



THE 5TH ADB-JSP SCHOLARS' RESEARCH FORUM

ADB-JSP, a Tool for Japanese Technology and Knowledge Transfer to ADB DMCs

22 June 2012 • Asian Development Bank Institute, Tokyo, Japan



Proceedings

The 5th ADB-JSP Scholars' Research Forum

*“ADB-JSP, a Tool for Japanese Technology
and Knowledge Transfer to ADB DMCs”*

Friday, 22 June 2012

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Asian Development Bank – Japan Scholarship Program

Preface

This time marks the 5th ADB-JSP Scholars' Research Forum, an activity participated by recipients of the scholarship program. The Asian Development Bank – Japan Scholarship Program (ADB–JSP) with financing from the Government of Japan has been going on for more than two decades, awarding scholarships to more than 2,800 students. The Program aims to provide an opportunity for well-qualified citizens of ADB's developing member countries to enhance their skills and knowledge by pursuing graduate studies in economics, management, science and technology, and other development-related fields at 27 leading academic institutions in ten countries within the Asian and Pacific Region.

In order to enhance the implementation of ADB-JSP, the ADB–JSP Scholars' Research Forum is organized to serve as a venue for wider dissemination of the scholars' research findings, and life experience sharing. It is believed that this Research Forum will bring benefit not only to the scholars but also to ADB in terms of enhancement of the ADB-JSP.

The 5th ADB–JSP Scholars' Research Forum under the theme “*ADB-JSP, a Tool for Japanese Technology and Knowledge transfer to ADB DMCs*” focuses research papers on Engineering/Scientific/Technical topics. Sixteen papers were submitted and 12 will be presented and commented by specialists/professors in the field.

We thank everyone who contributed to the preparation of this Research Forum and we hope that this activity will serve as a means for better understanding of the scholars' endeavors during and after their studies.

June 2012



Message

It is with great pleasure to greet the ADB-JSP scholars and alumni in the 5th ADB-JSP Scholars' Research Forum. We find this forum to be a remarkable endeavor initiated, prepared, and implemented by the ADB-JSP scholars with the assistance of the officers of the 13 Japanese designated institutions.

This event at the ADB Institute, Tokyo is the fifth forum in the 24 years of the ADB-Japan Scholarship Program which started in 1988 and we are all pleased to join this undertaking. We believe that the Research Forum will augment the significance of the ADB-JSP and provide insights into how the Scholarship Program implementation can be further enhanced. Moreover, this type of gathering will likewise foster camaraderie among the students, university officials, the Asian Development Bank, and the Government of Japan.

We cordially hope that the Research Forum will be a success.

Mr. Kazuhiko Koguchi
Executive Director for Japan, ADB

Ms. Cécile L.H.F. Gregory
Head and ADB-JSP Scholarship Administrator, OCO
Office of Cofinancing Operations, ADB

Mr. Katsuji Matsunami
Resident Director General, ADB-JRO

The 5th ADB–JSP Scholars' Research Forum
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and Knowledge Transfer to ADB DMCs"

Friday, 22 June 2012

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5, Kasumigaseki, Chiyoda-ku,
Tokyo 100-6008, Japan

PROGRAM

Master of Ceremonies: **Mr. Kazuo Kojima**
Sr. Financing Partnerships Specialist and ADB-JSP Coordinator

9:00 Registration

9:30 - 9:50 Welcome Remarks **Mr. Kazuhiko Koguchi**
Executive Director for Japan, ADB

Mr. Shigeo Shimizu
*Director, Development Institutions Division,
International Bureau, Ministry of Finance,
Government of Japan*

Mr. Katsuji Matsunami
Resident Director General, ADB-JRO

9:50 - 10:00 Photograph Session

10:00 - 11:00 Session 1
Moderator: : **Hiroyasu Sato**
*Associate Professor, Division of Environmental
Studies, University of Tokyo*

11:00 - 11:15 Coffee Break

11:15 - 12:15 Session 2.
Moderator: **Nobuaki Ohmori**
*Associate Professor, Department of Urban
Engineering, University of Tokyo*

12:15	-	13:30	Lunch Break	
13:30	-	14:30	Session 3	Moderator: Prof. Naoya Abe <i>Associate Professor, Department of International Development Engineering, Tokyo Institute of Technology</i>
14:30	-	14:45	Synopsis	Ms. Miho Ohara <i>Associate Professor, Department of Civil Engineering University of Tokyo</i>
14:45	-	15:00	Coffee Break	
15:00	-	15:45	"Development Challenges"	Mr. Ganeshan Wignaraja <i>Director for Research, ADB Institute</i>
15:45	-	16:30	Open Discussion	Moderator: Ms. Sunate Kampeeraparb <i>Associate Professor and International Student Advisor, Graduate School of International Development, Nagoya University</i>
16:30	-	16:45	Awarding of Certificates	Ms. Cécile L.H.F. Gregory <i>Head and ADB-JSP Scholarship Administrator, ADB-OCO</i>
16:45	-	17:00	Closing Remarks	Ms. Cécile L.H.F. Gregory <i>Head and ADB-JSP Scholarship Administrator, ADB-OCO</i>
17:00	-	17:15	Photograph Session	
17:15	-	19:00	Cocktail Reception	

Paper Presentations

Session	Time	Name	University	Title	Moderator
1	10:00-10:15	Keshab Sharma	University of Tokyo (Civil Engineering)	Influence of cyclic wetting and drying on strength and strain of crushed mudstone in direct shear test	Moderator: Assoc. Prof. Hiroyasu Sato
	10:15-10:30	Hoang Chi Thanh	University of Tokyo (Civil Engineering)	Attitude formation of affected households to resettlement project through knowledge and emotion exchange on social network-Lao Cai, Vietnam	
	10:30-10:45	Ramesh Pokharel	University of Tokyo (Civil Engineering)	Prioritization of the road network section for all construction project to provide all-weather access to the rural areas of Nepal	
	10:45-11:00	Umar Ahad Butt	University of Tokyo (Civil Engineering)	Seismic response of wind turbine support structures considering low structural damping and soil structure interaction	
C O F F E E B R E A K (1 1 : 0 0 - 1 1 : 1 5)					
2	11:15-11:30	Md. Masud Rahman Bizwaz	University of Tokyo (Division of Environmental Studies)	Water quality characteristics around Sumida river estuary, Odaiba, Tokyo Bay	Moderator: Assoc. Prof. Nobuaki Ohmori
	11:30-11:45	Rogene Lacanieta	Keio University (Graduate Program on Advanced Science and Technology)	A mutation test-based approach to evaluating test suites for web applications	

	11:45-12:00	Afiahayati	Keio University (Graduate Program on Advanced Science and Technology)	De novo assembly for metagenomic data from short sequence reads	
	12:00-12:15	Habibullah Bhuyan	Saitama University	Assessment of liquefaction potential based on SPT-N value and peak ground acceleration using GIS	
L U N C H B R E A K (1 2 : 1 5 - 1 : 3 0)					
3	13:30-13:45	Rahman Md. Aftabur	Saitama University	Numerical analysis for buried pipeline subjected to fault displacement	Moderator: Prof. Naoya Abe
	13:45-14:00	Frengki H. Pardede	Saitama University	Fluid flow containing micro-bubbles through fractured mudstone specimens	
	14:00-14:15	H. L. D. Nandika	Saitama University	Geotechnical characteristics of solid waste material from industrial landfill in Japan	
	14:15-14:30	Basit Sarfaraz	Saitama University	Dynamic response behavior of reinforced concrete column under water	
S Y N O P S I S (1 4 : 3 0 - 1 4 : 4 5)					
C O F F E E B R E A K (1 4 : 4 5 - 1 5 : 0 0)					

Influence of Cyclic Wetting and Drying on Strength and Strain of Crushed Mudstone in Direct Shear Test

Keshab SHARMA, Takashi KIYOTA and Hiroyuki KYOKAWA
Institute of Industrial Science
University of Tokyo

Abstract

In order to examine the influence of cyclic wetting and drying on strength and strain of crushed mudstone, a series of direct shear tests were conducted on the crushed mudstone under different stress condition by using a modified direct shear apparatus. A total of six tests were performed, out of which, three experiments were cyclic wetting and drying. It is noted that the creep shear deformation in the first wetting becomes larger as increase in the stress ratio, which would indicate high risk of slaking-induced instability at steep slope. While shear deformation decreases with the progress of cyclic wetting and drying, almost zero in third wetting. These tests show that the shear deformation during the drying is more significant than during the wetting with the step of the cycle. A reduction in the peak shear strength by 25 % after three cyclic wetting and drying was found.

1. Introduction

A soft rock such as mudstones is likely to be subjected to the slaking, which defined as the breakup of the rocks due to swelling and contraction caused by repeating wetting and drying (denoted as W/D). Mudstones experience periodic swell and shrink behaviour due to alternate W/D cycles at arid and semi-arid region with distinctive seasonal changes. When high embankment made of these materials is considered, long term stability and settlement problems may possibly arise from the occurrence of slaking of geo-materials due to repeated W/D cycles (Cetin et al., 2000). Several methods have been developed to assess the influence of cyclic W/D of geo-material under unconfined conditions. However, cyclic W/D in the field typically occurs in the presents of normal and shear stresses. In this study, three cycles of W/D were carried out, under three different anisotropic consolidation conditions.

2. Objectives

To analysis the deformation and strength characteristics as well as slaking of crushed mudstones under anisotropic stress conditions due to cyclic W/D by using modified direct shear apparatus.

3. Methodology

A modified direct shear apparatus having inside dimensions of 20 cm* 20 cm* 9.14 cm with 10 mm initial opening was used. A moisture sensor was inserted into shear box to measure the water content (w) of the specimen instantaneously. Crushed mudstone from the earthquake-induced landslide dam, Hattian Bala, Pakistan (Kiyota et al., 2011) was used for specimens. The slaking index (JGS 2132) of the mudstone was evaluated as level 1, while the slaking ratio (NEXCO-110, 2006) was 96.86 %.

In this study, loading process during the test consisted of three stages. 1) Initially both shear and normal stress were applied gradually maintaining prescribed stress ratio, $R (= \tau/\sigma_v)$. 2) Creep loading with three cycles of W/D. 3) Finally, after the third wetting a monotonic shear loading (denoted as ML) was applied at a constant rate of s (0.2 mm/min) under constant σ_v until the specimen's residual state was reached.

A series of the ML tests on dry specimens were also performed to compare strength and deformation characteristics with those of the cyclic W/D creep test.

4. Discussion

Figure 1 shows the typical instantaneous response of s and w of the specimen during the W/D cycles. The influence of wetting in the first cycle upon s appears to be significant for all specimens. For the second and third wetting processes, the increment of s is relatively very small, almost 1/8 times the increment of s in the first wetting. This may be attributed to the specimen densification due to previous W/D processes and water content before wetting. Figure 1 also shows that w decreases gradually during the first

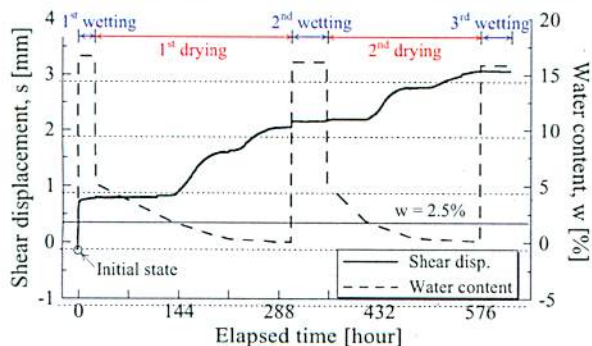


Fig. 1 Time histories of water content and shear displacement under cyclic W/D for 3 times for $R=0.5$

and second drying processes. Initially, no appreciable creep deformation is found to occur at higher w . When the w becomes about 2.5 %, the s occurs progressively with water

loss and finally tends towards an asymptotic value at w of about 0.7 %.

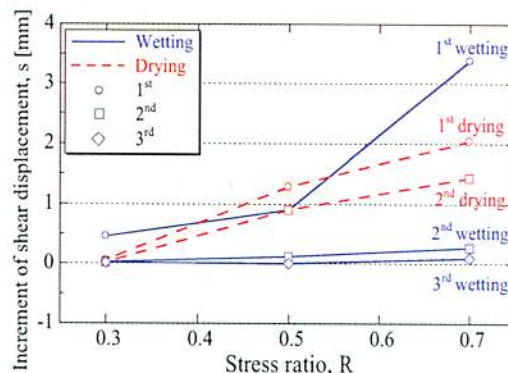


Fig. 2 Increment value of creep shear displacement. The above test results are summarized in Fig. 2, showing increment values of s at each R . The wetting-induced maximum creep s of 3.4 mm was observed at $R=0.7$ during the first wetting (see Fig. 2). Similarly, wetting-induced creep failure was observed at $R=0.8$ on the same material as the one in this study. Therefore, it seems that the s during wetting is proportional to the value of R , which would indicate high risk of slaking-induced instability at steep slopes. It can be understood that the maximum s was observed during the first wetting because the specimen

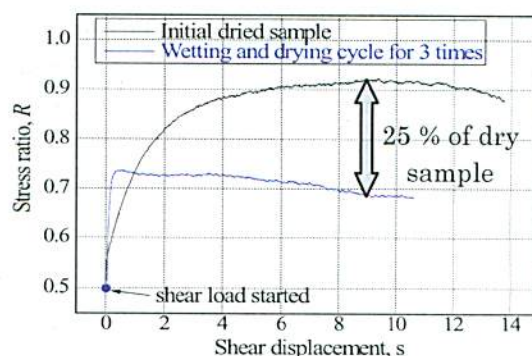


Fig.3 Effect of slaking on stress-strain characteristics

in this study was prepared by oven-dried crushed mudstone (Panabokke and Quirk et. al., 1956). One of the noticeable behaviors observed in these experiments is a quite large creep deformation during the drying processes. As shown in Fig. 2, the creep s during drying increases with the increase in the value of R . However, in the case of $R=0.3$,

the lowest w during the drying step is quite larger (about 3 %). This may be reason for relatively small s during the drying process at $R= 0.3$.

Figure 3 shows the relationship between the R and s . The specimen with cyclic W/D history exhibited largely different stress-displacement features from that of dry . The peak shear strength of the saturated and cycle test samples are reduced by about 25 % as compared to the dry test.

5. Novelty

The author has found no published systematic investigations into the influence of cyclic W/D on the strength and strain behavior of any geomaterials under isotropic stress condition. The author made new arrangement to measure instantaneous water content of specimen during experiment.

6. Conclusion

A significant s could be found in the first wetting process. However, the amount of s during wetting is decreased with progress of the drying and wetting cycles. During the drying process, a significant s is found to occur when w becomes less than 2.5 %. Shear deformation during drying is increased with the increase in R . A reduction in the peak shear strength by 25 % after three cycles of W/D was found.

References

- 1) Cetin, H., Laman, H. and Ertunc, A.: Settlement and slaking problems in the world's fourth largest rock-fill dam, the Ataturk Dam in Turkey, *Engineering Geology*, 56(3-4), 2000, pp. 225-242.
- 2) Kiyota, T., Konagai, K., Sattar, A., Kazmi, Z.
A., Okuno, D. and Ikeda, T.: Breaching failure of a huge landslide dam formed by 2005 Kashmir earthquake, *Soils and Foundations*, 51(6), 2011, pp. 1179-1190.
- 3) Panabokke, C. R. and Quirk, J.P.: Effect of Initial water content on stability of soils aggregates in water, *Soil Science*, 83(3), 1987, pp. 185-196.

Process of attitude formation of affected households to resettlement project and role of social network – Laocai, Vietnam

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Abstract

For the successful completion of involuntary resettlement projects, people's attitude toward the project is an essential issue. However, formation mechanism of the attitude has not been fully discussed in previous researches and resettlement policies. The attitude is not only based on individual person, but also people's collective opinion. Since people's attitude is affected by communication in the community, which made via social networks. In order to clarify the influence of the social networks, people's attitude and main factors for it, including social network's influence were surveyed. Interview was conducted to the all affected households in two villages over several years in a resettlement case accompanying a highway construction in Vietnam.

It is found that people's attitude toward the project shows high correlation with the affectivity sharing networks, indicating that communication of informal information plays important role in attitude formation. It is also discussed that people's relationship networks were considerably changed after the land acquisition. The change in relationship networks is different in two villages because of the difference of circumstance conditions of the two villages. People's social network can affect their attitude formation and can be influenced by various factors, suggesting the difficulty of management of attitude formation in the projects.

