need. The regulatory review is related to the rules of the provision of facilities and infrastructure of traditional modes. While the user needs are related to the implementation of traditional modes and accessibility. The results of the regulatory review obtained the difference in regulations that have not prioritized the needs of infrastructure. Review of user requirements is the availability of infrastructure for easy accessibility related to safety, convenience and security. Understanding user needs and regulatory support from the Government allows the continued sustainability of traditional transport by the community.

Keywords: *Traditional mode; sustainable; urban transportation; regulation; user need.*

Short Sea Shipping Policy in Indonesia and Other Countries

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Abstract. Coastal sea transport or Short Sea Shipping (SSS) is an alternative transportation of goods and people. Short Sea Shipping service is based on several regulations and policies related to the development of national, regional, and even international transportation. In Indonesia, SSS policy is known by the name of Sea Tol. In Europe, SSS policy is known by the name of Marco Polo I & II, in North America SSS policy involves 3 countries. In Japan, SSS serves national freight from north to south. Each country has different regulations, policies and approaches regarding SSS. The advantages and disadvantages of the experience of other countries can be used as the basis for the development of SSS in Indonesia.

Keywords: *Short Sea Shipping* (SSS)

Exploring Physical Attributes of Walkability from Perspective of Blind Pedestrians

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Abstract. Access has become a crucial issue for the persons with disabilities (PWDs), in which the inconvenient transportation facilities is contributed to the dependent living issue of PWD, specifically the visual impaired person. As a primary aspect of transportation, the walking facilities further needs to be carefully considered for facilitating their moving activities. Recently, the effect of built environment on walking behavior has obtained significant attention, which is generally constructed within the framework of walkability concept. The walkability has been extensively used for evaluating the physical attributes of pedestrian facilities by comparing it to the walker perception. Hence, the evaluation result can directly answer the needs of pedestrian. Despite of their recent research achievements, the walkability concept is mostly unsuccessful to take into account the blind walker characteristics. This paper then explore physical attributes of walkability environment in order to provide the friendly pedestrian facilities for the blind pedestrian, which is rarely explored. The research is established based on the blind walker perspectives within the micro-level analysis that incorporates a smaller unit of measurement (i.e., the street-level physical attributes). The physical attributes result are thus potentially to be utilized for analyzing the required pedestrian facilities for the blind pedestrians.

Keywords: *walkability index, blind walker, micro-level analysis, pedestrian facilities*

Pedestrian Perception about Facility of Pedestrian Crossings

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Abstract. Pedestrians are vulnerable road user which have potential conflicts with vehicles, especially when pedestrians crossing the road. The number of accidents which was involving pedestrians crossing on the roads were relatively high. Data showed that accidents which were involving pedestrians in Indonesia were 3878 events[1]. The purpose of this study is to determine the needs of pedestrians on the crossing facility and how pedestians desired types of crossing facilities. Data were collected by questionnaire distribution and interviews to the pedestrians. Collecting data and information were conducted in Bandung. Perception of comfort on each type of crossing facility, the majority of respondents choose pelican crossing and crossings with creative road marking with the highest comfort 50% and 51% respectively. Respondents' perception on the secure of each types of crossing facility is to assume that overpass/underpass has the highest secure pedestrian crossing by 48%. In addition, the recommendation of types of pedestrian crossing on Jalan Asia Africa Rd and Aceh Rd are pelican crossing on weekday and overpass/underpas at the weekend based on PV^2 formula.

Keywords: *crossing facilities; pedestrians; perception; questionnaire.*

Developing the Standard and Pedestrians' Perception of Level of Service for a Pedestrian Path

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Abstract. Sustainable infrastructure is one key variable in supporting sustainable transportation. One mode that really supports sustainable transportation is walking, since it does not need fuel, and does not produce any pollution. It also improves pedestrian health. Included in pedestrian path design should also be the fulfillment of user and planner interests. Recently, Indonesia published Regulation No: 03/PRT/M/ 2014 about the Pedestrian Level of Service (LOS), which intends to develop standard pedestrian LOS, including pedestrian movement and sidewalk capacity, as unlike the Bangkok standard, there is no parameter that represents pedestrian interest. Australian standards develop a pedestrian facilities approach. Identifying pedestrian interests can be done by measuring pedestrian perception of comfort, since comfort is an important parameter that influences the willingness to enhance the walking mode. This study aims to check the suitability between this standard pedestrian LOS and pedestrian perception of comfort in a commercial area, Pasar Gede market. This market has three sections: North, West, and South sections. The study concludes that, based on Indonesia regulation LOS, the pedestrian path around Pasar Gede market is categorized as level A at all sections, and this is the same as the Bangkok standards. According to the Australian's standard, the LOS is an A for the West section, B for the North section, and C for the South section. The results from measuring pedestrian perceptions of comfort, based on an interview survey of 288 respondents, shows that pedestrians have slight perceptions of discomfort for all sections. This means that although the pedestrian path fulfills the level of service for Indonesian Government regulation, it does not fulfill user satisfaction. Therefore, the Indonesian LOS standard for pedestrian paths doesn't provide equity for the pedestrian.

Keywords: *Pedestrian path, Pedestrians' Perception, Level of Service, Commercial area*

Comparison Overlay of Flexible Pavement Analysis Using AASHTO 1993 Method and Everseries Program

(Case Study: Daan Mogot Road, DKI Jakarta)

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Abstract. Jakarta Province's national road is one of most important road in logistics distribution in Java Island. Rapid load that occured on those road, affect pavement performance and often causing structural and functional failure. Functional failure is related to safety and comfort aspect disturbance, but structural failure related to ability of pavement to carry traffic loads. If pavement encounter structural failure, then those segments of pavement wouldn't carry traffic loads. This situation compounded if functional failure occured that will affect safety and comfort of road users. To avoid this situation, needs to periodical inspection and control to ensure these road can accomodate traffic demand.The purpose of this research is to analyze the structural capacity of flexible pavement based on deflection data from Falling Weight Deflectometer (FWD) and to compare the results of overlay thickness using AASHTO 1993 Method and Everseries Program. Analysis using AASHTO 1993 Method assumed 2-layer modeling system where deflection data d1 and d9 from FWD that has been segmented, used to determine the value of Resilient Modulus (M_R) and Pavement Effective Modulus (E_p). Parameters of determination overlay thickness using AASHTO 1993 Method are SNo value (Structural Number Origin), SNeff (Structural Number Effective) and SNF (Structural Number Future). Overlay Thickness by AASHTO 1993 method ranged from 5 cm to 13 cm. In the 2-layer system modeling Everseries Program, modulus can be calculated by Evercalc subprogram where input of this program is deflection data d1 to d9 from FWD that has been segmented. Furthermore, the overlay thickness calcutaed by Everpave subprogram which produces overlay thickness range from 5 cm to 25 cm. Based on the analysis result, there is a difference overlay thickness between using AASHTO 1993 Method and Everseries Program. Everseries program produce overlay thickness thicker than AASHTO 1993 method, because there are several different parameters such as deflection data, temperature by seasonal variations and traffic loads.

Keywords: *AASHTO 1993, Everseries, Evercalc, Everpave, Overlay*

Relationship between Perception of Walkability with Access and Egress Mode Choice for Train Usage

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Abstract. The purpose of this study is to understand whether there is a relationship between walkability perception with the selection of access mode and mode egress for train users who ride from Cicalengka station Bandung Regency, West Java, Indonesia. To analyzed the relationship is used crosstab method. The perception of walkability is related to distance, safety, comfort, and security, both for walkability from home to origin station and from destination station to final destination. The mode choices consist of walking, paratransit, motorcycle taxi, and own vehicles (or others for egress mode). To better understand the relationship is used several control variables, namely trip purposes, train usage, gender, and age. For access trip there is another control variable, namely vehicle ownership. The perception about walkability has more to do with access mode. Security has nothing to do with access and egress mode choice. The pattern of relationships between walkability measures with choice varies for each control variable.

Keywords: *access mode choice, egress mode choice, perceptions of walkability*

Application of GIS to determine the flood impact to road network and traffic disruption in Bandung Metropolitan Area

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Abstract. Floods in Bandung area often occur when the rainfall is high then the water volume exceeds the capacity of Citarum watershed. Floods cause economic and social losses. The purpose of this research is to get the GIS application model in the estimation of puddle area and road network in Bandung Metropolitan Area has disturbed. Geospatial map preparation methodology used statistical data from 11041 flood points, which divided into two groups, 7729 flood points to estimate the decision tree model and 3312 flood points to validate the model. The process of making flood vulnerability maps is approached by Chi-square Automatic Interaction Detection (CHAID) method, and validation using Receiver Operating Characteristic (ROC) method. Validation results in the area under the curve with a value of 93.1% for success rate and 92.7% for the prediction level. Chaid result is class 0 - 0,047 covering 76,68% area; Grades of 0.047-0.307 include 5.37%; Grades 0.307 - 0.599 (Low) covering 5.36%; Grades 0.599 to 0.4444 include 5.31% and grade 0.844-1 (high) covering 7.27% of the research area. Flood-prone road network is Link from Rancaekek (Area of PT Kahatex), link from Solokan Jeruk (Cicalengka-Majalaya), Link Baleendah, link Dayeuhkolot (M.Toha - Andir)

Keywords: *chaid, flood, gis, link road, rainfall, watershed*

3D Mobile Mapping Surveying for Road Condition Monitoring

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Abstract. Road is one of main infrastructures in transportation sector having important supporting role in realization of development acceleration and overcoming traffic problem in a region. In Indonesia, there are several types of roads such as national, provincial, residential/municipal. Since the significance role of those roads, the government should collect each road condition data periodically. Given road condition data, expected can be used to facilitate the road monitoring and to be analyzed if there are broken roads, it may have be repaired immediately by local government. However, many of roads are not yet put in up-to-date data collection. One cause of the problems is the long and time consuming process of road data inventory. Based on the issues, an effective surveying method is necessary as a solution to accelerate the implementation of road condition inventory with the accuracy meet the specified standards. One of methods for object of investigation in this study is carrying out road condition inventory survey using MMS (Mobile Mapping Syatem) method. MMS is one of scanning laser instruments that can record an object on a three-dimension scale by using mobile vehicle. Using mobile, the inventory of roads may be recorded indirectly in short time. Beside the advantage of MMS, there is still a question about how to get data immediately with the accuracy meet specified standards both for road conditions information and the position. This research aimed to formulate surveying design in order to acquire road condition data as well as information on the accuracy of road condition and geometric.

Keywords: *mobile mapping system, road condition, scanning laser instruments*

Swarm Algorithms Comparative Study for Solving Stochastic Optimization Problem of Container Terminal Design

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Abstract. This paper presents a comparative study of swarm-based algorithms by investigating its performance for designing facilities of container terminal (CT). The facilities design is conducted within the framework of stochastic discrete optimization, which is involved the number of equipment determination by taking into account the variation of demand and facilities productivity. The variation is generated by following the observed distribution based on the Monte Carlo simulation framework. The conflicting issue due to the increment of equipment number, which possibly produces the additional delay, is also modelled, specifically relating to the increasing of truck number. Since the optimization problem contain the large number of combination, the swarm-based algorithms are invoked to provide the feasible solution. Particle Swarm Optimization (PSO) and Glowworm Swarm Optimization (GSO) are then applied for tackling the optimization problem, and their performances are subsequently investigated, which is rarely elaborated in the CT facilities design.

Keywords: *Stochastic Optimization, Glowworm Swarm Optimization, Particle Swarm Optimization, Container Terminal Facilities Design*

The Analysis of Overloaded Trucks in Indonesia based on Weigh in Motion Data (East of Sumatera National Road Case Study)

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Abstract. Overloaded trucks phenomena generally common in developing countries where the traffic control is poor. In Indonesia, the percentage of overloaded trucks can reach more than 60% in the total number of trucks and may be one of the substantial factors that reduce the service life of the road pavements. This paper presents the analysis results of the weigh in motion survey data at East of Sumatera National Road (Jalintim) in Indonesia and the impact of overloaded trucks on the pavement. For the analysis the simplified approach was used, the axle loads were converted into representative single-axle loads based on 4th power formula by AASHTO 1993 equation. The vehicle damage factor of vehicles is presented. The axle load analysis will be compared with the Highways National Standard to estimate the remaining service life of pavement and IRI value prediction. The analysis showed that the vehicle damage factor that determined from weigh in motion data was extremely greater than vehicle damage factor of the national standard in Indonesia which may lead to accelerated deterioration, reducing the service life of the pavement structures and significantly influence the IRI value.

Keywords: *overloaded trucks, vehicle damage factor, service life, IRI prediction*

Porous Concrete Basic Property Criteria as Rigid Pavement Base Layer in Indonesia

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Abstract. Base layer with grained material tend to occur in saturated condition at the moment of rainfall or after rainfall. In that condition, the present of traffic might also create movement below the foundation layer and reduce its bearing capacity. Nevertheless, the foundation material that contain large fine creates base layer with low permeability and slow water movement. This paper presented the procedure and result of laboratory experimental study to obtain basic property criteria for rigid pavement base layer. Four basic parameters that were used were fresh density, compressive strength, void content and permeability. The minimum criteria for mix-design was attained by using water cement ratio 0.30, aggregate cement ratio 4.0 and varying aggregate size value along with sand addition, fly-ash replacement and chemical additive addition. It was found that porous concrete mixtures with sand and fly-ash inclusion were successfully surpassed the minimum compressive strength and permeability requirements for base layer which are required by Directorate General of Highways. In addition, the negative strong correlation between fresh density and void content created a fine potency to use the fresh density as a reference to set the desired porous concrete void content on the field.

Keywords: *Porous Concrete, Base Layer, Rigid Pavement, Fresh Density, Compressive Strength, Void Content, Permeability.*

TOPIC 3

WATER RESOURCES ENGINEERING AND MANAGEMENT

Model of Ciliwung River Flood Diversion Tunnel using HEC-RAS Software

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Abstract. As a coastal city which lays in lowland area, Jakarta is prone to flooding. One major river which flow through Jakarta is Ciliwung river. There are alternatives to reduce flood risk, such as: river capacity improvement, existing natural reservoir and polder system improvement, upstream reservoir construction, city drainage improvement, flood channel construction and flood diversion. This paper presents performance analysis of a proposed flood diversion of Ciliwung river to Cipinang river. Cipinang River has its downstream end at Eastern Flood Canal (Kanal Banjir Timur, KBT). This diversion is based on the available capacity of KBT. A 1-D numerical hydraulic model using HEC-RAS based on a proposed design is used to assess the performance of the diversion system in any combination of upstream and downstream boundary condition. Simulations were done for steady condition. The results shows that capacity of the system can be achieved for certain condition at upsream and downstream boundary. The effect at the downstream reach of Ciliwung and Cipinang river due to the diversion are also obtained.

Keywords: *diversion, flood, HEC-RAS, 1-D numerical model*

Erosion Index Formulation with respect to Reservoir Life in The Upper Citarum Watershed

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Abstract. This study aimed to formulate erosion index in the upper Citarum watershed with respect to the Saguling reservoir life. Soil and Water Assessment Tool model was incorporated to simulate hydrological processes in the catchment. From the calibration and validation results, the model is considerably of good performance. The simulated sediment inflow at Nanjung outlet was then extrapolated to determine the sediment inflow into the reservoir. The study revealed that the average value of sediment inflow into the reservoir is 29.24 tons/ha/year just below the tolerable erosion limit of 30 tons/ha/year assumed by Hammer (1981). It was also found that the relationship between sediment yield and sediment inflow is non linear. Erosion index is formulated as the ratio between the mean annual sediment yield generated in the watershed and the mean annual sediment yield that leads dead storage to be full in the designated life of the reservoir. Erosion index equals to 1.0 indicates that the dead storage will be full in the designated life of the reservoir. A classification of erosion index can be subsequently be made based on erosion index and reservoir life relationship.

Keywords: *dead storage; erosion hazard index; erosion index; MUSLE; reservoir life; sediment inflow; sediment yield; USLE.*

Development Land Erosion Model Using Model Builder GIS (Study case: Citepus Watershed)

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Abstract. Land erosion is the impact of increasing runoff discharge and land use conversion to impervious areas. Land erosion usually calculated by formula called USLE (Universal Soil Loss Equation) then modified as MUSLE (Modified Universal Soil Loss Equation). These formula calculate average annual soil loss in tons/areas depends on rainfall erosivity (R), soil erodibility factor (K), topographic factor (LS), cropping and conservation factor (CP). GIS (Geographic Information System) is a system designed to capture, manipulate, and analyze spatial/geographic data. There are some tools related water resources analysis in ArcGIS such as: watershed analysis and also have a tool for user to create their own model called model builder. This research was aimed to create a model to calculate land erosion using MUSLE formula by model builder in ArcGIS. The output for this research is the model which can be used to calculate annual soil loss in watershed area based on GIS systems. For the model trial and study case, we use Citepus watershed located on Bandung West Java, that has 5 river branches: Cibogo, Cikakak, Cilimus, Cipedes and Ciroyom. As the result of the model, the value of average annual soil loss in Citepus watershed can be calculated automatically by developed model.

Keywords: *Citepus, erosion, GIS, MUSLE, model.*

Study of the Relation between Sediment Characteristics and Multiphase Flow to the Presence of Sediment Oxygen Demand (SOD) in Open Channels

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Abstract. A laboratory study was conducted with the aim to determine the correlation between sediment characteristics and multiphase flow analysis of carrier fluid to the presence of SOD. Six sediment samples were tested on their physical and chemical characteristics along with particle size distribution of sediments to find the indication of oxygen consumption and to classify the soil sediment class. For multiphase flow analysis, there were two transition velocities calculated: the transition between a pseudo-homogenous flow and a heterogeneous flow and the limit deposit velocities at the onset of solid particle bed. The SOD test was done in laboratory-scale by using a 600-mL reactor. According to tests, the amount of organic carbon content (TOC) in the samples were ranging from 34.58 to 81.27%, with the sediments' textures categorised as silt loam, silty clay loam, and sand. In the channels, heterogeneous flow occurred in two channel segments, while the other segments' regime was classified as homogeneous flow. The obtained SOD values were varied from 0.2427 to 0.8487 $g/m^2/day$ with K_3 values obtained ranged from 8.6537 to 12.4028 m^{-1}. Based on all analysis, the organic characteristic of sediment holds a key role in the presence of SOD value.

Keywords: *open channel, sediment, sediment oxygen demand*

Groundwater Study in Boja District, Kendal, Central Java Province Based on Hydrogeology for Residential Development

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Abstract. Clean water availability is a crucial case for the sustainability and development of human life. Regional District of Boja is a highland area with rapid settlement growth. Currently this day, PDAM has not been able to supply clean water to the area. So the current water needs can only be fulfilled from groundwater resources in the form of a wellbore. The research purpose is to analyze the condition of groundwater based on hydrogeology. In this study, measured the depth of groundwater level and took groundwater samples from wells inhabitants that spread over 15 villages in the district of Boja. After samples were taken, physically observed to see its color and odor as well as laboratory test to measure the hardness value, the value of TDS, SAR, DHL, and WQI. Based on result, water discharge is 0,038417032 m3/s. Result of geolectrical measurement showed subsurface lithology are tuff, lapili, breccia, and andesite. Based on contour map depth of groundwater level showed flow accumulation of groundwater from south to north and southwest to northeast. Result of laboratory test showed value of hardness, TDS, SAR, WQI can be concluded that groundwater quality in that area are commonly good for consumption and for daily purposes.

