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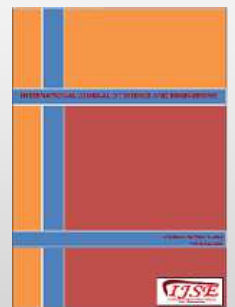
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VOLUME

IJSE Volume 3, Special Number,(ICRAESM 2015)

S.No. 1	Paper Title	NUMERICAL STUDY OF SPLIT INJECTION ON THE COMBUSTION AND EMISSION CHARACTERISTICS OF DI DIESEL ENGINE WITH DIFFERENT PISTON BOWL CONFIGURATIONS
	Authors	Santhosh Kumar Gugulothu and K.Hemachandra Reddy
	Pages	01-09
	Abstract	The engine performance is generally governed by various parameters like peak pressure, static temperature, heat release rate, knocks emission, etc. However, these parameters are intern influenced significantly by varying the swirl ratio, split injection and the piston bowl configurations. Split injection is one of the most powerful tools that decrease soot and No_x emission. A better understanding of in-cylinder fluid motion during induction process could improve the combustion process and burning rates of compression ignition engines. Hence, this investigation aimed to develop a numerical model for in-cylinder fluid motion to study the effect of variation of swirl ratio, split injection and piston bowl geometries on the engine performance characteristics. The model was developed in computational fluid dynamics (CFD) code, ANSYS FLUENT. The simulations were conducted for the combinations of swirl ratio, three split injection and four piston bowl geometries. The simulation results revealed that, the split injection and adopting suitable combination of combustion chamber configuration would greatly enhance the engine performance, besides reducing emission level to a greater extent.
S.No. 2	Paper Title	THF-Water mixture separation using Extractive and Azeotropic distillation: Review, Modeling and Simulation in Aspen plus
	Authors	Deorukhkar Onkar A., Sathe V.S. and Mahajan Yogesh S.
	Pages	10-16
	Abstract	<p>Separations, including enrichment, concentration, purification, refining, and isolation, are most important to chemical engineers. Separation of azeotropic mixtures is a topic of great practical and industrial interest. Azeotropic mixtures may often be effectively separated by distillation by adding a liquid material (entrainer) to the system. For the development of separation processes for azeotropic mixtures, there is a need for insight into the fundamental phenomena of non-ideal and azeotropic phase equilibria.</p> <p>In general, separation of homogeneous liquid mixtures requires the creation or addition of another phase within the system. The most common method is repeated vaporization and condensation and distillation where the vapor phase becomes gradually enriched in the more volatile components compared to the liquid. The separation of azeotropes and close-boiling mixtures is often faced in the pharmaceutical and special chemical industries. This paper aims to contribute to our understanding of the separation of THF-Water mixture within extractive and azeotropic columns by reviewing recently published work. Tetrahydrofuran and water form a minimum boiling azeotrope at 64°C, which contains water in 6.7% mass fraction. Conventional distillation to separate these two components cannot be used. In this work, various methods of solvents/entrainers will be tried upon for the purpose. The flow sheet will be simulate in suitable software like Aspen plus.</p> <p>Investigation of design parameters characterizing the operation and mass transfer phenomena of distillation columns have led to better understanding of the thermodynamic properties, heat and mass transfer mechanisms during the operation. This review focuses on extractive and azeotropic distillation columns, their description, design and operation, application areas, simulation and sensitivity analysis encountered and parameters characterizing the operation are presented together with the findings of published work.</p>
S.No. 3	Paper Title	FEA of Twin Tunnel Intake during Excavation
	Authors	Givin Pullimpallil Varkey and Anjana.P.
	Pages	17-25
	Abstract	The paper deals with the study of Tunneling in a sensitive area with shallow overburden in which the ground settlement is inevitable. This project discussed

