



Fig.1 A concrete structure damaged by chloride attack

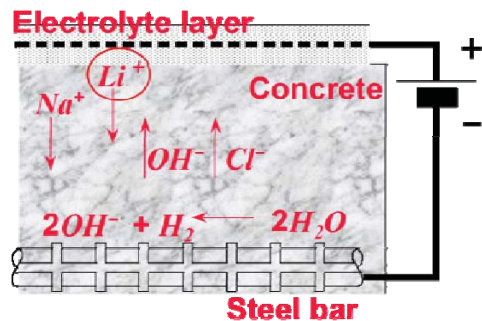


Fig.2 Principle of electrochemical repair methods

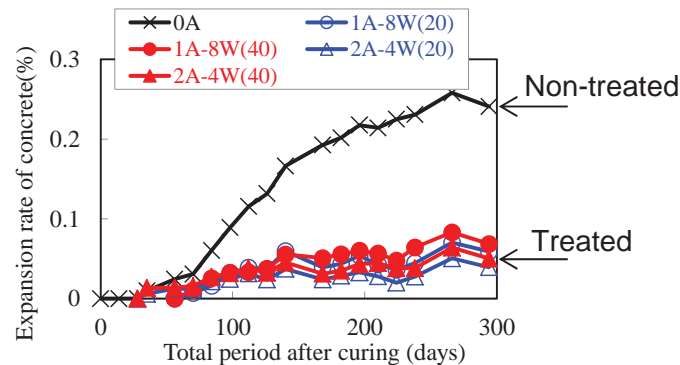


Fig.3 Suppression of concrete expansion due to applying electric current

### Content:

Reinforced concrete structures have been regarded as so excellent type of infrastructure because of their high durability guaranteed by the adequate design and construction. However, these days, a part of such structures have showed premature deterioration due to severe attack of environmental factors. Fig.1 shows an example of structures heavily damaged by the chloride attack supplied by sea water.

As the effective an repair method against steel corrosion in concrete as shown in the case of chloride attack, the electrochemical repair method has been focused. The principle of this method is shown in Fig.2. Electrochemical migration of ions in concrete or penetration of alkali solution into concrete results in improvement of the durability of structures.

Recently, our research team has tried electrochemical penetration of lithium ions which can suppress concrete expansion and cracking due to ASR. Fig.3 shows successful suppression effect achieved by the proposed electrochemical method.

Keywords: chloride attack, ASR,  
electrochemical repair methods

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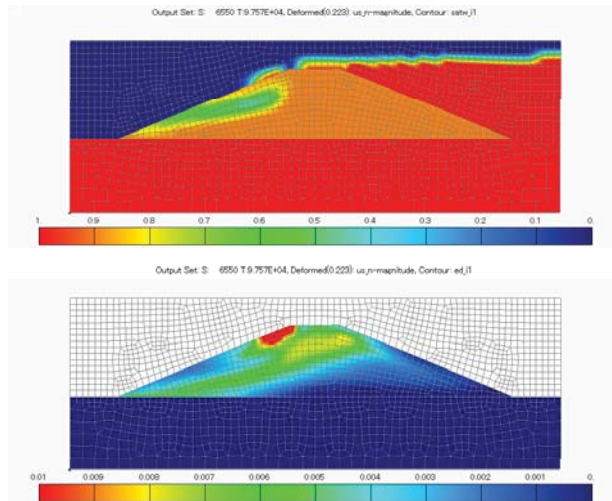
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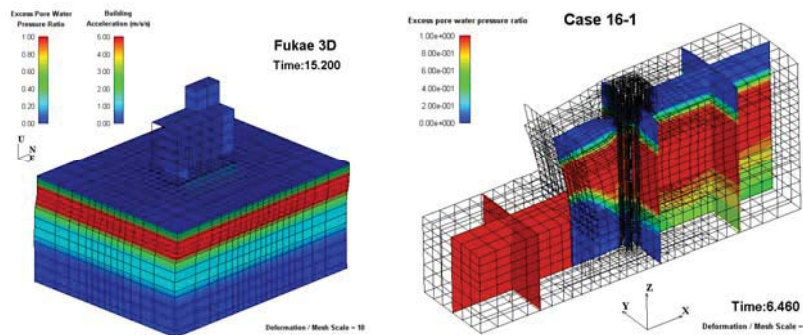
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Prediction of failure of river levee during overtopping



Prediction of soil-foundation-superstructure seismic response during liquefaction

## Content:

Recent natural hazards such as typhoon, earthquake, have caused severe damages to society due to the increase in population in Asian countries. Prediction and remediation method of ground and structures are necessary to mitigate the natural disaster.

Coupled hydro-mechanical properties and modeling of soil and their numerical methods are studied to understand the behavior of multi-phase soil structures consisted of soil skeleton, pore water and pore air. The major research subjects are the follows.