Keywords: *aquifer, flow accumulation, geoelectrical, groundwater, groundwater quality, hydrogeology, lithology*

The Performance of Equalization Model of Water Allocation Inter Irrigation Areas in River System

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Abstract. In Indonesia, water is public goods so it is necessary to control water allocation. Inequity of water allocation between water users is expanding, including irrigation as the largest user with fluctuate demand, and the density of headworks in the river are getting higher. Considering that water is limited, the practice of irrigation water allocation needs to be refined, from the traditional equity to volumetric equity. MEQAA (Model *Equaliasai* Alokasi Air/Equalization Model of Water Allocation) plays a role in determining water sharing between headworks in order to meet the maximum-equal K-factor (release demand ratio) in watersheds. MEQAA-Generic is a calculation machine with: conceptual-dynamic model; network equation according to mass balance principle; optimization-simulation; independent-based system; sustainability-efficiency-equity constraints; Excel-VBA. The inputs are: scheme system, inflow, and irrigation demand. The outputs are: K-factor, release and ecosystem quote. The model performance is identified by comparing the output to the class of K-factor based on treatment of water distribution within irrigated areas. The model test was performed in an uncontrolled and complicated independent system in Lombok river basin. As long as it is adequate for water sharing, MEQAA-G can always produce maximum-equal K-factor. The output model is used to control water allocation beatween headworks.

Keywords: *headwork, irrigation area, K-factor, network equation, water sharing*

Diversion Canal to Decrease Flooding (Case Study: Kebon Jati-Kalibata Segment, Ciliwung River Basin)

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Abstract. The flood in Jakarta has become a national concern in Indonesia. It is a haunting disaster, with a high probability to happen when heavy rainfalls in Jakarta and/or its upstream area. Based on data that was provided by Public Work Agency of DKI Jakarta, there are 78 vulnerable points of inundation in which, most of them are located in Ciliwung river basin, commonly in the meandering segments. One of the worst flooding occurs in Pancoran, at Kebonjati to Kalibata segment in particular. The river discharge in this segment is much higher as compared to the carrying capacity. In addition, this area has a high density of population and thus, difficult to increase the *river capacity* by enlarging the river dimension. In this research, a closed diversion canal is proposed as a solution. The effectiveness of the solution is evaluated using a numerical model, HEC-RAS 4.1. The diversion canal is designed as two culverts, with 2.0 m in diameter. Nevertheless, hydraulic jump may occur at the outlet of the canal due to the relatively steep slope. Therefore, the canal outlet should be designed accordingly. A Hydraulic structure such as a stilling basin can be employed to reduce the energy. The results show that the diversion canal has a good performance in decreasing water level and flood discharge in the study area. The canal has the capacity of 17,72 m^3/sec and succesfully decreases the water level by 4.71 – 5.66 m from flood level for 2 – 100 years returned period.

Keywords: *Ciliwung river, diversion canal, HEC-RAS, urban flooding*

Hydrological Responses over the Upper Citarum Basin Based on the Spatial Plan of West Java Province 2029

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Abstract. In 2010, a spatial plan for West Java Province up to year 2029 was published (*Perda* 22/2010). The main purpose of this plan is the guidance of settlement area development. As the resulting change of land-use will most likely result in a change of the hydrological responses of the river basin, this study aimed to assess the hydrological implications of the Spatial Plan 2029 within the Upper Citarum Basin. To assess these implications, a hydrological simulation based on current and future land-use was performed using the JAMS/J2000 hydrological model. To investigate the baseline conditions, the land-use 2010 was used. Following, we extracted the settlement area from the spatial development plan in 2029 and then superimposed it to the land-use 2010. Expansion of settlement areas over UCB was projected two times higher for 2029 relative to 2010. Two different land-use scenarios (2010 and 2029), and similar climate scenario (1990-2030) were used for the hydrological simulation. From the simulation results, the mean monthly simulated river discharge increased by 1.8% in the 2029 scenario compared to the 2010. Greater changes were noticed in the surface runoff with monthly averages increasing by 8.9%, primarily because of the significant expansion of settlement areas. This application of the JAMS/J2000 proved to be an appropriate tool to assess the impacts of environmental changes to the basin's hydrological dynamics.

Keywords: *environmental impact analysis, hydrological modeling, land-use change, spatial planning*

Hydraulic and Groundwater Chemical Parameters of the Aquifer in Malakasari, Bandung

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Abstract. In order to reveal the physical condition of the aquifer, the pumping test using Cooper-Jacob (1946) principle has conducted at well SM5. The observation data of the test then processed by AQTESOLV Program which generates various value of hydraulic properties i.e. 3.241x10-4 cm^2/sec for transmissivity (T), 8.103x10-6 cm/sec for conductivity (K), 0.05055 for storativity (S), and 3.852x10-3 ft^{-1} for specific storage (Ss). These data show that the aquifer may composed of unconsolidated sedimentary rocks ranged from coarse-fine sand to silt. In addition, also performed the feasibility test of groundwater by using Multimeter which produces chemical parameter data. The chemical parameter of eight well samples have average values of 6.62, 766.25 μs/cm and 376.25 mg/L for pH, Electric Conductivity (EC), and Total Dissolved Solid (TDS) respectively, while physical observation shows no turbidity and odor.

Keywords: *chemical parameters; groundwater; hydraulic properties; Malakasari aquifer*

Study on the Effectiveness of Infiltration Wells to Reduce Excess Surface Run Off in ITB

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Abstract. Institut Teknologi Bandung (ITB), Ganesha Campus, Indonesia, has an area of 28.86 hectares. The campus is located in Bandung. Starting from 2012, new buildings were constructed within the area, reducing the area of permeable surface significantly. In the past few years, there were several excess run-off incidents in the campus. The insufficient area of permeable surface as well as the inadequate capacity of the drainage system contributes to the excess surface run off. The drainage system has only two outlets. Moreover, in some areas, the drainage systems are disconnected. Thus, most the surface run off are stored within the drainage system. The purpose of this study is to evaluate the effectiveness of infiltration wells for reducing the local excess run off in ITB. Precipitation data and drained service area are used to estimate the design discharge from each building in ITB. In order to avoid the excess surface run off of certain locations in ITB, then the infiltration wells are proposed to balance the area of impermeable surface. The effectiveness of the infiltration wells are evaluated by assessing their number to their contribution in reducing the excess surface runs off.

Keywords: *effectiveness, excess run off, impermeable surface, infiltration wells, ITB*

2D Modeling of Flood Propagation due to the Failure of Way Ela Natural Dam

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Abstract. A dam break induced-flood propagation modeling is needed to reduce the losses of any potential dam failure. On the 25 July 2013, there was a dam break generated flood due to the failure of Way Ela Natural Dam that severely damaged houses and various public facilities. This study simulated the flooding induced by the failure of Way Ela Natural Dam. A two-dimensional (2D) numerical model, HEC-RAS v.5, is used to simulate the over land flow. The dam failure itself is simulated using HECHMSv.4. The results of this study, the flood inundation, flood depth, and the arrival time, are verified by using available secondary data. These information are very important to propose mitigation plan with respect to possible dam break in the future.

Keywords: *dam break; dam failure; flood propagation; HEC-RAS; two-dimensional; way ela natural dam*

Study on Water Resources Allocation for Kertajati, Jatitujuh, and Ligung Sub-Districts to Support the Development of West Java International Airport (BIJB) and Kertajati Aerocity Area

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Abstract. The Bandarudara Internasional Jawa Barat (BIJB) and Kertajati Aerocity are under construction and expected to be a center of economic activity supported by potential of natural resources and agriculture. They later will act as a driver of economic growth in West Java, especially for surrounding area such as Kertajati, Jatitujuh and Ligung Sub-districts. As an affect of the the development of BIJB and Kertajati Aerocity, the water demand of surrounding area will increase. Therefore, an analysis of water demand and availability is needed. This research supports by analyzing the water balance, water demand, and also water allocation using WEAP (Water Evaluation and Planing) software tool. Water balance of Cimanuk-Tomo, Cimanuk-Monjot, and Cilutung-Dam Kamun river are analyzed, water demand of the three sub-districts are also projected and become the inputs of the water allocation model. The result of WEAP model simulation shows that the Cimanuk River can meet the water demand of the three sub-districts until 2040.

Keywords: *water allocation, water balance, water demand, WEAP*

Application of Finite Difference Schemes to 1D St. Venant for Simulating Weir Overflow

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Abstract. Depth averaged equations are commonly used for modeling hydraulics problems. Nevertheless, the model may not be able to accurately assess the flow in the case of different flow regimes, such as hydraulic jump. The model requires appropriate numerical method or other numerical treatments in order to simulate the case accurately. A finite volume scheme with shock capturing may provide a good result, but it is time consuming as compared to the commonly used finite difference schemes. In this study, 1D St. Venant equation is solved using Artificial Viscosity Lax-Wendroff and Mac-Cormack with TVD filter schemes to simulate an experiment case of weir overflow. The case is chosen to test each scheme ability in simulating flow under different flow regimes. The simulation results are benchmarked to the observed experimental data from previous study. Additionally, to observe the scheme efficiency, the simulation time between the models are compared. Therefore, the most accurate and efficient scheme can be determined.

Keywords: *finite difference; lax-wendroff; mac-cormack; weir overflow*

The Role of Soil Pores in Generating Runoff in Steep-Slope Area of Tropical Catchment

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Abstract. Soil pores may play roles in generating runoff in steep-slope tropical catchment. Because of these limitations of hydrological measurement techniques, the lack of study regarding the impact of rainfall and soil characteristics on runoff generation in tropical catchment as Indonesia represent a critical gap in the hydrology literature. This paper document the soil hydrology within the concept of the flow mechanisms, and the characteristics of soil such as soil hydraulic conductivity, humus on the surface, and the existence of root systems. We have found that in a situation that soil pores have been filled up, a continuation of rainfall of certain intensity may produce saturated areas and part of soil water may emerge to the surface as return flow together with the direct fall on the area. In addition, in most tropical area, macrospore of root systems exists in surface layer modifying rainfall to pipe flow that contributes stream flow quite instantly. On the basis of these findings, the study suggest that runoff generation occurs as a combination of surface and subsurface flow, with the subsurface flow is the predominant process on the upper and the middle slopes, while saturated overland flow is important processes at the bottom of the hillslope. The spatial variation of hydraulic conductivity decides flow generations, so that it can be analyzed through water dynamics in every layer in the area.

Keywords: *hydraulic conductivity, infiltration, overland flow, rainfall, return flow, runoff, steep-slope, subsurface flow, surface flow, tropical catchment*

Analysis of the Upper Citarum Watershed's Baseflow Use Filtered Smoothed Minima Method

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Abstract. Baseflow is component of streamflow originating from groundwater discharge and it takes important contributions for the streamflow during dry seasons or low precipitation. To knowing capacity of the Upper Citarum watershed to fulfill its hydrology function baseflow separation in this paper uses filtered smoothed minima method. Data that used is daily streamflow from Nanjung Station for 1918/19-1934/35 and 1976/77-2014/15. Annual baseflow value of Upper Citarum watershed is ranged between 16,6–53,6 m3/second for 1918/19- 19 1934/35 period, and between 16,2–88,3 m3/second for 1976/77-2014/15 period. Spearman-Conley correlation test (α=5%) to annual baseflow in both periods shows there's no correlation and significantly trend. Kolmogorov-Smirnov test (α=5%) shows both periods have different distribution. Baseflow variability in Upper Citarum watershed is associated with climate variability and land use-land cover changes. Each of these factors has impact; with Indonesia wedged by Hindia and Pacific oceans, and building grows quickly in Upper Citarum watershed. Possibility of decreasing baseflow in Upper Citarum watershed could implicated drought in dry season and community that depend to that watershed. Then, water resource management and conservation need to improve watershed's quality, quantity, and continuity.

Keywords: *baseflow, climate variability, filtered smoothed minima method, land use- land cover changes, upper citarum watershed*

Land Cover and Climate Change Impact on River Discharge: Case Study of Upper Citarum River Basin

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Abstract. Citarum River is one of the main raw water sources for many cities and districts in West Java and Jakarta. Seasonal variation of Citarum River flow is very high, even after construction of the three cascade dams: Saguling, Cirata, and Jatiluhur, in order to have a reliable water supply for domestics, agriculture, and energy sectors, the area in the downstream of the dams still experience flood and drought in extreme wet and dry years. Upper Citarum River Basin (CRB) is the main catchment area of Saguling Dam, the most upstream of the three cascade dams. During the last 30 years, rapid economic development has lead to an increase of water extraction and land conversion from green or conservation area into open or developed area. In the other hand, evidence of climate change can clearly be seen from climatological record of some stations within the last few decades, which shows an increasing trend of some climatology variables. Combination between anthropogenic and climate change factors might result in more extreme hydrological event in the future, both in wet and dry years. In this study, Upper CRB river discharge is simulated using Sacramento Catchment Model. Historical river discharge, rainfall, climatology, and land cover from 1995 to 2009 was used for model calibration and verification of the effect of land cover change to river discharge. Multi-model mean of monthly rainfall and temperature projection from Coupled Model Intercomparison Project 5 (CMIP5) for RCP8.5 climate change scenario is statistically downscaled and used as input for simulation of future river discharge from 2045 to 2050. The result shows that combination between anthropogenic and climate change might result significant increase of high flow and decrease of low flow. Therefore, it is necessary to include land cover and climate change factors in the future infrastructure planning and management, especially for water supply system infrastructure development and operations.

Keywords: *climate change, land cover change, river discharge, Citarum River Basin*

The Diurnal and Semidiurnal Patterns of Rainfall and its Correlation to the Stream Flow Characteristic in the Ciliwung Watershed, Jakarta, Indonesia

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Abstract. Based on the data analysis of 15 years TRMM dataset, the common patterns of rainfall over the Ciliwung Watershed are diurnal and semidiurnal. Those patterns can be associated by a stationary or moving rainstorm with different magnitude and direction. Based on hydrological model simulations, both the pattern and movement have a significant role to the discharge. The discharge that triggered by semidiurnal pattern of rainfall can produces higher peak discharge and longer flood duration than diurnal pattern at downstream area. This result open possibility to improve our prediction on design discharge.

Keywords: *Flood, Ciliwung, Jakarta, diurnal pattern, TRMM, hydrological model.*

Effective Real-Time Forecasting of Inundation Maps for Early Warning Systems During Typhoons

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Abstract. Accurate forecasts of hourly inundation depths are essential for inundation warning and mitigation during typhoons. In this paper, an effective forecasting model is proposed to yield 1- to 6-h lead-time inundation maps for early warning systems during typhoons. The proposed model based on Support Vector Machine (SVM) is composed of two modules, point forecasting and spatial expansion. In the first module, the rainfall intensity, inundation depth, cumulative rainfall and forecasted inundation depths are considered as model input for point forecasting. In the second module, the geographic information of inundation grids and the inundation forecasts of reference points are used to yield inundation maps for spatial expansion. Sufficient data are not available for developing inundation forecasting models because of the lack of observed data of inundation maps. The inundation depths, which are simulated and validated by a physically based two-dimensional model (FLO-2D), are used as a database for inundation forecasting in this paper. An application to Chiayi City in southern Taiwan is conducted to demonstrate the superiority of the proposed model. The results show that the proposed model is able to provide accurate point forecasts at each inundation point. Moreover, the spatial expansion module is capable of producing accurate spatial inundation forecasts. The maps of the forecasted results are similar to that of the inundation data for short lead times. The forecasts are in good agreement with the inundation data, especially for the potential inundation area. Furthermore, the pattern of the forecasted maps is similar to that from the inundation data. Obviously, the proposed model provides reasonable spatial inundation forecasts, and is able to deal with the nonlinear relationships between inputs and desired output. In conclusion, the proposed model is suitable and useful for inundation forecasting.

Keywords: *FLO-2D, inundation map, inundation forecasting, support vector machine.*

Alternative Intake Station in Saguling Reservoir for the Needs of Raw Water in Bandung Metropolitan Area (Quality Aspect on Each Division of Discharge Class)

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Abstract. Bandung Metropolitan Area (BMA) region is the upper watershed of Citarum with an area of ± 2338 km^2. The status carried by BMA as a National Strategic Area from the perspective of economic interest (Appendix Government Regulation No. 26 Year 2008) plus a range of functions carried by the city of Bandung as the core area is the main attraction of investors to make investments that encourage the increasing migration flows. Increasing population and economic development and production activities in the region lead to successive land conversion and the growing need for clean water. These circumstances lead to an imbalance between supply and demand, in which on the one hand, demand for clean water is increasing. The potency of Saguling Reservoir as an alternative of raw water of BMA region in terms of quantity in this research was determined based on the determination of mainstay discharge. Mainstay discharge is the discharge available in a watershed at a certain time which its existence is calculated to be able to meet the rate of water demand. Saguling has 11 quality monitoring stations that show the condition of the quality of upstream to downstream of the reservoir, namely: Nanjung (input), Batujajar, Muara Cipatik, Muara Ciminyak, Cimerang, Cihaur, Muara Cijere, Muara Cijambu, Muara Cihaur, Intake Turbine, and Tailrace. The monitoring is conducted on twenty-nine (29) water quality parameters which consist of physical parameters and chemical parameters. In this study, the intake site selection 11 monitoring posts will be carried out by reviewing the concentration of all parameters in Government Regulation No. 82 Year 2001 on any division of discharge grade using 5-grade Makov Discrete method (very dry, dry, normal, wet and very wet). In addition, the calculation of the value of Water Quality Index (WQI) was done at each monitoring station for each division of discharge grade that has been done. The series of data flow and concentration parameters used in this study start from the year 1999 to 2014. The allocation of raw water discharge calculation for Saguling Reservoir in order to fulfill the needs of raw water in Bandung Metropolitan Area is 46,92m3/second (R5 dry for irrigation raw water supply and 29,53 92 m^3/second (R10 dry for drinking water supply). Based on the assessment of the concentration of measured parameters and determination of Water Quality Index, it can be found that around Muara Ciminyak location is the most qualified location to be used as drinking raw water intake for Bandung Metropolitan Area. Based on this study, it also notes that the determination of the concentration of pollutant parameters needs to be done on the each division of discharge grade occurred.

Keywords: *discrete Markov, raw water alternatives, saguling reservoir, water quality index*

The Success Rate of Irrigation Operation Evaluation for Dimoro Irrigation Area at Karaganyar Regency

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Abstract. Sustainable operation and maintenance activities determine durability and success level of irrigation infrastructure. Success indicator of irrigation operation such as increasing of water usage efficiency, increasing of plan intensity, decreasing of water distribution conflict, increasing of agricultural production result and decreasing of dryness of plant. Therefore, it is necessary to have a research to determine the success rate of irrigation operation and maintenance that had been carried out from 2013 – 2106 at Dimoro Irrigation Area. The Dimoro operational data records 2013 - 2016 were analyzed by simple weighting on each indicator to obtain total score of each year. By regression analysis on the total scores were obtained chart of success rate tendency. The results showed that the success rate of Dimoro Irrigation Area tend to increase and will be used as recommendation for the irrigation operation and maintenance in the following year.