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		the interaction between twin parallel tunnels with various soil layers and the actual distance between the tunnel. The objective of this study is to determine the magnitude of ground settlement induced by the interaction between a twin parallel tunnel and the various layers of soil and then to determine the actual spacing that must be provided between the tunnel in order to reduce the stress acting over it. The surface settlement is caused by a combination of ground loss at the tunnel, which includes the ground loss at the tunnel face, convergence of the tunnel opening and the closure of the physical gap between the concrete lining. The magnitude of intensity and extension of settlement significantly depends on several factors such as physical, mechanical and hydraulic properties of the interested rock/soil formation, geomorphologic condition, tunnel overburden, tunnel cross-sectional area, excavation methods and construction phases. Thus, study on this problem is crucial in order to predict the amount of ground settlement to enable preventive measure can be taken when and where necessary during the tunnel excavation. The result shows a different value of ground settlement at different spacing between the tunnels. With the help of pipe roof supports the deflection and stress intensity can be decreased, thus improves the lifetime of the tunnel. The result obtained delivers a great portion of engineering justification that may help engineer to make important decisions during the planning, design and construction stages of tunnels with shallow overburden. The modeling and analysis was carried out with the help of ANSYS Workbench 14.5 software.
S.No. 4	Paper Title	A Study on Multilateral Drilling and its Implementation in India
	Authors	Nripanka Kalita, M.A. Chowdhury and Minati Das
	Pages	26-34
	Abstract	Multilateral drilling is a new technology for exploration of hydrocarbons. This technology involves multiple drilling or multi-branched drilling into the formation from a single well to maximize the productivity, and make hydrocarbon recovery more efficient and more profitable. In this review paper based on earlier case studies on the implementation of this technology around the world, different types of multilateral drilling process and configuration have been discussed, to study its applicability in the present hydrocarbon exploration scenario. From the different case studies it is observed that this is the most feasible technique for high productivity in the present day scenario. The study shows an encouraging outlook for future implementation of these techniques in some of oil fields of India has been analyzed and found to be applicable.
S.No. 5	Paper Title	Wear Characteristic of Ultrahigh Carbon Steel (Hyper Eutectoid Steel) with Varying MicroStructure
	Authors	Shaila D Hosmani , Rajashekar Kurhatti and Vijay Kumar Kabadi
	Pages	35-41
	Abstract	Many researches are carried out the work on hypereutectoid steel varying in normal load and sliding speed, whereas very few researches are based on pearlitic, martensitic and cementitic structure. This work is based on changing the microstructure of the cementite into spheroidite. The present work is with the study made towards microstructure and wear behavior of hypereutectoid steel of composition 1% carbon. For this study the steel samples are subjected to different heat treatment procedures to achieve different percentage of phases i.e. pearlite + cementite, 100% martensite, martensite + cementite, and spheroidized cementite. For Specimens of size 30mm length and 10mm diameter the standard pin on disc wear testing machine was used under a constant load of 4kg for a uniform speed of 500 rpm under constant sliding distance. The analysis consists of measurement of hardness of individual phases and the weight losses due to wear tests conducted on them. Based on the tests conducted, annealed steel showed poor wear resistance among all the specimens. The martensitic steel showed good wear strength followed by the martensite + cementite sample. The spheroidized cementite sample showed the lowest wear rate among all.
S.No. 6	Paper Title	Feasibility study of using cement kiln dust for BOD reduction in the treatment of municipal wastewater
	Authors	Shenha G. Galagali, Anil C. Ranveer and Mahesh S. Salunkhe
	Pages	42-47
	Abstract	Municipal wastewater contains both organic and inorganic pollutants. These pollutants can be removed by chemical coagulation. The present study investigates the feasibility of utilization of cement kiln dust as a coagulant for municipal wastewater and discusses the optimum dose to obtain maximum removal efficiencies of COD. Cement kiln dust (CKD) is a useless byproduct from the cement industry and has a significant resource value for using lime as a substitute. The effect of different dosages of cement kiln dust ranging from (0.5-3.0) gm/l has been discussed on bench-scale tests. The result shows the feasibility of using kiln dust with optimum dose of 2 gm/L as a good coagulant for municipal wastewater.