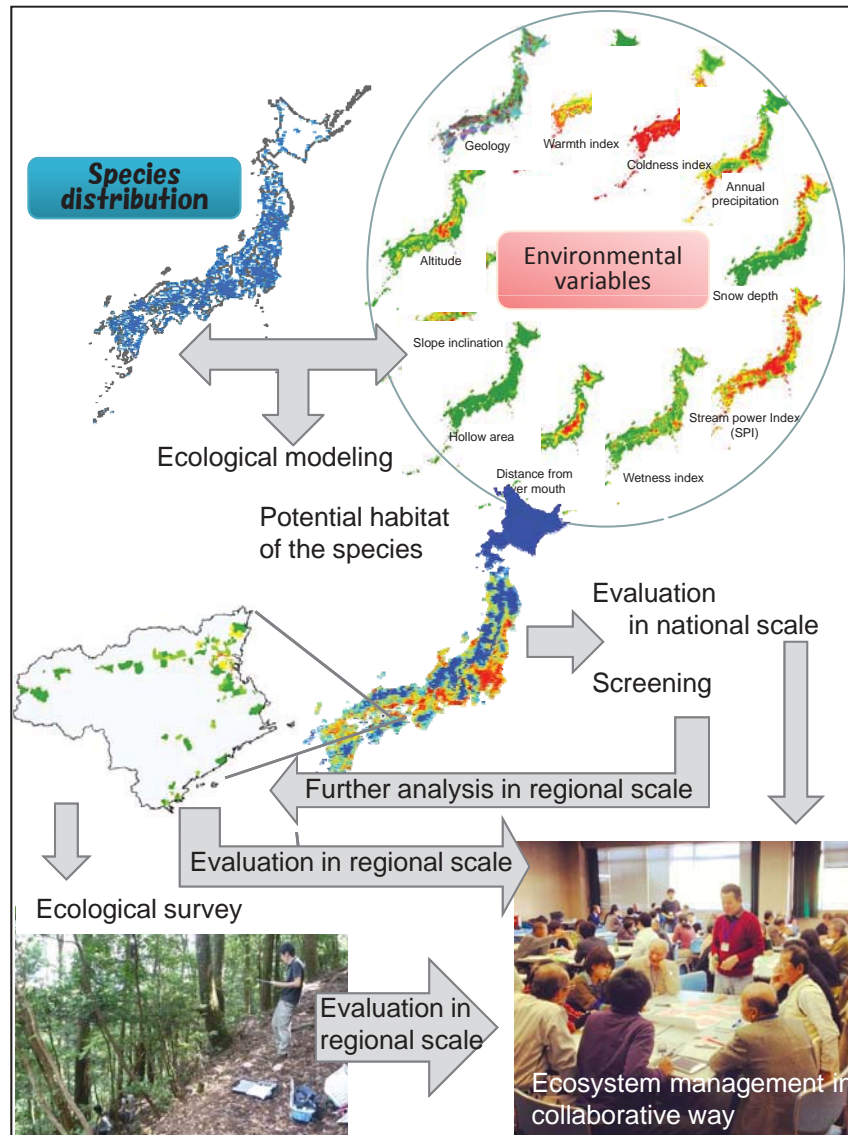
- Deformation and failure of soil structures such as river levee, road embankment and earth dam (upper figures)
- Liquefaction-induced settlement and lateral flow of ground, failure of soils structures
- Seismic behavior of foundation in a liquefied ground (lower figures)
- Combined hazard with rainfall and earthquake

Keywords: Natural hazard, numerical analysis

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## Content:

1. Evaluation and planning of ecosystems based on estimation of potential species distribution
  - National scale
  - Regional scale
2. Ecological survey in various ecosystems designing the method of conservation and restoration of ecosystems as regional resources
  - Forest (Natural, semi-natural, artificial, bamboo)
  - Grassland
  - Agricultural area (Paddy field and irrigation channel)
  - River
  - Wetland
  - Mangrove swamp, etc.
3. Way of collaboration for ecosystem management
  - Network of human resources
  - Management of collaborative process

Keywords : Ecosystem Management, Landscape Ecology

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# Mitigation Technique for Eutrophicated Sea Areas and Tsunami Disaster

## Professor Yasunori Kozuki



A stone tablet warns residents not to build homes below it.



Water Purification Channel in Amagasaki Canal



JYUNKAN of Nutrients n Amagasaki sea areas

### Content:

Japanese coastal areas are one of the most developed places on the earth. This is where people extract mineral resources, catch fish, develop aquaculture, engage in recreational activities, launch construction projects, etc. This is why it is necessary to organize the use of coastal resources in such way so it would not damage the natural environment and marine ecosystems. In the meantime, Japan has frequently suffered from tsunami damage. The tsunami following the 2011 Great East Japan Earthquake caused unprecedented damage. The Nankai Trough Megaquake are predicted to cause devastating tsunami damage. Our study aims to develop water environment improvement technology for closed sea areas and mitigation of tsunami disaster.

- 1) Development of Concrete contained Amino Acid for Mitigation of Enclosed Sea
- 2) Development of Environmental Quality Improvement Port and Channel with Citizen in Amagasaki Canal, Japan
- 3) The after-effects of hypoxia exposure on the clam *Ruditapes philippinarum* in Osaka Bay, Japan
- 4) Development of supporting system for pre-recovering for anti-Nankai Trough Megaquake Tsunami disaster
- 5) Historical Study of Earthquake Tsunami
- 6) Learning Method of Environment Conservation and Disaster Prevention

Keywords: Enclosed Sea Environment, Tsunami Disaster, Learning Method

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# Effects of Urban Policies Contributing to Increase in Physical Exercise

Professor Akio Kondo

## Increase in People suffering from Life-style related Disease because of Lack of Physical Exercise in Urban Area

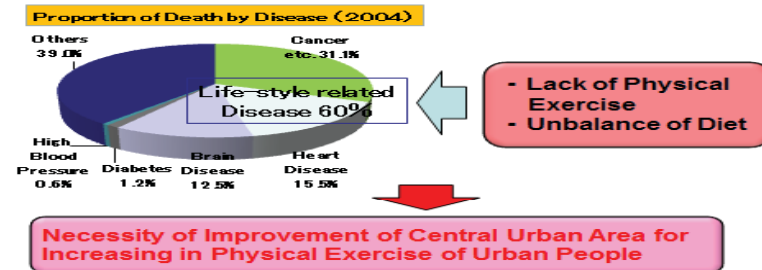


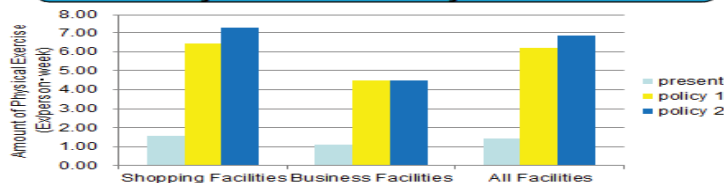
Fig.1 Motivation and Problems

## Proposal of Urban Policies Contributing to Increase in Physical Exercise

- Policy 1 : Improvement of Walking Path**  
This policy is that the walking path having beautiful scenery and the green environment where people enjoy walking are improved.
- Policy 2 : Provision of Information related to Health**  
The information is that the risk to get the disease of high blood pressure is reduced by 30 % if you walk more than 21 minutes in one way in commuting every day.

Fig.2 Proposal of Urban Policies

## Effects of Urban Policies on Increase in Physical Exercise by Policies



2 policies proposed here show the effects on increase in physical exercise. Amount of physical exercise increase when the policies are introduced in comparison with the present time.

Fig. 3 Effects of Urban Policies

## Content:

Many studies show that regular moderate physical activity such as walking and cycling is beneficial for health promotion. The aim of this study is to propose policies promoting physical activity and measure their effects. Focusing on the transport behavior access to living environment facilities, two policies are considered. One is supplying well-paved road for walking and cycling, another is providing information about the relationship between physical activity and health.