Keywords: *irrigation operation, simple weighting, success indicator, success rate tendency.*

Single Reservoir Operation Model Using Non Linear Program (Case Study: Darma Reservoir In West Java)

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Abstract. Darma reservoir is located in Darma district of Kuningan Regency of West Java province. Darma Reservoir is used for various purposes such as drinking water supply, irrigation water supply, fish culture, flood control and recreation (tourism). The decrease of water reservoir capacity is caused several factors such as sedimentation, lack of environmental conservation, decreasing of rain water volume caused by global warming and seepage occurring in Darma reservoir. In this research, non-linear programming method optimization technique is used to solve non-linear relationship between optimized variables. By determining the maximum annual water supply to be the objective function and determining the constraint functions using the solver on Ms excel, the release value can be obtained. Release obtained based on calculation with non linear program method can be compared with the actual release based on the data obtained. Where it aims to evaluate the performance of non-linear methods to actual conditions based on efforts to meet the demands (irrigation and Drinking water supply). This research is expected to be an input/recommendation for Darma Reservoir managers/operator as the guidance of water regulation. Hopefully, the demands of water can be fulfilled and the rule of water release on Dharma reservoir can be optimal.

Keywords: *decision making, non linier program, reservoir operation, rule curve*

3D Numerical Modeling of Flow in Sedimentation Basin

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Abstract. Normal operation sedimentation basin flushing systems require large volumes of water, typically up ten times of the deposited sediment volume for efficient flushing. A complete sediment removal, can only be realized by combination of mechanical removal with drawdown flushing. This operation reaches much longer operation time resulting in water loss and reducing power and energy production of Mini Hydro Power Plant (MHPP). The objective of this study is to improve the flushing system of sedimentation basin based on a numerical approach. Fluid motion is described with non-linear, transient, second-order differential equations. A numerical solution of these equations involves approximating the various terms with algebraic expressions. The resulting equations are then solved to yield an approximate solution to the original problem. The simulation result shows that the 3D numerical modeling of flow in sedimentation basin gives the reasonable result to predict the suspended load movement in the flow.

Keywords:*3D numerical modeling flow, MHPP, sedimentation basin, suspended load*

TOPIC 4

WATER AND WASTE ENGINEERING AND MANAGEMENT

Development of Audit Technology Approach for Performance Improvement of Faecal Sludge Treatment Plant (IPLT) (Case Study: IPLT Bawang in Tanggerang City and IPLT Pecuk in Indramayu District)

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Abstract. One of the infrastructure to support the achievement of the 100% sanitation target is faecal sludge treatment plant (IPLT). The condition of IPLT Bawang and IPLT Pecuk are not operating optimally. The development of audit technology approach needed for performance improvement of IPLT. The objectives of this research are to determine the weight of components technology priority that have affect to IPLT, assessing the achievement of performance in IPLT Bawang and IPLT Pecuk, and to determine the priority of performance improvement strategy in IPLT Bawang and IPLT Pecuk. This research consist of descriptive analysis about public sanitation condition in the study area by distributing questionnaires, scoring method analysis of IPLT technolo gy components using pairwise comparison method to determain main priority of technology component, performance analysis of IPLT Bawang and IPLT Pecuk using audit technology approach, and determining strategy of IPLT performance improvement. According to the result of questionnaires, community in Tangerang city as much as 89% defecation using private toilets and the last estuary of feces is 93% in septic tank meanwhile community in Indramayu district as much as 91% defecation using private toilets and the la st estuary of feces is 89% in septic tank. The weight of technology components that affect the performance of IPLT are humanware with weight 0,35, orgaware with weight 0,29, technoware with weights 0,24 and infoware with weight 0,13. The value of performance achievement IPLT Pecuk is 60,2% and IPLT Bawang is 58,1%. The priority of performance improvement strategy in IPLT Bawang are improvement strategies of humanware, technoware, infoware and orgaware, meanwhile in IPLT Pecuk are improvement strategies of technoware component, humanware, orgaware and infoware.

Keywords: *audit technology, IPLT, pairwise comparison, performance, sanitation*

The Use of $TiCl_4$ as Coagulant for Anionic Dyes in Textile Wastewater Treatment

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Abstract. Effluents from dyes wastewater that contains different types of dyes, which has very low biodegradibility because of its high molecular weight and complex structures. Method widely used to overcome this problem is by using coagulation. This study focused on the coagulation process with anionic dyes. Conventional coagulant will produce large sludge which will require further handling of sewage sludge. The coagulant used in this experiment is $TiCl_4$ that the sludge will be potentially reproduced TiO_2. TiO_2 itself can be used as photocatalytic agent in wide area including sewage treatment. This study conducted by $TiCl_4$ solution was tested on anionic dye solution sample. The result evaluated by zeta potential, TOC, COD and colour removal. This study indicates that Ti based coagulants are effective and promising coagulants for anionic dye wastewater treatment. The optimum condition is conducted at acid pH that is 2. $TiCl_4$ is able to reduce TOC and COD, color removal can achieved up to 97,17%. The optimum dossage of $TiCl_4$ was 0,125 mL/L. In addition, the flocculated sludge resulted can be recycled and reproduced TiO_2 which is potential as a photocatalyst agent.

Keywords: *anionic dye, coagulant, reproduced, sludge, $TiCl_4$, TiO_2*

Analysis of Drinking Water Supply System Improvement Using Fuzzy AHP (Case Study: Subang Local Water Company)

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Abstract. Study of infrastructure is required to improve the drinking water supply system, in order to achieve The Long-Term Plan Targets on Water Supply (RPJMN) 2015-2019 concerning 100% universal and equitable access to drinking water services, in accordance with the purpose of Sustainable Development Goals (SDGs) in 2019. Subang district was selected as a case study of water supply improvement because of the improving development in that area and the population growth rate, influencing the need for drinking water. The purpose study is to determine the problems of drinking water supply system, to analyze alternatives for improving water supply system by performing weighted ranking factors in drinking water supply improvement with AHP method and analyzed by fuzzy logic. The method for water supply system improvement could be performed by looking at influential factors using fuzzy AHP approach to obtain some appropriate alternatives. Technical and operational factors was considered the most influential factor in the improvement of water supply system, followed by management capacity, environment, and financial aspect. Fuzzy method with rule base input approach used in this analysis was influencing the output that became the policy alternative to improve drinking water supply.

Keywords: *fuzzy AHP, infrastructure improvement, local water company, sustainable development goals, water supply system.*

Screening The Effect of Cu, Mn, And Mg on Ethanol Formation in Degradation Process of Palm Oil Mill Effluent (POME) under Anaerobic Condition Using Two-Level Factorial Design Method

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Abstract. Palm Oil Mill Effluent (POME) is a high organic content residue resulting from palm oil mills during the process of extracting palm oil from fresh fruit bunches of oil palm. Anaerobic digestion can be used for the treatment of POME to reduce organic content and generate some substances, such as volatile acids, ethanol, and various gasses. During anaerobic fermentation process, microorganism requires the presence of trace elements for growth to improve their performance. This research will be carried out as a study of the presence of trace elements, such as metals (Cu^{2+}, Mn^{2+}, and Mg^{2+}) that has significant effects on ethanol formation. Circulating Bed Reactor was used and operated in a batch system for 48 hours with sampling every 12 hours and duplicating reactor variation. Nitrogen flushing for 15 minutes before running process aims to create anaerobic condition in reactor. Metal ions were screened and analyzed by using two-level factorial design method whether there is any correlation effect between the addition of Cu^{2+}, Mn^{2+}, and Mg^{2+} and ethanol formation. Several parameters which consists of Total Volatile Acids (TVA), dissolved Chemical Oxygen Demand (CODs), Volatile Suspended Solid (VSS), pH, Dissolved Oxygen (DO), and ethanol were measured every sampling due to process control. Mn metal is proven statistically affect both TVA and ethanol formation while Mg metal only affect TVA formation. Cu^{2+} and Mg^{2+} metals combination affect ethanol formation with largest detected ethanol concentration is 7,483.07 mg/L. The result from this study had identified the metal ions which has significant effect as a foundation for optimization ethanol formation.

Keywords: *anaerob digestion, ethanol, palm mill oil effluent, trace elements, two-level factorial design.*

Effect of Co, Zn and Mn Metal Towards Ethanol Formation in Anaerobic Process of Palm Oil Mill Effluent (POME)

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Abstract. Indonesia is one of the tropical countries whose economic contributor is palm oil industry. However, its by-product, such as Palm Oil Mill Effluent (POME) as wastewater, has potential to be utilized as an alternative energy with anaerobic digestion by using ethanol resulted in the process. The anaerobic treatment produces by-products such as Total Volatile Acids (TVA), ethanol, and various gasses until acidogenesis stage. Microorganism needs micronutrients as environmental factors that affects anaerobic process, such as heavy metals. In this experiment, artificial POME is utilized as wastewater feeds that will be treated for then to be screened whether there is any correlation effect between the addition of Zn, Mn, and Co metals and ethanol formation using 2^n factorial statistics. The experiment takes place using Circulated Bed Reactor (CBR) for 48 hours with sampling every 12 hour and duplicating reactor variation. Statistically, it is proven that Zn metal, Mn, and CoMn combination affect TVA formation while Mn and ZnMn metals combination affect ethanol formation with largest detected ethanol concentration is 9353.84 mg/L. Organic compound tends to switch to volatile acid rather than ethanol formation, happen when Zn metal and CoMn metals combination are added.

Keywords: *anaerobic process; ethanol; metal addition; palm oil mill effluent; total- volatile acid.*

Development of Cellulose Acetate Membrane from Nata de Coco in Hollow Fiber Form to Remove Azo Dyes in Textile Wastewater

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Abstract. Membrane technology is one of the advanced water treatment processes that is able to treat azo dyes in wastewater of textile industries. Cellulose acetate-based membrane, compared with other membranes which are made of polysulfone or polyethersulfone, is cheaper due to its abundant amount in nature. As the basic component of cellulose acetate, cellulose is commonly extracted from wood through pulping and bleaching processes to remove the lignin. However, to minimize the chemical use in the process of membrane development, utilizing other resources containing no lignin is one of the feasible way. Nata de coco, a bacterial cellulose produced in the fermentation of coconut water, is the potential substance used in this research. Several previous researches have proven the possibility of synthesizing cellulose acetate from nata de coco as the basic component of membrane development. The purpose of this study is to modify the cellulose acetate- based membrane from nata de coco in hollow fiber form. This research consists of the membrane synthesis and a feasibility test to compare the performance of cellulose acetate-based membrane with other commercially available membranes. The test is implemented for textile wastewater containing Reactive Black 5 (RB 5) with concentration of 10 ppm, 15 ppm and 20 ppm. The result indicated a similarity of physical characteristics between cellulose acetate-based membrane from nata de coco and commercially available cellulose acetate membrane. Therefore, nata de coco is found as a prospective and effective material for cellulose acetate membrane.

Keywords: *azo dyes, cellulose acetate, hollow fiber, membrane, nata de coco.*

Time Motion Study of Municipal Solid Waste Transfer System in Bandung City

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Abstract. An increase of population in Bandung. Leads an increasing to municipal solid waste generation, and force the municipalities to make the system more efficient, including the transfer system as a part of the municipal solid waste management. Efficient means getting more with less capital (collect more garbage using less tools, less manpower and less time). So, time motion study of municipal solid waste transfer system was needed because it is important to know the time consumed for doing the motion element of municipal solid waste transfer system. The main objective of this study was to measure the time consumed and to determine which scenario that less time consuming. The results of the time motion study showed that between a different type of transfer system, the time consumed was different. Motion time for collection vehicle at SCS (Stationary Container System) transfer station was less than HCS transfer station because the process of garbage unloading at HCS (Hauled Container System) transfer station consume more time. So, it is recommended for Bandung city to use HCS type of transfer station.

Keywords: *hauled container system, municipal solid waste, stationary container system, time motion study, transfer system*

Kinetics of Nutrient Removal in an On-site Domestic Wastewater Treatment Facility for Office Building

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Abstract. Domestic wastewater from office building has not been maintained well especially in the areas where the sewerage system is unavailable. The aims of this research were to investigate the performance and kinetics of nutrient removal in an on-site domestic wastewater treatment facility which consists of anaerobic and aerobic systems for treating wastewater from office building. The experimental data obtained from the variations of COD:N:P ratio 250:28:2.5, 350:38:2.9, 450:47:3.3, and 600:60:3.7 with three different HRT 48h, 24h, and 12h. A One-way ANOVA was performed to investigate the effects of HRT and initial concentration of TN and TP on the performance of nutrient removal. In order to obtain the kinetic coefficients, First Order, Second Order and Stover-Kincannon Models were employed. The results showed that maximum TN and TP removal efficiency were 56% and 86%, respectively. The results of one-way ANOVA showed that HRT and initial concentration of TN and TP gave the significant effects on nutrient removal ($p < 0.05$). Second Order and Stover-Kincannon Models were found to be more appropriate models for prediction of TN removal in this facility. Controlling HRT and C: N: P ratio may keep good performance of nutrient removal in this facility.

Keywords: *domestic wastewater from office building, kinetics of nutrient removal, on-site domestic wastewater treatment facility P.*

Control of pH of Retained Water in the Coastal Waste Disposal Site

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Abstract. After landfilling of wastes is completed, the stabilization of landfilled ground requires much time and cost. Therefore, this study aimed to control the pH of retained water in the coastal waste disposal sites during landfilling process, by conducting field surveys and laboratory experiments. In field surveys, we investigated the changes of retained water quality such as pH, salinity, and dissolved oxygen. The results show the pH of retained water has risen to about 10 when the volume of landfilled wastes reached about 25% of landfill capacity. In lowing the pH, we considered a low-cost method by pumping seawater from the adjacent sea into the landfill. The mechanism in this method is that, H^+ dissociated from HCO_3^- in the fresh seawater react with OH^- eluted from wastes would result in pH decrease. The laboratory experiments were conducted to verify the effect on pH change by adding fresh seawater to alkalized seawater. As a result, the effect of injecting fresh seawater into alkalized seawater with pH higher than 9 was confirmed. Therefore, this treatment method is suggested to enable the disposal sites to be used promptly after landfilling is completed, by adding fresh seawater to purify the retained water and waste at low cost during landfilling process.

Keywords: *coastal waste disposal site; early stabilization; field survey; laboratory experiment; pH; retained water.*

Treatment of Leachate from Sarimukti Landfill Using Ozone with Activated Sludge as Catalyst

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Abstract. Leachate is the liquid waste from anaerobic decomposition in a landfill. The ozonation process can be used for leachate treatment which can be optimized by various advanced oxidation process (AOP) such as the addition of peroxide (H_2O_2), UV, and catalytic ozonation. Sludge from sedimentation in water treatment plant contains Aluminium (Al) and Silica (Si) which can be utilized as catalysts to accelerate the initiation of the $OH^{\bullet}$ formation in AOP, subtituting chemical addition or UV exposure. Sludge contains 5.96% of Al and 9.35% of Si which can affect of its cation exchange capacity and affects the active site in the catalyst. This study aims to determine the effectivity of sludge in the ozonation process to treat leachate. A 1,5 L semi-batch reactor containing 1 L sample was used in this experiment. The rate of oxygen supply was at 4 L/min taken from ambient air as connected to an ozone generator. Two groups of sludge weighting 1.5 grams, 3.0 grams and 4.5 grams were used. One group were physically activated by heating at 105°C for 24 hours. The other group was physically treated and immersed in $ZnCl_2$ of 3 mol/L, for 24 hours. The best result was obtained by the physically activated sludge with mass of 4.5 gram O_3-L-4,5 AF. The differences of removal efficiency between O_3-L-4,5 AF with the control (O_3) for turbidity were respectively 13.02% and 7.81%, for EC were 10.57% and 8.29%, for COD were 49.44% and 37.50%, and for residual ozone concentration at the end of contact time were 7.6 mg/L and 9.7 mg/L. It can be concluded that activaed sludge and ozonation can be used as a catalyst in leachate treatment.

Keywords: *catalytic ozonation, green catalyst, leachate, sludge from water treatment plant.*

The Treatment of Used Reagent Glass Bottles Using Solidification Technology

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Abstract. Used reagent glass bottles are solid waste that people rarely pay attention to in Indonesia. In many cases, the bottles are disposed off without proper handling and treatment, due to the lack of research and information on the aspects of reduce, reuse, and recycle technology. There is therefore an urgent need for an alternative treatment of these bottles. One potential treatment forsuch waste is to transform the glass bottles into raw materials for concretes. The objective of the research is to determine the influence of crushed glass particles to the quality of the concrete; particularly its compressive strength and leachate quality.The potential reduction of glass bottles will also be calculated.The glass bottles used in this research are the brown or amber ones, taken from X Water Laboratory in Bandung. The concrete was designed to meet the K225 type requirements. Experiments were done using 0%, 25%, 50%, and 75% of crushed glass particles. In the concrete production, these crushed glass particles will replace the coarse aggregates. This research measured compressive strength and Toxicity Characteristic Leaching Procedures (TCLP) tests in accordance to SNI03 - 1974 – 1990 RegardingCompressive Strength Test Method and TCLP Extraction Procedures for Hazardous Waste (from BAPEDAL's draft in 1992).At the end, it was found that the concretes using all variations of glass concentrations meet the K225requirements, with the two highest compressive strengthsrecorded for the 0% glass waste (283,4 kg/cm^2), and 25% (223,3 kg/cm^2).As for the TCLP, it showed that concentrations of $Cr^{6+}$for the concretes using all variations of glass concentrations were all under the threshold of 2,5mg/l, according to Hazardous National Regulation 101/2014. If all of these variation are being applied, then there is a potential reduction of 600 – 2100 waste bottles of the X Water Laboratory.

Keywords: *coarse aggregates, concrete, compressive strength, glass bottle wastes, TCLP.*

Removal of Copper (II) Ion in Aqueous Solutions by Sorption onto Alkali Activated Fly Ash

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Abstract. Fly ash is a particulate material produced from coal combustion power plants with major components are silica, alumina, iron oxide, calcium oxide, magnesium oxide, and carbon which are ideal for metal adsorbents. The potential use of fly ash in the wastewater treatment process is obvious because it can be obtained cheaply in large quatities and it can be used as an adsorbent. However, fly ash still shows lower adsorption capacity unless it is activated. In this study, fly ash activated by NaOH 14 M and KOH 14 M solutions. The batch experiments were carried out to study the sorption of copper ions from aqueous on alkali activated fly ash. The influence of initial concentration and contact time were examined at constant pH and dose of adsorbent. The sorption capacity of copper ions increased with the initial concentration and contact time. The sorption capacities followed the order Na1>Ka1>FA. The adsorption isotherm model exhibited that the Langmuir model is very suitable with copper ions adsorption onto fly ash and alkali activated fly ash. Kinetic study shows that adsorption of copper ions onto FA, Na1, and Ka1 follows the pseudo second-order kinetics.

Keywords: *adsorption, alkali activated fly ash, copper, isotherm, kinetic.*

Effect of Aeration Rates on Removals of Organic Carbon and Nitrogen in Small Onsite Wastewater Treatment System (*Johkasou*)

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Abstract. Onsite application of oxygen supply in domestic wastewater system may be influenced by several factors that can inhibit the oxidation and nitrification processes. In this study, the influence of aeration rate on the *Johkasou* performance was focused using two *Johkasou* facilities serving up to five persons household. In the *Johkasou* A (JO-A) system, we increased the aeration rate from 30 to 63 $L.min^{-1}$ whereas, in the *Johkasou* B (JO-B), it was decreased from 59 to 34 $L.min^{-1}$. Water and sludge samples were collected from the anaerobic-anoxic-oxic zones before and after adjustment of the aeration rate measured for organic matters and nitrogen parameters. Increasing the aeration rate in JO-A resulted in a high removal of organic matter (82.5%) and nitrogen (60.3%) compared to decreasing of aeration rate in JO-B (52.0% and 33.0%, respectively). The percentage of SDN exhibited a maximum when the aeration rate was increased compared to decreasing of aeration rate. These results indicate that application of a high aeration rate increases removal of organic matter and nitrogen and enhances ammonia transformation. It is therefore recommended to apply high aeration rates in *Johkasou* system.