S.No. 7	Paper Title	A Case Study on Use of Polycrystalline Materials in Manufacturing Processes
	Authors	Shreyas A. Gurav , Nirmohi V. Sasmile and Sachin S. Dharia
	Pages	48 - 56
	Abstract	<p>- In manufacturing process, tipped tools are of great importance. Manufacturing industries use ceramic cutting tool inserts on large scale but, on the other hand environmental regulations are also binding over the tool manufacturers. Many of the manufacturing industries have started using polycrystalline diamond (PCD) and polycrystalline cubic boron nitride (PCBN) cutting tools which are less harmful to the environment. The automotive and aerospace industries use these materials for gaining precision and better surface finish.</p> <p>In this paper, comparison between currently used tools and polycrystalline diamond (PCD) and polycrystalline cubic boron nitride (PCBN) tools is done with the help of case study. Case study consists of detailed information about currently used ceramic tool inserts in local industry and its analytical comparison with advanced tools used globally. The paper also describes the performance of polycrystalline diamond (PCD) and polycrystalline cubic boron nitride (PCBN) tool inserts.</p>
S.No. 8	Paper Title	ANALYSIS OF INFILLED RC FRAME WITH AND WITHOUT SOFT STOREY
	Authors	Akash Anirudh , Deepthi I Gopinath
	Pages	57-67
	Abstract	<p>Infill frame is a composite structure formed by the combination of moment resisting plane frame and infill walls which are mainly used to increase lateral stiffness. The project concerns about on the effect of lateral loadings on the of infilled reinforced concrete (RC) frame with and without soft storey which includes masonry as infill with and without opening, shear wall as infill . Symmetrical office building of (G+9) floors located in the seismic zone –IV is taken for modeling for the initial frame. The modeled and static analysis is carried out in ETABS 9.7 on the models such as bare frame, masonry infill frame, masonry infill frames with 10% ,20% , 30% centre and corner opening, shear wall infill frame and compared on the basis of displacement, axial force, bending moment(top and bottom) of column. The result shows that how infill frames increase stiffness of the structure.</p>
S.No. 9	Paper Title	PERFORMANCE OF BRACED RC FRAMES USING LINEAR STATIC ANALYSIS ON DIFFERENT ASPECT RATIO
	Authors	Abhilash T. Daniel and George M. Varghese
	Pages	68-80
	Abstract	<p>Concrete is by far most useful material for building construction in the world and in last decades reinforced concrete structures has played an important role in construction industry. Providing strength, stability and ductility are major purposes of seismic design. It is necessary to design a structure to perform well under seismic loads. In this paper linear analysis is carried out for high rise R.C building with different pattern of bracing system. The shear capacity of the structure can be increased by introducing Steel bracings in the structural system. Especially the use of bracings in an RC building increases the seismic performance of the building and it can be used for retrofitting for buildings which are structurally weak. There are 'n' numbers of possibilities to arrange steel bracings such as Diagonal, X, K, V, Inverted V or chevron and global type concentric bracings. A typical 9 story building is designed for various types of concentric bracings like Diagonal, V, X, ZX, INVERTED V, ZIPPER and Performance of each frame is carried out through linear static analysis. In this project the buildings aspect ratios are changed and purposefully the sections of the building are kept same for all aspect ratio so that it will help us to study the effect bracing on building with inadequate sections. Three types of sections i.e. ISMB, ISMC and ISA sections are used to compare for same patterns of bracing. Effect of each bracing are analysed and compared . This project also helps to study chances of retrofitting of buildings using steel bracings</p>
S.No. 10	Paper Title	STUDY AND ANALYSIS OF OXYGEN ENRICHMENT ON SINGLE CYLINDER FOUR STROKE DIESEL ENGINE
	Authors	Digvijay Paymal , Kunal Sarda , Kiran Sabale ,Yogesh Kamble and S.J.Desai
	Pages	81-84
	Abstract	<p>Pollution is one major factor which affects the environment nowadays, resulting in greenhouse effect and global warming. Suitable methods are introduced to increase the engine fuel economy and bring down the emissions within the tolerable limit. One way of doing it is by inducting oxygen into the combustion chamber since oxygen is a combustion enhancer. The amount of oxygen entering into the combustion chamber if increased would result in better engine performance and lower emissions. Oxygen can be inducted in the intake stroke by the help of an external source and mixing chamber is provided so that it helps in better mixing of air and supplementary oxygen. This additional increase of air will affect all parameters of the engine like operating temperature, fuel</p>

		<p>consumption, Brake power efficiency, and heat release.</p> <p>Tests were conducted on a compression Ignition engine for various concentrations of oxygen from (21% to 26.5%). This experimental study shows better fuel economy and better brake specific fuel consumption but led to a very high percentage of Oxides of Nitrogen.</p> <p>The Oxygen enters the engine's combustion chamber, and mixes with the fuel. The introduction of Oxygen into the combustion chamber creates a more efficient, complete combustion; thereby increasing fuel efficiency while at the same time reduces emissions and increasing power and performance.</p> <p>The method of providing oxygen which we have used in our study is actually not suitable for implementing in actual automobile application. But this problem can be solved in the future by designing a suitable oxygen separation membrane with respect to the engine requirements.</p>
S.No. 11	Paper Title	THE STUDY ON USE OF RICE HUSK ASH
	Authors	Megha Kalra , Garima Srivastav and Atul Thakur
	Pages	85-88
	Abstract	Since olden times materials like mudstone are being used as construction material. A lot of efforts are being made to utilise industrial waste to replace cement. These materials are known as supplementary cementitious material. Also, reduction in consumption of cement reduces the carbon emission produced during cement manufacturing process. Different types of SCMs available are Fly ash, rice husk ash, silica fume and ground granulated blast furnace slag. Rice husk ash (RHA) is a by- product obtained after burning rice husk at very high temperatures in rice plant. It is a light weight pozzolanic material which can replace cement from concrete without affecting the properties of concrete. This paper describes the introduction and production of rice husk ash and its various applications in the construction industry. Henceforth, the properties of rice husk ash are also mentioned. Future recommendations about RHA are also included.
S.No. 12	Paper Title	DEVELOPMENT OF PASSENGER CAR UNITS (PCU), CASE STUDY- NAL STOP, PUNE
	Authors	Suhas Vijay Patil, P. R. Adavi
	Pages	89-95
	Abstract	In this paper an attempt is made to find out Passenger Car Unit (PCU) value for Nal Stop. Passenger Car Unit (PCU) value of each class of vehicle is very important for any mixed traffic flow studies. These may be concerning traffic flow parameters, capacity, signal design, parking lots etc. The work took into account the effect of mixing of traffic, speed and headway. A set of PCU values was then derived.
S.No. 13	Paper Title	Effect of Austenizing Temperature on the Wear Properties of CAD I
	Authors	Pratik Dangra , Dr. Sunil Patil and Madhavi Harne
	Pages	96-103
	Abstract	The abrasion wear resistance of ductile cast iron is improved by the incorporation of an extra phase in the matrix, typically consist of carbides. The objective of the present work is to produce carbides in a ductile cast iron which is subsequently austempered, to obtain the carbidic austempered ductile iron (CADI). Two variants of (CADI) were produced by heating carbidic ductile iron (CDI) to a austenitization temperature of 1000°C for the period of 1hr and quenching in salt bath at temperature range 325°C for the period of 2hr, and 4hr. The microstructural characteristics of the produced CADI were evaluated by optical microscope. The abrasion wear resistance was evaluated by testing in accordance with ASTM G 99 standard. Heat treatment parameters affect the microstructure of the carbidic austempered ductile iron which can be characterized by optical microscope, XRD and SEM.
S.No. 14	Paper Title	ENCRYPTION AND DECRYPTION OF TEXT DATA WITH RSA CRYPTOGRAPHY USING MATLAB
	Authors	Shipra Sahu , Jai Singh and Javed Ashraf
	Pages	104-110
	Abstract	The Research was under taken in order to develop better and faster algorithms for implementation of RSA system in Cryptography. Various types of Symmetrical and Asymmetrical Cryptography methods were studied. Faster implementations of public-key cryptography, and in particular of RSA are of utmost importance nowadays. Computer security is becoming increasingly important to companies and organizations all over the world. Computers are being used for communications between companies that may be in different cities or even different countries. So in this paper we secure our textual data with RSA cryptography using MATLAB.
S.No. 15	Paper Title	Reducing Inconsistent Flaring Process by Automation
	Authors	Nital Patel , Shalin Shah and Akash shah
	Pages	111-115