First, we estimate the health awareness of residents by a questionnaire survey carried out in Tokushima urban areas and find out that about 30% of residents are considered health is important in their behavior. And then, the quantity of physical activity is calculated. The quantity of physical activity under policies is found to be 1.5~7.2Ex per week more than that without policies.

Keywords: Urban Policies, Physical Exercise, Estimation of Effects, Life-style related Disease

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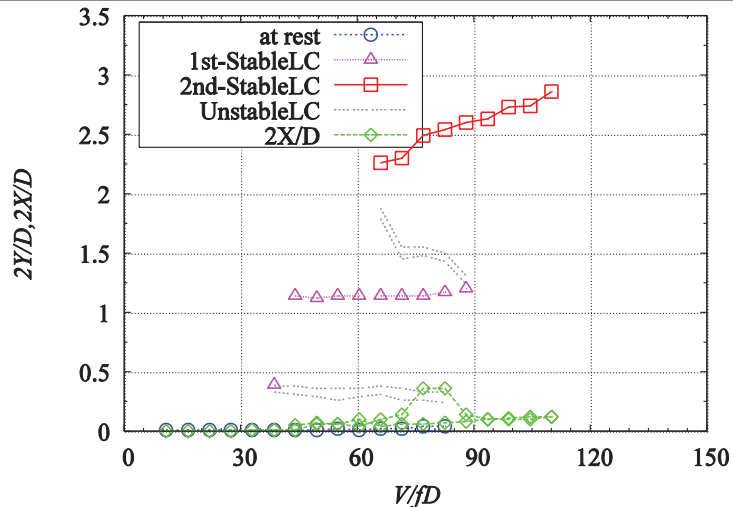


Fig.1 Example of transverse & longitudinal response of the leeward cylinder in tandem arrangement (ratio of central distance of cylinders,  $L$ , to diameter,  $D$ ,  $L/D=3$ , Scruton Number,  $Sc$ , is 16.4)



Fig. 2 Experiment of wake excitation behind railing of building roof for possibility of wind-generated electricity

## Content:

In multiple objects, components and structures of circular cross-section located on the downstream of the upstream object, by the mutual interference with the downstream circular section body and the downstream flow of the upstream object, the aerodynamic unstable vibrations, also referred to as wake excitation is generated, but the mechanism of the vibration has not been entirely clear.

In this study, it is intended to clarify the mechanism of unstable aerodynamic wake excitation and to be used in wind-generated electricity of this phenomenon of the cylinder. Here, the wind power energy of aerodynamic vibration of downstream cylinder is obtained as follows: the horizontal material or the like of Railing or parapet of the building roof and wheel guard of the bridge is used for the upstream object and a cylinder is set up behind them. It is able to fulfill a significant contribution to reducing CO2 emissions.

Keywords: closed arrangement of cylinders, wind tunnel and field test

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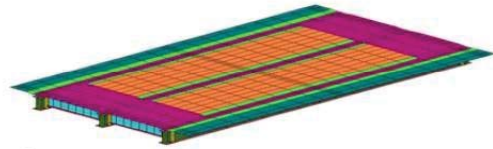


Fig.1 Analytical model of steel girder bridge

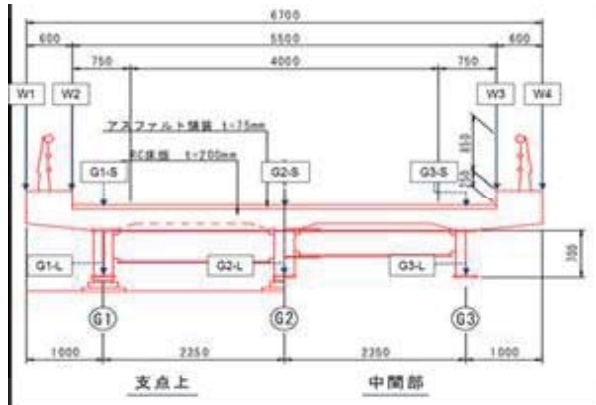


Fig.2 Points for measurement of vibrations (Ten points: W1~W4)

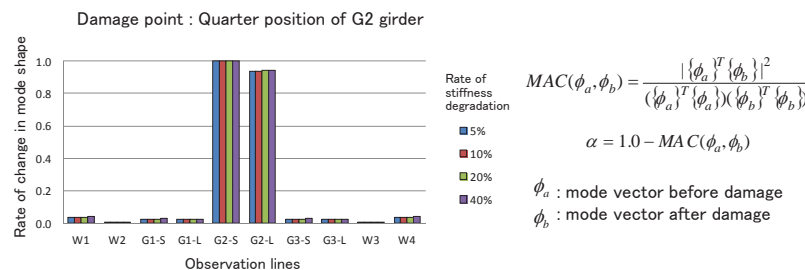


Fig.3 Rate of change in mode shapes at each observation line

## Content:

I deal with a method for damage identification of composite girder bridges based on the changes in the modal characteristics. Generally damage to structure causes any change in modal characteristics of the structure.

In this study, from the results of modal analyses of a girder bridge with sixty damage scenarios, it became clear that the changes in the primary mode shapes of target lines and in the primary natural frequency have a close relation to the places and degrees of damages to the bridge. We proposed a method for damage identification of girder bridges based on the changes in modal characteristics and examined the validity of the method based on the results of damage identification for other damage scenarios of the bridge.

Fig.1 shows an analytical model of steel girder bridge used in this study. Fig.2 shows the cross section of the bridge and the vibration measurement points are indicated on it. The rates of change in the first mode shape in the case that quarter position of G2 girder is damaged are shown in Fig.3. From Fig.3, it is clear that the rate of change in the first mode shape at the points near G2 girder are predominant. This suggests that we can find the damaged girder from the change in the first mode shape.

The other analytical results show that the changes in both the first mode shape of observation lines and the first frequency respectively give the damage location and degree. I will study further on damage identification method for road bridges both analytically and experimentally and finally verify our method through the application to real bridges.