1. Introduction

Project for the development of infrastructure of the society requires the land for the implementation and it is often accompanied by the relocation of the residents and the land acquisition. It obviously affects the people's life and it is necessary to avoid or minimize the negative influence.

In order to achieve a successful outcome of a resettlement project, besides the implementation of good living standard defined in previous researches (Cernea, 2000; Scudder, 2006) and policies related to resettlement (World Bank, 1990; Asian Development Bank, 1998), it is also essential to ensure that majority of affected people have positive attitude toward the project. Even project authorities prepared good condition and fully provide information to the affected people, it is

possible that the affected people have negative attitude because the process how the community develop their attitude toward the project is complex and sensitive to many factors. Deep understanding of formation mechanisms of people's attitude is necessary for the successful outcome with proper treatment of the affected people. We discuss the influence from the social networks on the attitude formation.

2. Objective

The main objective of this research is the clarification of the process of attitude formation of affected household in the resettlement/land acquisition project from the viewpoint of dynamics of social networks.

Based on the expected clarification of the attitude formation, proper treatments with

affected community will be discussed in order to improve people's positive attitude to project and to mitigate damage of their social network.

3. Methodology

Survey sites are two affected-villages in a resettlement case accompanying the Noibai-Laocai highway construction project in Vietnam, partly funded by the ADB's loan.

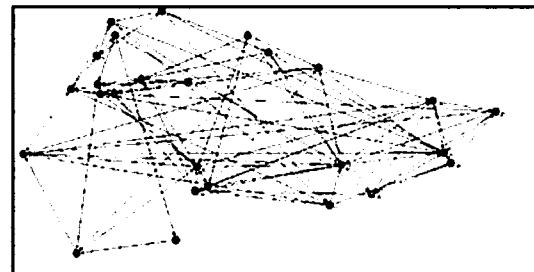
Interview survey has been conducted to all of the affected-households in the two villages and to concerned people such as project authorities and local leaders through following project stages: compensation fee payment, land acquisition and relocation, and post-land acquisition. In order to clarify the influence of the social networks on the people's attitude formation, the attitude and its main reasons including social network's influence were asked. In addition, network for information sharing was surveyed. Through the interview, we investigated their knowledge sharing network, affectivity sharing network, relationship networks, and working networks. Knowledge sharing network is the network on which people exchange relatively formal information. Affectivity sharing network is for the communication about feeling, etc. Working network is the network of people who work together frequently and, usually helping each other.

Qualitative and quantitative analyses were used to clarify the role of social networks in the process of attitude formation. Interview was conducted as the qualitative part. In addition, correlation between attitude level and properties in social network, such as number of links and network position, were also analyzed as quantitative part. In viewpoint of dynamic of social network, correlation and interaction between the attitude change and the change of social networks were deeply investigated.

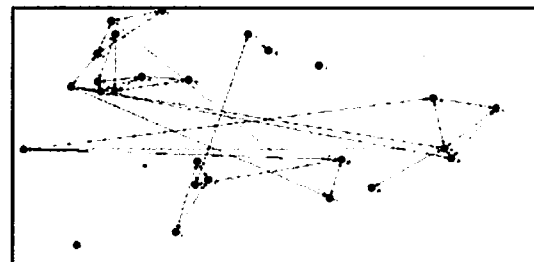
4. Discussion

The results show that the attitude is influenced by different factors in different stages. In beginning, attitude is determined by trust on the government. After compensation program start, the attitude shows strongly correlation with the affectivity sharing network regarding compensation fee, which is a new network based on closed relationship networks. In the later stage, after starting of land acquisition and civil work, experiences of affects of resettlement contribute to influence on people's attitude.

We also discuss how external factors affect the social networks in the community. After resettlement, the people need alternative jobs. That affects traditional relationship among people helping each other and social network in the community was altered. Availability of jobs is different for different villages and that causes the different types of social networks in the affected villages. It clarifies the mechanism how the community after land acquisition is affected by circumstantial conditions (Fig. 1).



(a) in June 2009 (Total no. of link = 90)



(b) in September 2011 (Total no. of link = 37)

Fig. 1 Change of Relationship Network among affected-households in village Bong after land acquisition

5. Novelty

The research investigates formation mechanisms of people's attitude and social network through the resettlement process in a highway project in Vietnam in order to achieve proper treatments with affected communities. While the formation mechanisms have not been fully investigated in previous researches and resettlement policies, which mainly focus on well preparation of living condition and full provision of correct information to affected people.

6. Conclusion

The study presents main factors for people's attitude formation through project process are:

- a) Trust in government in beginning stage,
- b) Affectivity sharing network after compensation program was carried out, and
- c) Experiences of resettlement after starting of the land acquisition stage.

It indicates that people's attitude is not solely determined rational judgment based on formal information, but influenced by the informal information shared via daily communication. It was recognized that the knowledge about the project is essential for the formation of positive attitude, but it should be accompanied by various transient main factors.

Communication of informal information should be paid more attention in order to achieve people's positive attitude.

Relocation and losing rice field (or breaking the working relationship) causes the change of relationship network, which triggered the decrease of the number of links. Circumstantial conditions such as availability of alternative job, are different in two villages because of the distance from the city center. It caused the difference of the change in working networks.

References

- ADB (1998)** Handbook of Resettlement. Manila: Office of Environment and Social Development. Asian Development Bank.
- Cernea, M. (1997)** The Risks and Reconstruction Model for Resettling Displaced Population. *World Development* 25 (10), pp. 1569-87
- Scudder, T. (2006)** The Future of Large Dams: Dealing with Social, Environmental, Institutional and Political Costs. Earthscan Publications.
- World Bank (1990)** Involuntary resettlement. Operational Directive 4.30. Washington, DC: The World Bank

Prioritization of the road network section for the construction project to provide all-weather access to the rural areas of Nepal

Ramesh Pokharel
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Abstract

Most of the rural road network sections in Nepal are closed in rainy season due to flooding in river, soil erosion in mountainous area, earthen condition of pavement and unavailability of bridge. This paper suggests a methodology to prioritize the rural road network section to upgrade from "Dry-Weathered Road" to "All-Weathered Road" to provide an access to the rural people in all-weather situation in Nepal under budget constraints. The methodology evaluates the socioeconomic impact of network upgrading as an accessibility index of a village. Road sections are identified in two steps. First step selects the sections which can provide higher accessibility to the isolated village during rainy season. Second step gives the ranking of road network section to optimize the road network performance.

1. Introduction

Transport planners are facing the problem on selection of road network project. One popular methodology is evaluating the project based on cost benefit analysis (CBA). However, a CBA method always gives economic evaluation of project. When disaster happens or closure on a road due to rainy season, road network becomes unreliable. Some of the villages/cities/towns become isolated and some of the people have to use long detour route. The importance of the road network section differs from location to location. For making reliable road network, identification of important section is major concern of the evaluation methodology.

In the rainy season most of rural roads of Nepal are not functional due to flooding in river, soil erosion in mountainous area, earthen condition of pavement and unavailability of bridge. This paper suggests a network evaluation methodology based on the accessibility of the villagers. The methodology prepares the priority list of the road network section for upgrading project from "Dry weathered road" to "All weathered road".

2. Objective

The main objective of this study is to develop the decision tool for the government authority for selection of road network for upgrading project from "Dry weathered road" to "All weathered road" with focus on connectivity to the major service centre.

3. Methodology

This study reviewed the previous research on the reliability of road network by selecting and analysing the existing practical evaluation methodology in the context of practical application and identifying their impracticality. The new evaluation methodology has been developed by overcoming impracticality and finally it is applied on small example road network under scenario.

4. Discussion

A new evaluation methodology is focused on connectivity by accessibility importance.

An accessibility of an area with respect to the service centre is given by the equation [1].

$$A_i = \sum_{j=1} P_j / L_{ij} \quad (1)$$

It has modified and normalised as

$$A_i = \frac{P_i}{\sum P_i} * \frac{\sum_{j=1} P_j / L_{ij}}{\sum P_j} \quad (2)$$

Where,

i= origin node (city/town/village)

j= Destination node (service center)

A_i =Accessibility index of a village i

P_j =Population of city j (service center)

P_i = Population of village i

L_{ij} = shortest path between i and j

The methodology first identifies the isolated node(village), having accessibility index zero by assuming the links closure on rainy season. The priority list of road network section is prepared only for isolated village in the first step. The link which improves with the highest total accessibility of the isolated villages prioritized first. The calculation process will repeat until the isolated village becomes connected. The second step of calculation procedure is activated if there is an existence of road section after completion of first step. In the second step, methodology calculates the total accessibility index of all village with respect to service center by upgrading the remaining section one at a time. The link which improves with the highest percentage of accessibility index from worst case is prioritized first. Calculation process repeats until the remaining closed links finish. Finally, the priority list of all dry weather road section is prepared as an important section for connectivity in top and section for the optimum network performance in the last.

5. Novelty

Numerous studies have been attempted to evaluate the road network from the reliability perspective. Taylor, Sekhar et al. [2] proposed the evaluation methodology for vulnerability analysis of road network. Jenelius, Petersen et

al. [3] proposed the methodology to find out the important links and exposed municipality. MLIT [4] evaluates the road network in disaster situation. All existing practical evaluation methodology failed to consider the multiple link closure condition, considering the affected population at the same time, also calculation procedures are not so relevant. DoLIDAR [5] gives the criteria for the selection of upgrading road based on i) road connecting major service center and passing from the several villages, ii) higher traffic volume, however, this criteria does not prioritize the road section in large network.

New proposed methodology considers the multiple section closure condition in rainy season along with the affected population in the origin villages, and relevant calculation procedure which focus on connectivity and network optimization separately.

6. Conclusion

The proposed road network evaluation methodology is very useful decision tool for the road section upgrading project by giving importance to the connectivity to the village people.

References

1. Hansen, W.G., *How Accessibility Shapes Land Use*. Journal of the American Institute of Planners, 1959. **25**(2): p. 73-76.
2. Taylor, M.A.P., S.V.C. Sekhar, and G.M. D'Este, *Application of Accessibility Based Methods for Vulnerability Analysis of Strategic Road Networks*. Networks and Spatial Economics, 2006. 6(3-4): p. 267-291.
3. Jenelius, E., T. Petersen, and L. Mattsson, *Importance and exposure in road network vulnerability analysis*. Transportation Research Part A: Policy and Practice, 2006. 40(7): p. 537-560.
4. MLIT, *Enhancement of the entire network for disaster prevention measurement manual ネットワーク全体の脆弱性に関する計測マニュアル暫定案* 2011, Road Beuro, MLIT, Japan http://www.mlit.go.jp/road/ir/ir-hyouka/pdf/nw_manual.pdf (accessed 11/16/2011).
5. DoLIDAR, *A Manual for Preparation of District Transport Master Plan 1999*, Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR) Nepal

Seismic Response of Wind Turbine Towers and Foundations Considering Soil Structure Interaction

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Abstract

This paper specifies response spectrum method for prediction of seismic loads with consideration of intensity of the earthquake, soil and structural properties of wind turbine support structures. In this study, a damping correction factor for low damping wind turbine towers and for high damping footing structures is proposed. This study further presents SR (Sway-Rocking) model to take into account soil structure interaction effects and to evaluate seismic response of footing structure. The accuracy and reliability of specified design response spectrum is evaluated through comparison with time history analysis of different sized wind turbines, i.e., 400 kW, 500 KW and 2000 KW.

1. Introduction

A wind turbine support structure was damaged due to seismic loading in Kashima city, Japan during March 11, 2011 earthquake. Therefore stability of wind turbine support structures under such extreme conditions needs to be investigated for reliable design in seismically active regions. Response spectrum method specified in this research is accurate, reliable, time efficient. There is no any literature, existing code and standard available to specify response spectrum for wind turbine support structure. The IEC [1], a worldwide organization for standardization, refers to the response spectrum available in the design building codes. The design building codes are not applicable to wind turbine support structures owing to its unique characteristics like long period, low damping and heavy top. Response spectrum of such low damped structures shows excessive fluctuations and such uncertainty in response can not be captured by existing damping correction factor models defined in Eurocode [2] and BSL [3].

2. Objectives

This study is devoted to following main two research objectives:

- To propose damping correction factor for wind turbine towers and foundations for accurate seismic load evaluation.
- Consider SR (Sway-Rocking) model to evaluate seismic response of wind turbine foundations.

3. Damping Correction Factor

To account for excessive fluctuations in the response spectrum of low damped systems [4], damping correction factor is proposed as a function of spectral uncertainty, natural period and damping ratio so that,

$$F_{\zeta}(\zeta, T, \gamma) = \left(\frac{7}{2 + 100\zeta} \right)^{\alpha}, \quad \alpha = f(T, \gamma) \quad (1)$$

Where, T is natural period, ζ is damping ratio and γ is the quantile value for desired reliability level. BSL and Eurocode define damping correction factor as a function of damping ratio only and a constant value of 0.5 is used in Eurocode for the exponent α . To establish the proposed damping correction factor, first a set of 35 seismic waves, 5 with observed phase and 30 with random phase, were used to evaluate excessive fluctuations in the acceleration response spectrum for damping ratios ranging from 0.5% to 20%. Figure 1 shows acceleration response spectra for damping ratios of 0.5% and 5% that correspond to wind turbine structures and buildings respectively. It can be observed that at low damping ratio of 0.5%, in case of wind turbine support structures, excessive fluctuations in the spectral acceleration occur. To determine probability distribution that represents uncertainty involved, response spectrum is divided into three sections so that $0.05 < T < T_B$ refers to Section I_A , $T_B \leq T \leq T_C$ refers to Section I_B and $T_C < T < 5$ refers to Section I_C .

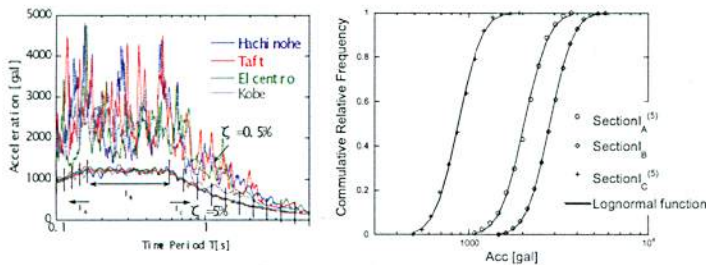


Figure 1. Sections of acceleration response spectra for statistical analysis

Sections I_A and I_C are divided into ten subsections $I_A^{(i)}$ and $I_C^{(i)}$ ($i = 1 \sim 10$), whereas Section I_B is considered as a single section to calculate the statistical properties. Figure 1 shows a cumulative relative frequency of acceleration response in the sections $I_A^{(5)}$, I_B and $I_C^{(5)}$, which follows log normal distribution.

It is now possible to define the percent quantile γ of acceleration for a desired reliability level by modeling the uncertainty of acceleration response with logarithm normal distribution function. Three quantile values of 20%, 50% and

80% are used to investigate exponent α of the damping correction factor by using equation (2).

$$\alpha = f(T, \gamma) = aT + b\gamma + 0.5$$

$$a = -0.07, b = 0.7 \text{ for } \xi \leq 5\%$$

$$a = 0, b = 0 \text{ for } \xi > 5\%$$
(2)

The acceleration response spectrum calculated by proposed formula agrees well with the calculated results for all quantile, γ and damping ratio values of response acceleration. Introduction of natural period T of structure has lead to accurate estimation of response spectrum in the long period regions. Also uncertainty of the response spectrum can be incorporated by changing quantile value, γ .

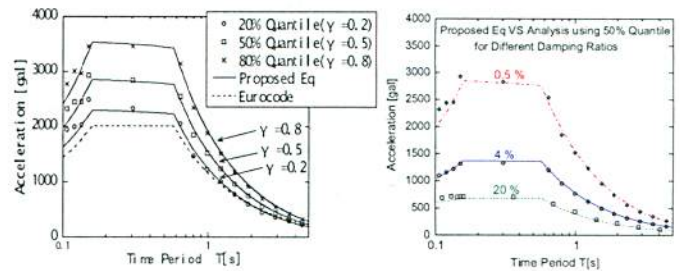


Figure 2. Proposed damping correction factor shows good agreement with all quantiles and damping ratios

4. Seismic Response of Footing Structure

SR model [5] is taken into account in order to consider the effect of soil structure interaction and to evaluate seismic response of wind turbines footing structures. Figure 3 elaborates shear force profile obtained by performing response spectrum method considering SR model. Footing response in SR model is compared with the current BSL model. Whereas, conventional model used in BSL code not only underestimates shear response at the footing base but also from the tower structure.