	Abstract	This paper is proposed to automate the flaring process used to flare the polytetrafluoroethylene (PTFE) lined pipes used as liners in steel pipes. The PTFE material is very sensitive to the amount to heat added during the flaring process which is the most critical parameter for the flare quality. Thus by employing automation the quantity of heat added during the flaring process can be controlled. Thus the main objective is to improve the quality of flaring process along with enabling it to be reproducible. The control functions are implemented in programmable logic controller (PLC). This will help to control tool movement and delay period for each operation taking inputs from operator. The work will be beneficial in the various methods viz. increase the rate of production, reduce the labour skills and cost along with highly reliable and reproducible process. On a longer run it is going to save a large amount of capital of the industry. The same project concept can also be applied to various other sectors for multiple works on the same station such as computer numerical control (CNC) machines, assembly lines, etc.
S.No. 16	Paper Title	Basalt: Unconventional Uses of a Conventional Rock
	Authors	Ruby Siddiqui , Shumaila Naseer , Baseer Uddin
	Pages	116-123
	Abstract	<i>Basalt is a common extrusive volcanic rock formed by decompression, melting of Earth's mantle. It has extensive occurrence all over the world. In India, it covers 4000 Km² parts of peninsular India. Natural basalt rock has been used as a prominent construction material in the form of slabs, stonework, tiles, pavement etc.</i> <i>With advent of technology, it is now possible to modify basalt rock into fibers through bushing and vertical melting method similar to glass. Basalt fibers are capable of being used to make heavy loaded conveyer pipes, pipelines for heat supply (high temperature resistance), fire proofing clothes etc. basalt fiber mesh is used as the framework in panels for structural reinforcement and material integrity. Basalt fibers have high chemical resistance, high thermal resistance, low flammability, high mechanical strength, abrasion resistance, good elasticity, high tensile strength (even greater than same size steel mesh), high thermal and acoustic insulation properties, and excellent adhesive property. Basalt fibers are renewable and could be most eco-friendly, non-toxic alternative to metallic building material. A more futuristic research for discovering more unconventional and collaborative uses of basalt fiber could be a boon to construction industry.</i>
S.No. 17	Paper Title	ECONOMICAL ANALYSIS OF SOLAR DRYER WITH PCM FOR DRYING AGRICULTURAL PRODUCTS
	Authors	Aiswarya .M.S
	Pages	124-134
	Abstract	Solar energy is the most readily available source of energy. It is also the most important of the non-conventional sources of energy because it is non-polluting and therefore helps in decreasing the greenhouse effect. Drying by exposure to the sun is one of the oldest method using solar energy for food preservation. Solar dryer is a device used for product drying with proper application of solar energy. Solar dryer can successfully employ a cost effective drying technique. Design improvements of solar dryer would lead to better performance of the system. This work is intended to develop a solar dryer with Phase Changing Material (PCM) for drying agricultural products. Developing efficient and inexpensive energy storage device in solar dryer is as important as the development of new energy sources. This reduces the time between energy supply and demand there by plays a vital role in energy conservation. The solar drying system consists of baffled flat plate collector of 1m ² area, drying chamber, blower and PCM chamber. Potato and cassava root were selected as drying material in this solar dryer. Time required for reducing the moisture content from initial moisture content to final moisture content were observed in open sun drying and in solar dryer . Potato and cassava root placed within the dryer required 2 days to attain final moisture content but the product placed under the open drying required 4 days to reach final moisture content. Samples dried in solar dryer was overall accepted, whereas traditionally open sun dried samples was less preferred by consumers for its color and texture. In this work, 3 kg of paraffin wax was used as a latent heat thermal storage. From the experimental results, it is found that the solar dryer implementing paraffin wax as thermal storage medium successfully maintains the temperature around 35 ⁰ C- 40 ⁰ C for five consecutive hours. The economic analysis of the solar dryer was conducted by payback period method. The capital cost of solar dryer was Rs. 30000/-. The payback period of the solar dryer with PCM was found to be approximately 6 months.
S.No. 18	Paper Title	Comparison of Overall Heat Transfer Coefficient of a Nano Fluid with Water in Heat Exchanger
	Authors	Prof B.Vishnu Prasad , Prof B. Jaya Prakash and Dr. V. Venkata Ramana