Keywords: modal analysis, damage identification, stiffness degradation, bridge

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# Placement related Performance Evaluation of Fly Ash Concrete

Professor Chikanori Hashimoto

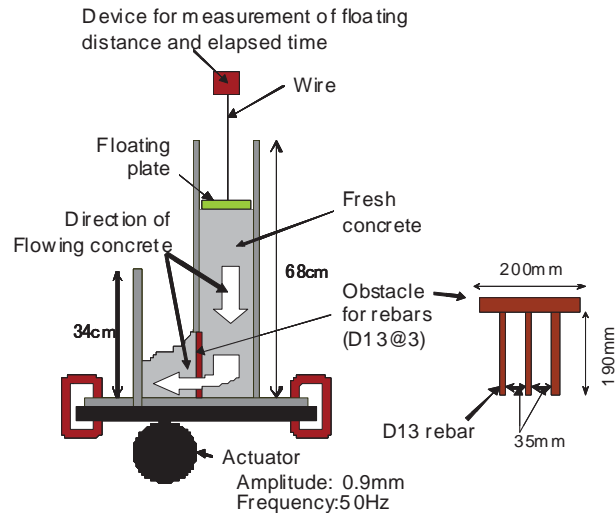


Fig.1 Overview of the box shaped-filling ability test on table vibrator

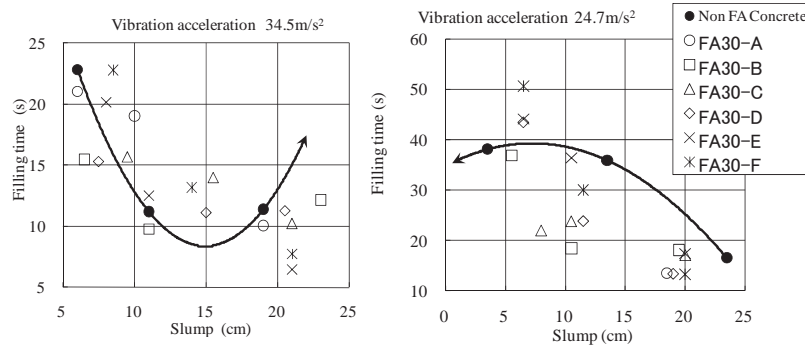


Fig.2 Effect of vibration acceleration on filling time of six fly ash concretes and normal concrete

## Content:

Fly ash brings about fair concrete placement ability to fresh concrete mixture, i.e., easy flow while construction and stability against segregation during and after works. Fly ash is an assembly of fine particles with spherical shape of the specific surface area more than 3000cm<sup>2</sup>/g.

My laboratory team paid their attention to the filling time acquired by the box shaped filling ability test (See Fig.1) on a table vibrator in view of workability. The time when the floating plate falls down to 20cm is used as the characteristic index. In engineering viewpoint, shorter filling time indicates fair compactability by vibrating works.

The summary of slump versus vibration filling time is shown in Fig.2. The vibration acceleration of 34.5m/s<sup>2</sup> was targeted for placing concrete into pre-cast units or forms of seismic resistant RC members having large amount of steel. Another case of 24.7m/s<sup>2</sup> is thought to be placing in normal sites.

As a matter of fact, the filling time of fly ash concrete was smaller than the normal one over 20cm of slump. It implies that the arching risk was more avoided for fly ash concrete. It is thought to be a mechanism why fly ash concrete exhibits higher workability especially in the case of high consistency.

Keywords: fly ash, fresh concrete, filling ability test, construction placement, slump, vibration, filling time

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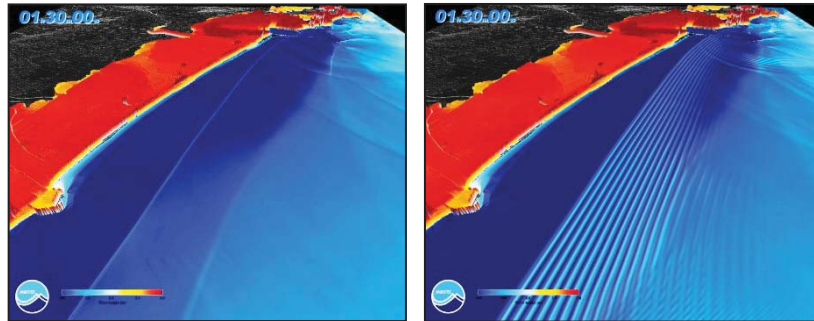
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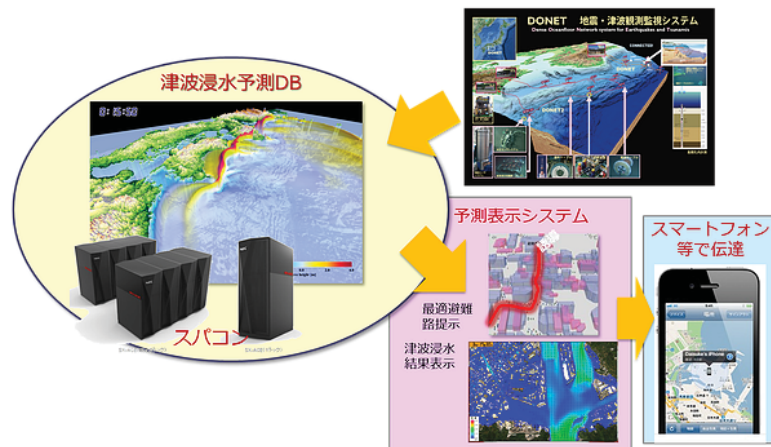
### <2011 Tohoku Tsunami Simulation>



Numerical tsunami simulation based on the long-wave theory

Numerical tsunami simulation based on the Boussinesq dispersive theory

### <Tsunami Prediction using Super-computers>



Database based tsunami prediction system (under development)

We develop a tsunami simulation code named JAGURS under a collaboration among several tsunami research institutes. The long-wave equations are commonly used in the tsunami prediction, but it is essential to include the characteristics of tsunami dispersion for detail investigations. Accordingly, JAGURS solves the nonlinear Boussinesq dispersive equations in both of spherical and Cartesian coordinates. A variable nested algorithm is used to increase spatial resolution in the target region. JAGURS is optimized on super-computers such as the K computer and Earth simulator to conduct large-scale tsunami calculations with high-speed.

Our research focuses on the Nankai subduction zone in the southwestern Japan, where the great earthquake accompanied by tsunami is anticipated to occur in the near future. Tsunami database including all possible tsunami scenarios in the Nankai subduction zone is being created with JAGURS on the super-computers to enhance awareness of residents and countermeasures of the local-governments.