Keywords: *aeration rate, ammonia, Johkasou, nitrification, organic carbon, SND*

Leachate Treatment Using Anaerobic-Aerobic Biofilter And Denitrification Process

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Abstract. Most of the leachate treatment in Indonesia using pond system, that is maturation ponds, anaerobic ponds, stabilization ponds, and continued using wetland. The weakness of this technology is long retention time between 30-50 days, thus the pond requires a large area. In addition, the processed leachate still do not meet quality standards that are allowed to be discharged into the environment. To overcome these problems, one alternative is to use a combination of processing leachate within anaerobic-aerobic biofilter and denitrification. The technology is expected to shorten the retention time so that the land required for the processing of leachate is not too extensive. The processed leachate is also expected to meet the quality standards are allowed to be discharged into the environment. The experiments were conducted by using two fixed bed anaerobic reactors with effective volumes of 60 liters each, two fixed bed aerobic reactors with 40 liters and 10 liters volumes, and a denitrification reactor with a volume of 5 liters filled with limestone and sulfur. Both anaerobic and aerobic reactor are filled with a honeycomb type plastic media. The experiment Results show that leachate treatment using anaerobic - aerobic biofilter and the denitrification process with a total hydraulic retention time of 12 day, the retention time in the anaerobic reactor 8 (eight) days , the retention time in the aerobic reactor 3 (three) days and retention time in the denitrification reactor 1 (one) day can be generated COD removal efficiency of 97 %, ammonia removal efficiency of 97.56 %, TSS removal efficiency 87.5 % , and nitrate removal efficiency of 86.4 %.

Keywords: *anaerobic, aerobic, biofilter, denitrification, leachate.*

Th Study on E-waste (CRT TVs/Monitors and Washing Machines) Generation, A Case Study in Bandung

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Abstract. Modern day's rapid development in technology has forced a shift in trends and popularity of electronic products. This causes early obsolescence of former technologies such as cathode ray tubes, leading to massive disposal in a short amount of time. To be able to predict this newly developing waste stream, a study on the generation of such electronic waste products is needed. In a case study focusing on Bandung, questionnaires to primary sources of e-waste such as households, offices, schools and laundromats are done to determine not only the number of e-products that is used and discarded, but also how e-waste is treated firsthand when it becomes unwanted. The e-waste generation predicted is about 65.000 units of CRT TVs per year, 19.000 CRT monitors per year and 48.000 washing machines per year. Survey results show that when proper waste collection and recycling is implemented, CRT TVs and monitors will have been eliminated within a decade (2028 being the marking year) meanwhile the trend for washing machine consumption continues to incline up until today.

Keywords: *Bandung, cathode ray tube, decade, e-waste, generation, washing machine, waste stream.*

Mixing of Alkaline Tunnel Seepage with the Surrounding Shallow Groundwater for pH Reduction

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Abstract. Alkaline tunnel seepage with pH exceeding the environmental standard has been discharged from a tunnel located south of Hokkaido, Japan. Although the injection of liquefied carbon dioxide into the seepage has been used for such alkaline seepage, this method is expensive and unsustainable. Thus, a new method of mixing the seepage with the surrounding shallow groundwater was applied. The tunnel seepage and groundwater were collected every month, and pH and chemical composition were measured to clarify the change in the quality. Then, the weakly alkaline tunnel seepage was mixed with the shallow groundwater at several different mixing ratios to understand the relationship between the pH and mixing ratio. Aeration experiments were also conducted to evaluate the effects of the dissolution of atmospheric carbon dioxide. The results showed that the pH of tunnel seepage was stable at around pH8.7. The pH of the groundwater was around pH6.6. The aeration experiments showed that the pH of the mixed water samples increased with aeration time. Therefore, by considering the aeration time of the mixed samples, and the results of mixing experiments and geochemical calculations, 41.2 L/min of groundwater was estimated to be required to reduce the pH below pH 8.5.

Keywords: *aeration experiment; alkaline tunnel seepage; mixing ratio; pH reduction; shallow groundwater.*

Evaluation of Waste Transfer Operation at TPS Patrakomala Bandung City

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Abstract. For years Bandung City has problems in its municipal waste management, due to a limitation of service coverage and transfer station (TPS) facilities and its management. One of the government's efforts to solve the problems was by implementing a waste-free area program, known as Kawasan Bebas Sampah (KBS). One way to support the KBS program is by having a waste transfer station with reduce-reuse-recycle treatment facilities (TPS 3R). The purpose of this study was to identify the potential TPS to be functioned as TPS 3R and evaluate its transfer operation system. This study was conducted by selecting potential TPS, collecting its infrastructure data, supporting equipment, and waste vehicles by observation, interview, and physical measurements (for 8 days) to identify its existing operational and evaluating its collection-transfer operation system according to Regulation of The Minister of Public Works No 03, 2013. The criteria selection was developed based on government regulations, stakeholder interview, and related policies. It was identified that TPS Patrakomala was the most potential TPS to be functioned as TPS 3R, but still operates without scheduled operation system. In TPS Patrakomala, the waste vehicles consisted of four conventional handcarts, eight motor bikes, and two pick-up cars per day, collecting waste respectively 1,4; 2,6; 3,6 m^3/trip, which were done 2 trips/day. At the end, a city dump truck will pick up the waste from TPS Patrakomala once or twice a day, with a capacity of either 10, 13 or 14 m^3. Even with the average waste transported were above the truck capacity (respectively 20; 22; 26 m^3/truck/trip) there were still some waste unstransported from TPS. In the near future, the result of this study will be used to design a TPS 3R which is expectedly contribute to the improvement of wast management in Bandung City.

Keywords: *transfer station, TPS 3R, Kawasan Bebas Sampah, Bandung City, municipal waste, waste vehicles, waste collection, waste transfer.*

Assessment the Level of Readiness of the Waste Bank Development into a City Scale Waste Bank

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Abstract. Waste Bank is one of the strategies used to implement waste reduction at the source. Bandung city is one of the cities that implemented this program, either through government or NGO. Resik Waste Bank of PD Kebersihan is one of the waste bank built by the government of Bandung City. This study aims to assess the level of readiness of the waste bank development into a city-scale waste bank by waste bank indicator development, through descriptive analysis approach, referring to the integration of laws and guidelines on waste banks. The result of analysis showed that there are three aspects in the assessment of readiness of development of city-scale waste bank, theyare quality of building construction, management system, and operational system. This indicator used to assess the implementation of Resik Waste Bank to be developed into a city-scale waste bank. Assessment for each indicator using the ordinal and Guttman scale. The result of the assessment showed that Resik Waste Bank is ready to be developed into a city-scale waste bank with a value of 85.11 supported by adequate buildings and operational facilities. However, it is necessary to have independent financial management, related regulations of health and safety, and monitoring evaluation conducted at least once a month.

Keywords: *city scale, indicator development, resik waste bank*

Study on the Leaching Performance of Chromium (Cr) and Cadmium (Cd) from the Utilization of Solidified Nickel Slag as Concrete Floors

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Abstract. With the increasing demands on metals extraction, the hazardous waste resulted from mining industry has also raised. In this paper, the solidification of nickel slag containing heavy metals is described. The treatment involved a waste solidification process, using nickel slag as the fine aggregates substituting agent, that aimed to determine the optimum dosage of nickel slag that met specification in the construction of concrete floors. A series of technical feasibility test were carried out by replacing the weight proportions of sand with nickel slag gradually from 0% to 100% to examine the compressive strength, absorption rate, durability and leaching performance. The results indicated that even though all mixture variations possessed high value of absorption rate indicating high permeability concrete mix, all mixtures, however, had good durability. Furthermore, based on the compressive strength test, a mixture with 60% substitution of nickel slag is considered as a viable replacement of sand in the concrete floors construction in conformance to American Concrete Institute. The leaching performance test showed that leachability of heavy metals content, particularly Cr and Cd from mortar specimens were below the standard according to Indonesian Government Regulation No 101 of 2014, therefore, in terms of environmental point of view, the utilization of solidified nickel is considered safe to be used as concrete floors.

Keywords: *aggregates, binder, concrete, nickel slag, solidification*

Nitrogen Removal Efficiency in Continous Airlift Reactor using Aerobic Granular Sludge

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Abstract. Aerobic granules as one of promising development of activated sludge has been studied by many researchers, especially in batch reactors. But in some cases, the operation of the batch reactor system were difficult to be operated in full scale plant; especially because of inadequate actions of the operator. On the other hand, continuous reactor provide an easier operation and maintenance. This study was operated in 7.2 L of continuous airlift reactor using aerobic granular sludge in room temperature. Artificial wastewater was used with 100:20 of COD/N and sodium acetate was used as the sole carbon source. It was operated in five decreased variations of HRT; 12, 10, 8, 6, and 4 hours of HRT, with about 800 mg/L of COD, 1.6-4.8 g COD/m^3day of OLR and 0.44-1.13 kg N/m^3day of nitrogen loading rate. The maximum removal of total nitrogen was happened in 10 hours of HRT with 0.56 kg N/m^3day of nitrogen loading rate, which reached 25.5% of removal. It reached 44.7% of ammonium removal in the same HRT variation. The removal efficiency was reduced with the decreased HRT.

Keywords: *aerobic granules, airlift reactor, biogranules, nitrogen removal*

TOPIC 5

OCEAN AND MARITIME ENGINEERING

Underwater Acoustics Ray Tracing Modeling from a Black Box in Indonesian Waters

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Abstract. One part of the black box that can produce an underwater acoustics wave is Underwater Locator Beacon (ULB). Ray tracing is used to detect the presence of a black box of an airplane that crashed into the waters by detecting the underwater acoustics wave from the ULB. The aim of this modeling to see how the underwater acoustics propagation from a black box can be calculated so a minimum depth of a pinger locator can be determined to detect a black box. In this paper, underwater acoustics propagation will be modeled using Ray Tracing method. Ray tracing modeling will be applied at the Lombok and Makassar straits where those two straits are the deepest straits in the Indonesian waters. Each strait will be divided into 3 sections, so there will be a total of 6 regions to be evaluated in this paper. The required data include the data of temperature, salinity, and underwater acoustics celerity which will be derived from the World Ocean Atlas (WOA) database. The assumptions used in this modeling are no transmission loss along the underwater acoustics propagation ray path, and the reflection from the sea bed and the sea surface will be a perfect reflection. Based on the modeling results, it can be concluded that the minimum depth of placement of a pinger locator at the Lombok1 (L1) section is 153.8 *m*, Lombok2 (L2) section is 256.8 *m*, and Lombok3 (L3) section is 328.8 *m*, while for the location of Makassar1 (M1) section is 271.3 *m*, Makassar2 (M2) section is 243.2 *m*, and Makassar3 (M3) section is 4.5 *m*.

Keywords: airplane black box, Lombok strait, Makassar strait, ray tracing, underwater acoustic, pinger locator

Model of Fluid Flow and Pressure Distribution around Rectangular Shape using Laplace, Vorticity-Transport and Poisson Equation

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Abstract. The influence of fluid dynamic is crucial to the continuation of ocean structure operation. The main parameters for the analysis of fluid dynamic effects to objects are the flow pattern, the value of the fluid velocity and pressure distribution around the object. For doing such analysis require the modeling of motion of fluids passing through the object. In this project, the modeling is performed with finite difference numerical methods and software MATLAB, with some fluid conditions namely steady and incompressible fluid flow. The analysis of modeling results includes the verification of the results with the Bernoulli principle, and comparisons between models of ideal fluid (potential flow) with viscous fluid. From the results of the modeling, the pattern of fluid flow around objects in potential flow case and viscous fluid case (with a low Reynolds number) generate a laminar flow pattern.

Keywords: bernoulli principle, low reynold number, navier-stokes equation, viscous flow

Development of Risk-Reliability Based Underwater Inspection for Fixed Offshore Platforms

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Abstract. Risk Based Underwater Inspection (RBUI) method for offshore platform is recently used for efficiency and optimization in the oil and gas operation. By RBUI method, platform with higher risk level will need more often inspection than those with lower risk level. However, the probability of failure (PoF) evaluation in RBUI method is usually carried out in semi quantitative way by comparing failure parameters associated with the same damage mechanism/failure mode between a group of platforms. Therefore, RBUI will not be effective for platforms spreaded in distant areas where failure parameter associated with the same failure mode may not be the same. The existing standard, American Petroleum Institute, Recommended Practice for Structural Integrity Management of Fixed Offshore Structures (API RP-2SIM), is limited on the general instructions in determining the risk value of a platform, yet it does not provide a detail instruction on how determining the Probability of Failure (PoF) of platform. In this paper, the PoF is determined quantitatively by calculating structural reliability index based on structural collapse failure mode. Meanwhile, consequence of failue (CoF) factor calculated quantitative in accordance to API RP-2SIM. Therefore, the method in determining the inspection schedule is called Risk-Reliability Based Underwater Inspection (RReBUI). Models of 3-legs jacket fixed offshore platform in Java Sea and 4-legs jacket fixed offshore platform in Natuna Sea are used to study the implementation of RReBUI.

Keywords: *Offshore platform,* R*isk based underwater inspection, Reliability Based Underwater Inspection, Structural Reliability*

Dynamic Response of Breasting Dolphin Moored with 40,000 DWT Ship due to Parallel Passing Ship Phenomenon

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Abstract. When a ship is moving through another ship moored nearby, hydrodynamic interactions between these ships result in movements of the moored vessel. The movement may occur as surge, sway, and/or yaw. When a ship is passing a moored vessel parallelly, this effect will give a dominant lateral force on the moored ship and response from this phenomenon will appear in a certain time. Only dynamic response due to sway force is considered in this study, the sway force shall be absorb by the breasting dolphin. 40,000 DWT shall be moored to the breasting dolphin. Three passing ships size are considered The breasting dolphin shall be modeled as a single degree of freedom model. This model will be subjected to a force caused by parallel passing ship. The model is assumed to be in a state of quiet water, this assumption is taken so that the fluid does not provide additional force on the model. The SDOF system shall be analyzed using a computer program designed to solve an ordinary differential equation.

Keywords: *Sway Force, Parallel Passing Ship, Structural Dynamic, Berthing, Breasting Dolphin*

Semarang-Demak Coastal Dike (and Toll Road)

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Abstract. Over a long time, Semarang city has been experiencing coastal flooding as a major problem. This coastal flooding is annual and inevitable due to the descendant of the groundwater level as the impact of population growth and groundwater exploitation factors. Simultaneously, the Semarang-Demak section of the Northern Java Coastal Tollway is planned to be constructed. The idea of making a "two in one" structure to fight the coastal flooding and to fulfill the tollway construction plan at once arises. The purpose of this paper is to offer design alternatives to support the plan and to provide a recommendation based on design analyses as well as concerns from past design experiences. To the degree that is enabled by available secondary data, reasonably detailed engineering calculation are performed so that dimensions of each alternate structure are presented to the extent that enables fairly accurate calculation. Results of the structural and geotechnical analyses performed using suitable softwares for each type of analysis and concerns based on past experiences for each alternative are investigated to make the most effective and efficient decision.

Keywords: *Semarang, dike, flood, subsidence, flood defence*

Efficiency Comparison between Conventional and Modern Port Operation System for Small-Scale Dry Bulk Cargo

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Abstract. Since the president launched Sea Toll Road Program in 2015, the improvement in ports' operation systems has become Indonesia's foremost necessity. This improvement commonly leads to equipment modernization, while realistically, modern equipment does not always amount to a productive performance, especially in the context of small-scale ports. Instead, it is prone to creating wasteful capital and maintenance cost as well as making the planning time ineffective. This study compares two options of port operation systems in a small port, which is conventional and technologically-advanced method for dry bulk cargo. It results in thin gaps between each option's financial assessment variables, which are Internal Rate of Return, Benefit/Cost Ratio and Payback Period, regardless of a stark difference between each option's equipment cost. This study concludes that with the right approach, the conventional operation system is still the most efficient option compared to its contemporary opposite.

Keywords: *ports, dry bulks, port operations, financial analysis*

Application MuTsunami in Mentawai Island Indonesia

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Abstract. Software MuTsunami as research tool in Coastal Research Group Institut Teknologi Bandung, was applied to simulate propagation of tsunami and sediment transport in Mentawai. The Tsunami occurred in 25 October 2010, 21:42:22 (GMT +7). The hydrodynamic model was based on Non-Orthogonal curvilinear coordinate in spherical coordinate (Muin, 1993, 1997a, 1997b). The results of simulation were compared with observational data, which was collected by group of researcher from Institut Teknologi Bandung, Waseda University, and Yokohama National University (Mikami et. al., 2014). The agreement between the model and observational data are very good.

Keywords: *mentawai, non-orthogonal curvilinear, sediment transport, spherical coordinate, tsunami.*

Adaptive Port Planning under Disruptive Trends with Focus on the Case of the Port of Kuala Tanjung, Indonesia

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Abstract. As a national strategic project, the Port of Kuala Tanjung draws significant attention at national and international level. Considering the semi-greenfield nature of the port, the diverse set of stakeholders, and the prevailing disruptive trends in the world port business, a robust first-phase port layout is required to kick-start the project and guarantee the overall sustainability of the port development. The objective of this research is to identify any uncertain or disruptive trends, both present and future, and access their implications towards the Port of Kuala Tanjung. Adaptive Port Planning (APP) framework[1] will be used as the main methodology in this research. A combination of a literature review and interviews with experts are used to both identify the sources of the uncertain and disruptive trends mentioned above and also to propose adaptation strategies. Based on our qualitative study and interviews with experts, we have concluded that the consolidation of major shipping lines, multi-nationality partnerships, Indonesian regulation, and ship breaking regulations are currently the four most relevant contributions to uncertain and disruptive trends towards the port. To mitigate potential risk and seize opportunity provided by these trends, an industrial port complex concept might become the most promising alternative.

Keywords: *Adaptive port planning; Catalyzing effect; Disruptive trends; First phase port layout; Integrated infrastructure planning; Self-sustainable port phase*

[1] Taneja P, *The Flexible Port,* 2013

Adaptive Port Planning for Phase II of New Priok Development in Indonesia

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Abstract. The initial masterplan of New Priok in the Port of Tanjung Priok was developed in 2012 is being updated to cater to new developments and new demands. In the new masterplan (2017), Phase II of development will start from 2035-onwards, depending on the future conditions. This study is about creating a robust masterplan for Phase II, which will remain functional under future uncertainties. The methodology being applied in this study is scenario-based planning in the framework of Adaptive Port Planning (APP). Scenario-based planning helps to open up the perspective of the future as a horizon of possibilities. The scenarios are built around two major uncertainties in a 2x2 matrix approach. The two major uncertainties for New Priok port are economics and sustainability awareness. The outcome is four plausible scenarios: Green Port, Business As Usual, Moderate Expansion, and No Expansion. Terminal needs in each scenario are analyzed through traffic analysis and identifying the key cargos and commodities. In conclusion, this study gives the wide perspective for Port of Tanjung Priok for the planning Phase II of the development. The port has to realize that uncertainties persevere and are very likely to influence the decision making as to the future layouts. Instead of ignoring uncertainty, the port needs to make the action plans to deal with these uncertainties.