	Pages	135-145
	Abstract	<p>Ultrahigh performance cooling is one of the important needs of present day industry. However for cooling purpose, low thermal conductivity is a prime limitation in developing energy efficient heat transfer fluids. To fulfill such requirements nano fluids play an important role. These nano fluids are engineered by suspending nano particles of sizes below 100 nm in heat transfer fluids (water, ethylene glycol, oil etc.). Innovative heat transfer fluids are produced by suspending metallic/non-metallic nano meter sized solid particles and many experimental works have shown that these nano fluids have substantial higher thermal conductivities compared to the base fluids and can change the thermal properties of the base fluids. The aim of this paper is to summarize some developments in research on the stability of nano fluids, enhancement of thermal conductivities, and heat transfer characteristics of alumina (Al₂O₃) based nano fluids. The Al₂O₃ nano particles in the range of 70 to 230 mesh size were used to prepare nano fluids with different concentrations, analyzed for better heat transfer coefficient and to validate, experiments were conducted to study enhancement in the heat transfer coefficient with a heat exchanger. It is observed that the overall heat transfer coefficient is considerably increased.</p>
S.No. 19	Paper Title	Artificial Eye (Bionic Eye)
	Authors	Shaily Tomar and, Richa Sharma
	Pages	146-150
	Abstract	<p>India is now home to the world's largest number of blind people. In 37 million people across the globe 15 million blind people are from India. 75% of these are cases of avoidable blindness. On the other hand, while India needs 2.5 lakh donated eyes every year, the country's 109 eye banks in which 5 located in Delhi manage to collect a maximum of just 25,000 eyes, 30% of which can't be used. Meanwhile, shortage of donated eyes is becoming a huge problem. In 15 million blind people in India, three million that is 26% of whom are children who suffer due to corneal disorders. But only 10,000 corneal transplants are being done every year because of shortage of donated eye. The bionic eye aims to restore basic visual cues to people suffering from eye diseases such as retinitis pigmentosa, which is a genetic eye condition</p> <p>.A video camera fitted to a pair of glasses will capture and process images. These images are sent wirelessly to a bionic implant at the back of the eye which stimulates dormant optic nerves to generate points of light (phosphenes) that form the basis of images in the brain. Thus even blind people can have vision.</p>
S.No. 20	Paper Title	Design and Development of Blackboard Wiping Device
	Authors	Sharachandra Kusugal, Veena Badiger, G. S. Guggari and S. Shivakumar
	Pages	151-155
	Abstract	<p>Automatic blackboard dusters are made to reduce the man-power involved in cleaning blackboards and also to reduce the fatigue caused due to traditional wiping device. The dust which is generated while cleaning is so hazardous to health which causes many respiratory problems and also manual method is time consuming. To reduce such problems Automatic Blackboard dusters are one of the alternatives. This paper work presents the design and Fabrication of automated blackboard wiping device. The system consists of following basic units: Blackboard, wiper mechanism, wiper, DC motors, water sprayer and remote controller. The working of this system is based on windshield wiper mechanism of the car. The system uses oscillatory motion of the four bar wiper mechanism to clean the blackboard. The system also uses a water sprayer to spray water or cleaning solution for effective cleaning of the blackboard. The device makes teaching efficient and reduces human efforts.</p>
S.No. 21	Paper Title	NEW METHOD FOR LIQUEFACTION ASSESSMENT BASED ON SOIL GRADATION AND RELATIVE DENSITY
	Authors	Bambang Istijono and Abdul Hakam
	Pages	156-162
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NEW METHOD FOR LIQUEFACTION ASSESSMENT BASED ON SOIL GRADATION AND RELATIVE DENSITY

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ABSTRACT - The liquefaction potential assessment in a soil deposit is an important aspect of earthquake engineering practice since its contribution to the safety of construction. The physical properties of sand soil that include grain size and density had known give effects to the liquefaction resistance. Those physical properties of sand soil associated to liquefaction resistance have been studied in laboratory. The new method as a results of that study is demonstrated here to assess the liquefaction potential. The example case is a real construction design of reclamation shore in order to develop a new port in Medan, Indonesia. Since the limitation of reclamation source material, it founds that the gradation of the ready use materials are suspect to liquefaction. Then, using the new methods, the solution to treat those material as part of the construction requirement. The treatment to be accomplished is compaction efforts to reach a certain relative density in order to avoid the possibility of liquefaction on site.