Keywords: Tsunami, Nankai Trough, Disaster Prevention

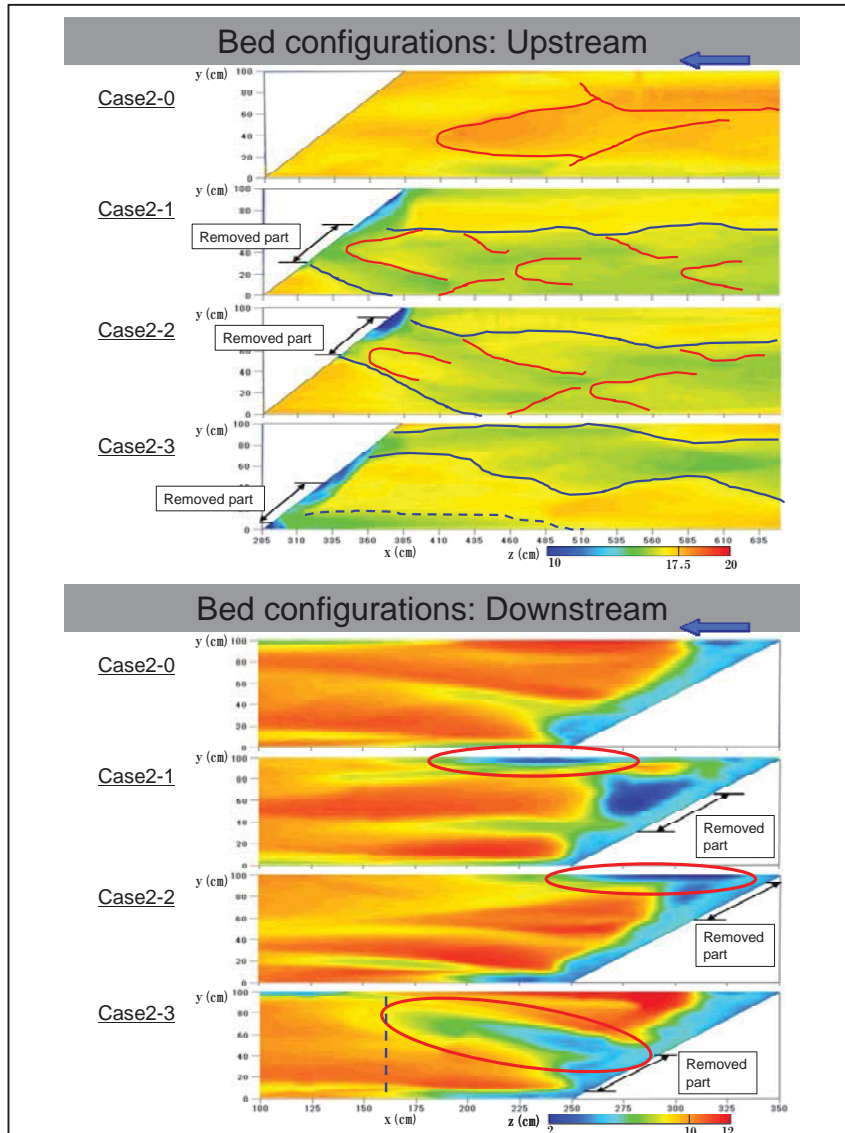
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## Content:

Dams and falling works usually contribute river bed stabilisation, but they at the same time bring some defects on river environments, such as yielding a still water section, depositing sediments there, and preventing fish migrations. Several engineering schemes can be considered to improve such a situation, i.e. full removal, height reduction, redesigning such as slit-type, etc. These schemes, however, naturally cause bed degradation in the upstream reach and abrupt increase of sediment supply in the downstream reach, then it possibly leads to channel instability. Owing to the lack of information on river bed change following dam removal or falling works improvement, these schemes have not widely adopted in real rivers.

A series of experiments were conducted to study effects of falling works improvement on scouring and bed evolution around it. Water surface profiles, velocity distributions and bed configurations at an equilibrium condition were measured.

Keywords : Falling works, Partial removal, Experiment, Bed evolution, Velocity distribution

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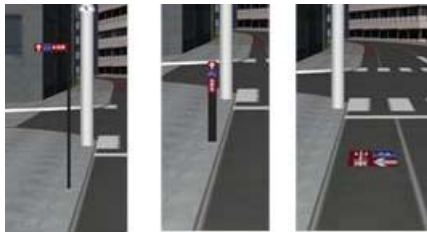
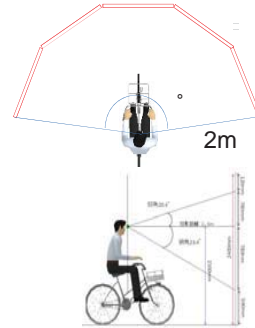
Faculty of Engineering  
Tokushima University

# Analysis Systems for Bicycle Behavior and Safety Facilities

Professor Hideo Yamanaka



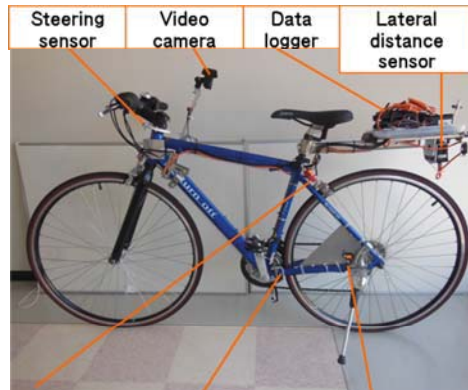
Wide vision bicycle simulator



Road signs and markings



Repeated coloured sign syste,



Probe Bicycle

street	~105°	~75°	~45°	±15°	~45°	~75°	~105°
old ~75°	0%	0%	0%	0%	0%	0%	0%
old ~45°	0%	3%	11%	11%	3%	0%	0%
old ±15°	0%	2%	13%	22%	7%	1%	0%
old ~45°	1%	2%	7%	12%	2%	1%	0%
old ~75°	0%	0%	0%	1%	0%	0%	0%
young ~75°	0%	0%	0%	0%	0%	0%	0%
young ~45°	1%	5%	22%	30%	12%	3%	1%
young ±15°	1%	2%	4%	8%	4%	0%	0%
young ~45°	0%	0%	2%	2%	1%	0%	0%
young ~75°	0%	0%	0%	0%	0%	0%	0%

Example of Gaze fixation by bicycle users

## Content:

Japan is one of the top bicycle friendly countries as the transport mode for urban areas. It is not so safe for bicycles that use sidewalks on both directions. Studies on bicycles are not enough comparing with that on motor vehicles. Our study aims to make clear the effects by road design, signs, warning system for bicycle safety by developing the following methods for analyzing their behavior.