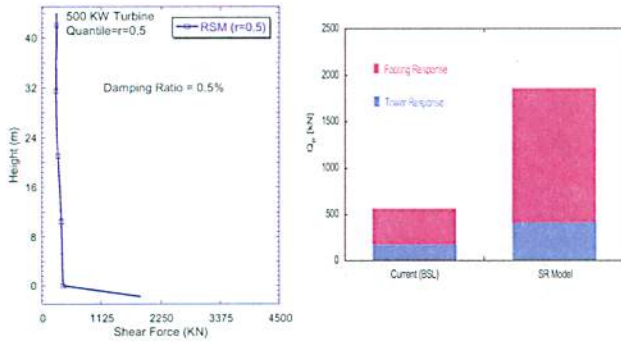


Figure 3. Shear force profile considering SR Model

5. Conclusion

This research has presented first time response spectrum method for seismic load evaluation of wind turbine towers and foundations considering Soil Structure Interaction.

References

- [1]. IEC61400-1. Wind turbines. Part 1: Third edition, 2005.
- [2]. Eurocode 8: Design of structure for earthquake resistance; Part 1: General rules, seismic actions and rules for buildings, 1998-1:2004.
- [3]. BSL, The Building standard law of Japan, The building centre of Japan, 2004 (in Japanese).
- [4]. Ishihara T, Sarwar MW, Numerical and Theoretical Study on Seismic Response of Wind Turbines, Proc. of EWEC 2008: 2008.
- [5]. AIJ, Architectural institute of Japan, Seismic Loads Commentary, (2004).

Water quality characteristics around Sumida river estuary, Odaiba, Tokyo Bay

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Abstract

Water quality deterioration often causes hypoxia and phytoplankton bloom in estuarine and coastal system, but the mechanism that controls hypoxia and phytoplankton bloom vary among estuaries and often difficult to discern. A series of automated water column time series measurement has been established around Sumida river estuary, Odaiba, Tokyo bay. The data obtained from the three fixed stations during the period of June through September 2011 reveal the occurrence of episodic surface phytoplankton blooms followed by hypoxic events. Three hypoxic events and four phytoplankton blooms occurred between June to September. High bloom and pronounced haline stratification resulted in high DO in the surface layer at the outer part of Odaiba and low DO in the bottom layer at the inner part of Odaiba. Oxygen-rich and oxygen-poor water were transported down-estuary by ebb tides resulting in DO heterogeneity throughout the area. The observations from summer 2011 suggest that the hypoxic events and phytoplankton blooms have close correlation with predominant wind, seasonal water column stratification, light availability, fresh water discharge following precipitation and tidal range periods. Based on these findings, we can project into future years the times when summer blooms and hypoxia are most likely to occur around Sumida river estuary, Tokyo Bay.

1. Introduction

Tokyo Bay is one of the most eutrophic semi-enclosed embayment in the world having degraded water quality, decreasing in fishery landing and frequent occurrence of phytoplankton bloom and depletion of dissolved oxygen concentration in the water column in stratified season. The development of this water is due to the substantial oxygen consumption to decompose large amount of organic materials that are internally produced and received from the surroundings of Tokyo Metropolitan and nearby cities (e.g. Pokavanich et al., 2009; Koibuchi and Isobe, 2007.). Sumida river estuary (Odaiba) is located on the west bank of Tokyo Bay which is among the limited natural ecosystem left in the Bay. However, the highly fluctuating mechanism on the development and fate of hypoxic water and phytoplankton bloom associated with stratification in response to environmental factors around this estuary has not yet been adequately addressed or documented by continuous time series observation. This study focused on the occurrence and extent of hypoxic water and

phytoplankton bloom around the estuary to determine the regulating factors and horizontal transport by current which most influence hypoxia and phytoplankton bloom with special attention to the role of water column stratification and physical forcing.

2. Objectives

- To provide a detailed description of the mechanism on the occurrence of hypoxic events and phytoplankton bloom in response to hydrographic and environmental factors.
- To describe the DO and Chlorophyll-a spatial heterogeneity special attention to the role water column stratification and horizontal tidal mixing associated with wind.
- To propose some guidelines based on these findings to mitigate the adverse effect on the estuary ecosystem.

3. Methodology

The study site is the upper bay area (Odaiba) of Tokyo Bay (Fig.1) which is located at the central part of main island (Honshu), Japan. All observations and measurements were carried out at the three fixed stations at Odaiba during summer 2011 (June to September). The hydrographic conditions (e.g. water level, flow velocity, water temperature, salinity), water quality condition (e.g. chlorophyll-a and DO concentration) were monitored in every 10 minutes interval by two Yellow spring Incorporated (YSI-6600) sensors and to continuously record the vertical profile of the horizontal current velocity. During the observation period, daily and hourly climatological data such as precipitation, wind speed/direction and solar radiation at the Haneda Meteorological Observatory station were obtained from the website of Japan Meteorological Agency (JMA). Daily flow rates of Sumida river estuary (Sugama observation point) were obtained from the tables of river discharge (Ministry of Land, Infrastructure and Transport, River Bureau).

4. Discussion

Time series of wind speed, tidal elevation, solar radiation, precipitation, river discharge, water temperature, salinity, dissolved oxygen and chlorophyll-a concentration of station 1 in June-September, 2011 are shown in figure. 3. Salinity influenced stratification more than temperature indicating pronounced haline stratification and this stratification was persistent until early September. The prevailing winds were southerly from June to early September. Six hypoxic events were occurred from June to early September 2011 (Figure.3). All of these events seemingly resulted from one or more of three environmental factors: low solar radiation (resulting in reduced oxygen production via photosynthesis), increased fresh-water discharge (resulting in enhanced haline stratification preventing ventilation of waters). In mid August and early September following rain events and increases in freshwater flow from the river. Hypoxic waters were terminated between every successive period by the sudden or abrupt increase in DO concentration as indicated by the six hypoxic events in the figure.3 with the combined effect of south wind and experienced

by large river discharge structure followed by precipitation. There were five major phytoplankton blooms (defined as the period with Chlorophyll-a concentrations exceed 60 µg/L) during the observation period denoted by period 1, 2, 3, 4, 6 & 6 in figure 3. The onset of bloom were strongly influenced by the availability of light (>10 MJ/m²/day), continuous south wind >6 m/s and discharge events while the ends were influenced by different factors such as north wind, light limitation and water column stratification. During these 6 periods, when the north began to blow, the bloom stopped rapidly because north wind caused outward transport of phytoplankton from the estuary to bay and conversely when south wind began to blow high chlorophyll-a concentration of waters enters into estuary mouth caused phytoplankton bloom.

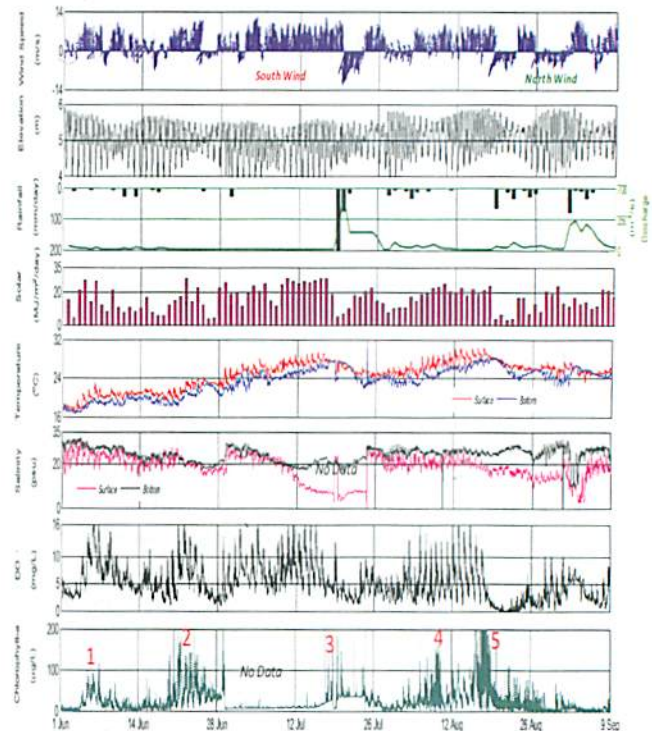


Fig.3. Time series of wind speed/direction, tidal level, precipitation, solar radiation, discharge, water temperature, salinity, dissolved oxygen and chlorophyll-a concentration at station 1 during the observation period

5. Conclusion

From the present study, it is clear that wind events and solar radiation associated with stratification contributed to the development and termination of bloom and hypoxia. Northward wind and low solar radiation associated with stratification contributed to the development of hypoxic events while due to

southward wind under strong solar radiation hypoxic events were terminated. During south wind under high solar radiation, phytoplankton blooms were developed and when the north began to blow, the bloom suddenly stopped. In addition high bloom occurred during strong stratification which made differences from the other periods while north wind contributed to elimination of each bloom.

References

1. Koibuchi, Y., M. Isobe(2007): Phytoplankton bloom mechanism in an area affected by eutrophication: Tokyo Bay in Spring 1999. Coastal Engineering Journal, Vol.49, pp. 461-479.
2. Pokavanich, T., Yagi, H., Aiji, R., Furudo, k., Morohoshi, K., Ogawa H., Ussui T., Kanda, J. (2009): Highly fluctuating behavior of hypoxic water off Tama river estuary, Tokyo Bay. Proceeding of 3rd International Conference Estuaries and Coast, Vol.1, pp.419-426.

A Mutation Test-based Approach to Evaluating Test Suites for Web Applications

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Abstract

With the ever-increasing popularity and dependence of people to the Internet, Web-based applications have become prevalent. Thus, the importance of web application testing has become very important to ensure reliability and security. Many proposed test tools have been evaluated through experiments using programs that have been seeded with software bugs. However, such bugs are seeded manually or seeded using past bug information, and as a result they are not seeded exhaustively. In this paper, we focus on creating a system that systematically seeds bugs to web applications by leveraging on the concept of Mutation Testing, a method of creating buggy versions of a software called mutants to determine the quality of a test suite. We conducted an experiment where we applied the implemented framework to a sample application. With this, we were able to effectively evaluate a test suite and point out possible improvements to it. Also, we were able to illustrate weaknesses in the test suite and refine the definition of mutants.

1. Introduction

The Software Engineering field has established many methods to verify the correctness of a software products. By using test suites to execute various software testing techniques, the correctness of products can easily be judged.

However, a question may be raised on how complete and correct is the test suite being used for a particular software. Using the multiple Validation and Verification approaches like the Combinational Model Testing or the State Machine-based Testing among others, the coverage of a test suite can be evaluated.

Mutation Testing is one of the less used techniques that focus on evaluating the correctness and completeness of a software test suite. Introduced by Richard Lipton in 1971, the Mutation Testing approach introduces faults in a software program in order to evaluate the test suite created for it. It does so using a series of steps that begin with creating mutants, which are versions of the software that contain a slightly modified line of code based on what are called mutation operators. These mutants are

then tested against the test suite. The idea is that there should be at least one negative test result produced by each mutant. If the mutant successfully generated a negative result, that mutant is said to be killed. The mutation test is then evaluated by using the metric mutation score. Mutation Score is computed as:

$$\text{MutationScore} = \frac{\text{KilledMutants}}{\text{TotalMutants} - \text{EquivalentMutants}}$$

where equivalent mutants are defined as mutations that are syntactically different to the original version but semantically similar. In general, Equivalent Mutants are hard to detect and involve some degree of manual analysis to categorize.

For the past four decades, Mutation Testing has been used in countless experimental and real-world programs, mostly written in Java, Fortran, and C [1]. However, it has rarely been used in the more modern paradigm of Web Applications. The goal of this study is to evaluate the feasibility of using Mutation Testing on a web application. Specifically, it aims to produce a working framework for testing

an existing web application and point out the framework's effectivity and possible improvements. It also aims to contribute further to the study of Mutation Testing. For this study, Java Pet Store by Sun Microsystems will be used as a sample web application.

2. Experimental Setup

As mentioned, Java Pet Store is used as the software to be tested. The reason for this is that this software can be considered a complete web application with the source being open-sourced. Furthermore, the study focus on the application's Search functionality, due to time constraints.

The study uses an existing Java-based tools for generating mutants called Muclipse [4] and MuJava [5]. Since these tools have been slightly modified in order to work for the updated Java syntax used by Java Pet Store.

The study also uses Tesma, an off-the-shelf tool for automated generation of test suites.

The study created an automated system for deploying the mutants in the server, written in Visual Basic. An automated mechanism for executing the test suite for each mutant was also written using Javascript and JavaServer Pages (JSP). Finally, a system for automated compilation of results was written in JSP and JavaDB. Figure 2 illustrates the overall architecture for this study.

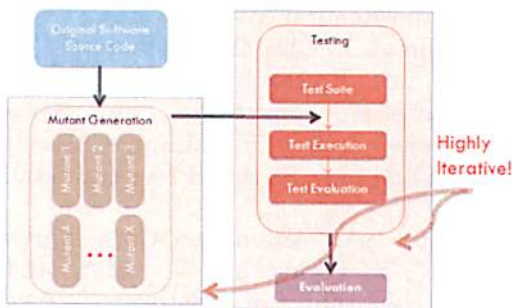


Fig.1. Mutation Testing - General Architecture

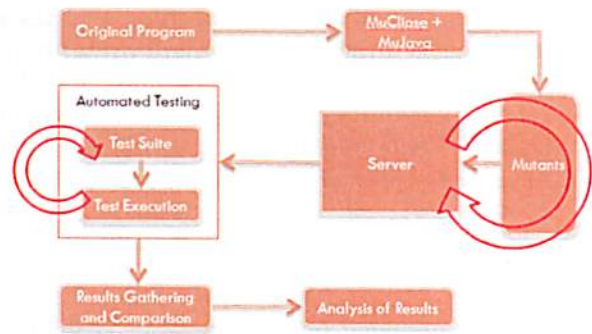


Fig. 2. Experimental Setup

3. Results and Discussion

For the mutation generation using Muclipse and MuJava, the setup was able to produced more than 4500 mutants. Among these mutants, the ones that are significant to the Search function was determined using class-level analysis. Thus, it was concluded that 441 of these mutants are relevant to the function to be tested and these were used for the actual Mutation Testing.

Also, the test case generator 38 test cases for the test suite for the Search function. Using the 441 mutants and these 38 test cases, the actual Mutation Testing was executed.

Mutation Score

The following table shows the summary of results.

	Killed	Unkilled	Equivalent	Total
# Mutants	223	2	216	441
Percentage	50.6%	0.5%	48.9%	N/A

Using the Mutation Score formula mention in the Introduction (i.e., disregarding the Equivalent mutants from the overall computation), the experiment gets a mutation score of 99.%. However, it is necessary to include the equivalent mutants in the analysis of these results.

Equivalent Mutants

In general, an equivalent mutant is a mutant which behaves the same as the original code. However, "behave" can be interpreted in a variety of ways, and our framework focuses on

the execution result, i.e., html file. We thus manually checked the 216 equivalent mutants to see if there are mutants that may not be equivalent depending on the definition of "equivalent". This resulted in our finding the following three types of equivalent mutants:

Type 1: Behavior will not change regardless of input.

Type 2: The changed part is never used during execution.

Type 3: The changed part is "corrected" later.

A Type 1 equivalent mutant can be considered as a strict equivalent mutant in terms of no possible test case can be made to kill it. Figure 1 in section 2 shows an example of Type 1 equivalent mutant. Types 2 and 3 equivalent mutants were considered as equivalent, because we restricted the test target to just the search.jsp Web page. For example, Figure 3 shows an example for Type 2 mutant, where the call to the setModifiedDate method has been changed to a call to the setDisabled method. Of course, the behavior of the mutant itself is different from the original code, but the result of this method call is not used when executing the search.jsp page, i.e., the change does not appear in the resulting html file. Thus we cannot make a test case that can kill it, so we considered this as equivalent. Figure 4 shows an example for a Type 3 mutant, where the call to the setImage.