Keywords: *Indonesian ports; port's design; port planning; scenario-based planning*

Structural Development for Well Service Activity in Limited Capacity Platform

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Abstract. In answer to the oil industry situation, Oil Company must come with breakthrough ideas to reduce the operation cost. One of many ideas is to replace drilling rig, which is used for work over/well services activities, with working barge. The challenges of this idea are the operation and structural platform capacity especially the majority of PHE WMO wellhead platform is braced monopod. To minimize the risk of drilling equipment located on the platform, engineering study is proposed. Wellhead platform will be assessed to ensure reliability of the platform. The process and method of operation during well service will also be developed. The proposed mitigation includes: Global Structural Check for Platform Integrity, Local Structural Check for Strengthening, Localized load for Additional Equipment, and Weather-Time-Frame Constraint. Using the proposed methods, COMPANY can ensure the platform integrity and ensure SAFETY during well service activities.

Keywords: *Structural Analysis, Structural Limitation, Well-Service, Strengthening*

Renewable Energy Potentials along the Bay of Bengal due to Tidal Water Level Variation

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Abstract. The projected increase in energy demand coupled with concerns regarding present reliance on fossil fuel and associated environmental concerns had led to increased interest in exploiting renewable energy sources. Among different renewable energy sources, tidal energy is unique and most suitable because of its predictable nature and capability to ensure supply security. Tide consists of both kinetic and potential energy which can be converted to electricity using well-proven technology. Potential energy of tides - the principle focus of the study, is stored due to rise and fall of the sea level. Head difference created due to tidal variation between basin side and sea side of a barrage stores potential energy which is converted into fast moving water that rotates turbine and generates electricity. Bangladesh with its long coastline has promising prospects of tidal energy resource development. The study focuses on tidal energy resource exploration and exploitation along several competent locations of the Bengal coastline. Tidal records of flood and ebb tide of these locations are analyzed to calculate the potential energy. Finally, available potential techniques of energy extraction are evaluated for annually generated energy estimation. This study investigates the prospect and utilization of tidal energy concept and reviews the possibilities and opportunities of employment of the technology for sustainable development and climate change mitigation in context of Bangladesh.

Keywords: *Bay of Bengal, Energy extraction techniques, Potential energy, Tide, Tidal Barrage, Yearly Potential.*

Analysis of Ocean Wave Characteristic in Western Indonesian Seas using Wave Spectrum Model

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Abstract. Understanding the characteristics of the ocean wave in Indonesian Seas particularly in western Indonesian Seas is crucial in order to establish secured marine activities (e.g., sea transportation, offshore-engineering-activities, and tourism) in addition to construct reliable and well-built marine infrastructure. Three-years-data (July 1996 - 1999) simulated from Simulating Waves Nearshore (SWAN) model were used to analyze the ocean wave characteristics and variabilities in eastern Indian Ocean, Java Sea, and South China Sea. The interannual or seasonal variability of the significant wave height is affected by the alteration of wind speed and wind direction. Interactions between Indian Ocean Dipole Mode (IODM), El Niño Southern Oscillation (ENSO) and monsoon result in interannual ocean wave variability in the study areas. Empirical Orthogonal Functions (EOF) analysis produces 6 modes represents 95% of total variance that influence the wave height variability in the entire model domain. Mode 1 was dominated by annual monsoon and has spatial dominant contribution in South China Sea and Indian Ocean. Java Sea was influenced by Mode 2 which is controlled by semi-annual monsoon. In Mode 1, ENSO effect was identified in South China Sea and IODM effect was captured at Indian Ocean and at Java Sea (Mode 2). A positive (negative) IODM strengthens (weakens) the winds speed in Java Sea during the East (West) season and hence contributes to Mode 2 in increasing (decreasing) the significant wave in Java Sea.

Keywords: enso*, eof, monsoon, seasonal, wave*

Hydrodynamics Modeling of Kung Krabaen Lagoon, Chanthaburi Province, Thailand

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Abstract. Kung Krabaen Lagoon (KKBL) is a small low-inflow water body situated at the eastern part of Thailand. The KKBL is 6.7 km2 in area and surrounded by mangrove forest. There are vast areas of tidal flat occupied nearly 60% of the lagoon that host some of the most productive seagrass habitats in the region. The lagoon was used as an intake and recipient water for some intensive shrimp aquaculture complex in the country, located behind the mangrove forest. However due some shrimp disease epidemics and possibly deteriorated water quality, the complex is now taking the intake water from the outer sea through very expensive (to construct and to maintain) irrigation system. Objective of this study is to investigate the KKBL's hydrodynamics using a numerical simulation model validated with measured water levels in the lagoon. The simulation model was setup two-dimensionally based on the Delft3D-FLOW. Results suggested that water currents inside, at the mouth and at the outer sea of the lagoon are mainly governed by tide and wind. Offshore of the lagoon, there are strong tidal currents flowing along northwest and southeast direction. The tidal currents flow into the lagoon through its mouth before dispersion rapidly inside the lagoon. Mean circulation largely varied seasonally and had direct correlations outer sea seasonal mean currents and the monsoons.

Keywords: *Gulf of Thailand; numerical simulation; seasonality; seagrass; tidal flat; monsoon*

Inventory and Integrated Assessment of Rivers and Estuaries in Indonesia Case Study: Serayu River, Central Java

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Abstract. Proper Operation and Maintenance (O & M) activities are crucial to ensure that infrastructure will continue to function effectively and efficiently. Currently, due to lack of proper O & M, many facilities in Indonesia deteriorate significantly soon after they have been built and become non-functional before they reach their design life. In 2016, the Directorate General of Water Resources, Ministry of Public Works and Housing of Indonesia has launched a campaign to reactivate the O & M program to improve the sustainability of water resources in Indonesia. This campaign is known as "Gerakan Cinta Operasi dan Pemeliharaan Sumber Daya Air (CinOP SDA)", which means the Movement for Love of Water Resources Operation and Maintenance. One of the programs is on River Maintenance and River Infrastructure O & M. A successful implementation of this program requires a thorough and actual information of river system and its infrastructures. This paper presents the necessary steps to conduct an inventory and assessment of a river system, which is carried out at the Serayu River in Central Java Province as an example. It is shown that the method is simple enough to be implemented to any river in Indonesia. The final products of this study are recommendations for the O & M activities and a database using GIS system of the Serayu River as an example. A manual for river inventory and assessment is also created, which can be readily applied to all Indonesian rivers and estuaries.

Keywords: *river; estuary; infrastructure; inventory; integrated assessment; sustainable; Serayu River; Operation and Maintenance; walkthrough; database*

TOPIC 6

CONSTRUCTION MANAGEMENT

A Global Review of Public Private Partnerships Trends and Challenges for Social Infrastructure

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Abstract. In developing countries, the government which has limited budget for public infrastructure development should choose which infrastructure should be developed. Most countries decided to build more economic infrastructure than social infrastructure because former have direct economic impact for society. The involvement of private sector in public infrastructure financing has been accomplished for decades in the form of Public Private Partnership (PPP). However, the implementation is also more often for economic infrastructure but some countries have started to implement PPP for social infrastructure (education, healthcare, care of the elderly, etc.) when they think to add human capital and improve quality of life. This study attempts to review a set of public private partnership implementation models relevant for social infrastructure development in some countries. Moreover, this study also more explores to the challenges and issues in different areas of social infrastructure. The outcome is to show a trend public-private partnership for social infrastructure in some successful projects from different countries. The challenges and issues about implementation public-private partnership for social infrastructure also be a part of the results from this study. Finally, the study has a valuable input for implementation of PPP on social infrastructure in Indonesia.

Keywords: *Public Private Partnership, social infrastructure, trends, challenges, Indonesia.*

Initial Study on Building Information Modeling Adoption Urgency for Architecture Engineering and Construction Industry in Indonesia

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Abstract. This paper presents our initial study on Building Information Modeling (BIM) adoption urgency for architecture, engineering and construction (AEC) industry in Indonesia. Currently, BIM is being adopted by many countries around the world because of its' efficiency and other benefits. Meanwhile, most of AEC industries in Indonesia still using conventional method and there are no regulations from Indonesian AEC authority for adopting BIM. With that situation, study of BIM adoption in Indonesian AEC industries is important. This study uses a qualitative approach with explorative type. Input from the survey is evaluated qualitatively using content analysis, distribution analysis and correspondence analysis method. Based on analysis result, it shows that BIM as a mean to encourage more sustainable approach in AEC industry is still in its development phase but it shows great potentials and it gives stakeholders a better way to achieve sustainable built environment. Current lack of awareness and understanding of BIM in Indonesia, particularly in the education sector, is a key factor that impedes BIM adoption and one that can be addressed by integrating BIM into AEC curriculum. Government and practitioners alike need to develop a strategic roadmap to pave way for successful BIM implementation.

Keywords: *adoption urgency, Building Information Modelling, construction industry sustainability*

Development of Work Breakdown Structure (WBS) Standard for Producing the Risk Based Structural Work Safety Plan Of Building

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Abstract. A construction project is inseparable from a series of tasks in the form of activities. Activities that take place on a project can be disrupted due to various reasons, one of the causes of the disruption of project activities are accidents on construction projects. The risk of workplace accidents can be prevented with early identification and analysis of the potential danger that exist in every activity contained in the project's WBS. The need for a standardized WBS in preventing the risk of workplace accidents is very important because it would present a risk assessment, impact and frequency arising from workplace accidents. The aim of this study is to develop a risk-based WBS standard particularly for structural work, by using a qualitative approach. The results of this research are WBS standard for building, source of potentially dangerous risk at structural work,and the development of safety plan using a risk-based WBS that has been standardized, as a form of prevention, reduction or even nullify the risk of workplace accidents (to obtain zero accidents) during construction project implementation.

Keywords: *work breakdown structure*; *safety plan*; *risk*

Communication & Conflict Management to Improve Succes Rate of Design & Build Team Collaboration In Indonesia

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Abstract. Modern world of construction promotes efficiency as an important factor for competitiveness. Concept of lean construction, Design and Build (DB) contract and all the things that promote efficiency in construction are expected to improve the conventional contracting systems. As the complexity of construction management develops, the answer of that phenomenon i collaboration. Although if a collaboration is not managed properly, it will have a negative impact on the success of the collaboration itself. This study aims to examine the management of communication & conflict factors in the collaboration of the DB team to improve the collaboration of the DB team in Indonesia. In this study the authors hypothesize that communication and conflict factors are greatly affect the success of the project team collaboration. With questionnaire method involving 127 respondents who are divided from building and infrastructure project, the authors collect data which then analyzed using SPSS and SEM PLS 3.0. From the analysis of the data, it was found that (1) the indicators of seeking agreement (conflict variable) and (2) communication planning indicator (communication variable) proved to have direct and significant influence on the success of collaboration, and need to be managed properly since procurement phase to increase succes rate collaboration in DB team. The results of this study are aimed at assisting other projects in developing communication and conflict management for success on their project team collaboration.

Keywords: *Project collaboration; conflict in project; project communication*

Integrating Standard Operating Procedures for Basement Work Area

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Abstract. Excavation work area for basement construction, is one of area quite risky to be the cause of occurrence work accident caused by unsafe condition. In attempt of preventive action for support the project in order to achieve one of it goals that is zero accident, so it needed to create a standard operating procedure in the form of practical and obvious guideline which can be understood as well as rules commonly. This studies done by interviewing the safety officers to determine dangerous area at the building construction in order to be identified regarding it unsafe conditions. Based on previous studies and the interview result along the approval form safety officers, then excavation work area for basement construction review was made more distantly related to unsafe conditions. So that the excavation work area for basement construction was identified for 17 types of risk. The result of this studies is the recommendation of standard operating procedure which is has been through validation process by the safety officers. The recommendation was create in the form of flowchart described in detail on the description of the unsafe condition, risk of harm, and preventive action which is then visualized by sketch of site management to safe condition at excavation work area for basement construction. The recommended of standard operating procedure refers to the clauses of occupational safety contained in national and international standards.

Keywords*: excavation work, basement, unsafe condition, occupational safety*

2

Comparing the Environtental Impacts of Concrete Works: In-Situ Method and Prefabricated Construction Method

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Abstract. Increased construction activities due to infrastructure development have raised environmental concerns. The environmental impact from the processes to construct is assumed to be fairly minor compared to those from the operation of infrastructure facilities. However, the construction processes are significant activities; thus, estimating the energy use and greenhouse gas (GHG) emissions is important for contractors in implementing more responsible practices, e.g., selecting greener materials and methods. A study has been conducted to observe the environmental impacts of two different methods in constructing reinforced concrete floor: in-situ method and prefabricated method. This study investigated the concrete flooring of 28,244 square meter as part of a plant in Jakarta area. This study compared energy consumptions and CO_2 emissions for both methods. The use of different tools and equipment of all activities were closely examined to estimate the amount of gasoline consumptions. The emissions were estimated based on references/literatures. The results showed that the in-situ method consumed 6,887.40 MJ per cubic meter of concrete, and produced 719.39 kg CO_2 per cubic meter of concrete. The activities related to producing fresh concrete consumed the most energy (37.36%); the activities related to installing reinforced steels generated the most CO_2 emissions (41.51%). Concrete floor construction with prefabrication method, while it was faster, the environment impacts was higher than the traditional in-situ method. The prefabrication method consumed 15,079.12 MJ per cubic meter of concrete and produced 1,911.52 kg CO_2 per cubic meter of concrete.

Keywords: *emissions, energy consumption, concrete, in-situ, prefabrication, contractors.*

The Influence of Wage, Age and Experience to Labor Productivity in Construction Works in Kota Langsa, Aceh

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Abstract. Construction works, as well as other production process, depends on how people work towards it. This industry is still the riskiest among others and the success of the work is determined by labor productivity. Productivity is needed to calculate the project work schedule as a whole. Yet, productivity is calculated using the time work of worker in site. Labor productivity is affected by many factors such as wage, age, experience and discipline. Moreover, productivity is also affected by environment, labor condition, leadership, type of work, level of difficulty etc. How these aspects give effect in construction work productivity is still needed to be verified. This article will discuss how the aspects influence the value of productivity. We limit our research on wage, age and experience from 15 workers for each category for the brick work. The research is held in four construction sites in Kota Langsa, Aceh in late 2016 until early 2017. We observe the effective time, time of contribution, and ineffective time. Productivity is obtained by calculating the work volume and effective time. The work volume is acquired by measuring it directly in site. The research on wage results that productivity is not really affected by level of wage. However, age and experience give us an interesting result. Then the result is analyzed in order to get the notion of influence of these three aspects to the value of labor productivity and how to manage it properly to ensure the project goes well.

Keywords: *Age; Effectiveness; Experience; Labor; Productivity; Wage.*

Value Engineering Application for Conceptual Design of Seawater Desalination Plant in Jakarta

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Abstract. Jakarta has approximately 10.2 million inhabitants with a serious problem about clean water availability. Today, it just 54% of clean water availability that could be fulfilled to Jakarta crowd. The need of prospecting new clean water resources is highly urgent for Jakarta future life. By employing abundant sea water, desalination is a highly effective way that has been proven by value engineering toward the sustainability of clean water in Jakarta. The concept of desalination project is finished through FAST diagram and benchmarking method. It results IRR 13%, net product value Rp3.782 trillion, payback period of 13.39 years, and benefit cost ratio of 3.00. To make this project complete and reasonable, the public-private partnership should be conducted for modal sharing. From four analyzed scenarios, the best alternative makes the government budget 60% for initial cost, spend half for operational and maintenance cost, and obtain 20% from the whole project revenue.

Keywords: Clean water, Seawater desalination, Value engineering.

Comparison Study of Casting Concrete Methods Based on Cost and Time Used

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Abstract. The effective and efficient cost and time planning is one of the keys to succeed the construction project. The selection of implementation method is one of the influential factors in the construction project's effectiveness and efficiency. A structure work is the first phase in a construction project which consists of reinforcement, formwork, and concrete casting. Therefore, a research in the selection of implementation method of the structure work is valuable to conduct, especially the concrete casting selection method in purpose to gain the effectiveness and efficiency of the project. The aim of this study is to know the cost and time comparison value among the time scheduling model by concrete casting implementation methods using Readymix concrete pump and site mix; Readymix concrete pump and manual; and cast with all Readymix concrete pump. The secondary data of this research was taken from Sewutomo Hotel of Yogyakarta. To make the data analysis of the cost and time based on the casting implementation, Ms Project and Ms Excel computer programs were used. The result of the analysis shown that concrete casting implementation methods using Readymix concrete pump and site mix cost Rp. 3,195,687,978.53 by duration of 154 calendar days; casting with Readymix Readymix concrete pump and manual cost Rp. 3,268,397,006.86 by duration of 160 calendar days; and casting with all Readymix concrete pump cost Rp. 3,368,235,460.86 by duration of 149 calendar days.

Keywords ***:*** *ms project, network diagram, project scheduling, readymix concrete*

Sustainable Development of Built Residential Design: The Concepts and Implementation in Padang City

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Abstract. Sustainable construction terminology intended that each stage of the life cycle of infrastructure, starting from the planning phase to demolition always consider sustainable development concepts. Likewise, indeed, to housing built by the developers. Often we see the phenomenon of the alteration /destruction of the house after occupancy by the user. The methodology of this research is conducted by distributing of a questionnaire for 38 respondents of 9 residential. The classification of those residential is based on the level income which is from middle to lower standard and the maximum 5 years of long stay duration of societies. The selections of respondents were taken by using Simple Random Sampling method. The distribution of sampling questionnaires was conducted for two months. The results of this study indicate that housing in Padang City does not implement the concept of sustainable development because consumers still need renovation after buying a house. The total cost spent to renovate according to respondents more than fifteen million Rupiah. The only reason why the owner did renovation is the needs of the owners to increase the capacity of the design of their home. As a suggestion of this research is developers need to consult with the consumers before the purchase of housing with the indent system.

Keywords: *design, development, padang, residential, sustainable.*

Evaluation of Partial Construction Support of Toll Road Investment in Indonesia

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Abstract. Indonesia has targeted to operate 1,000 km of toll roads in the period of 2014-2019. The government needs to provide a Viability Gap Funding (VGF) support to make financial feasibility. The policy to provide VGF support is written in the Presidential Decree No. 38/2015 where a construction grant with the Ministry of Finance's approval is mentioned. Actually, based on Public Works and Housing's Ministerial Decree 1/2017, the Ministry of Public Works and Housing provides support in form of partial construction. This study is aime to evaluate the 'partial construction' form of support from the point of view of regulation, institution, effectiveness, attractiveness, as well as implementation and anticipated risks. This evaluation shows that regulations are still incomplete. From the institutional point of view, this form of support is easier to provide as cross sectoral approval would not be needed. With regard to investment attractiveness, state-owned company investors would be interested to obtain this support, while private investors would be less attracted. The main risk that should be borne by the investors is responsibility for the sections that are not designed and constructed by themselves. The government's additional risks are in form of consequences of escalation, construction failures, and delays.