1) Bicycle simulator with wide visions : We analyze effects by warning system and road markings in order to decrease bicycle intersection accidents. Cooperated bicycling and driving simulator system is under developing for the analysis of conflicts in junctions

2) Probe bicycle: It can measure speed, braking, steering, vibration, and overtaking speed and lateral distance of vehicle aside automatically in order to evaluate level of service for bicycles.

3) Eye movement analysis system : By using Eye-mark recorder (EMR-9) which can measure eye movement during cycling, we analyze the effects on gaze behavior by the factors such as old people, junctions, bus stop, night time and so on.

Keywords : Road design, Bicycle facilities, Traffic safety

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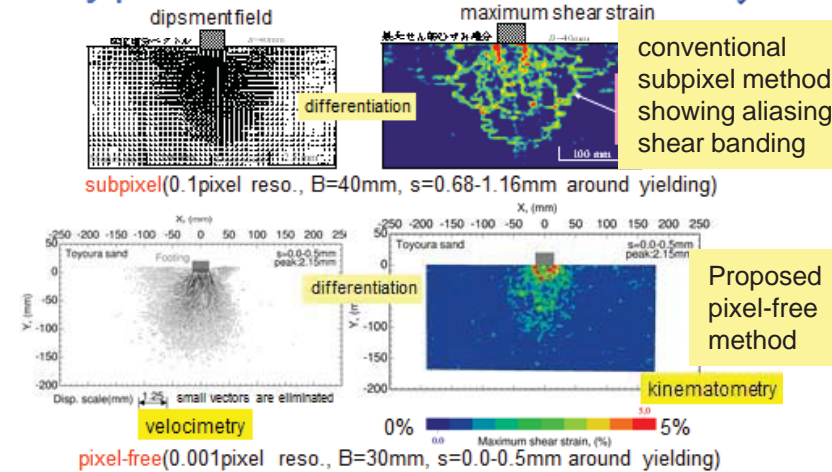
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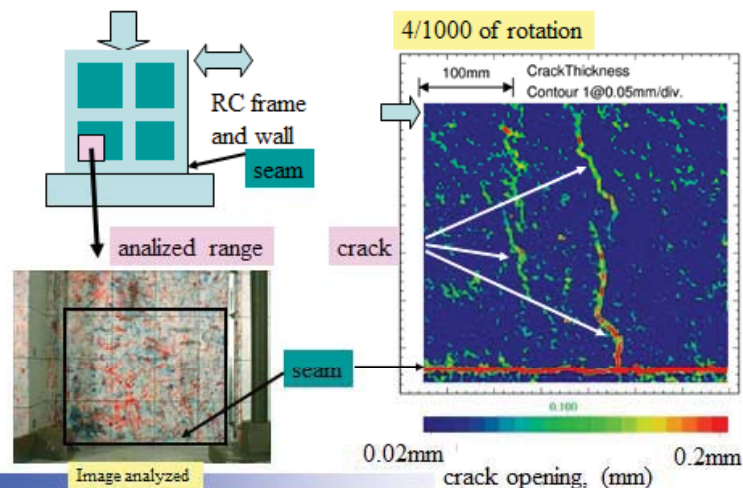




## Why pixel-free? evidence (1g tests)



## Crack opening due to cyclic combined loading



Kinematometry is a newly coined word, which means a method to obtain kinematic information, i.e., movement and deformation, especially strains of geotechnical objects. A new precise matching algorithm was developed. The algorithm provides completed pixel-free measurements, which can eliminate accumulation of errors produced in successive photometry analysis. Errors in strain calculation arising from the discrete structure of conventional raster image data are also avoided by means of this pixel-free algorithm having a 0.001 pixel of resolution.

Accuracy of the algorithm was examined by using both artificially deformed images and actually translated images. The results showed that the errors were less than 0.2 pixels for artificially deformed images within 20% of strain, while 0.05 pixels for translated images.

Figures presented here are examples of the applications: shear banding under strip footing and crack opening in reinforced concrete structures subjected combined cyclic loading.

K. Ueno et al. (2014): Surface kinematometry by image processing for geotechnical model tests, Physical Modelling in Geotechnics, Vol. 1, pp. 337-343, CRC Press.

Keywords: deformation and failure characteristics of sand, kinematometry

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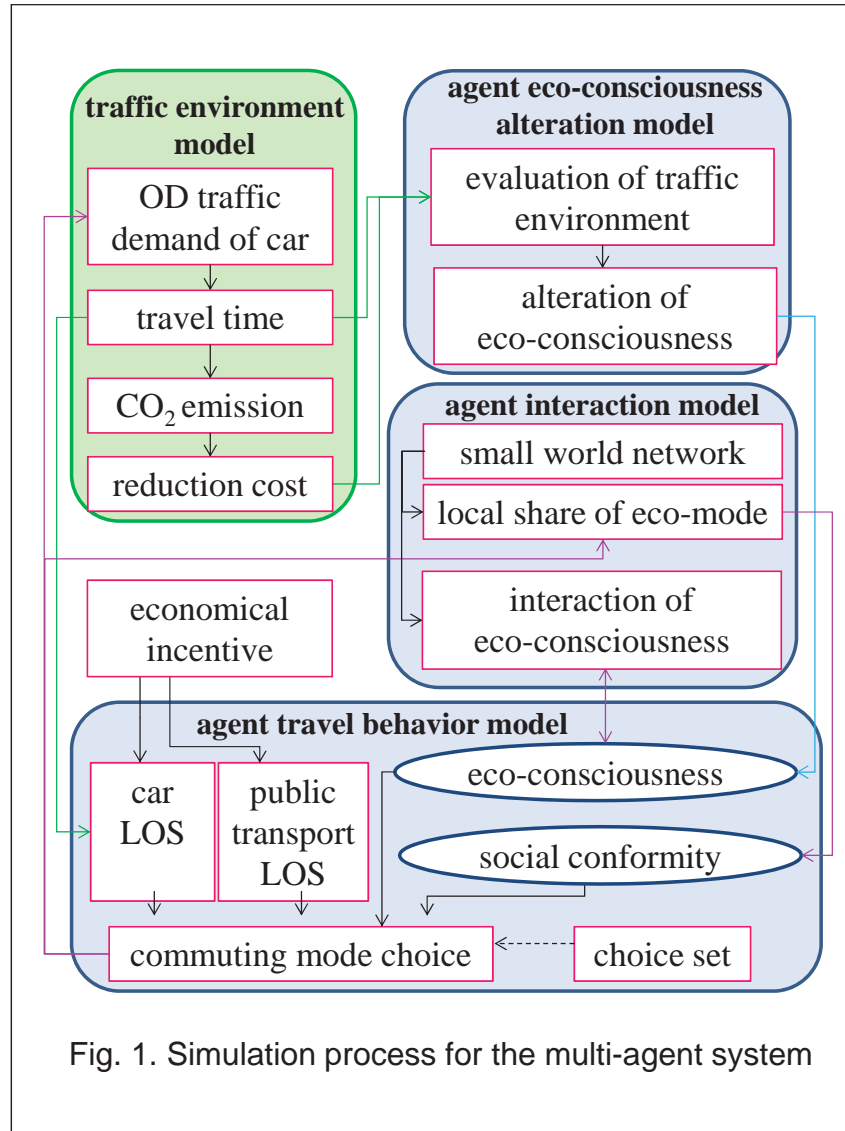