<pre> ... fieldx = indexDoc.getField("modified"); if (fieldx != null) { indexDocument.setModifiedDate(fieldx.stringValue()); // (*) } ... </pre> <p style="text-align: center;">(a) Original Code</p>
<pre> ... fieldx = indexDoc.getField("modified"); if (fieldx != null) { indexDocument.setDisabled(fieldx.stringValue()); // (*) } ... </pre> <p style="text-align: center;">(b) Mutant</p>

Fig. 3. Type 2 Equivalent Mutant

<pre> ... fieldx = indexDoc.getField("image"); if (fieldx != null) { indexDocument.setImage(fieldx.stringValue()); // (*) } ... fieldx = indexDoc.getField("product"); if (fieldx != null) { indexDocument.setProduct(fieldx.stringValue()); // (-) } ... </pre> <p style="text-align: center;">(a) Original Code</p>
<pre> ... fieldx = indexDoc.getField("image"); if (fieldx != null) { indexDocument.setProduct(fieldx.stringValue()); // (*) } ... fieldx = indexDoc.getField("product"); if (fieldx != null) { indexDocument.setProduct(fieldx.stringValue()); // (-) } ... </pre> <p style="text-align: center;">(b) Mutant</p>

Fig. 4. Type 3 Equivalent Mutant

4. Conclusion

The setup was able to kill a significant amount of mutants, showing promising results. The experiment is not, in any way, enough to conclude the validity of Mutation Testing as an approach for evaluating Web Application. But it is a start. Further experimentation with bigger test cases and software is to be done. The more important contribution of this paper is that it was able to classify two new types of equivalent mutants. This can be important in the future evaluation of this type of testing.

References

- [1] An Analysis and Survey of the Development of Mutation Testing, Y. Jia, M. Harman, TR-09-06, Kings College London. (2009)
- [2] An Experimental Evaluation of Selective Mutation, A. J. Offutt, G. Rothermel, and C. Zapf, in Proceedings of the 15th International Conference on Software Engineering (ICSE93). Baltimore, Maryland: IEEE Computer Society Press, pp. 100107. (1993)
- [3] "MuJava : An Automated Class Mutation System", Y. Seung Ma, J. Offutt and Y. Kwon. Journal of Software Testing, Verification and Reliability, 15(2):97-133. (2005)

De novo Assembly for Metagenomic Data from Short Sequence Reads

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Abstract

Next generation sequencing (NGS) technologies have allowed an explosion in sequencing with the increased throughput and decrease in cost of sequencing. Therefore the field of metagenomic has to adapt to the new type of sequencing data. Metagenomes have presented assembly challenges, how to assemble multiple genomes from mixed sequence read of multiple species. Single-genome assembler is not sensitive enough when applied in this case. There are only three assemblers (MetaVelvet, MetaIDBA and Genovo) currently attempt for metagenomes. In this research, we attempt to develop a more effective de novo assembly for metagenomic data from short sequence reads. We modify Genovo, using outputs from a de bruijn graph based single genome assembler, Velvet, as an initial contigs generation. Using the prior contigs information, the quality increases, but the computational time is still higher. We continue to modify the assembly program to obtain high quality metagenomic assembly and realistic computational cost.

1. Introduction

NGS technologies have allowed an explosion in sequencing with the increased throughput and decrease in cost of sequencing. Metagenomes have presented assembly challenges, how to assemble multiple genomes from mixed sequence read of multiple species. The challenges are from uncertainty about the population's size and composition. Metagenomic analysis requires sensitive methods which can reconstruct sequences even for the low coverage species. Single-genome assembler is not sensitive enough when applied in this case.

While there are a number of effective single genome assemblers, only three (MetaVelvet, MetaIDBA and Genovo) currently attempt to assemble multiple genomes. MetaIDBA and MetaVelvet use de bruijn graph approach [5][6], while Genovo introduces generative probabilistic models. Genovo uses random initial contigs generation [4].

2. Objective

The objective of this research is to develop a more effective de novo assembly for metagenomic data from short sequence reads.

3. Methodology

We modify Genovo, using an output from a de bruijn graph based single genome assembler, Velvet [7], as initial contigs generation. Genovo is a de novo sequence assembler under a generative probabilistic model. It performs a series of iterated deterministic and stochastic hill-climbing moves, based on the iterated conditional modes (ICM) algorithm. A Chinese restaurant process accounts for the unknown number of genomes in the sample [4]. The hypothesis is the quality will increase using that prior informations.

For initialization, Genovo samples the location of a read in an empty sequence, while in our modified Genovo, the sampling process is in prior contigs. Same to the Genovo, the initial location of a read in the prior contigs is set to a constant value. We made two variants of the modified Genovo. First, the sampling process of a read is in every prior contigs and an empty sequence (1st modified), second, it is only in a prior contig and an empty sequence (2nd modified).

4. Discussion

We carried on to compare our modified Genovo in real metagenome (taken from 4 different studies in 7 datasets: SSR001043, SSR001066, SSR001069, SSR001078, SSR001087, SSR001326 [1][2][3][8]) and simulated data (200000 reads of simulated data used in metaVelvet[5]). We only use part of it because both Genovo and its modified require high computational cost. Three measurements (total contig length, N50 and the number of contig) are used to evaluate the assembly capacity and two measurements (cover rate and chimera rate) are used to evaluate the assembly quality. We use functions from metaVelvet[5] to measure the assembly quality. The comparison in real metagenomic data is used to measure the assembly capacity while in simulated data is used to measure the assembly quality.

For real metagenomic data, we use different quality of prior contigs in order to know their effects. The prior contigs are gotten from Velvet with different kmer, 57 and 97. The contigs from Velvet using kmer 97 are better than kmer 57 because the length of reads is more than 100 bp. We only use prior contigs with length greater than 500 bp.

The results for the total contig length can be seen in Figure 1. The x axis in the histogram is the name of dataset and the y axis is the assembly performance. The iteration parameter is 200. We choose 200 because it is enough to reach convergence. Using the modified Genovo, the total contig length increases except for two datasets, SRR001043 and SRR001326. It means that using modified Genovo, more reads are assembled. Using prior contigs with better quality, the 1st modified increases the total contig length for two datasets, while the 2nd modified for four datasets. The 1st modified is better than the 2nd modified for 5 datasets with prior contigs kmer 57, whereas the 2nd modified is better than the 1st modified for 5 dataset with prior contigs kmer 97. We can say that using prior contigs with better quality, the 2nd modified can reach higher total contig length. N50 increases for all datasets except for SRR001066. Overall, the N50 for Genovo and its modified is still low.

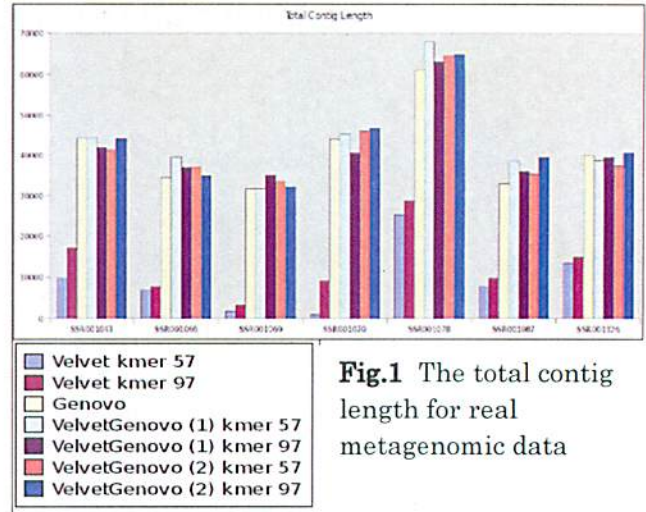


Fig.1 The total contig length for real metagenomic data

The number of contigs increases for three datasets. Using the prior contigs with better quality, the 1st modified increases the number of contig for a dataset while the 2nd modified for 5 datasets. Overall, the number of contig for Genovo and its modified is higher than Velvet. We can say that using prior contigs with better quality, the 2nd modified can reach higher number of contig.

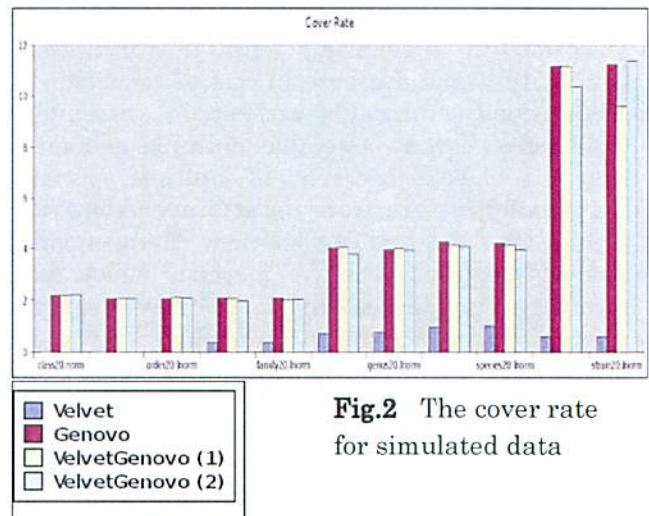


Fig.2 The cover rate for simulated data

The result for simulated dataset is shown in Figure 2. That figure only shows the cover rate because the chimera rate for all datasets are zero. It may be caused by using only part of datasets. The prior contigs resulted from Velvet with kmer 75 and the iteration parameter used is 100. The cover rate doesn't increase or decrease significantly for all datasets, except for strain20.lnorm dataset.

The memory required for modified Genovo is same with Genovo, but the time cost is higher. The 1st modified Genovo requires twice until 3 times while the 2nd modified requires until twice.

5. Novelty

This research attempts to develop a more effective de novo assembly for metagenomic data from short sequence reads by modifying Genovo using output from a de bruijn graph based single genome assembler, Velvet, as initial contig informations in Genovo.

6. Conclusion

Utilizing the prior contigs can be one of the alternatives to increase the assembly capacity performances, but it is not significant and we still have a remain work to decrease the computational cost. Based on the results, we will continue our research to obtain better quality metagenomic assembly and realistic computational cost. For the next step, we will try to utilize paired read information to increase the assembly performance and use other alignment method to decrease the computational cost.

References

1. Biddle, J.F., et al. (2008) Metagenomic signatures of the Peru Margin seafloor biosphere show a genetically distinct environment. *Proc. Natl. Acad. Sci. U.S.A.* 105, 10583–10588
2. Breitbart, M., et al. (2009) Metagenomic and stable isotopic analyses of modern freshwater microbialites in Cuatro Ciénegas, Mexico. *Environ. Microbiol.* 11, 16–34
3. Dinsdale, E.A., et al. (2008) Functional metagenomic profiling of nine biomes. *Nature* 452, 629–632 (2008)
4. Laserson, J. et al. (2011) Genovo: de novo assembly for metagenomes. *J Comput. Biol.*, 18, 429-443.
5. Namiki, T. et al. (2011) MetaVelvet : An extension of Velvet assembler to de novo metagenome assembly from short sequence reads , 2011 ACM Conference on Bioinformatics, Computational Biology and Biomedicine.
6. Peng, Y. et al. (2011) Meta-Idba: a de novo assembler for metagenomic data. *Bioinformatics*, 27(13), i94-i101.
7. Zerbino, D.R. et al. (2008) Velvet: algorithms for de novo short read assembly using de Bruijn graphs. *Genome Res.*, 18, 821–829.
8. Vega Thurber, R.L., et al. (2008) Metagenomic analysis indicates that stressors induce production of herpes-like viruses in the coral *Porites compressa*. *Proceedings of the National Academy of Sciences* 105(47), 18413–18418

Assessment of Liquefaction Potential Based On SPT-N- Value and Peak Ground Acceleration Using GIS

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Abstract

Conventionally, SPT-N based methods have been widely accepted for the liquefaction assessment of soil deposit during earthquake. The March 11' 2011 Gigantic Tohoku Pacific Earthquake was the strongest to hit Japan in recent years and caused extensive liquefactions in several prefectures. This paper assesses the prediction accuracy of several SPT-N-based methods for a specific area where both liquefaction and non-liquefaction incidents are observed during the March 11' 2011 Gigantic Tohoku Pacific Earthquake. In this paper, an extensive analysis on commonly adopted parameters has been done and found that Peak Ground Acceleration (PGA) and SPT blow count are most important influencing factors to assess liquefaction potential of soil deposit during earthquake. Moreover, Geographical Information System (GIS) is used to obtain soil liquefaction hazard map. Methodologies of hazard assessment and the resulting maps will be presented in this paper. These maps are useful for assessing the approximate zones affected by hazards and for disaster prevention planning.

1. Introduction

Three aspects of soil liquefaction are of special interest now a day. These are the likelihood of liquefaction occurrence in a given earthquake, the effect of liquefaction and the response of foundations in a liquefied soil. Most of the soil liquefaction assessment methods available up to date are simply empirical; namely the cyclic shear stress due to shaking is estimated by a simplified procedure, and the cyclic resistance of soil is based on an empirical approach.

Factor of safety against liquefaction (FL) is estimated from the ratio of cyclic resistance of soil (CRR) to cyclic shear stress (CSR) due to shaking (Seed et al. 1971). Parameters affecting the factor of safety are also of special significance. This safety factor is important to assess individual soil layer in a given deposit.

The probability of liquefaction is more suitable than the safety factor as an index for mapping liquefaction potential in a regional basis. Moreover, liquefaction potential index (PI) is very much useful to address the severity of liquefaction in a region affected by earthquake (Iwasaki et al. 1984).

2. Objectives

This research work is intended to fulfill the following objectives:

- a) To assess SPT-N based soil liquefaction methods
- b) To determine most important influencing factors for FL
- c) To produce Liquefaction hazard map in GIS

3. Methodology

In this study, the Saitama City of Saitama Prefecture is targeted as a case study in this paper. Saitama Prefecture has been affected by several destroying earthquakes of magnitudes greater than eight in the past times. The great Kanto Earthquake of magnitude 8.3 in 1923 hit this area which was the latest great one before March 11' 2011 Gigantic Tohoku Pacific Earthquake.

According to April 1, 2011, the city has an estimated population of 54,444 with household number is 21,449 and the density of 1,603.658 persons per km². The total area is 33.95 km². The city was founded on October 1, 1986. The city is located at 36°04'30"N and 139°43'45"E. Average altitude of the city is 9 meter. The city is almost downstream of Tone River. It is at Saitama Prefecture in Kanto region and 43 km from Tokyo at N-W corner.

The March 11' 2011 Gigantic Tohoku Pacific Earthquake shook Satte City of Saitama with the observed peak ground acceleration 200 gal. (<http://earthquake.usgs.gov/earthquakes/eqinthe news/2011>).

Individual borehole data from the Satte City area are analyzed to get FL values based in Iwasaki et al. (1981), Tokimatsu & Yoshimi (1983), Seed et al. modified by NCREE (2001) and Japan Rail Association (2001) methods. Subsequent analyses are done based on parameters as SPT-N value, water level, peak ground acceleration, fines content and so on. Finally liquefaction hazard zonation map is produced based on liquefaction potential index (Iwasaki et al. 1984).

4. Discussion

Although SPT-N based methods generally include computations of CRR and CSR, the analysis philosophy and computation details are slightly different. Chang et al. (2011) adopted some existing methods of SPT-N based liquefaction potential evaluation to the extensive damage induced by the 1999 Chi Chi Earthquake in Taiwan and concluded that Seed et. al method modified by NCREE was the most applicable to this case study.

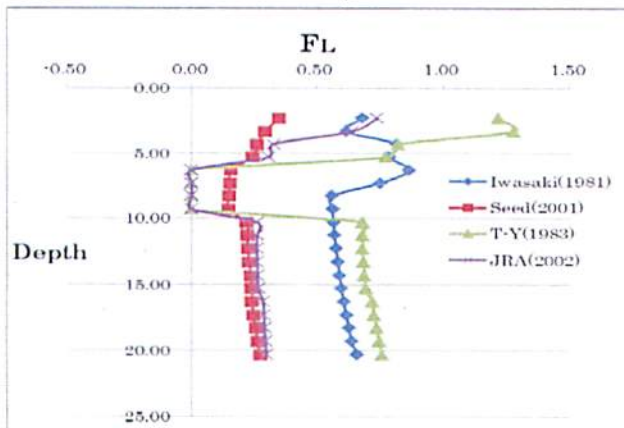


Figure 1. Method evaluation

It is evident in Fig. 1 which assembles the FL values obtained by various methods that JRA(2002) method, modified after 1995 Kobe earthquake in Japan, is so close to Seed (2001) method.