Keywords: *Liquefaction, Earthquake, Grain size, Relative density, Reclamation*

I. INTRODUCTION

Liquefaction and related construction failures are commonly associated with earthquakes. Liquefaction usually refers to the loss of strength in saturated cohesionless soils due to the build-up of pore water pressures during dynamic loading. The propagation of shear waves during seismic loading causes the soil to loose internal contract and increases the water pore pressure in soil mass. The seismic shaking usually occurs in relative short time that resulting the soil performs an undrained material. In the liquefaction condition, the effective stress in soil mass is rapidly decreased and thus the shear strength of the soil dropped off to essentially zero. In this condition, the individual soil particles are released from any confinement [1].

The liquefaction potential assessment in a soil deposit is an important aspect of geotechnical earthquake engineering practice since its correspondence to the construction stability and safety. A very famous method named "simplified method" was proposed in the past to assess the liquefaction potential of a natural soil deposit in certain site (Figure 1). That method was developed based on the liquefaction experience related to the field test data [2]. The use 'simplified method' has been presented to demonstrate the liquefaction potential assessment at the coast of Padang due to the M 7.6 West Sumatra earthquake in 2009 [3] [4] (Figure 2). However in practice the application of this method actually is not as simple as its name since it involves many parameter that rarely used in civil engineering such as earthquake magnitude and depth factor. To improve the procedure, many later researches based on a number of liquefaction histories around the world were conducted continuously [5]. The application guidance by means of penetration-based methods has been discussed [6].

It has been recognized that the newly deposited loose sands under the shallow ground water are susceptible to

liquefaction [7]. It has also been summarized a number factor of soil that effect the liquefaction potential such as liquefaction histories, geological processes, soil typesand sizes, relative density and effective stress. Besides the earthquake properties such as applied peak acceleration, a_{max} and duration of the motion, the soil properties that are needed to be evaluated related to the liquefaction potential are [8] [9]:

- Relative density, D_r
- Initial stress of the soil, σ_i
- Mean grain size of the soil, D_{50}
- Over consolidation ratio, OCR
- Initial pore pressure, u_i

In spite of sands were historically considered to be the only type of soil that susceptible to liquefaction, but later observation showed that clayey soil also experienceto liquefaction. The clayey soils may have a tendency to liquefy under a vibration load if they satisfy at least the first three of the Chinese criteria [10] that are:

- Fraction finer than 0.005 mm less than 15%
- Liquid Limit, LL less than 35%
- Natural water content more than 0.9 LL
- Liquidity Index less than 0.75

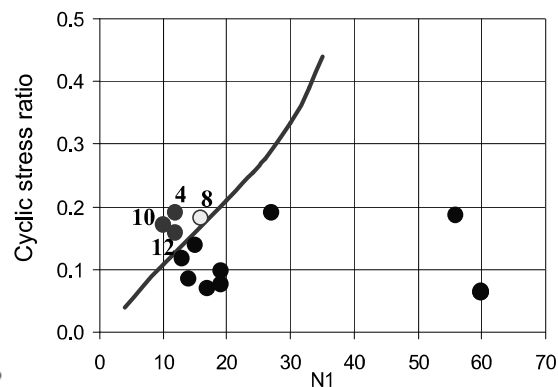
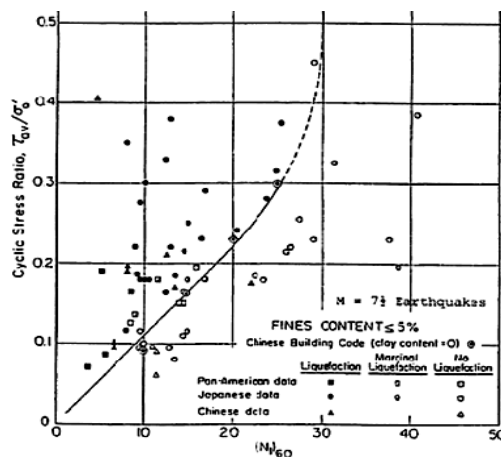


Fig. 1 The ‘Simplified Method’ chart [2]. Fig. 2 Liquefaction Using ‘Simplified Method’ [3].

The distribution of liquefied soil particle in the past indicates that the liquefaction in soil has relation to their size distribution. Based on the Kocaeli earthquake 1999 in Turkey, the results of sieve analysis tests of soil from several location has been plotted in Figure 3 [11]. Then due to Padang earthquake 2009 [3] it also has been also reported the particle distribution of liquefied soil samples as shown in the same figure (shadowed). The distribution of liquefied soils in Padang compose fine sand more than 60% with the fine content less than 20%. Based on the liquefaction histories around the world, 78% of the mean grain size of liquefied soils happened for size of 0.1125 to 0.3375 [12]. For Padangliquefaction, the mean grain size D_{50} is about 0.15 to 0.35mm. This grain size value then become a parameter to be consider on this liquefaction study.