Fig. 1. Simulation process for the multi-agent system

## Content:

Consciousness for the environmental problem of individual trip maker is important for eco-commuting promotion. Consciousness for environment would be changed by influence of other people. Therefore, the multi-agent transport simulation model with social network in small world is developed to describe the local interaction on commuting mode choice process in the study. The outline of the multi-agent simulation system is shown in Fig. 1. The developed simulator consists of four interactive procedures such as the agent travel behavior model, the traffic environment model, the agent eco-consciousness alteration model and the agent interaction model. The commuting mode choice is described considering with the social interaction in the agent travel behavior model. On the other hand, the carbon dioxide emission from the traffic flow on urban network is estimated in traffic environment model. Moreover, the agent updates the consciousness for environment according to the evaluation of traffic environment in the agent eco-consciousness alteration model. Furthermore, the eco-consciousness of the agent is influenced by the related agents in the agent interaction model. Particularly, the relation between agents is defined based on the small world network.

Keywords : multi-agent simulation, social interaction, small world network, consciousness for environment, transport mode choice

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# The effects of global warming and dams for Native Dolly Varden in Japan

Associate Prof. Yoichi Kawaguchi

## Dolly Varden (*S. malma*)



**In Kanayama River, a total of 28 dams are present in less than a 5 km stretch. Widened streams and riparian deforestation resulted in warming the stream temperatures.**



## Content:

We investigated population abundance of native Dolly Varden *Salvelinus malma* in mountain streams of northern Japan in relation to several physical habitat characteristics including water temperatures and small dams. Hokkaido Island is the world's southern most distribution margin of native Dolly Varden, and it has been projected that many populations would suffer from severe summer stream temperature warming due to habitat alterations such as construction of erosion- and flood-control dams and potential impacts of global climatic warming. However, there has been little effort in obtaining basic information on the species' population abundance and thermal habitat over successive years. Therefore, in an attempt to initiate long-term research, we began collecting fish data by electrofishing and temperature data by installation of temperature loggers in 37 streams in 2000. We found that several Dolly Varden populations showed signs of recruitment failures among years and less abundance in streams where summer maximum stream temperatures far exceeded the species' thermal tolerance of around 16°C. In this paper, we will primarily focus on our findings during 1999-2001 and 2006-2013 field surveys.

**Keywords:** Global warming, restoration ecology, stream ecology,

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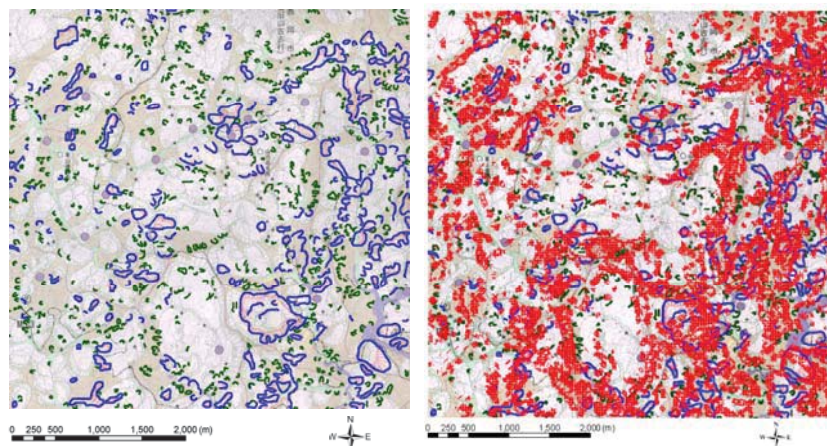
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# Analysis, Evaluation and Disaster Mitigation of Landslides and Engineered Slopes under Earthquakes and Rainstorms

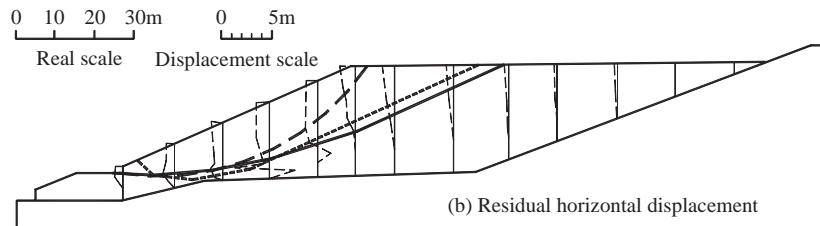
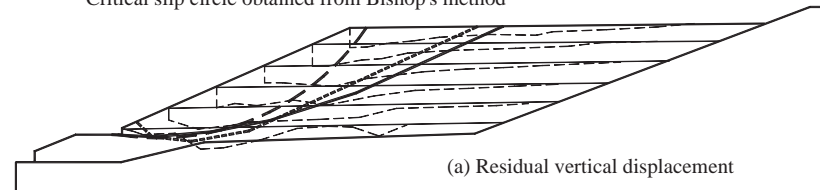
Associate Professor Jing-Cai Jiang



Distribution of landslides in the Yamakoshi village area triggered by 2004 Niigata-ken Chuetsu Earthquake

Distribution of calculated seismic displacements of slopes and actual earthquake-induced landslides

- Slip surface with maximum permanent displacement
- - - - Critical slip surface located in static FE stress field
- · - Critical slip circle obtained from Bishop's method



Estimated and observed deformations in Kotobukiyama fill slopes caused by 1978 Earthquake off Miyagi Prefecture

## Content:

My research interests cover a number of areas in landslides and engineered slopes under earthquakes and rainstorms: field reconnaissance and investigation of earthquake or/and rainfall-induced slope disasters, mitigation of slope disasters natural and engineered slopes associated with highways, and slope stabilization works. Our research achievements in three-dimensional slope stability analysis, back calculations of shear strengths of landslide soils, remedial works of large landslides and rockfall numerical simulations have been published as original papers in top-rank international journals in geotechnical engineering, such as *Soils & Foundations*, *Canadian Geotechnical Journal*, *Computers & Geotechnics*, and *ASCE Journal of Geotechnical and Geoenvironmental Engineering*.