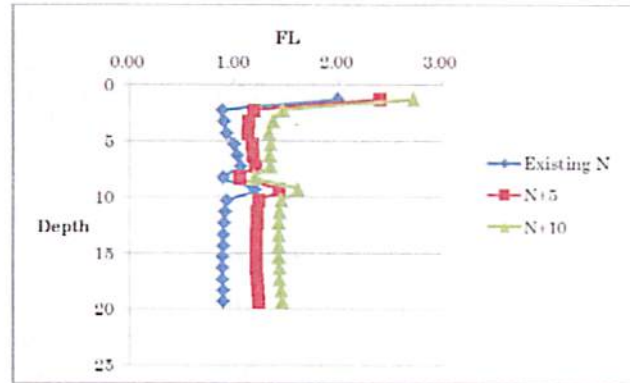


Figure 2. SPT-N based FL evaluation

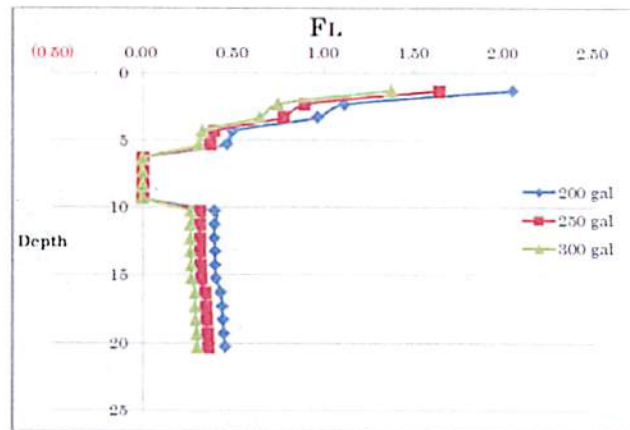


Figure 3. PGA based FL evaluation

Subsequent influencing factors have been analyzed and found that SPT-N value of an existing soil deposit and horizontal peak ground acceleration of an earthquake are the most sensitive in the computed liquefaction potential (Fig.2 & Fig.3) by Seed(2001) method. Successive sensitive factors are hammer energy ratio, fines content and ground water table.

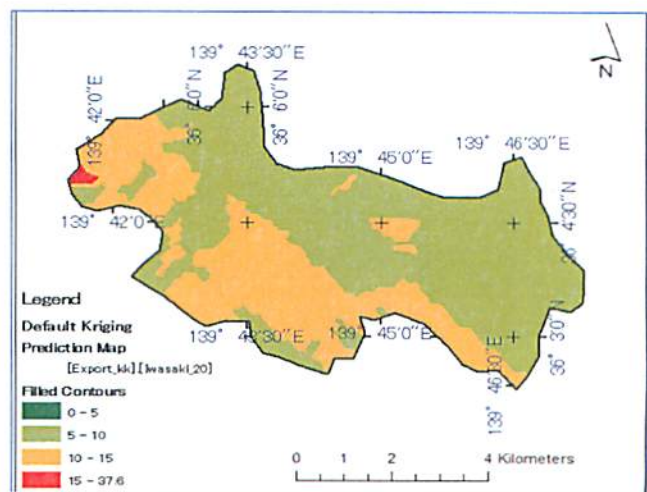


Figure 4. Liquefaction potential (PL) surface map

5. Novelty

This study will facilitate to select the appropriate method for analyzing liquefaction probability of a region for a given earthquake. Moreover, sensitivity of parameters will assist to consider the hierarchy factors.

6. Conclusion

This study examines the computation sensitivity and prediction accuracy of several SPT-N- based methods. This case study for Saitama City of Saitama is a representation of March11 '2011 earthquake. Field contour PL value (Fig.4) is very useful to assess approximate areas affected by earthquake.

References

1. Seed HB, Idriss IM (1971). Simplified procedure for evaluating soil liquefaction potential. *Journal of Soil Mech. Division*, 97(9): 1249-73.
2. Iwasaki, T., Arakawa, T., Todika, K. (1981). Simplified Procedure for assessing Soil Liquefaction during Earthquakes, in *Proceedings of International Conference on Soil Dynamics and Earthquake Engineering*.
3. Japan Rail Association (JRA), Design code and explanations for roadway bridges, Part V- seismic resistance design, Japan; 2002.
4. Chang, M., Kuo, C., Shau, S., & Hsu, R. (2011). Comparison of SPT-N-based analysis methods in evaluation of liquefaction potential during the 1999 Chi-Chi earthquake in Taiwan. *J. of Computers and Geotechnics*, 38(2011), 393-406, ELSEVIER.

Numerical Analysis of Buried Pipeline Subjected to Fault Displacement

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Abstract

Earthquake induced permanent ground deformation can affect significantly buried water or gas pipelines when crossing an active fault. Numerical analysis of buried pipeline accounting for fault movement has been performed using 3D Distinct Element Method (DEM) and Finite Element Method (FEM). Around 110 thousand Spherical particles are considered to represent the soil behavior and DEM simulation has been performed to the model. Strike-slip fault movement is then applied and response of pipes and particles are observed. Pipe is considered as 3D beam element in the model and fixed boundary conditions are specified for compatibility of the analysis. Pipe response has been calculated using 3D FEM. Dynamic behavior of pipes and particles has also been well thought –out in the analysis. Axial strain has been analyzed and also the strain rate with the increment of fault movement is observed through the simulation. Soil-pipe interaction is understandable to some extent from the force-displacement relationship at pipe nodal points. Particle effects on the movement of pipes have also been analyzed in this research.

1. Introduction

Buried pipelines are commonly used to transport oil, water, sewage and natural gas. Underground pipelines in high seismic zones are subjected to permanent ground deformation and wave propagation hazards. Seismic action is entirely different in buried structures from the other types of structure. The major causes of damage to buried pipeline during an earthquake are due to permanent ground deformation when crossing an active fault and axial elongation owing to relative movement of adjacent part of earth crust. Soil-structure interaction is an important criterion for the analysis of buried pipe. Researchers have been presented several types of model to obtain the seismic response of buried pipelines depending upon the model and response quantities of interest.

2. Objective

The main objectives of this research study are given in the following:

- [1] Study on existing model and analysis type of buried pipe.
- [2] Numerical modeling of buried pipe using 3D DEM & FEM.
- [3] Response analysis of buried pipe considering the effect of fault movement.

3. Methodology

The numerical analysis of buried pipeline has been performed using the combination of Discrete Element Method (DEM) and Finite Element Method (FEM). DEM is an important tool in modeling the behavior of granular materials. This method can be distinguished from the FEM since it models its objects as systems of discontinuous bodies interacting with each other. Spherical particles are used to simulate the soil particles in this model. Beam element has been used to represent pipe and pipe is fully buried in the soil particles. In this analysis, model size is taken as 30cm x 80cm x 50cm and 16 pipe elements have been considered. There are six degrees of freedom at each nodal point of the pipe. Particles move with gravity and they contact with pipe elements. The movement of particles follows the DEM simulation and response of the pipes has been calculated using 3D FEM. After the sedimentation process, strike slip fault movement is given to the model and deformation response of pipes is analyzed. Typical layout of the model is shown in the following figure:



Figure 1: Proposed Model of Buried Pipeline

4. Discussion

The deformation of pipes has been analyzed in this numerical model. It was observed that particles pushes the pipes near the fault crossing zone and hence suffer much deformation than other part of the pipes. Deformation response of pipe with the increment of fault displacement is given in Figure-2. The effect of boundary condition can be seen foremost at the far end of pipe whereas in the inner part, particle movement follows the pipe displacement. Only the axial deformation has been analyzed owing to horizontal movement of the model. Axial displacement was increased attributable to increment of fault slip and compatible with the analysis. Axial strain in the pipe element has been contributed by particle movement and increased with the increment of fault displacement and shown in Figure- 3. Force between pipes and particles and deformation of pipes has also been considered and the alliance was found somewhat understandable and seen typical force-deformation relationship in the middle part of the pipes and given in Figure-4.

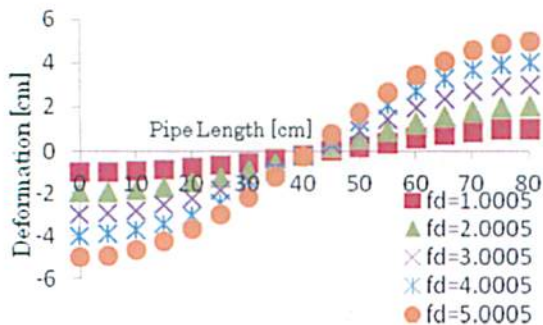


Figure 2: Deformation of pipe

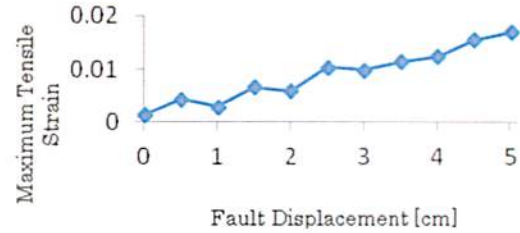


Figure 3: Strain Increment

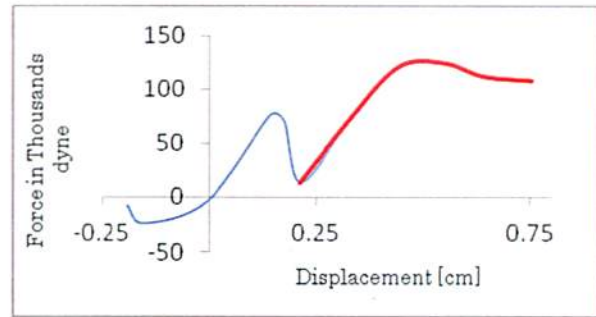


Figure 4: Force-Displacement Relationship

5. Novelty

Many of the researchers have been working on the simulation of buried pipes using numerical techniques. The main concern in numerical modeling is defining the interaction between pipes and surrounding soil. So far most of the research were carried out using FEM where pipe modeled as beam or shell element and springs were used to simulate soil behavior. In this research study , authors use spherical particles to represent real like soil and pipes were fully buried into the soil particles. DEM simulation shows more rational behavior of granular materials instead of using spring system to represent soil particles.

6. Conclusion

The above described research is the preliminary simulation of the 1st author's master study. The author conducted this initial simulation to observe the characteristics of particles movement and responses of pipes when subjected to fault slip. However, the particle size and pipe diameter is chosen roughly in this analysis. The model size has been taken 80 cm in the preliminary analysis which is not quite enough to understand the behavior of pipes and particles accounting for fault movement. The authors are now working on a comparatively large model to simulate the realistic behavior

between pipes and particles using smaller particle size and practically available pipe diameter. The author's specific aim is to show the strain and deformation of pipes with the accounting for fault movement. He will also try to consider different types of fault movement and analyze response pipes more scrupulously which might be used as reference in designing buried pipeline subjected to fault displacement.

References

- [1] T.K. Datta: Seismic response of buried pipelines: A state-of-the-art review, Nuclear Engineering and Design, Vol. 192, pp 271-284,1999
- [2] Anshel J.Schiff: Northridge Earthquake lifeline performance and post-earthquake response. Technical Council on Lifeline Earthquake Engineering, August 1995
- [3] Lee DH, et al: Seismic behavior of a buried gas pipeline under earthquake excitations. Engineering Structures (2009)
- [4] Yun Wook Choo, Tarek H.Abdoun, Michael J. O'Rourke, Da ha: Remediation for buried pipeline systems under permanent ground deformation. Soil Dynamics and Earthquake Engineering 27 (2007) 1043-1055
- [5] P.A Cundall and O.D.L Strack: A discrete numerical model for granular assemblies. Geotechnique 29, No. 1, 47-65,1979.

The effect of micro-bubbles on fluid flow through fractured mudstone specimens

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Abstract

Understanding multi-phase fluid migration in rock formations, especially through fractured materials, is essential in the earth science field since it is a common phenomenon in nature. Methane gas dissociation from the seabed and Carbon Capture Sequestration (CCS) Technology are closely related to the transport mechanism of multi-phase liquid in which migration of gas bubbles is one of the main factors.

This study focuses on how the presence of micro-bubbles in the fluid affects the hydraulic properties of fractured mudstone as well as the behavior and interaction of micro-bubble-containing fluid flowing through fractured specimens at the microscopic level.

For the first experimental study, fractured rectangular diatomaceous mudstone specimens were examined. The specimens were set up in a shear-test apparatus and had still or micro-bubble-containing pure water flowed through them via a constant head gradient. Preliminary results showed that permeability had an inverse relationship with the presence of micro-bubbles in saw-cut specimens.

As this study only considered single fractures, future research should examine the effect of micro-bubbles in mudstone with multiple fractures. Moreover, the physical behavior of the interaction between micro-bubbles and the fractured or saw-cut surface still needs further attention.

1. Introduction

Methane gas dissociation and Carbon Capture Sequestration (CCS) are two closely – related topics when observing the mechanisms, behavior, and interaction of multi-phase fluid transport through fractured rock mass. Gas bubble migration is one of the main factors in the accumulation and dissociation process of methane hydrate below the seabed. Besides the formation and dissociation process of methane hydrate, the seabed floor layers also play an important role in gas migration. Buoyancy is the driving force behind gas migration. However, the resistance to migration into the pore network of the overlying sediments is limited by capillary

entry pressure and the layer's resistance to fracture. Thus, the migration of fluids is just as an important issue in gas-hydrate geology as it is in conventional gas and oil geology (Ginsburg and Soloviev, 1996). CCS is one recent technology that aims to minimize the level of atmospheric carbon by capturing carbon dioxide and storing it underground. Injection techniques are a very important factor here as permeable, or fractured, pathways are usually created after injection activity.

2. Objectives

The main objectives of this research are:

- 1) To investigate the effect of the presence of micro-bubbles in fluid-flow on the hydraulic properties of fractured diatomaceous mudstone.
- 2) To investigate the behavior of micro-bubbles and how they interact with fluid-fractured mudstone.

3. Methodology

Research was carried out as follows (Figure 1).

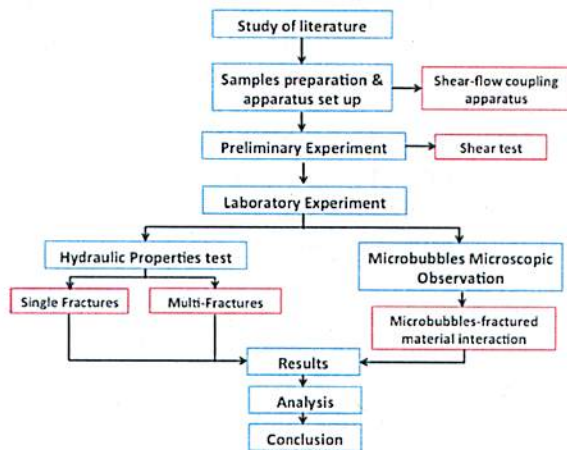


Figure 1 Flow chart of research methodology

4. Discussion

Micro-bubbles

40-50µm micro-bubbles were produced using a hydrodynamic generator (Asupu AS-K1). The size distribution of micro-bubble particles one second after generation is shown in figure 2.

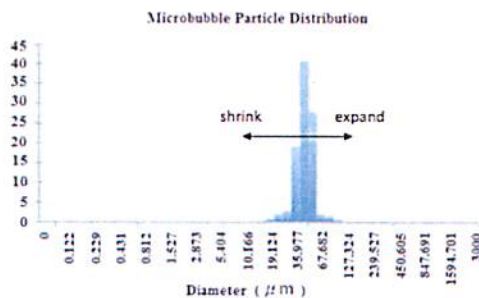


Figure 2 Micro-bubble size distribution one second after bubble generation

Micro-bubble size distribution was not stable after bubble formation. After bubble generation, micro-bubble size either increased or decreased over time. The effective time for micro-bubble analysis was found to be less than 3 minutes.

Diatomaceous Mudstone Properties

Diatomaceous mudstone has uniform material properties. The porosity value (65.92%) was measured with an MIP test. Other properties of this sample are below:

- Bulk density = 0.629 gr/cm³
- Wet density = 1.310 gr/cm³
- Water content = 107.77%
- Hydraulic conductivity = 1e-10 ~ 1e-8 m/s

The MIP test also showed a maximum pore size diameter of 0.5-0.6µm. Thus, the properties of this sample were similar to cap-rock layer material in reservoir facilities and suitable for micro-bubble observation through fractured specimens (Smith *et al.*, 2010).

Permeability in Fracture Specimens

The first permeability test was conducted on saw-cut specimens and analyzed with the equation developed by Snow (1968).