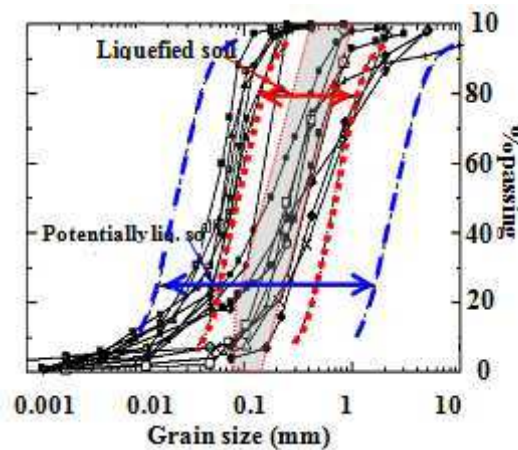


Fig. 3 Grain Size Limit for Liquefaction [11]

II. NEW ASSESSMENT METHOD

To have a good estimation of the liquefaction problem in practice, a simple liquefaction potential assessment becomes essential. In this paper, a straightforward liquefaction potential assessment based on laboratory experiments and its application are presented. A series of laboratory testing has been done by placing soil samples in the round container. The considered factors in the laboratory experiments to develop the new method are:

- Relative density, D_r
- Mean grain size of the soil, D_{50}
- Applied peak acceleration, a_{max}
- Duration of the motion, t

these tests the relative density D_r and the mean grain size D_{50} became variables. The reach the state of liquefaction, the soil samples are placed on the shaking table and vibrated for 0.3g and 0.6g accelerations. During the testing the acceleration and the settlement of the indicator bar that are place on the samples are recorded.

The new criterion used in laboratory is the rate of settlement during shaking. The settlement rate of about 0.1 cm/sec is taken as the separation criterion to distinguish between liquefied and non-liquefied soils in laboratory. The rate settlement more than 0.1 cm/sec indicated that liquefaction has happened in this saturated soil samples. The general results of the tests are presented as a new chart as shown in Figure 4. The linear boundary line are made up for each acceleration 0.3g and 0.6g. This chart then is used to assess the liquefaction potential in later study case.

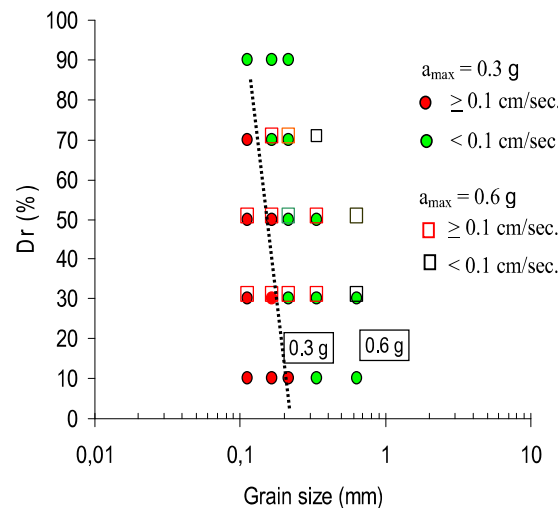


Fig.4 Liquefaction Chart Based on D_r – D_{50} .

An important variable of the samples in this experiment is the relative density D_r of the soil that essentially used in practice. Relative density of the sample is defined as the ratio of densities of sand in dry condition using the following equation:

$$D_r = \left(\frac{\frac{1}{\gamma_{d, \min}} - \frac{1}{\gamma_d}}{\frac{1}{\gamma_{d, \min}} - \frac{1}{\gamma_{d, \max}}} \right)$$

Where γ_d , $\gamma_{d, \min}$ and $\gamma_{d, \max}$ respectively are current, minimum and maximum dry unit weight of soil. The relative density is expected to describe the relationship between the initial densities with liquefaction potential using Figure 4. In general practice, a soil mass can be grouped according to its relative density value is shown in the Table 1:

Table 1. Designation of Soil Based on Relative Density

Relative density, D_r :	Description
10%	very loose
30%	loose
50%	medium dense
70%	dense
90%	very dense

III. LIQUEFACTION ASSESSMENT

Medan Marine Port in North Sumatra Province of Indonesia, is under development to build the capacity for container transportation services in around Sumatra region. This development needs are clamation work to construct the container yardas well as ship dock. The material resources for reclamation work is required from

the local area.

3.1 Reclamation Material Requirements

It was found that the available material has a very limited amount. The material also must meet several criteria that are included the volumetric unit and the gradation range as shown in Figure 5. In fact the available materials are fine sands that have grain sizes about in the lowest requirement. Those granular materials are included in the category of fine sand. Since the reclaimed sands will be always below sea level then the saturated conditions will always be experienced on them. Then liquefaction potential assessment of the reclamation work become essential.