Keywords: *feasibility of toll road investment, viability gap funding.*

Success Indicators of Knowledge Transfer for the Transferee on The Construction Joint Venture in Indonesia

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Abstract. Generally, joint ventures in the construction sector in developing countries is a tool of knowledge transfer from the foreign construction company were parties as transferor to the local company as a transferee. More than two decades of joint ventures have been implemented, but until now have not obtained clarity the extent its success on the transferee. This research aims to explore a set of success indicators of knowledge transfer on the perspective of the transferee in the construction joint venture as a result of its involvement in the joint venture for the construction sector during the time. By using the method of content analysis and Partial Least Squares in the Indonesian context, this study carried out to obtain a set of valid success indicators of the knowledge transfer for the transferee in usage. The study results there were 22 valid indicators identified which can be relied upon to explain the success of knowledge transfer on the perspective of the transferee as a result of its involvement in the joint venture in the construction sector during the time. The study results are also the answer to the research gap about the research on the scope of knowledge transfer in both the construction sector and the industrial sector widely.

Keywords: construction; contractor; Indonesia; joint operation; joint venture; knowledge transfer.

TOPIC 7

GEOTECHNICAL ENGINEERING

Grouting Design for Slope Stability of Kedunguling Earthfill Dam

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Abstract. Kedung Uling earthfill dam is located in Wonogiri Regency, Central Java, Indonesia. The dam encountered cracks, sliding and settlement at the embankment wall. To minimize sliding and settlement and to optimize the dam, both field investigation and laboratory tests have been proceeded for slope stability analysis and remedial embankment wall. Soil and rock investigation around the dam, which is followed by 10 core drillings, have been conducted. Laboratory tests such as direct shear and index properties have also been performed. The results were further used for dam slope stability model using slide 6.0 and were used to analyzed factor of safety (FS) of Kedunguling dam. 10 conditions of dam were simulated and strengthening body of dam with grouting was designed. The results showed two conditions, which are condition of maximum water level with and without earthquake at downstream, were unsatisfy Indonesia National Standard (SNI) for building and infrastructure. These conditions can be managed by using grouting for increasing stabilization of embankment wall. By setting up grouting, factor of safety increases and agree with the SNI standard requirement.

Keywords: *earthfill dam, grouting, slope stability.*

Modeling Slope Topography Using Unmanned Aerial Vehicle Image Technique

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Abstract. Nowadays, a wide range of site planning, field investigation and slope analysis need to be carried out for slope protection and landslide-related disaster reduction. To enhance the efficiency of topography modeling, unmanned aerial vehicle (UAV) has become a new surveying technique to obtain spatial information. This study aims to determine the topography of a slope by using a digital camera mounted on UAV to photograph with a high degree of overlap. The 3D point clouds data were generated through image feature point extraction integrated with accurate GPS ground control points. It is found in this study that the obtained Digital Surface Model (DSM) data, compared with the traditional field surveying techniques, has much superior performance. The resolution of the DSM has reached 1.58 cm. Also, the error of elevation and distance between DSM and actual 3D coordinates obtained by traditional total station survey is acceptance. It is clear that such a UAV surveying technique can replace conventional surveying methods and provide complete and accurate 3D topography information in automatic and highly efficient manner for most geotechnical applications.

Keywords: *3D Topography Modeling; Digital Surface Model (DSM); Global Positioning System (GPS); Image Analysis; Unmanned Aerial Vehicle (UAV).*

Bearing Capacity Zonation of Very Expansive Soils at Jatinangor Area, West Java, Indonesia

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Abstract. Expansive soil is a kind of soil that has ability to shrinkage and swelling. According to Ronny (2014) Jatinangor area has expansive soil that is so very influential in the planning of infrastructure construction. This research aimed to measure the bearing capacity of the very expansive soils in Jatinangor area and to determine the correlation between activity number of soil and its bearing capacity. The method used is to collect the soil physics and mechanics data. Based on the soil mechanics data, the research location is divided into three zones of allowable bearing capacity, those are zone with allowable bearing capacity < 4 T/m^2, zone with allowable bearing capacity 4-7 T/m^2, and zone with allowable bearing capacity > 7 T/m^2. The correlation between activity number and bearing capacity of soil follows the equation qa = -1.9505(A) + 6.957 with correlation coefficient is -0.7911.

Keywords: *activity number, bearing capacity, expansive soil, foundation, plasticity index.*

Probabilistic Analysis of Cut-Slope Stability for Tropical Red Clay of Depok, West Java as an Effect of Rainfall Duration and Intensity

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Abstract. Landlslide in Indonesia, specifically in Java island, occurs during rainy seasons. In Java island, it is known that the tropical red clay have the ability to stand at steep angles, while in stability analysis due to rainfall, practicioners only consider the rise of groundwater table. Previous studies states that one of the factor affecting factor of safety (FS) for tropical red clay slopes is the formation of saturated zones due to matric suction. This research studies the effect of rainfall intensity and duration to FS of cut-slopes as parametric study with probabilistic analysis for different height of 10m, 20m, and 30m also slope angles of 27^o, 45^o, 55^o, and 70^o. Rainfall parameter are taken from FTUI rainfall station for advanced pattern and three-days duration of rain. Analysis of seepage uses SEEP/W and slope stability uses SLOPE/W. It is known that the significant increase of probability of failure due to the three-days rainfall is achieved at the 10m height and 70^o-angled slope. Increase of the probability of failure is mainly due to rainfall infiltration which saturates the suface and pore water pressure increase until certain time where infiltration stops and turn into surface run-off.

Keywords: *cut-slope geometry, probability of failure, slope stability, tropical red clay, unsaturated soil*

Assessment of Bridge Substructure in Java Island

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Abstract. Bridges play important roles in transportation system. Hazard to substructure of bridges become amplified. Based on previous year data, at least one-third of total bridges in Indonesia are damaged in certain level of defect. The performance of existing bridges shall be in-check everytime. Substructure of bridge itself is prone to hazards such as ground displacement, slope instability, seismic-related hazard and scour. Traffic data and soil investigation data will be used to analyse ground displacement and slope instability where the bridge located. Local geological and seismic data will be used to assess seismic-related hazard. Quantitative data is technical information and analyses from geotechnical aspects. Qualitative data is an expert system collected from bridge expert and local goverment. The expert system will have a rating system for each aspect. Fuzzy-based method is an effective tool for modeling some vague datas and this ease the decision-making process. Fuzzy Analytical Hierarchy Process (FAHP) will be used to analyses geotechnical aspect and expert system. Hazard identification, risk rating, risk analysis, and risk assessment are steps conducted in FAHP method. Classification and rating of risk can be done with proposed method. This assessment can be a tool or recommendation for local government where the bridge located.

Keywords: *assessment; bridge; Fuzzy-based; hazard; Java Island; substructure.*

Development of Dynamic Impact Cone for assessing Induced Partial Saturation (IPS) as Liquefaction Mitigation Technique

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Abstract. Liquefaction of saturated loose sands during an earthquake has been a great concern for practicing earthquake engineer because it can cause great loss and damage. Current liquefaction mitigation techniques used in practice are expensive. A new mitigation technique which is innovative, practical, and cost effective was proposed by Yegian et al. [1] called "Induced Partial Saturation" (IPS). This method involves in generating minute gas bubbles within the pores of fully-saturated sand and thus transformed it from fully-saturated state to become partially-saturated state. This paper described the development of a dynamic impact cone to assess the effect of IPS treatment on saturated loose sand specimens. This dynamic impact cone consists of a simple cone, rod, ruggedized pore pressure transducer, string pot, and DAQ (data acquisition system). The simple cone with a pore pressure transducer incorporated at its tip was driven into fully and partially (treated) saturated sand specimens prepared in the laboratory. The pressure transducer measured excess pore pressure during impact at the tip of the cone while the string pot measured the penetrations depth per impact, the results of the two specimens than compared. The initial density of the fully and partially saturated specimens and their preparations method were similar to allow for good comparison. The tests results such as the excess pore pressure and the penetration indicate that the impact penetration on the fully-saturated specimens liquefied sand, but could not liquefy the partially-saturated sand. Therefore the concept and development of this cone has promising future applications.

Keywords: *cone penetration, dynamic impact cone, excess pore pressure, induced partial saturation, liquefaction, pressure transducer.*

Observational Method for More Reliable Settlement Prediction for Reclamation on the Holocene Marine Clay Deposit in Jakarta Bay

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Abstract. Construction of the 276 and 312 ha reclamation on the Holocene marine clay deposit in Jakarta Bay is on-going. Settlement has been measured during the construction in order to satisfy the requirement of residual settlement. This paper briefly discusses limitation of accuracy of settlement prediction based on purely parameters derived from laboratory and in situ testing, in particular the Holocene marine clay. A reliable 'observational' method which makes full use of the monitoring data is described and estimates reliable residual settlement. More accurate settlement method is then also briefly described taken into account complex loading history. Finally, the factors, which are source of inaccurate settlement predictions and its implications, are included in the discussion.

Keywords: *geotechnical engineering; land reclamation; observational method; settlement; Holocene marine clay.*

Advancement of the Analysis of Seepage through Cracked Soils

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Abstract. Seepage is one of the problems analyzed in geotechnical engineering. Conventionally, the analysis is performed on the condition that the soil is intact. The presence of desiccated cracks demands a seepage analysis that considers not only the soil matrix part of the cracked soil but also the crack network. Currently, there are three approaches in the analysis of seepage through cracked soils: (i) Analysis by modeling cracked soil as a homogeneous material with cracks are represented as macropores, (ii) Analysis by modeling cracked soil as a material with bimodal pore-size distribution, and (iii) Analysis by modeling two components in cracked soil separately: the soil matrix and the crack network. Each approach is reviewed and discussed in this paper. The newest research results are incorporated in the discussion.

Keywords: *seepage; cracked soils; unsaturated soils.*

TOPIC 8

ENVIRONMENTAL PROTECTION AND MANAGEMENT

Risk Assessment Method for Identification of Environmental Aspects and Impacts at Ore Milling Process Industry

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Abstract. PTFI applies the international standard of environmental management system based on ISO 14001:2015. The implementation of clause 6.1.2 requires every organization to identify the environmental aspects of its operations, as an initial step in environmental management. Concentrating Division operates in ore processing into concentrate as PTFI main product. The objective of this research is to obtain a structured approach in identifying environmental aspects and impacts so that an evaluation on the risks, opportunities as well as severity of possible environmental impacts can be conducted. The methods used life-cycle approach and risk assessment method, with four-cell risk assessment matrix in environmental risk determination. The results of this risk assessment can give an overview on the risk rank on the significance value of environmental aspects and impacts, so that control priority can be determined in order to reduce the risks.

Keywords: *environmental aspects; environmental impacts; environmental management system; ISO 14001:2014; life-cycle; risk assessment.*

Measuring Performance of Accessible Built Environment: An Indian Perspective

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Abstract. In India, standards are the key guiding tool for the design, control and execution of a building. It also provides facilities to the differently able bodies to live with dignity as Indian constitution desires. These standards are not only guide the designers to make building fully accessible but also reviewed as future of the nation. However, it has been observed by the Indian scholars that the present accessibility standards are not very efficient to make fully accessible built. This is so because measurement techniques for built environment have not been used while developing the standard. It is clear that without good measurement techniques that the environmental variables are not addresses properly and then outcome would be negotiated. Authors have identified few physical environment measurement tools through literature study, which provides fare evaluation method to understand accessibility of physical environment. The aim of this study is to understand various evaluation methods to appreciate accessible built environment in Indian context. The objectives of the study are to understand how built environments are measured, to evaluate built environment with full scale simulation exercise, to critically examine the measured built environment and to appreciate identified measurement tool to develop efficient accessible building standard. The result of this study shows that adopting a sequential method of measurement tool to evaluate accessible built environment are provide us a fare idea of standard efficiency and could revise the standard accordingly.

Keywords: *Accessibility, Building Standard, Measurement, Built Environment.*

Environmental Analysis for Supporting Water Resources as Availability of Water Supply System Using AHP Method

(Case Study: Subang District, West Java)

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Abstract: Water supply system in Indonesia, in addition to relying on self-provision of public or services in each city and district. The water need rates are increasing continuously affected by population growth. In the other side, raw water to support water supply have decreasing capacity. Several factors in environment was evaluated using AHP method to achieve policy priority in decision making for conservation and rehabilitation the availability of water resources. A multicriteria approach for combining prioritization methods within the analytical hierarchy process (AHP) was proposed. The method will be used depends on the result of multicriteria evaluation of their vectors priority performance with rank reversal measures. From the AHP environment analysis, water catchment area was important priority factor to support the availability of water resources with 0,294 in that scoring. Surface water condition determine the water resource potential for water supply to guaranteed quality, quantity, and continuity of water supply. Rainfall and topography in distribution area was influencing the water discharge. AHP method overcame the decision making support in water resources management, beside on environment evaluation.

Keywords: *AHP, environment, decision making support, water resources, water supply*

Insight look the subsidence impact to infrastructures in Jakarta and Semarang area; Key for adaptation and mitigation

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Abstract. Land subsidence is not a new phenomenon for Jakarta and Semarang areas. The occurrence of land subsidence was recognized at least in the early development of both areas. According to some publications, the value of Jakarta's subsidence may reach 2-4 meter in certain place, especially in northern part of Jakarta. Meanwhile, more than 2 meter of subsidence is taking place in northern part of Semarang, while few of decimeters in the southern. Some techniques are being used to derive land subsidence information in these areas such as repeated leveling measurements, GPS surveys, and InSAR measurements. The impact of land subsidence in Jakarta and Semarang could be seen in several ways, such as sea inundation ("Rob" in Javanese), problem on infrastructures, the wider expansion of flooding areas, etc. Cracking on housing, street, "sinking" on the bridges and dyke, problems on drainage are examples of infrastructures problems due to the land subsidence. Huge costs have already been spent to fixing those infrastructures problems both in Jakarta and Semarang. Since mostly liniear pattern of land subsidence are recognized in both area today and probably in the next years to come, in this case the impact especially on infrastructures are probably will getting worse a head too. Certainly, it would lead to more costs in the near future and absolutely need to be concern. Insight look the subsidence impact to the infrastuctures in Jakarta and Semarang area would raisen the concern, and it is also become key for adaptation and mitigation.

Keywords: *adaptation, impact, insight look the problem on infrastructures, land subsidence, measurement, mitigation*

The Role of Occupational Accident Risk Assessment In The Implementation of Total Quality Management In A Textile Industry

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Abstract. Issues of occupational safety and health in Indonesia are still often overlooked. It is indicated by the high number of accidents, especially in manufacturing industries. This study aims to identify, calculate, and control risks of occupational accidents in the implementation of Total Quality Management (TQM) in a textile company. This study consists of four phases, namely: data collection, data analysis (FINE and Quantitative analysis), determining risks control (QCC), and conclusions. The results showed occupational accidents has increased over the last three years, most often in male workers (84 %), for the morning shift (6 am to 2 pm), with the category of minor accidents (54 %), and the highest score occurred in the production division (74 %). The risk assessment showed the substantial level, namely: due to hitting objects, pinched by tools, affected by falling objects, and risk of falls, with the highest occupational risk score for hitting objects (79.44 %) causing hand injuries (53.67 %). The result of QCC implementation showed that an administrative training for workers could reduce accidents. It can be concluded that risk assessment has an important role in providing inputs to improve the performance of TQM's companies, particularly in reducing the number of occupational accidents.

Keywords: *occupational accident, risk assessment, total quality management.*

Utilization of Alternative Fuels and Materials in Cement Kiln Towards Emissions of Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)

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Abstract. Co-processing in cement industry has benefits for energy conservation and waste recycling. Nevertheless, emissions of benzene, toluene, ethylbenzene, and xylenes (BTEX) tend to increase compared to a non co-processing kiln. A study was conducted in kiln feeding solid AFR (similar to municipal solid waste, MSW) having production capacity 4600-ton clinker/day (max. 5000 ton/day) and kiln feeding biomass having production capacity 7800-ton clinker/day (max. 8000 ton/day). The concentration of VOCs emissions tends to be higher at the raw mill on rather than the raw mill off. At the raw mill on, concentration of total volatile organic carbon (VOCs) emission from cement kiln stack feeding Solid AFR 1, biomass, Solid AFR 2, and mixture of Solid AFR and biomass is 16.18 mg/Nm^3, 16.15 mg/Nm^3, 9.02 mg/Nm^3, and 14.11 mg/Nm^3 respectively. The utilization of biomass resulted in the lower fraction of benzene and the higher fraction of xylenes in the total VOCs emission. Operating conditions such as thermal substitution rate, preheater temperature, and kiln speed are also likely to affect BTEX emissions.

Keywords: *BTEX, co-processing, cement, VOCs, waste*

The Assessment of Water Supply and Sanitation In Urban Sprawl Dominated by Home Made Tofu Industry

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Abstract. Assessment of water supply and sanitation was conducted in an urban sprawl that home-made Tofu is the major activity. Most workers of the Tofu industries temporarily live in the area while the situation is classified as poor in suburban area. The assessment tool consists of components on water quality, water source and pollution, human resources development, safe water consumption, and sanitation facility. It was found that the index is 67 in case the weights of all components are the same. It means that the water supply and sanitation conditions are fair. In fact, it is not the same as the real situations. It seems that home industry detracts the accuracy of the calculated index. In most cases, an assessment tool was usually applied for only in an area that the activity is only domestic. The fact in the study area is that inhabitant main activity is labor in tofu industries. They only temporary stay in rented houses, so they do not want to spend money to improve the conditions. Similarly the owners do not want to improve the facilities in order to reduce spending. Thus, accurate assessment can be found if economic activity and the social behavior are considered.

Keywords: *home industry, Index, sanitation, urban poor, and water supply*

Mount Telomoyo, a New Aspiring Geopark Area in Indonesia As a Step Of Environmental Protection

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Abstract. Mount Telomoyo is a stratovolcano in Central Java, Indonesia located in the Semarang and Magelang district. The volcano was constructed over the southern flank of the eroded Pleistocene-age Soropati volcano, which has a height of 1,300 metres. The Soropati volcano collapsed during the Pleistocene, leaving a U-shaped depression. Mount Telomoyo grows on the southern side of the depression, reaching over 600 metres above the depression's rim. From that process as a mentioned before, we can find such as pyroclastic rocks and lava from the volcanism process and we can find lahar deposits and alluvium from erosional process. There is a big opportunity if Mount Telomoyo pronounced as a new aspiring geopark in Indonesia, for example is Mount Telomoyo will be exposed globally which is good for many scope such as economic, education, and social view. The way to be a geopark area may be long, but of the government of these two district (Semarang and Magelang district) has a same vision mission, and strong intention for it, these things can be happened for sure in the future. This is also may be the one of answer for the preservation of human living and the challenge of how to increase not only Magelang and Semarang district tourism, but also Indonesian national tourism.