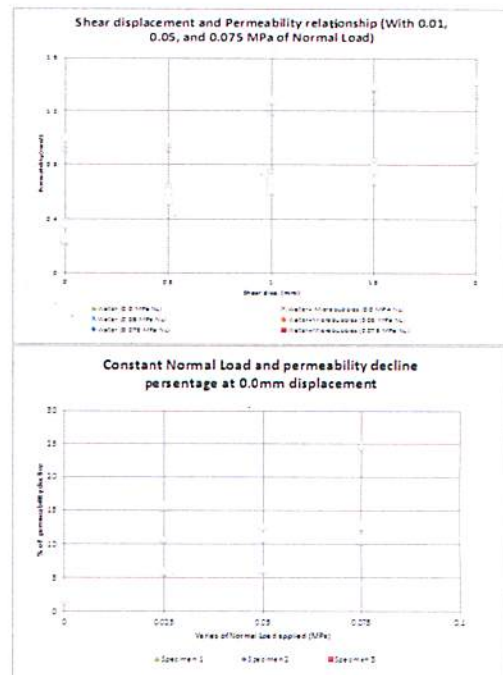


Figure 3 Permeability of saw-cut specimens under varying of Normal loads

The permeability of water containing micro-bubbles was consistently lower than that of pure water. As the applied normal load was increased, the decline percentage of permeability tended to increase.

Three-Dimensions of Shear Fracture

Initial fractured specimens were obtained by using CT-Scan tomographic imaging (Fig. 4) Fracture properties, aperture and area, were calculated.

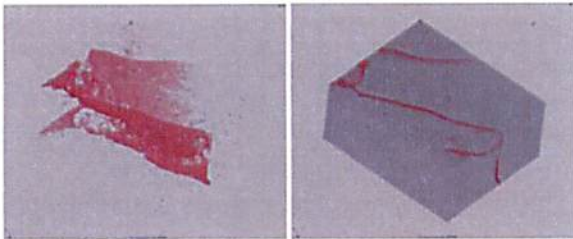


Figure 4 3-D Fracture of specimen-1

5. Novelty

Observing the mechanism, behavior, and interaction of multi-phase fluid transport through fractured rock mass is a major challenge in the fields of rock engineering and earth science as it is a common phenomenon in nature. Based on this, an attempt is made in the present study to investigate the micro-bubble liquid phase transport mechanism through sedimentary rock, especially fractured rock.

6. Conclusion

Micro-bubble presence in fluid flow reduced the permeability of fractured specimens by about 10% in saw-cut specimens. Initial 3D fractures of specimens are clearly defined as a reference for future fluid micro-bubble shear tests.

References

1. Domenico, P.A and Schwartz, F. W., 1990, "Physical and Chemical Hydrogeology", Jhon Willey & Son, Canada
2. Ginsburg, G. D. & Soloviev, V. A. 1996, "Methane migration within the submarine gas-hydrate stability zone under deep-water conditions", Marine Geology, vol. 137, pp. 49-57
3. Smith et al., 2010, "Carbon dioxide storage risk assessment: Analysis of caprock fracture network connectivity", International Journal of Greenhouse Gas Control 5, pp. 226-240
3. Sudisman, R. A., 2012, "Experimental Study on Fluid Flow Containing Microbubbles Through porous Sandstone & Sand Grains", Master Thesis, Saitama University
4. Westbrook *et al.*, A. 2009, "Escape of methane gas from the seabed along the West Spitsbergen continental margin", Geophysical Research Letter, vol. 36, no. L15608

Geotechnical characteristics of solid waste material from an industrial landfill in Japan

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Abstract

Knowledge of geotechnical properties of landfilled solid waste is important for optimizing design of engineering landfill and assessing its stability and settlement during its operation and after post-closer. In this study, geotechnical properties of solid material with different size fractions taken from a post-closer industrial waste landfill in Japan were measured. Laboratory tests were performed to determine the index properties of water content, grain size distribution and composition, total organic content, C/N ratio, specific gravity, Atterberg limits, pH and EC values, and geotechnical properties of compaction, compressibility and shear strength parameters. Based on the measurement of the geotechnical properties for solid waste material with different size fraction in this study, the stability and settlement of post-closer landfill will be investigated.

1. Introduction

Landfills are manmade structures and considered as the first generation of environmentally accepted solid waste disposal method. The proper selection of engineering properties of waste material is critical in the analysis and design of solid waste landfill to meet long term performance. For instance, leachate flow in landfill, settlement and slope stability of landfills depend on the geotechnical properties such as hydraulic conductivity, compressibility and shear strength (Mylene palapayon et al, 2007). However, the accurate determination of geotechnical properties of solid waste is very complicated due to heterogeneity nature, wide variation of particle size distribution and time dependent degradation. In this study, an attempt has been made to determine the likely range of geotechnical properties of post-closer landfill waste materials.

2. Objective

The main objective of this research was to determine the physical and geotechnical properties of solid waste material at a selected post-closer landfill in Japan and compare its properties with previous studies. Additionally, based on these results, settlement and stability

characteristics of this landfill will be evaluated in future studies.

3. Methodology

The samples were collected from a post-closer industrial landfill at Saitama prefecture, Japan. However, it was noticed that considerable amount of compost materials were also present with the industrial waste. In sampling, those compost materials and capping soil were mixed with industrial waste sample.

As there is no standard testing procedure for waste materials, the testing was conducted according to the procedures established by ASTM and JIS for soil with incidental modification to suit the waste material being tested. The sample was divided in to two fractions by its maximum grain size of 2 mm and 10 mm, respectively.

4. Discussion

Fig. 01 shows the particle size distribution graph for the total solid waste sample.

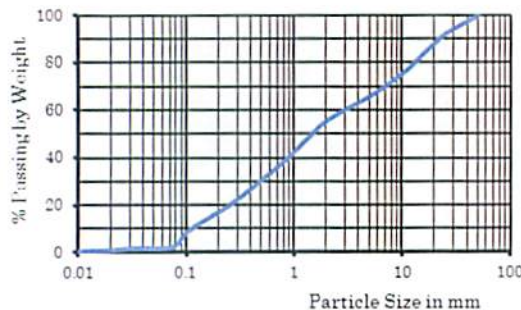


Fig. 01- Particle size distribution

Fig. 02 shows the average results of Waste composition. In this study, only the sample fraction greater than 5 mm was analyzed. However, only 32% of total waste was represented this group.

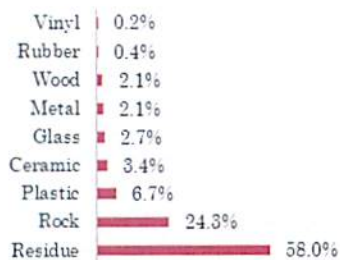


Fig. 02-Waste composition

The specific gravities were calculated for both finer fraction ($D < 2$ mm) and coarser fraction ($D < 10$ mm) and the average values were 2.72 and 2.62, respectively.

The average moisture content of total SW was 48% and Liquid limit and plastic limits were 65% and 42% respectively.

Table 01 presents average results of ignition loss and C, H, and N percentages and hence C/N ratio for both coarser and finer fractions.

Table 01- Ignition loss and C/N ratio

Parameter	Particle size	
	D<2mm	D<10mm
Ignition loss (%)	18.2	17.2
Carbon (%)	0.25	0.17
Nitrogen (%)	13.75	5.68
Hydrogen (%)	2.18	0.81
C/N ratio	56	33

The average pH of SW was 8.8 and electrical conductivity was 2.8 mS/cm.

The maximum dry densities (ρ_{dmax}) for both finer fraction and coarser fraction were evaluated to be 2.6 g/cm³ and 2.9 g/cm³ and optimum moisture content (w_{opt}) to be 39% and 36%, respectively.

One dimensional consolidation tests were done for the samples of both finer fraction and coarser fraction at higher degree of compaction (above 90%). The measured values of C_c were 0.15 for finer fraction at 1.28 initial void ratios and 0.20 for coarser fraction at 1.21 initial void ratios.

5. Novelty

Geotechnical investigation of landfill material is rarely undertaken due to its heterogeneous nature and time dependent degradation. However, Knowledge of the likely ranges of geotechnical properties of landfill material is required to assess the potential modes of failures during its operational period and after closer. The purpose of this study was to examine the geotechnical properties of this specified post closer landfill and hence to evaluate the stability and possible settlement characteristics to take remediation action.

6. Conclusion

Fundamental physical and chemical properties of buried wastes are comparable to those reported in the literature of aged landfill MSW. This can be due to the presence of compost in the tested samples.

Measured compaction indexes such as w_{opt} and ρ_{dmax} are similar for both coarser and finer fractions. However, measured C_c value for

coarser fraction was higher than that of finer fraction. Further research study is needed to study compressibility characteristics for different compaction levels and temperature.

References

1. Landva, G.D. Knowels, 1990. Geotechnics of waste fills-theory and practice, ASTM STP 1070
2. M. Palaypayon and H. ohta, 2007. Estimation of Shear Strength parameters of MSW in Landfills, JSPS

Dynamic Response Behavior of Reinforced Concrete Column under Water

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Abstract

The influence of water, in design of reinforced concrete structure, was not considered in present codes and specifications. Due to viscosity and incompressibility of water, at the rate of crack opening and closing, water will entered in cracks and cannot move out of the cracks when cracks are about to close. This condition leads very high water pressure induced in these cracks which may shatter and flatten the rough crack surfaces. The possible high internal water pressure due to the viscosity and incompressibility of water caused smoothing of crack surfaces lead to the reduction in flexural capacity. Based on experimental consideration clarify the influence of water on the dynamic response behavior of reinforced concrete columns under water. When the columns were in the seismic excitation under water, the water pressure in the cracks leads to a major change in stress distribution inside the concrete. This excited stress condition makes the enhancement in cracks. Increase in damage potential is affected by the influence of the water. The experiments have been performed to investigate differences in the inelastic dynamic behavior of reinforced concrete columns subjected to simulated input motion with different time duration and different environmental condition like air and water.

1. Introduction

In recent years, the experimental approaches have often been applied to investigate the dynamic behavior of reinforced concrete structures. Most of the experimental works including the pseudo dynamic tests and shaking table tests were concentrated on the behavior of different types of structures. From the disasters of Off Tokachi Earthquake 1968, Kobe Earthquake 1995 and Tohoku Earthquake 2011, it is considered that the time duration plays an important role on the damage potential and for accurate estimation of deformation capacity of RC structures. According to evidence from past strong earthquake, reinforced concrete columns are susceptible to diagonal tension cracking. For the accurate assessment for deformation capacity, influence of water should be checked in this research.

2. Objective

The objective of this research is to investigate the possible enhancement of cracks and degradation of seismic performance of reinforced concrete columns under influence of water.

3. Methodology

The structural dimensions of the specimens are shown in Fig. 1. Four specimens have been constructed with same structural details like longitudinal and shear reinforcement. Specimens were flexure dominant type with 16-D13 main reinforcement and D6 @ 50mm c/c shear reinforcement. In order to investigate the internal behavior of reinforcement and concrete, strain gauges were attached especially at the plastic hinge location. For the external behavior of column laser type displacement transducer, level gauge and accelerometer were used. Specimens were subjected to dynamic cyclic

loading at the top. Input wave was sinusoidal wave with step by step increase in amplitude and two time repetition for each cycle. Displacement rate was Low (static) and high (dynamic) which was 1 mm/sec and 200 mm/sec maximum respectively.

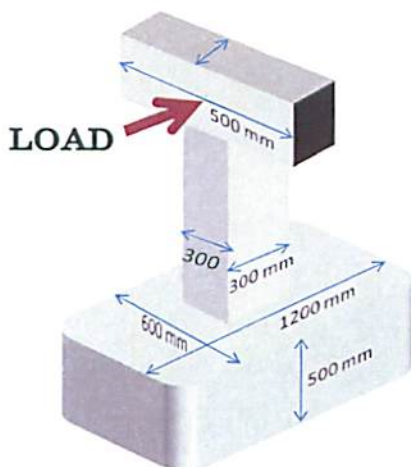


Fig. 1 Structural Dimensions of Specimen

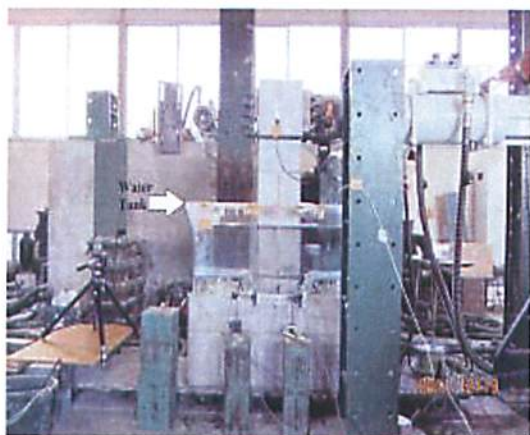


Fig. 2: Arrangement into water tank

The test has been performed under two different environments in air and in water, as shown in plan of loading in table. 1. Arrangement in water tank is shown in Fig. 2.

Table.1 Plan of loading

Column No.	Environment	Loading
1 & 2	air & water	static
3 & 4	Water & air	dynamic

4. Discussions

Dynamic response of the specimens in term of ductility (showed in Fig. 3) under different state of loading with different environments as mentioned in table. 1. Load carrying capacity of the specimens was different in static load case and in dynamic load case. Where strain rate does not affect on the ultimate load carrying capacity whether specimen is in water or in air. The specimens were tested upto 9δ in static loading and 7δ in dynamic loading, so their response was shown in Fig. 3 respectively.

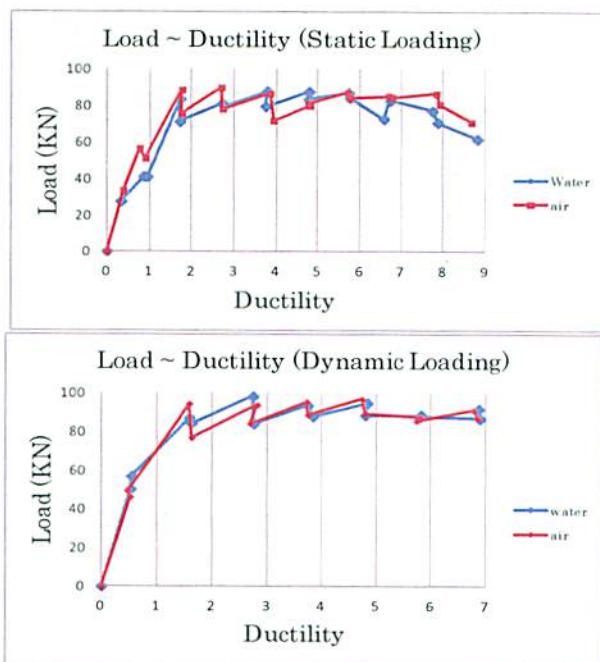


Fig. 3: Response of column in term of Ductility

5. Novelty

In this research work, experiments were tested under water to take its influence as shown in Fig. 2.

6. Conclusions

Based on this study the following conclusions can be drawn:

1. Strain rate does not affect on ultimate load carrying capacity of specimen under different environment.

2. Maximum load of the dynamically-loaded specimen was about 10% higher than that of the statically-loaded specimen both in air and in water.

References

Hong-Gun Park a, Eun-Jong Yu b, Kyung-Kyu Choi c; Shear-strength degradation model for RC columns subjected to cyclic loading; *Engineering Structures* 34 (2012) 187–197

H. Mutsuyoshi, A. Machida; Behavior of reinforced concrete member subjected to dynamic loading; *JSCE* vol. 354/ V-2 (1985-02)

Mahin, S.A, and V.V. Bertero; Rate of loading effects on un-cracked and repaired reinforced concrete members; Report no. EERC 72-9 Earth quake engineering research center Uni. Of California, Barkeley, December 1972.

Understanding the Behavior of Piles Group Bearing Capacity in Ground Deformation

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Keywords: Pile group, Ground deformation, soil – pile interaction

Abstract

The influence area of pile loading was observed by model test of pile group in dry silica sand. To understand the behavior of soil deformation of pile group, four cases were conducted by using 9 and 3 piles configuration with different spacing. Conclusions can be drawn that 2.5D pile spacing, were performed as pile group better than 5D pile spacing.

1. Introduction

Soil deformation around a piled foundation is a critical aspect of a foundation design. For example, in axially loaded piles, where subjected to load parallel to its axis will carry the load partly by shear generated along the shaft and partly by normal stresses generated at the base of the pile. Therefore, understanding the mechanism of pile resistance is very important.