In order to complete that aim, the sieve analysis of reclamation sands has been conducted. This analysis is purpose to investigate soil distribution as presented in Figure 5. To see whether the material is susceptible to liquefaction, in the same figure are plotted boundary area based on events Earthquake liquefaction ground Sumatra 2009 [3] and also boundary made up from Turkey liquefaction [11]. It is clearly seen that reclamation sands from available sources are susceptible to liquefaction since it is in exactly those boundaries. The D_{50} of those reclamation sands are between 0.12 to 0.30 mm in diameter.

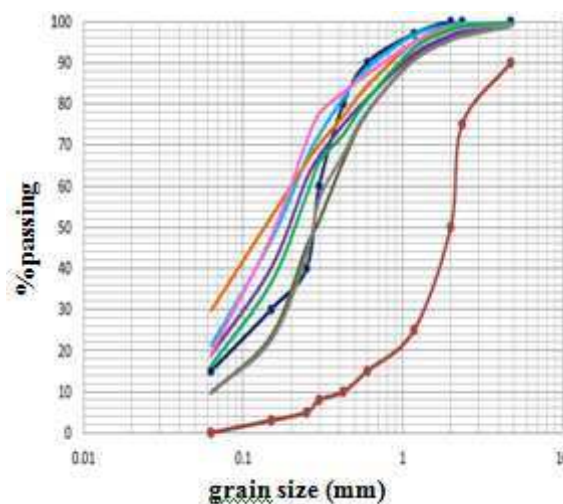


Fig.5 Particle Distribution of Reclamation Sand

3.2 Indonesian Seismic Map

To perform the analysis of liquefaction potential, the maximum required acceleration caused by the future earthquake that may occur at the site of the port must be estimated. The maximum acceleration values are taken from the Indonesian seismic map for the area around the planned port that is $a_{max}=0.3g$ (Figure 6).

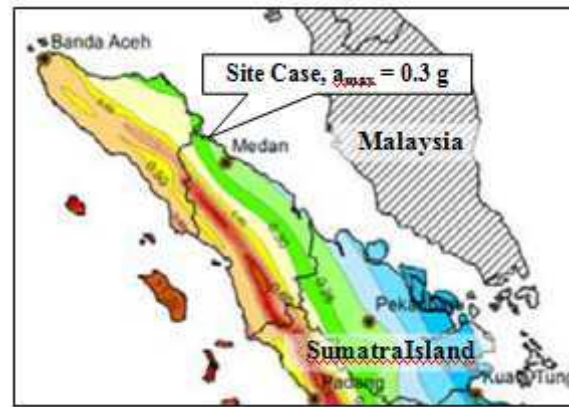


Fig. 6 Seismic Map for Medan Area.

3.3 Relative Density Requirement

The test results of unit weight of the original source reclamation material and the values of the maximum and minimum unit weight from compaction tests of the same material are shown in Table 2.

Table 2. Relative Density of Sands

Parameter	value (kN/m ³)	D _r (%)
□ d _{natural}	12.0	30
□ d _{min}	10.7	0
□ d _{max}	16.8	100

Both value Relative density, D_r and Mean grain size, D₅₀ as well as maximum acceleration a_{max} are the plotted in the 'Liquefaction Chart' as shown in Figure 7. It shows that point initial points pair D_r and D_{0.5} of original material still under the line 0.3g which indicated that the material prone to liquefaction in case of earthquake.

In Figure 7 then also plotted the required point in order to avoid liquefaction potential on chart. The required points have minimum relative density of 60%. In the real practice, the additional requirement make use of compaction effort must be done to have Relative density of 60% in the field.

IV. CONCLUSIONS

In this paper, a new method for liquefaction potential assessment of a soil deposit based on the relative density and the mean particle size has been presented. It shows that the method is practically essential to determine the liquefaction potential using physical properties of soil. Both relative density and mean particle size give unique relationship for the liquefaction resistance of soil against possible earthquake.

Based on the analysis of the study case of reclamation work, the specification of relative density is required to prevent liquefaction in the future. The additional requirement should be included in the process of reclamation work in order to achieve relative density as prescribed.

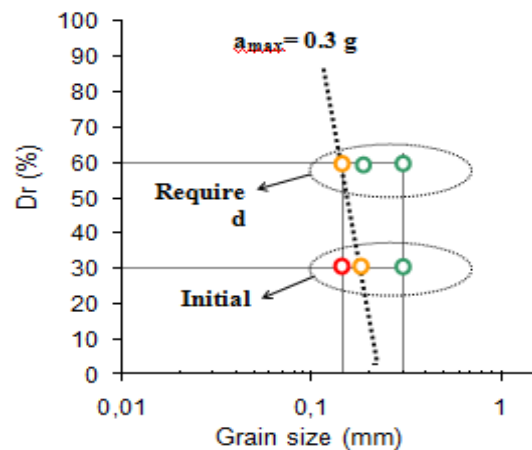


Fig. 7 Liquefaction Assessment for Medanport.

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