Keywords: *geopark, mount telomoyo, environmental, protection*

Stream Sediment Geochemical Survey of Selected Element In Catchment Area Of Saguling Lake

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Abstract. Saguling Lake is one of the largest lakes in West Java Province that accommodates domestic and non-domestic wastes via the Citarum River as its main water source. This study aims to determine the geochemical background concentration in water catchment area of Saguling Lake. The knowledge of the geochemical background concentration of heavy metals is essential for defining pollution, identifying the source of contamination, and for establishing reliable environmental quality criteria for soils, sediments, and surface waters. The value of geochemical background concentration will be used for assessment of the sediment quality in Saguling Lake by applying the sediment quality assessment method i.e. Contamination Factor (CF). Assessment of sediment quality is very important to determine the actual condition of water in the lake and as the basis for management of waters environment in Saguling Lake in the future. The search for geochemical background concentration was taken at 22 sampling points in the unpolluted water catchment area. The type of sediment is the stream sediment. Samples were collected and analyzed for Cd, Cr, Cu, and Pb Each sample was digested in agua regia and analyzed by ICP-EOS. Results showed background of concentration of stream sediments which are: Cd 0.34 ± 0.10 mg/kg, Cr 110.57 ± 28.61 mg/kg, Cu 49.93 ± 9.28 mg/kg, and Pb 18.62 ± 9.83 mg/kg. Based on the assessment result, it is concluded that the sediment quality in Saguling Lake is categorized as polluted by Cd, Cr, Cu, and Pb metals.

Keywords: *background, contamination, geochemical, heavy metal, Saguling.*

The progressive realization of human rights to water: the legal basis, policy implications, and monitoring challenge

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Abstract. Since 2010, the United Nations General Assembly had explicitly recognized the human right to water and sanitation and obliged States to provide for its progressive realization and entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for essential personal and domestic uses. This paper scrutinizes the legal basis and the policy implication for human right to water in Indonesia, before and following the annulment of the Water Resource Law 7/2004. This paper considers that one of the greatest challenges is to find an appropriate and internationally-comparable methodology in measuring the progressive realization of human rights to water and sanitation. We also highlight the importance of composite indicators and concludes that single variable indicators are insufficient to capture the range of issues involved in the realization of the human rights to water.

Keywords: *human rights, policy, progressive realization, water supply.*

Assesment of $PM_{2.5}$ Emission from Corn Stover Burning Determining in Chamber Combustion

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Abstract. Chamber measurement were conducted to determine particulate matter ($PM_{2.5}$) emission from open burning of corn straw at Garut District, West Java. This study aims to estimate concentration $PM_{2.5}$ of five varieties of corn stover (Bisma, P29, NK, Bisma, NW). Corn residues burning were collected and burnt in chamber combustion in accordance by burn in the field. The chamber was designed to simulate open burning in the field, which was observed in the field experiment that meteorological condition was calm wind. The samples were collected using a minivol air sampler. The assessment results of $PM_{2.5}$ concentration (mg/m^3) from open burning experiment in the chamber for five varieties of corn stover (Bisma, P29, NK, Bisi, NW) was 1.05; 0.284; 0.404; 0.378; 0.292 respectively. Fluctuations in the value of emission factors among these varieties reflect variations in combustion conditions (combustion efficiency) and other parameters including water content, biomass conditions and the meteorological conditions. The results of this study presented provide useful information for the development of local emission factors for $PM_{2.5}$ from open burning of corn stover in Indonesia.

Keywords: Chamber burning; corn stover; emission factor; Garut district; Particulate matter($PM_{2.5}$).

Impact of Trend in the Wind Direction in the Tuban District toward the Dust Spread

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Abstract. Indonesia is a developing country that is being carried out development in all fields, including to build physical infrastructure. For it was needed the construction materials, one of which cement. Cement has a great significance in the process construction because the presence of cement to make between the material construction such as sand, gravel, iron, etc., become desperate and are not easily separated. To meet the needs of the cement is established cement plants, one of which is PT. Semen Gresik (Persero) Tbk. Tuban Plant. This presence of cement plant gives effect to life the surrounding people at the plant site, one of on air quality, especially dust. This research tendence are to determine the model of trend the wind direction in the Tuban District and its impact on the spread of dust into the surrounding environment are affected by wind speed and direction and rainfall. This research uses research methods such as collecting secondary data which includes data intencity rainfall, the average long rains, wind speed and the dust quality monitoring data. For determine the model of trend the wind direction in the Tuban District, using a soft file Windrose. For determining the impact toward spread of dust into the environment, it uses the air quality monitoring secondary data. The result of research are that the trend of the wind direction is toward the east at a speed of wind around 3.6 m/s to 5.7 m/s. While the level of the spread of dust based on data from air quality monitoring at several locations showed that the levels of dust in free air is still below the environment quality standard. Because the high intensity of the spread of dust and constantly then it needs to be management of the dust with planting trees and the dust extraction tools that are environmental friendly.

Keywords: *wind direction, dust spread, quality standard, the quality of dust*

Development Water Quality Assessment Using Macrozoobenthos Based Multimetric Concept

(A Case Study of Citarum River's Headwaters)

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Abstract. Development of water quality assessment using macrozoobenthos, one of which is the approaches of multimetric concept. macrozoobenthos were an organisms that can evaluated changing of environmental quality as long as they live because disturbance that happened in the river. The aim of this study was to develop and apply macrozoobenthos based multimetric concept for the assessment of streams and rivers quality Citarum headwater. The research methodology of this study was observation method. Specifically, the study examined the headwaters of Citarum river which were divided into four stations. Station 1 or the site reference was located in the foothills of Mount Wayang with height 1.886 m with land use secondary forest. Station 2, 3, and 4 or the site test were situated in four *Kampong*s (small villages), namely Cikitu with height 1.521 m and activity surrounded vegetable garden with dairy cows livestock, Babakan with height 1.057 m and activity surrounded plantation with settlement, and Andir with height 745 m and acitivity surrounded were field, settlement, and sand mining respectively. The research had been carried out from July 2014 to September 2015 to sufficiently capture the condition of the river in both wet and dry seasons. Macrozoobenthos sampling using surber net mesh with 0.5 mm pore size indicated that the site in Mount Wayang showed Cumulative Biotic Index (CBI) at 23 during wet season which can be categorized as no/low disturbances. Meanwhile in *Kampong* Babakan and Wangisagara, the CBI was found at 11 and 13 respectively which means medium disturbances were apparent. This study was also discovered that the classification of the sites on the basis of the commonality of macrozoobenthos community presented a correlation between the level of land use disturbances and organic pollution. In addition, index resulting from the application of multimetric approach through CBI was relatively sensitive to distinguish the area where disturbances were absent and the area which experienced land use disturbances and organic pollution. Apart from that, this study reported no significant difference caused by seasonal changes. Therefore, these development can be used as assessment tools in ecological biomonitoring and management of Citarum river.

Keywords: *cumulative biotic indeks; headwaters of citarum river macrozoobenthos; multimetric*

Assessment of Infectious Waste Management Practices at Hospital with "Paripurna" Accreditation Level in Bandung, Cimahi and East Jakarta, Indonesia

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Abstract. This study includes a survey of the procedures available and methods of handling and disposing of infectious waste at Military hospital with "Paripurna". Accreditation level in Bandung, Cimahi and East Jakarta Indonesia. A total three (3) military hospitals with equal type of hospital and level accreditation were surveyed during the course of this research. The results of the survey showed that the equal type of hospital and level accreditation give different result of infectious waste handling and disposing. It showed that the hospital with highest level of accreditation still have less appropriate practices when it comes to segregation, collecting, storage and disposal of waste generated in comparison to developed country. Assessment of infectious waste handling divided into six parameters: Hospital policy at organizational structure, status of cleaning services worker, classification/segregation process, collect and transport the infectious waste, condition of temporary storage of infectious waste and disposal phase. It appears that hospital authorities should pay better attention to educational planning, organizational resources and supervision. In this study using outsourcing healthcare worker to collect the infectious waste were more safe and effective in infectious waste management. This study increases the understanding of the potential problems associated with infectious waste, thereby increasing awareness of how to improve management of hospital infectious waste to better protect worker, public and environment.

Keywords: *medical waste,solid waste, biomedical waste, hazardous waste, waste handling*

Acidic Wet Deposition in Bandung City Indonesia

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Abstract. Acidic deposition (acid rain) has been known to cause negative impact to environment. Measurement of rain chemical composition was done in March to August 2016 to investigate temporal variation of atmospheric deposition in Bandung City. Rainwater samples are collected at four sampling sites. The chemical properties of the rain determined were pH and ionic concentrations of SO_4^{2-}, NO_3^-, Cl^-, Ca^{2+}, Mg^{2+}, Na^+, K^+ and NH_4^+. The rainwater was typically acidic with the range of mean pH between 5.29 – 5.56 and mean electric conductivity value range between 16.37 – 19.96 µS/cm. Temporal variation showed higher SO_4^{2+}, NO_3^+ and NH_4^+ concentration in August when rainfalls were the lowest (214.88 mm). Similar temporal variation for the mean pH (5.98) and electric conductivity (25.36 µS/cm) in August. Ca^{2+} highest concentration was observed in June. Generally, the major component of precipitation chemistry were SO_4^{2-} and NO_3^-, Ca^+ and NH_4^+, for anion and cations, respectively. The largest proportions of the total anions in all sampling sites was SO_4^{2-} ranged from 32% (Lembang) to 37% (Buah Batu) followed by NO_3^- (13 – 15%) and and Cl^- (0 – 5%). For cations, NH_4^+ dominated with proportion ranged between 21 – 27% and subsequently Ca^+ (13 – 19%) and followed by Na^+, Mg^+, K^+ and H^+. The Neutralizing Factor (NF) results reveal that Ca^{2+} and NH_4^+ are the dominant neutralization substances in the rainwater. However it should be noted that reduced nitrogen (NH_4^+) act as mobile nitrogen that further will acidify the environment, particularly to soil ecosystem downstream.

Keywords: *S and N deposition, rainwater chemistry, acid rain, urban air pollution*

Ozone concentration profile and its prediction in two different urban land use characteristics

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Abstract. Tropospheric ozone becomes a concern in urban air quality due to its severe effects to human health and plants. Ozone formation is complex and depends on precursors (NO_x and VOC) which are emitted from motor vehicle under favorable meteorological condition. Ozone generation is largely affected by precursor concentration variations that are dictated by source strength in different landuse characteristics. Two locations in Jakarta, Indonesia that represent different land use as city center/road side area (Thamrin) and residential area (Jagakarsa) at the outskirt of the city were chosen in this study. To predict ozone concentration in both locations, Multiple Linear Regression (MLR) was applied to describe relationship between ozone and its predictors (pollutant concentration and meteorological conditions). The predictors were thirty minutes average-data during 2011-2012 namely CH_4, CO, NMHC, NO, NO_2, THC data concentrations, wind direction and speed, temperature, solar radiation and relative humidity. The predictor contribution to variation of ozone concentration can be explained by all predictors based on coefficient determination (R^2). R^2 of Jagakarsa (44.16%) is greater than Thamrin (R^2=34.15%). Higher R^2 indicates MLR perform better in residential area than near road-side, due to less generation-destruction process dynamics in Jagakarsa. Meteorological factors and precursors showed high significant correlations to Ozone except CH_4 which is an unreactive compound.

Keywords: *ozone modelling, tropospheric ozone, oxidant pollution, secondary pollutant, , road-side pollution*

Identification of On-Road Motorcycle Characteristics for Refinement of Activity Data in Emission Inventory Method Development

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Abstract. Mobile source is a challenge in emission inventory in Indonesia, since it lacksof related database and proper tools such as emission factors and modelling that are suitable for local condition. As motorcycle is considered to be one of the biggest emission sources from transportation in urban area, this paper aims to identify motorcycle composition profile that operated in Bandung City. The profile is the very first step for building proper emission inventory methodology. Engine technology, fuel type, and driving pattern are the key factors in emission inventory. Such data are not commonly available from local revenue offices (DISPENDA). Questionnaire survey to minimum 100 respondents with 13 questions was conducted on this study. The questionnaire seek data on type and engine specification, fuel used, average speed, and duration of riding. Regarding technology, the result show that EURO II and EURO III have almost the same proportion. Most people choose engine capacity that less than 150cc (92%). For fuel, RON 92 (53.4%) is the first commonly chosen, while 32.9% of respondents used RON 90. Motorcycle usage characteristics show that the average speed of motorcycles were 30 – 45 kph (38.4 % on weekday and 40.1% on the weekend) with riding duration of 1-2 hours/ day (48% on weekday and 38% on the weekend). There is different pattern of traffic during weekday and weekend, since Bandung is tourist destination on the weekend. It was estimated that motorcycle travel for about 30 – 90 km/day. This characteristic will be useful for the process of building a suitable motorcycle emission inventory for urban area in Indonesia.

Keywords: *Bandung City, emission factor, motorcycle engine technology, Indonesia, fuel usage*

Study of Whole Effluent Acute Toxicity Test (*Daphnia magna*) as an Evaluation of Ministry of Environment and Forestry Decree No. 3 in 2014 Concerning Industrial Performance Rank in Environmental Management

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Abstract: Only 15% of the industries in Citarum Watershed, specifically in Bandung Regency, West Bandung Regency, Sumedang Regency, Bandung City and Cimahi City, are registered as PROPER industries. They must comply to indicators as written in the Minister of Environment and Forestry Decree No. 3 In 2014 concerning Industrial Performance Rank in Environmental Management, as requirement to apply for PROPER. Wastewater treatment and management, referencing to Minister of Environment and Forestry Decree No. 5 In 2014 concerning Wastewater Effluent Standards, must be performed to be registered as PROPER industries. Conducting only physical-chemical parameter monitoring of wastewater is insufficient to determine the safety of wastewater discharged into the river, therefore additional toxicity tests involving bioindicator are required to determine acute toxicity characteristic of wastewater. The acute toxicity test quantifies LC_{50} value based on death response of bioindicators from certain dosage. *Daphnia magna* was used as bioindicator in the toxicity test and probit software for analysis. In 2015-2016, amount of industries that discharged wastewater exceeding the standard was found greater in non-PROPER industries compared to PROPER industries. Based on the toxicity level, both PROPER and non-PROPER industries have toxic properties, however PROPER industries of 2015-2016 is more toxic with $LC50_{96}$ value reaching 2.79%.

Keywords: *Daphnia magna*, LC50-96 hour, PROPER, acute toxicity test, wastewater

Study of Heavy Metal Distribution (Cu, Cd, Cr, Pb, Zn and Ni) in Brantas River, Malang-Mojokerto Segment

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Abstract: Brantas River is the largest river in East Java province. Having utilized as water supply and wastewater disposal from industry containing heavy metals in their production process, Brantas River might have been affected by industrial wastewater discharge. This study aims to determine heavy metals concentration, namely Cd; Cu; Cr; Pb; Ni and Zn, in water and sediment at Brantas River, specifically segments of Malang City, Malang Regency, Blitar, Kediri and Mojokerto. This research was conducted in June 2016, by sample collection from 9 locations along the river. Heavy metal concentration (Cd, Cu, Cr, Pb, Ni and Zn) in water and sediment were determined through sample extraction then measured using ICP OES (Inductively Coupled Plasma Optical Emission Spectrometry). In water samples, concentration of Cu, Pb and Zn in Pagerluyung exceeded the stream standard in East Java Provincial Regulation No. 2 In 2008, while Zn was also found exceeding the stream standard in Bumiayu, Sengguruh, Kademangan, Mojoroto and Meritjan. Cd concentrations in sediment samples exceeded concentration standard based on Ohio EPA Standard (2010) across all locations. Cr concentration in sediment have exceeded the standard in Bumiayu, Sengguruh, Kademangan, Mojoroto, Meritjan and Kertosono. Pagerluyung water sample had the highest heavy metal concentration, while Sengguruh and Mojoroto was the highest for sediment samples. Water pollution index can be measured using equation of pollution index referencing to Minister of Environment and Forestry Decree No. 115 in 2003, which made Brantas River categorized as lightly polluted rivers.

Keywords: *Brantas River, Heavy Metal, Pollution, Quality Standard, Water & Sediments.*

ABSTRACT BOOK

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Acidic Wet Deposition in Bandung City Indonesia

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Abstract. Acidic deposition (acid rain) has been known to cause negative impact to environment. Measurement of rain chemical composition was done in March to August 2016 to investigate temporal variation of atmospheric deposition in Bandung City. Rainwater samples are collected at four sampling sites. The chemical properties of the rain determined were pH and ionic concentrations of SO_4^{2}-, NO_3-, Cl^-, Ca^{2+}, Mg^{2+}, Na^+, K^+ and NH_4^+. The rainwater was typically acidic with the range of mean pH between 5.29 – 5.56 and mean electric conductivity value range between 16.37 – 19.96 µS/cm. Temporal variation showed higher SO_4^{2+}, NO_3^+ and NH_4^+ concentration in August when rainfalls were the lowest (214.88 mm). Similar temporal variation for the mean pH (5.98) and electric conductivity (25.36 µS/cm) in August. Ca^{2+} highest concentration was observed in June. Generally, the the major component of precipitation chemistry were SO_4^{2-} and NO_3^-, Ca^+ and NH_4^+, for anion and cations, respectively. The largest proportions of the total anions in all sampling sites was SO_4^{2-} ranged from 32% (Lembang) to 37% (Buah Batu) followed by NO_3^- (13 – 15%) and and Cl^- (4 – 7%). For cations, NH_4^+ dominated with proportion ranged between 21 – 27% and subsequently Ca^{2+} (13 – 19%) and followed by Na^+, Mg^+, K^+ and H^+. The Neutralizing Factor (NF) results reveal that Ca^{2+} and NH_4^+ are the dominant neutralization substances in the rainwater. However it should be noted that reduced nitrogen (NH_4^+) act as mobile nitrogen that further will acidify the environment, particularly to soil ecosystem downstreams.

1 Introduction

There are two meanings of wet deposition terms determined by The World Meteorological Organization (WMO). Firstly, wet deposition is a process of scavenging of any gases and/or particles from the atmosphere by liquid (i.e., water droplets) and solid (i.e., ice crystals) phases. The process involves removal of any species by droplets/ice crystals within clouds (i.e., in-cloud scavenging), and by falling drops/snowflakes (i.e., below-cloud scavenging). Second, wet deposition is the mass of material deposited from the atmosphere to the underlying surface in precipitation (over unit of area during unit of time) [1].

Acid deposition in the general is precipitation with a pH level of less than 5.6 and thus is considered to be acidic, and when it falls on the Earth it is considered to be "acid deposition." Acid deposition from atmospheric precipitation can makes soils, lakes and ponds become acidic. Sulfur dioxide and nitrogen oxides, typical air pollutants are transformed into sulfuric and nitric acid compounds in the atmosphere, with resultant changes of their properties. These acid compounds are carried by the wind as fine particles (aerosols) on sunny days. They dissolve in rain drops on rainy days or within clouds, then fall to the Earth's surface, making the environment acidic. Research has detected this transport on a continental scale, with effects extending beyond national borders [2].

Acid rain is a mild combination of mainly sulfuric and nitric acid. Sulfurous acid and nitrous acid are less stable and are present only in very low amounts. Sulfuric acid and nitric acid are the main acids present in acid rain. The problem occurs when rainwater combines with gaseous oxides of sulfur, nitrogen, and phosphoric and hydrochloric acid mists. The latter two and sulfur are released into the atmosphere from automobile exhausts, industries and electric power plants [3].

Nitrogen deposition has had a detrimental impact on temperate ecosystems resulting in soil acidification and a reduction in plant biodiversity. Soils release base cations during acidification process, such as calcium and magnesium, neutralizing the increase in acidity, if base cations have been depleted, aluminium was released from the soils, often reaching toxic levels was superseded by iron release into soil water [4].