Some studies about the behavior of the piles group were conducted in large scale test by Vesic (1967); and model test by Goto et al. (2012), Aoyama et al. (2012). However, bearing mechanism of piles group in sand are not clear yet.

2. Objective

In this paper, the influences of spacing between piles were presented. By observing the difference between the load – settlement characteristics, ground deformation, the result were expected to give a new vision of development of bearing capacity theory in piles group.

3. Methodology

Group pile loading tests were conducted in a large rigid soil tank with the frontal wall of the tank was made of transparent acrylic plate to conduct the visible test under group pile loading in 2D analysis of ground deformation.

Loading process was utilized using loading unit for axial loading of pile group and on the surface of model ground, air bags were put on to apply the confining pressure. The detail of this unit was described in Goto et al. (2012)

Test was performed in two conditions. First, by using 9 piles (3×3), it was performed with different center-to-center spacing between piles: Case 12 with 5 times (200mm, 5D) and Case 14 with 2.5 times (100mm, 2.5D) diameter of piles. Then, by using 3 piles also with different center-to-center spacing between piles: Case 15 with 5 times (200mm, 5W) and Case 16 with 2.5 times (100mm, 2.5W) width of piles. Both conditions were performed under different confining pressure, For case 12 and 14, confining pressure started from 200kPa – 150kPa – 100kPa – 50kPa for first sequence, then loaded again start

from 50kPa – 100kPa – 150kPa – 200kPa. On the other hands, Case 15 and Case 16 was performed with 50kPa – 100kPa – 150kPa – 200kPa. In this paper, the behavior of the early stage loading process will be presented.

Model piles were made of aluminum closed by flat plate at the bottom. For 3×3 configuration, cylindrical shape (O_{outer} 40mm) was used and for 3×1 configuration were utilized rectangular piles (40mm×90mm). To measure both the axial force and bending moment, strains gauge were attached inside the piles. For cylindrical piles, utilized at 5 levels along the piles and each level had 4 strain gauges. On the other hands, for rectangular piles, it was attached at 2 levels along the piles with only had 1 strain gauges per level.

Model ground was made of air-dried Silica Sand No.5. It was constructed by sand spreading method and manual compaction at every 150mm thickness with the relative density calculated from that weight, was around 85%. Below the initial height of pile tips, several horizontal colored sand layers were installed. The model of pile group was set on the ground when reach the initial height of pile tip, and then fixed to a steel plate called "footing". After that, the ground was built again up to 1200mm in height. Then the above-mentioned air bags were installed on the surface of the ground.

4. Discussion

Figure 1 illustrates the relationship between total load and the settlement of case 12 and 14. In terms of elastic modulus in which shown, case 14 had bigger elastic modulus than case 12. It means that case 12 settled more than case 14 at the same load.

Figure 2 shows the ground deformation of case 12 and case 14 after all loading process. By drawing horizontal line (red-dotted) between the edges of colored sand, clear difference between case 12 and case 14 was observed. Case 12 shows that the deformation was larger in area than at case 14. Aside from the soil bulb

development which both case exhibit the same deformation (shown in zoom), case 14 likely behaved individually. No significant deformation along the colored sand at the case 14. This meant that pile group at case 12 was perform better than case 14 in terms of interaction between piles.

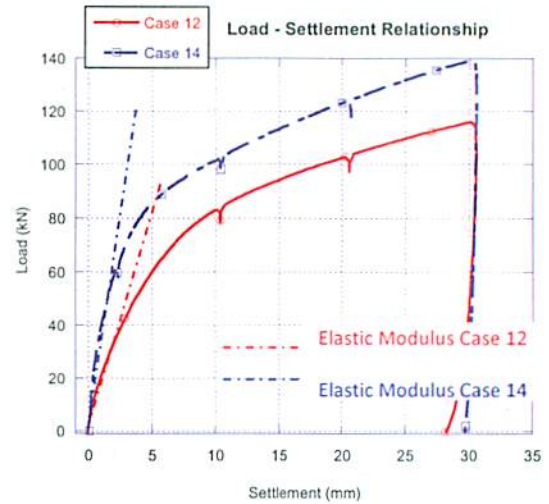


Figure 1 Load – settlement relationship case 12 and 14

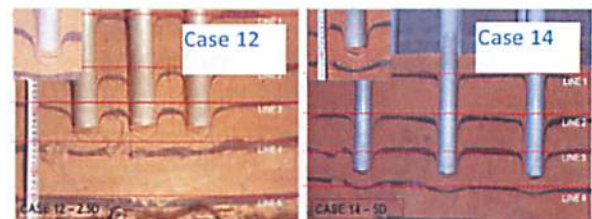


Figure 2 Ground deformation in case 12 and case 14

Another comparison of soil – pile interaction in piles group in 2 dimensional will be presented in case 15 and 16. Both cases were using the same apparatus, but the only difference was the use of square pile in contact with observation wall. A direct observation can be done simultaneously with the loading process. However, due to friction force between piles and the wall, the behavior of load – settlement cannot be compared with case 12 and 14. Therefore, comparison performed only in ground deformation.

Figure 3 shows the deformation in 2 dimensional of case 15 and case 16. Red dotted line in each picture meant as the initial positions of each color sand layer before loading test. At case 16 shows that deformation of colored patterns was similar which is explained at the case 14. Each pile of case 16 behaved individually in surrounding model soils. On the other hands, case 15 was agreed with the behavior of case 12. At the case 15, the colored sand in between piles was move downward together.

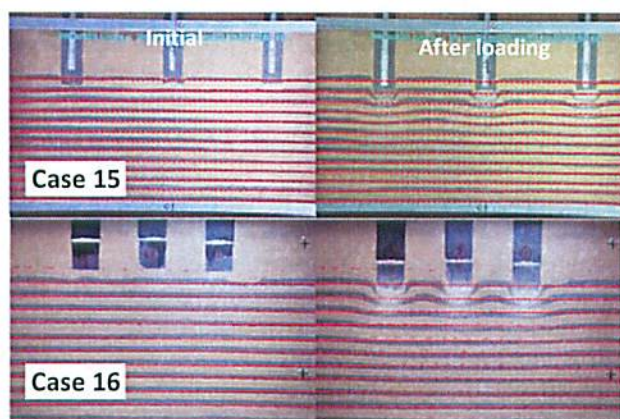


Figure 3 Ground deformation in case 15 and case 16

5. Novelty

Verification of existing theory of analyzing capacity of pile group was need by conducting model test. Furthermore, by expanding research in image analysis during loading process, a new theory expected to be developed.

6. Conclusions

Vertical loading tests of piles group with two conditions were conducted. Evaluating of load – settlement relationship, followed with comparison of the ground deformation between two different conditions of pile spacing, 5D and 2.5D, it can be drawn the conclusions as followed,

- 1) Elastic modulus in case 12 is smaller than case 14; it may be drawn as the effect of spacing between piles and affect the behavior of ground deformation.
- 2) The ground deformation below the base of piles at case 12 and case 15 was deformed

uniformly downward. While at case 14 and case 16 deformed individually.

- 3) Soil bulb development was observed in beneath pile tip of all cases tested.

References

- 1) Goto, S. Aoyama, S., Liu, B., AyalaAlarco, R., Takita, A. and Towhata, I. : Model pile and pile group bearing capacity in large scale soil tank test, Proceedings of IS-Kanazawa2012,2012
- 2) Vesic,A.S : Ultimate Loads and Settlements of Deep Foundations in Sand, Symposium on Bearing Capacity and Settlement of Foundations, Duke University, 1965
- 3) Aoyama, S. Goto, S., Liu, B., AyalaAlarco, R., Takita, A. and Towhata, I.: Bearing mechanism and the interaction between piles and soil under group pile loading, Proceedings of IS-Kanazawa 2012, 2012.

Simulation of Fire Spreading Following Earthquake in Urban Areas

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Abstract

The harm of fire spreading following earthquake in urban areas is significant. The degrees of disasters caused by fire spreading are excessively higher than direct losses caused by earthquake itself. The simulation results can be used as key parameters to manage disasters, reduce losses and save human lives in urban areas. Fire spreading simulations in urban areas are informative for knowing the fire spread area with time, total number of people and buildings exposed to fire with time, the quantity of water needed to put out fire according to the type and numbers of buildings exposed to fire etc. Past experiences showed the degree of disaster was found to be affected by time of shaking (morning, noon, evening and night). This study proposed to improve the simulation model considering the time of trigger earthquake.

1. Introduction

Natural disasters are unwanted but inevitable phenomena. Earthquake is one of that which is an event of shaking ground due to tectonic activities. It can be neither stopped nor exactly predicted. Earthquake leads several kinds of disasters including fire spreading. Structural damages are directly related to intensity of earthquake or strength of ground shaking which causes both human and properties losses. In some great earthquakes such as San Francisco Earthquake (1906), the great Kanto Earthquake (1923), the Kobe Earthquake (1995), the losses were significantly amplified by fire spreading. Fire spreading is not the primary effects of earthquake. It is raised due to primary effects (such as structure damages and other infrastructure initiated the ignition of fire). The fire following earthquake leads for expanding the damages in urban areas so much. A fire initiated in a building of densely populated urban area is easily liable to spread into the community. There are a lot of chances of multiple fire breaks out in those densely built urban area during the large earthquake which might cause disastrous damage to those area. The essence of fire spreading simulation after earthquake in urban areas was realized after huge losses due to fire spreading after San Francisco Earthquake, Kanto Earthquake, Kobe Earthquake etc. Several research groups have proposed the various simulation models. Hamada and Horiuchi [1,2] proposed empirical models based on past experiences. Tokyo fire station [3] has modified those models considering recent incidents. Himoto and

Tanaka [4] are well known for physics based fire spreading simulation in urban area. They have developed the simulation models and verified in Kyoto Higashiyama area. The study of fire spreading phenomenon after earthquake in urban areas is become necessary to manage the upcoming disasters and to minimize the degree of severity of losses. This study proposed the modification on simulation model considering time of hitting earthquake.

2. Objective

The ultimate objective of this study is to simulate the post-earthquake fire spreading in densely built urban areas. This is ongoing research and currently it proposes a modified model.

3. Considerations for modification

Simulation program for the city fire (simfire) developed by National Institute for Land, Infrastructure and Transport is being used for planning and development of anti-disaster assessment in Japan. This program is tried to modify here. Broadly, the whole program can be divided into three sections. The input data required to run a city fire simulation are prepared by generation tool. Three kinds of data: rooms.dat, woods.dat and walls.dat are separately prepared in the program which are related to geo-spatial information. Urban area is generally defined as the place where the people's activities are higher. So, the urban area includes the residential, commercial, industrial and other well built up areas. The concentration of the people's activities varies according to the times

of day such as, most of people stay in residential area in night and morning, the commercial areas are crowded in day and evening, official areas are occupied in office hours etc. It is already experienced that the degree of damages or losses due to earthquake in particular area will increase or decrease regard with the time of triggering earthquake also. For example, if earthquake occurs in night or morning, damages and injuries will increase in residential areas where if the earthquake occurs in day time, the injuries will increase in commercial and official areas. This trend is also truthful for the fire spreading after earthquake in urban area. This kind of considerations are not included the previous simulation models. Closely monitored human activities can be used to identify and varying the sources of ignition points. It is difficult to quantitatively analyze human activities directly. However consumption patterns of various facilities indicate it. Monitoring several facilities (electricity, water supply, gas and other facilities), the people's activities and the usages of various kinds of household appliances can be considered.

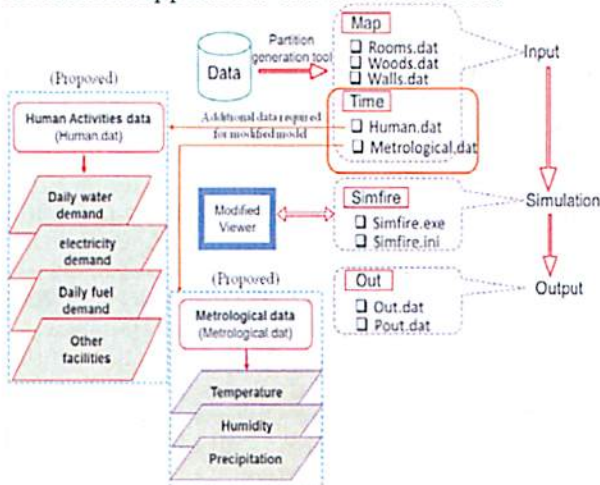


Fig. 1 Layout of simulation program

Similarly, the thermal environment of buildings (thermal radiation and atmospheric temperature, humidity) shall change with seasonal variation of climate. The high air temperature will make combustible materials drier and more flammable. The air temperature itself varies within day as well as the average temperature also changes according to seasons (month). The larger humidity will increase the moisture content in combustible materials and will slow down the fire spread rate. If it rains,

the temperature of burning materials and flame will descend and the burning intensity will decrease. Fig. 1 shows the schematic flow of the simulation program. The human activities data and meteorological data are assumed to be added in modified simulation model.

4. Novelty

Simulation results resembling real phenomena are more reliable to use in practical field. This study firstly tried to consider the human activities and time of triggering earthquake in post-earthquake fire simulation.

5. Conclusion

The post-earthquake fire spreading simulation is important to evaluate fire performance of the urban areas. In past earthquake, the damages and losses were noticed to be affected by time of triggering earthquake. A simple improvement process considering the time of triggering earthquake is proposed in post earthquake fire simulation.

References

1. Hamada, M., (1951), "On Fire Spreading Velocity in Disasters", Sagami Shobo, Tokyo.
2. Horiuchi, S., Kobayashi, M., and Kakai, S. (1974) "Study on the Emergency Escape in City Area", Transactions of the Architectural Institute of Japan, Vol. 233, 45-71.
3. Tokyo Fire Department (TFD), 2001, "Development and Use of the Method for the Evaluation of Local Preparedness for Earthquake Fires", Fire Prevention Deliberation Council Report, Tokyo Fire Department, Tokyo.
4. Himoto, K., and Tanaka, T. (2000) "A preliminary model for urban fire spread", Proc., 15th meeting of the UJNR panel on Fire Research and Safety, S.L. Bryner (editor), Vol. 2, 309-319.
5. Federal Emergency Management Agency (1999), "HAZUS99 Technical Manual", National Institute of Building Sciences, Washington DC.

Damage Detection in Prestressed Concrete Bridges Based On Structural Damping Identification

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Abstract

Detecting the damages at earliest possible stage in structures has become one of the current research interests among civil engineering community because healthy infrastructure system is one of the important factors which support to a positive economy of a country. Many accidents of prestressed concrete (here after PC) bridges have been reported in literatures and the main reason of these failures is corrosion damage in tendons. These collapses have been occurred without any warning. Therefore it has become an urgent need of study to detect these damages at their earliest stages. When the corrosion has been occurred in PC tendon, there is a common phenomenon that a certain friction occurs between steel tendon and concrete interface during the vibration of structure. Because of this frictional energy dissipation in the corroded members, the damping of the structure could be increased. In this study, a method is trying to develop to detect the corrosion induced damages in PC beams based on structural damping changes by conducting a laboratory test.

1. Introduction

Currently used damage identification methods in structural health monitoring (SHM) are mostly categorized; the visual inspection or localized nondestructive test methods such as acoustic or ultrasonic methods. All of these experimental techniques require the prior knowledge about the vicinity of the damage and the portion of structure being inspected should be readily accessible. Sometimes it is very difficult to have access to vicinity of the damage due to many constraints such as height and clear available space. These conventional damage detection methods may overlook the damage activity in sometimes especially when damage in the structures have been found in a situation where no outward indication of distress apparent. These undetected damages may result the catastrophic failure of structures. As Pearson K, et-al [1] reported that the collapse of precast segmental post-tension bridge in Wales (United Kingdom) had been occurred, six months after its periodic visual inspection and no sign of deterioration were apparent at that time. Therefore these conventional damage detection methods provide false sense of security. The performance of the structures ensured by this type of limited methods may always remain doubtful.

Past investigation and survey [2, 3] have been revealed that reinforced concrete and PC bridges have deteriorated even before their designed service-life due to corrosion and other environmental effects. There were many accidents in PC bridges reported in the

literatures [1,4] and the primary reason of these accidents was corrosion in pc tendon. As these collapse occurred without any prior warning. It is an urgent need to detect such corrosion induced damages in PC bridges at earliest possible stages.

Nowadays, vibration based damage detection (VBDD) methods gain more popularity and mostly use in SHM because of detection of damages at earliest stages and these methods don't need knowledge about damage location and accessibility to the location of damages. The basic principal idea of this technology is that commonly measured modal parameters (frequencies, mode shapes, and modal damping) are functions of the physical properties of the structures (mass, damping, and stiffness) and therefore changes in the physical properties of the structures will cause detectable changes in their modal properties.

When VBDD methods are used for SHM the main difficulty arises for its practical implementation caused by the sensitivity of modal parameters to damage. The frequency and mode shapes are not so sensitive indicator against damage as reported by different researchers [5, 6]. Damping of a system is associated with energy dissipation within a system. When damage is present in a system, some of energy is dissipated through defects. This dissipation in energy reflected as change in the damping value of damage system. Beside the dynamic behavior, the structural damage due to corrosion in PC tendon in PC beams lead to change in its static behavior. The behavior changes from ductile to brittle [7].

2. Objective

The main objective of this research is to investigate the sensitivity of modal damping ratio against corrosion-induced damages and to develop the damping model for corroded PC beams.

3. Methodology

For preliminary investigation, some small scale post tensioned PC beams were casted in the laboratory and corroded by artificial accelerated corrosion "impressed current" technique with three different level of corrosion. After corrosion process, modal testing was performed on corroded and control beams. The setup of dynamic modal testing is shown in Fig.1.

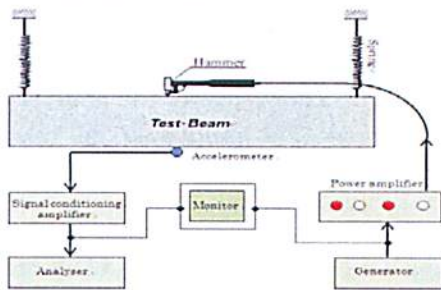


Fig. 1 Modal testing setup

The specimens were tested in free-free end condition. The test beam was excited with impact hammer and response was captured with accelerometer which was attached on opposite face. The position of accelerometer and impact point was selected to capture the mode of required interest. After getting the vibration data, the frequency response spectrum is obtained by applying Fast Fourier Transform (FFT) on input vibration data and structural damping is obtained by applying Log-decrement method on free decaying vibration record.

4. Discussion

The modal damping ratio for different level of corrosion is shown in Fig.2. The modal damping ratio is increased with increasing the level of corrosion. Modal damping is stable and sensitive indicator against corrosion induced damage. On the other hand modal frequency does not show any influence of change against corrosion induced damage Fig.3

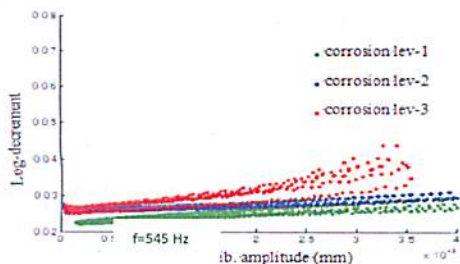


Fig.2 Log-decrement with different level of corrosion

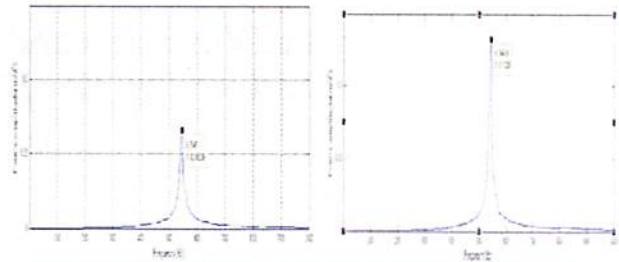


Fig.3 Frequency spectrum a).no corrosion b). corrosion level-1

5. Novelty

Usually PC structure experience the load during their service-life within elastic limit, it is very difficult to detect corrosion induced damage within elastic limit because corroded PC structures do not show any significant difference in their structural behavior within this limit (deflected shape and structural stiffness almost the same as of uncorroded pc structures). In this research work, the main emphasize is given to detect the corrosion induced damage in PC beams within elastic limit based on structural damping identification.

6. Conclusion

Based upon structural damping identification, it is possible to detect the corrosion induce damage in PC beams by conducting accurate modal testing.

References

- 1) Pearson, K. et.al, The performance of post tensioned bridges, *Parsons Brinkerhoff Limited*, Taunton, United Kingdom (2004)
- 2) Wallbank, R.J., The performance of concrete in bridges: a survey of 200 highway bridges, *Department of Transportation*, London 1989
- 3) Mutsuyoshi, H., Present situation of durability of post tensioned PC bridges in Japan, *Proceedings of workshop on durability of post tensioning tendons*, Belgium (2001)
- 4) Schokker, A., et.al, Grouts for Bonded Post-Tensioning in Corrosive Environments, *ACI Materials Journal* (2001)
- 5) Capozucca, R., Detection of damage due to corrosion in prestressed RC beam by static and dynamic tests, *Construction and Building Materials*, (2007)
- 6) Zuccarino, L. et.al, Sensitivity of modal parameter for damage detection in corroded beam element of Pescara benchmark, *9th international conference on damage assessment of structures, DAMAS*, (2011).
- 7) Rinaldi, Z. et al, Experimental evaluation of the flexural behavior of corroded P/C beams, *Construction and Building Materials*, (2010)
- 8) Daniele Z, Structural damage detection and localization by using vibrational measurements, *Doctoral thesis*, Universita degli studi di, Bologna (2003)

Characteristics of Vibration and Noise in Residential Environment Induced by Road Traffic and Railway

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Abstract

Heavy machines or vehicles produce vibration and noise, which can be detected by the people and can affect them in many ways: their quality of life and working efficiency can be reduced. The simultaneous effect of vibration and noise might lead to a total disturbance in residential environment. The main objective of this study is to investigate the simultaneous effect of vibration and noise on subjective responses. Measurements of building vibration induced by road traffic and railway were made by our research group at several single-family Japanese houses. Vibration data were analyzed to know the characteristics of vibration and noise occurred in real residential environments. The result shows that dominant frequencies are largely varied with location and source. The knowledge of the analysis result will be used to investigate combined effect of vibration and noise on annoyance in residential environment.

1. Introduction

Annoyance in residential environment due to combined effect of vibration and noise has been a worldwide problem. In terms of building vibration which may affect human occupants, vibration source may be either external or internal. Vibrations induced by external sources, such as: road traffic and railway may cause intolerable discomfort to humans in residential environment. Vibrations in buildings due to these sources are complex in nature: intermittent events characterizing pass-bys of road traffic and train involve various directions, magnitudes, frequencies, and durations of motion. The vibration usually occurs simultaneously with noise.

Previous studies concerned with simultaneous noise and vibration have mainly dealt with the effect of one stimulus on another. Howarth and Griffin [1] discussed the experimental results that increases in noise had less effect on the annoyance rating at higher magnitude of vibration and vice versa. Only few studies have been concerned with combined effect of environmental stimuli. The combined effects of vibration and noise on annoyance are reported in Howarth and Griffin [2] and Paulsan and Kastka [3]. It was reported by Howarth and Griffin [4] that the total annoyance was the summation of the individual effects of vibration and noise stimuli.

The objective of the investigation described in this paper was to understand the characteristics of vibration and noise in real residential environments so as to investigate subjective responses to simultaneous vibration and noise in such environments in an experiment planned.

2. Methodology

Measurements of environmental vibration and noise were made at five single-family Japanese houses by the side of a road or railway. Vibrations were measured simultaneously at the substructure and the second floor in all three orthogonal directions. Noises were measured at two locations that were inside and outside of the house with the windows closed. The duration of the measurement were over 40 minutes, which was long enough to record typical vibration and noise induced by road traffic or railway.

The Fourier transform was applied to the vibration and noise records so as to understand the frequency contents of the vibration and noise from their spectra. For the evaluation of vibration with respect to human responses the Vibration Level was calculated with the data recorded. The Vibration Level is defined in the Japanese Industrial standards (JIS) C 1510 that has been adopted in Japan as legal specifications for vibration measurement and evaluation under

the vibration Regulation Law. The vibration Level is defined as Eq.1 and Eq. 2

$$L_v = 20 \log_{10} \frac{a_{1v}(t_0)}{a_0} \quad [\text{dB}] \quad (\text{Eq. 1})$$

$$a_{1v}(t_0) = \left[\frac{1}{T} \int_{-T/2}^{T/2} [a_{1v}(t)]^2 e^{-\frac{t_0-t}{\tau}} dt \right]^{1/2} \quad [\text{m/s}^2] \quad (\text{Eq. 2})$$

a_0 : reference acceleration, 10^{-5} [m/s²]

$a_w(t)$: frequency : weighted acceleration [m/s²]

τ : time constant : 0.63 s

3. Results and Discussion

An example of the time history of vibration recorded and its spectrum is shown in Fig. 1. The vibration shown in the figure was recorded at the second floor in a house E by the side of road traffic. It can be seen that vibration are transient nature. The dominant frequency presented in the table was defined as a frequency at which the spectrum obtained by the Fourier analysis was greatest. The data of one event for 20 seconds were analyzed to make a comparison of amplitude spectra of signals recorded at the substructure and the second floor. From Table 1, it can be seen that dominant frequencies are largely varied from 5.6 Hz to 54.5 Hz. Acceleration produced by underground railway are maximum than others. On the other hand, magnitude of Vibration Level has seen highest in surface railway among all.

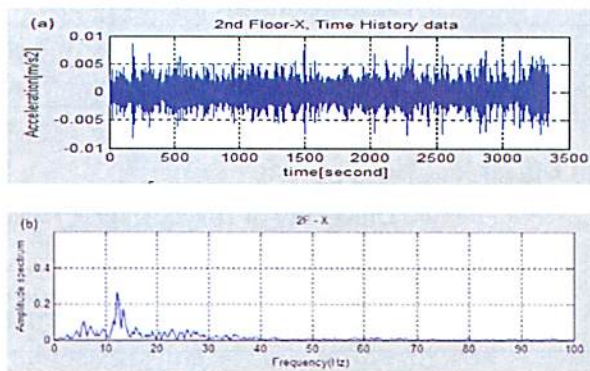


Fig: 1 An example of recorded signals at 2nd floor (a) in Time domain, and (b) in frequency domain.

Table 1

House	Measurement Point	Direction	Dominant frequency (Hz)	Max. Acceleration (gal)	Max. Vibration Level (dB)
A : surface railway, 2-storey	Substructure	X	13.2	3.13	55.9
		Y	13.2	4.13	59.3
		Z	12.5	8.69	62.9
	2 nd Floor	X	9.5	3.23	56.5
		Y	7.96	5.36	58.8
		Z	45.2	23.15	66.1
B : elevated railway, 2-storey	Substructure	X	16.2	1.47	44.1
		Y	34.5	1.91	45.9
		Z	16.5	2.13	47.9
	2 nd Floor	X	11.5	4.72	47.9
		Y	7.6	3.04	47.4
		Z	16.5	7.01	52.3
C : underground railway, 2-storey	Substructure	X	33.4	15.83	60.4
		Y	32	12.12	54.5
		Z	58	53.60	65.8
	2 nd Floor	X	32.5	3.62	51.8
		Y	33.2	5.26	50.4
		Z	33.2	32.96	60.1
D : 6 lane road, 2-storey	Substructure	X	13.5	1.18	47.8
		Y	9.1	4.34	50.7
		Z	9.6	6.72	54.1
	2 nd Floor	X	6.5	4.04	64.1
		Y	5.6	7.44	59.7
		Z	54.5	8.34	56.2
E : 2 lane road, 3-storey	Substructure	X	12.5	0.69	45.1
		Y	13.5	0.97	48.5
		Z	14	1.54	51.0
	2 nd Floor	X	13	0.87	51.4
		Y	16.2	2.51	55.2
		Z	14.5	7.43	54.2

4. Future work

The knowledge of the characteristics of maximum Vibration Level, dominant frequency and noise identified from the analysis result will be used in planning an experiment involving human subjects so as to investigate subjective responses to simultaneous vibration and noise in residential environments.

References

1. H. V. C. Howarth and M. J. Griffin (1990) *Applied Ergonomics* **21**(2), 129-134. The relative importance of noise and vibration from railways.
2. H. V. C. Howarth and M. J. Griffin (1990) *Journal of Sound and Vibration* **143**, 443-454. Subjective response to combined noise and vibration: summation and interaction effects.
3. R. Paulsen and J. Kastka (1995) *Journal of Sound and Vibration* **181**(2), 295-314. Effects of combined noise and vibration on annoyance.
4. H. V. C. Howarth and M. J. Griffin (1991) *Journal of the acoustical Society of America* **89**(5), 2317-2323. The annoyance caused by simultaneous noise and vibration from railways.

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78	Mr. Md. Habibullah Bhuyan	Scholar/Presenter	Saitama University
79	Mr. Md. Aftabur Rahman	Scholar/Presenter	Saitama University
80	Mr. Damith Nandika Hiniduma Liyanage	Scholar/Presenter	Saitama University
81	Mr. Frengki Hariara Pardede	Scholar/Presenter	Saitama University
82	Mr. Shahzad Saeed	Scholar	Saitama University
83	Mr. Md. Shafquat Hasan	Scholar	Saitama University
84	Mr. Asif Arshid	Scholar	Saitama University
85	Mr. Chandana Kumara Nawarathna Mudiyansele	Scholar	Saitama University
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89	Ms. Nirmala Kumuduni Dharmarathne	Scholar	Saitama University
90	Ms. Margarita Pelango Dizon	Scholar	Saitama University
91	Ms. Sushmita Hossain	Scholar	Saitama University
92	Mr. Thanh Tung Pham	Scholar	Saitama University
93	Mr. Naoya Abe	Associate Professor, Department of International Development Engineering	Tokyo Institute of Technology
94	Professor Motoko Shuto	Professor, Department of International Public Policy	Tsukuba University
95	Ms. Aichurek Mamazhanova	Scholar	Tsukuba University
96	Mr. Emerson Sanchez	Scholar	Tsukuba University
97	Prof. Jay Rajasekera	Professor of Management Systems and Strategy Graduate School of International Management International University of Japan	International University of Japan
98	Prof. Wenkai Li	Assistant Professor of Operations Management	International University of Japan
99	Ms. Vandee Chimcherd	Scholar	International University of Japan
100	Ms. Fatima Lourdes Del Prado	Scholar	International University of Japan
101	Ms. Thi Anh Thu Le	Scholar	International University of Japan
102	Mr. Moinul Islam	Scholar	International University of Japan
103	Mr. Samir Sharma	Scholar	International University of Japan
104	Ms. Kiyoko Tanaka	Assistant Administrative Manager	Ritsumeikan University
105	Ms. Tuyen Pham Dan Van	Scholar	Ritsumeikan University
106	Mr. Baterdene Sharav	Scholar	Ritsumeikan University
107	Mr. Kimty Seng	Scholar	Ritsumeikan University
108	Ms. Sunate Kampeeraparb	Associate Professor and International Student Advisor, Graduate School of International Development	Nagoya University
109	Ms. Marie Donna Montesa Ballesteros	Scholar	Nagoya University

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111	Ms. Ika Permata Sari Silalahi	Scholar	Nagoya University
112	Ms. Ariunsarnai Ganbat	Scholar	Nagoya University
113	Mr. Surenjav Chuluun	Scholar	Nagoya University
114	Prof. Nobuaki Matsunaga	Coordinator, Graduate School of International Cooperation Studies	Kobe University
115	Ms. Mai Nguyen Thi	Scholar	Kobe University
116	Mr. Mizan Bustanul Fuady Bisri	Scholar	Kobe University
117	Mr. Md. Mehedi Hasan Sikdar	Scholar	Kobe University
118	Mr. Takahiro Fujiwara	Research Assistant Professor	Kyushu University
119	Ms. Ratih Madya Septiana	Scholar	Kyushu University
120	Prof. Yamagami Susumu	Vice President	Ritsumeikan Asia Pacific University
121	Mr. Masashi Kimura	Coordinator	Ritsumeikan Asia Pacific University
122	Mr. Galey Tenzin	Scholar	Ritsumeikan Asia Pacific University
123	Ms. Thanh Huong Nguyen	Scholar	Ritsumeikan Asia Pacific University
124	Ms. June Cahyaningtyas	Scholar	Ritsumeikan Asia Pacific University
125	Ms. Ei Mon Swai	Scholar	Ritsumeikan Asia Pacific University
126	Mr. Phuong Hoang Nguyen	Scholar	Ritsumeikan Asia Pacific University