Preliminary study evaluation of air quality in Bandung City showed factor characteristic of airborne

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particulate matter samples were attributed to sea salt, soil dust, vehicular emissions and biomass burning and industrial emissions. Many scale factories are located in and around the city with several pocket of slum areas, lacking waste disposal system, rapid growth of industry, residential area, population and motor vehicle has caused air pollutant problem in Bandung City [5].

Wet deposition is the most effective scavenging process to removing particulate and gaseous air pollutant from atmosphere in Bandung City. We present the precipitation chemistry and wet deposition that occurred at four sampling sites in Bandung City from February to August 2016. Weekly bulk precipitation chemistry samples were analyzed for the anion of SO_4^{2-}, NO_3^-, Cl^- and for the cations of Ca^{2+}, Mg^{2+}, Na^+, K^+ and NH_4^+ in additional to pH and conductivity measurement.

2 Material and Method

Rain water samples were collected on a weekly basis in four sampling stations from March 2016 to August 2016. These stations were distributed in Bandung City. The locations of the sampling sites were chosen in order to represent various geographical conditions and expected pollution levels and are presented in Figure 1.

Three of the sampling sites are placed in urban areas. The first installed in an altitude of 1271 m asl at Lembang farming area. The second was installed at an altitude of 803 m asl in Coblong area and the third was installed at an altitude of 742 m asl in Sumur Bandung . The fouth was installed at an altitude of 642 m asl at Buah Batu area.

Fig. 1. Sampling site

2.1. Sampling Equipment and Methods

The rainwater samples was collected manually using a polyethylene bottle (1000 mL) with a polyethylene funnel (12 mm in diameter) and put on a stainless steel cylinder. The funnel equipped with a filter plug (1 mm mesh) to protect large debris. The inside wall of canister painted with black color to diminish light levels around the collecting bottle and to inhibit biological growth [6].

Rainwater sampling was collected on a weekly basis from March to August 2016. The bulk collector bottle was replaced with a clean one and funnels were rinsed with deionized water. Samples bottle were placed in a cool box with blue ice and were transported from the sampling sites to the laboratory.

2.2 Laboratory Analysis Method

Upon arrival at the laboratory, samples were immediately weighed for volume determination, followed by pH measurement (Sartorius Professional Meter PP-20) and electric conductivity (Agilent Technologies 3200 C). The pH meter and conductivity meter were calibrated before measurement. Samples were sealed from the atmosphere and stored in the dark at 4°C in the refrigerator until analysis. Major ions (SO_4^{2-}, NO_3^-, Cl^-, Ca^{2+}, Mg^{2+}, Na^+, K^+ and NH_4^+) were analysis using ion chromatograph DIONEX ICS 500 DP.

2.3 Quality Assurance

2.3.1 Ionic Balance (IB)

The accuracy of laboratory analysis was determined using ion balance analysis. Ionic Balance is the sum of major anions in a water sample that is theoreticaly should equal to sum of major cations. In reality, factors such as the presence of unknown ions that have not been analyzed, analytical error or measurement precision could cause differences in ion balance (IB) was calculate by Equation 1 [6]:

$$IB = (\sum_{anions} - \sum_{cations})/(\sum_{anion} + \sum_{cations}) \; x \; 100\,\%_s \qquad (1)$$

It is suggested that the difference between ions were IB ± 8% if sum ions > 100 µeq/L, IB ± 15% if sum ions 50 – 100 µeq/L and IB ± 30% if sum of ions < 50 µeq/L [2].

2.3.2 Precipitation Weight Mean (PWM) Concentration

In order to determine the influence of air pollution to rainwater chemistry, precipitation weighted mean (PWM) concentration was calculated to eliminate the effect of rainwater amount for each ion analyzed. PWM is carried out by summing the product of ion concentration and the precipitation amount, obtained from rainwater sampler, for each data pair and dividing the result by the sum of precipitation amount for a certain period [6].

$$C_{w,j} = \Sigma C_{j,k} \, . \, P_k / \Sigma P_{k\,s} \qquad (2)$$

where :
$C_{w,j}$: precipitation weighted concentration for ion j ($meqL^{-1}$)
Cj,k: ion j concentration in precipitation of time k ($meqL^{-1}$)
Pk = precipitation amount of time k ($mm\ time^{-1}$)

3 Result and Discussion

3.1. Precipitation Chemistry

Generally SO_4^{2-} and NO_3^- for anion and Ca^{2+} and NH_4^+ for cations, were found as major component in precipitation chemistry, at all sampling sites (Table 1). Table 1 present mean, minimum and maximum of pH, conductivity and concentration of major ions in rainwater in Bandung City. Mean concentration of SO_4^{2-} ranged from 39.90 µeq/L (at Lembang) to 78.76 µeq/L (at Sumur Bandung) and mean concentration of NO_3^- ranged from 19.47 (at Lembang) to 27.41 µeq/L (at Sumur Bandung). Mean concentration of Ca^{2+} ranged from 31.43 µeq/L (at Coblong) to 51.61 µeq/L (at Lembang) and NH_4^+ ranged from 29.07 µeq/L (at Lembang) to 49.70 µeq/L (at Sumur Bandung).

Gaseous pollutant such as SO_2 and NO_x are released into the atmosphere when fuels such as oil and coal are burnt. SO_2 and NO_x are the major causative agents (precursors) of acid deposition. The high concentrations of alkaline ions (mainly Ca^{2+}, NH_4^+) in the atmosphere have played an important role to neutralize the acidity of rainwater, but it is worth noting that the emission of NO_x from the automobile exhaust is increasing and becoming the important precursor of acid rain [7].

We observed that the lowest mean rainwater pH value in Buah Batu was 5.28 which was less than pH value of 5.6 of unpolluted rainwater at equilibrium with atmospheric CO_2 [8]. Carbonic acid is a weak acid, it brings down the pH of the rainwater to 6.0 – 5.2. With pH levels ranging between 6.0 – 5.2, rainwater is acidic, but still not dangerous. This is a reversible reaction. Sometimes, the pH level can even become as low as 2. This phenomenon of acidic rainwater precipitation, is called acid rain.

The mean electric conductivity in rainwater samples ranged from 15.67 µS/cm at Buah Batu – 19.37 µS/cm at Sumur Bandung. The common range of electric conductivity for precipitation sample is from < 0.5 to 100 mS/cm [2]. Precipitation conductivity is mainly contributed by water soluble ions, the value being related to the total sum of anions and cations in the rainwater. Low precipitation conductivity is an indicator of good atmospheric environmental quality [9].

In term of ionic balance, more than 65% of the data is characterized by positive ionic balance value, which means the sum of anions in the samples exceeds that of cations. The chemical determination of heavy metals, aluminum, mercury, and organic compounds will aid in the characterization of precipitation if the ion balance not meet criteria [2].

3.2 Temporal Variation of Precipitation Chemistry

Monthly variation of precipitation chemistry is shown in Figure 2. Higher SO_4^{2+} and NO_3^+ anions concentration were observed in August (89.41 µeq/L and 35.69 µeq/L) and cation NH_4^+ (77.76 µeq/L) when the lowest rainfall was observed (214.88 mm). But cation Ca^{2+} higest concentration (94.27 µeq/L) was observed in June (521.67 mm).

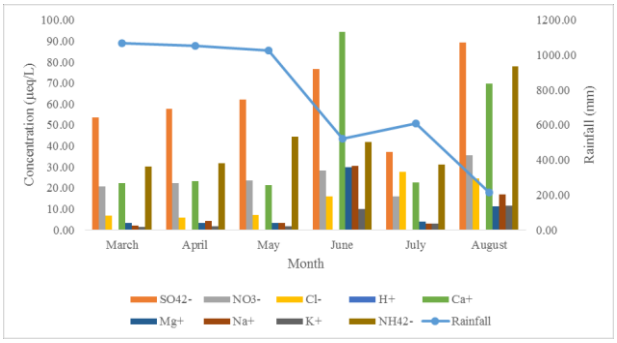

Fig. 2. Temporal variation of precipitation chemisty in Bandung City.

3.3 Temporal Variation of pH and Electric Conductivity

Temporal variation of pH and electric conductivity presented in Figure 3. Data show mean pH (5.98) and mean electric conductivity (25.36 µS/cm) were slightly higher in less rainy periods in August. This can be explained by the fact that, in drought periods, the atmosphere is considerably more polluted, so the wet scavenging process carries a higher load of compounds which increases both measured parameters.

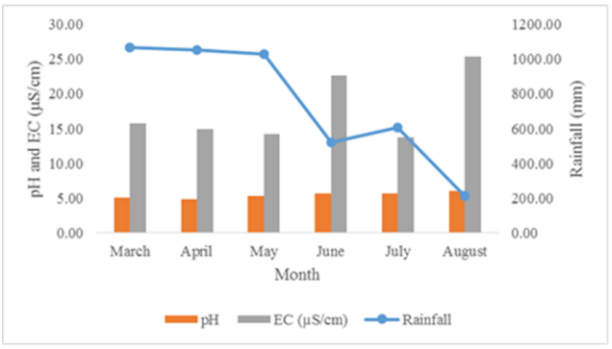

Fig. 3. Temporal variation of pH and electric conductivity in Bandung City emporal variation of precipitation chemisty in Bandung City

Table 1. Mean, minimum and maximum of pH, conductivity (µS/cm) and concentration (µeq/L) of major ions in rainwater collected four site from March to August 2016 (n = the number of samples)

	Lembang n=24		Coblong n = 24		Sumur Bandung n = 24		Buah Batu n = 24	
	Mean	Min-Max	Mean	Min-Max	Mean	Min-Max	Mean	Min-Max
SO_4^{2-}	39.90	9.22-81.84	64.70	18.00-135.38	78.76	32.35-192.33	65.36	20.82-125.97
NO_3^-	19.47	0.00-67.70	27.22	11.12-67.61	27.41	14.16-55.29	22.62	9.01-41.68
Cl^-	13.59	2.23-71.62	13.29	3.39-77.26	11.69	3.95-39.26	9.80	3.33-30.42
Ca^+	51.61	4.41-827.8	31.43	7.65-91.81	45.67	15.69-204.97	44.34	16.64-132.60
Mg^+	21.77	0.49-440.44	5.26	0.58-18.91	6.72	2.30-28.53	6.34	2.43-16.20
Na^+	23.46	0.07-398.37	5.98	0.13-26.19	6.84	0.87-29.25	6.14	0.74-25.03
K^+	9.09	0.61-76.33	3.93	0.51-29.04	2.89	0.97-48.36	3.50	0.87-15.79
NH_4^+	29.07	0.00-70.66	49.22	16.30-206.16	49.70	23.06-86.45	37.75	0.00-88.45
H^+	0.01	0.00-0.04	0.01	0.00-0.06	0.01	0.00-0.04	0.01	0.00-0.02
pH	5.63	4.36-7.71	5.41	4.24-6.79	5.38	4.10-6.29	5.28	4..68-6.36
Cond.	17.88	4.94-134.90	17.71	5.34-50.45	19.37	12.84-40.41	15.67	5.61-27.7

2.4 Precipitation-weight Mean Concentrations (PWM)

The proportion of Precipitation Weight Mean (PWM) concentrations in the rainwater sample shown the most anion components of rainwater sample in all sampling sites was SO_4^{2-}, which contributed for 32% (at Lembang) – 37% (at Buah Batu) to the total anions, followed by NO_3^- (13 – 15%) and Cl^- (4 – 7%). Both NH_4^+ (21 – 27%) and Ca^+ (13 – 19%) were the major cations components, followed by Na^+, Mg^+, K^+ and H^+.

Precipitation Weight Mean (PWM) concentrations in the rainwater sample for each sampling site location as shown in Figure 4, Figure 5, Figure 6, and Figure 7.

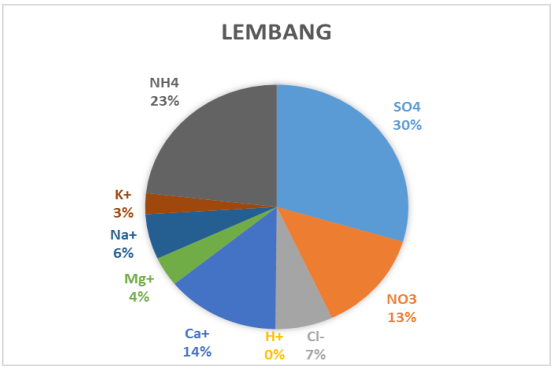

Fig. 4. Precipitation Weight Mean (PWM) concentration in Lembang

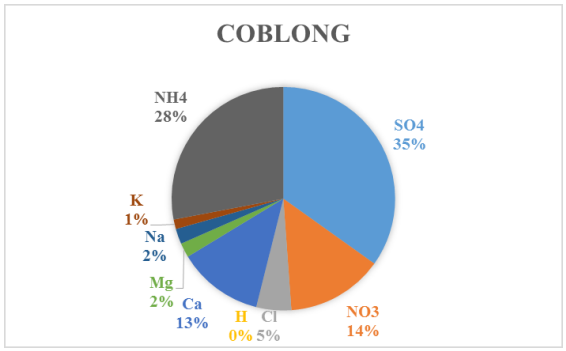

Fig. 5. Precipitation Weight Mean (PWM) concentration in Coblong

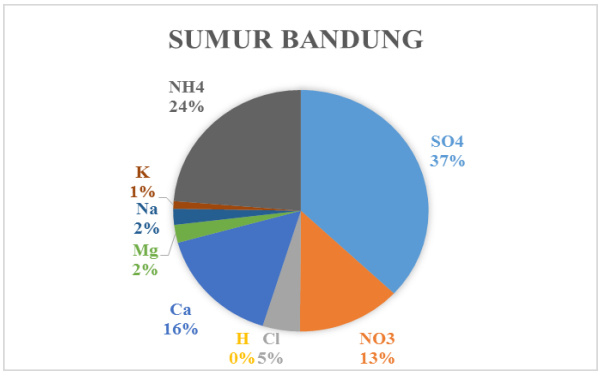

Fig. 6. Precipitation Weight Mean (PWM) concentration in Sumur Bandung

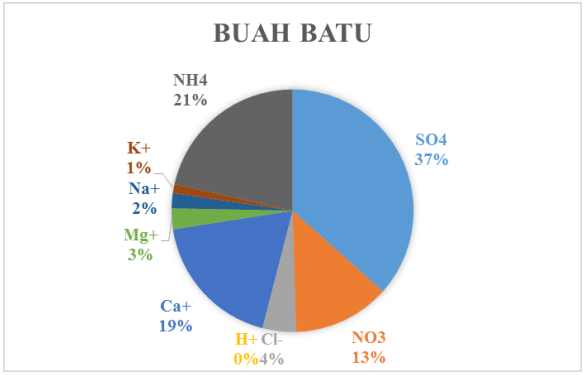

Fig. 7. Precipitation Weight Mean (PWM) concentration in Buah Batu

2.5 Neutralizing Factor (NF)

Neutralization factors (NF) can be used to evaluate the neutralization of precipitation by Ca^{2+}, Mg^{2+} and NH_4^+, which are calculated by the following Equation 3 [10,11,12,13,6] :

$$NF_{Xi} = [X_i^{2+}] / [SO_4^{2-} + NO_3^-] \quad (3)$$

where Xi is the chemical component of interest, with all the ions expressed in μeq/L.

The NF values for Ca^{2+}, Mg^{2+} and NH_4^+ in rainwater of the study area are 0.87, 0.37 and 0.49 (at Lembang); 0.34, 0.06 and 0.54 (at Coblong); 0.43, 0.06 and 0.47 (at sumur Bandung) and 0.50, 0.07 and 0.43 (at Buah Batu). The results reveal that Ca^{2+} and NH_4^+ are the dominant neutralization substances in the rainwater.

2.6 Sources of Emission

To identify the sources of emission which affects the quality of atmospheric precipitation was used to quantifies the sources emissions [14]. The result found ratio SO_4^{2-}/NO_3^- were 2.05 (at Lembang), 2.38 (at Coblong), 2.87 (at Sumur Bandung) and 2.89 (at Buah Batu). The results showed that sulfuric emissions still dominated, however the ratio is not as high as the one found in cities affected by industry. Ratio SO_4^{2-}/NO_3^- at Dhanbad City, known as coal city in India was 16.94 due the fact that the site are located beside or in industrialized urban areas [14]. SO_2 and NO_x come from electric power generation that relies on burning fossil fuels, like coal [3].

Nitrate and sulfate are the major component of acid rain and their concentrations are increasing rapidly in the atmosphere growing to anthropogenic activities such as the burning of coal and petroleum fuels. Nitrogen in precipitation is present mainly as ammonium (NH_4^+) and nitrate (NO_3^-). NH_3 emissions sources from soils, oceans, and animal excreta. Sulfate in precipitation in different areas study were sea-salt sulfate, emissions of SO_2 from industrialized areas and local sources as coal combustion and biogenic sulfur [15].

2.7 Wet Deposition Rate

Wet deposition rate for certain study periods were present in **Table 2**. The highest wet deposition rate of anion due to SO_4^{2-} with mean ranged between 15.90 kg/ha in Lembang to 45.45 kg/ha in Sumur Bandung. For cations, wet deposition rate of Ca^{2+} ranged between 8.58 kg/ha in Lembang to 11.60 kg/ha in Buah Batu. NH_4^+ has significant rate for cation in all sampling sites with range values between 4.60 kg/ha in Lembang to 10.77 kg/ha in Sumur Bandung.

Calcium is a major netralising agent that may play an important role in the precipitation chemistry in Bandung City. Calcium in rainwater may be contributed from soil dust, coal combustion and cement factories [16]. The neutralization capacity of soil dust from desert and semi-arid areas northern China was largely related to the calcite ($CaCO_3$) content of the soil, so precipitation pH in this part of China has remained high despite the high sulfur emissions and large quantities of sulfuric acid in the precipitation. The chemical composition of the anthropogenic emitted calcium dust are not known, but is likely a combination of $CaCO_3$, CaO and $CaSO_4$ [17].

Table 2. Wet deposition rate (kg/ha)

Sampling Site	Rainfall (mm)	Anion (kg/ha)			Cations (kg/ha)				
		Cl	NO_3	SO_4	Ca	Mg	Na	K	NH_4
Lembang	829.88	4.00	10.02	15.90	8.58	2.20	4.48	2.95	4.35
Coblong	1155.61	5.44	19.51	35.91	7.28	0.74	1.59	1.78	10.26
Sumur Bandung	1201.52	4.98	20.42	45.45	11.00	0.98	1.89	3.36	10.77
Buah Batu	1304.94	4.53	18.30	40.97	11.60	1.01	1.84	1.79	8.89

4 Conclusions

The total amount of wet precipitation measured during the sampling period (March to August 2016) for Bandung City were ranged between 214.99 mm – 1067.32 mm. The mean pH showed that samples had their majority acidic properties. This acidity was directly associated with SO_4^{2-} and NO_3^-, where SO_4^{2-} that were found to be the main contributor to this characteristic.

On the other hand, the neutralization process mainly originated from the presence of Ca^{2+} and NH_4^+. Cation wet deposition rate of Ca has highest. Calcium is a major netralising agent that may play an important role in the precipitation chemistry in Bandung City. Ammonium (NH_4^+) came the second and showed significant rate for cation in all sampling site. There are not many agricultural areas in the city of Bandung. It is suggested that ammonia is originated from decomposition process of waste and wastewater mix in open channel in Bandung City are. However, this is still need further investigation.

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