## Present and recent interests of research:

- Risk assessment of earthquake-induced landslides
- Seismic instability evaluation of large scale cut/rock slopes
- Static/dynamic shear strengths of landslide soils and slope stabilization design
- Characteristics of failure/slip surfaces and ground water of landslides in fissure soils
- Landslide potentials around reservoirs and their risk/damage assessment under strong earthquakes
- Rockfall numerical simulation using DEM and DDA

Keywords: landslides, rainfall, earthquake, disaster mitigation

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# Clarification of effective stress for unsaturated soils and its application to static liquefaction of infinite slope during rainfall

Associate Profssor Hisashi Suzuki

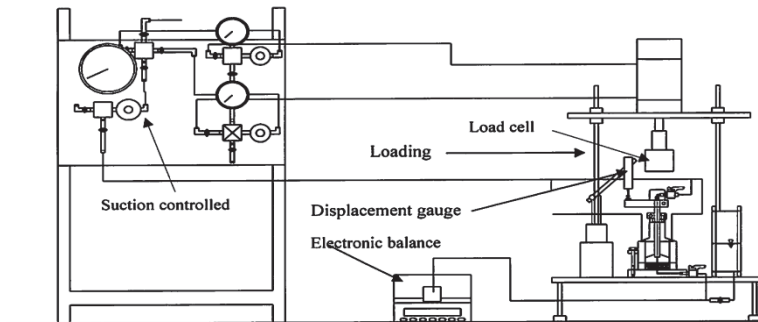


Fig. 1 Suction controlled consolidometer apparatus

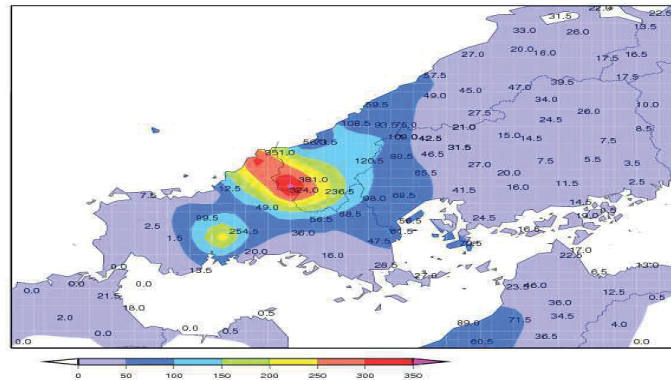


Fig. 2 The precipitation in Tuwano-Cho on 28<sup>th</sup> July in 2013 and its avalanche of rock and earth

## Content:

Soil mechanics had established by finding out effective stress principle for saturated soils. The absolute assumption of it is that soil particles and water are incompressible. However, unsaturated soils includes high compressible air. Bishop has proposed the famous effective stress, but his equation was denied by the collapse phenomena with the decrease of suction. Moreover it is too difficult to determine the effective stress parameter  $\chi$ .

Recently, elasto-plastic and seismic response analyses of unsaturated ground are performed by using the simple effective stress which  $\chi$  is equal to degree of saturation  $S_r$ . The validity of this equation was verified the suction controlled consolidometer apparatus as shown in Fig.1. I will intend to apply effective stress for unsaturated to static liquefaction of infinite slope during guerilla heavy rainfall as shown in Fig.2. As avalanche of rock and earth is occurred when soils changes from solid to liquid, that is, static liquefaction, then there are no effective stresses in unsaturated soils slope. I will mathematically solve instability of infinite slope.

Keywords: soil water characteristic curve,  
suction, static liquefaction

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# A METHOD FOR ESTABLISHING STAGE-DISCHARGE RATING CURVE BY USING RAINFALL, WATER LEVEL DATA AND RUNOFF MODEL

Associate professor Takao Tamura

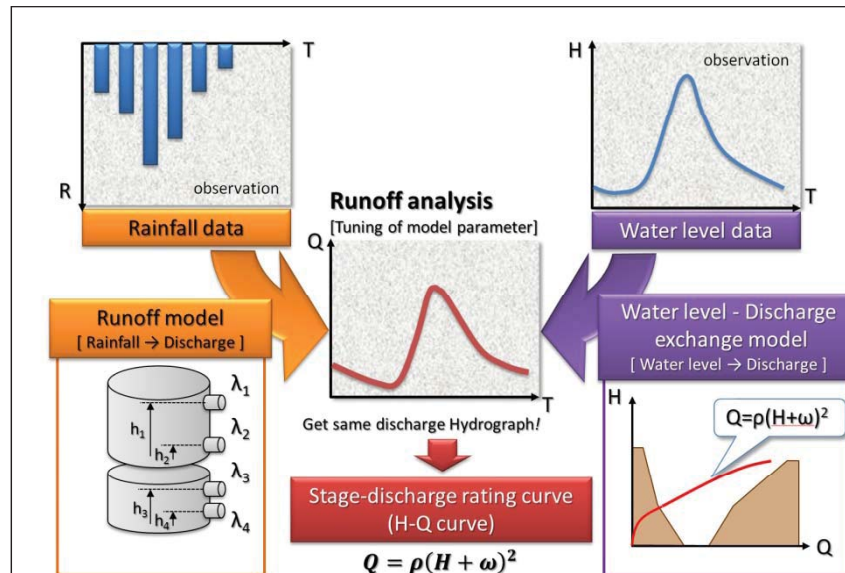


Fig.1 Method of making H-Q curve by using runoff model, rainfall data, and water level data

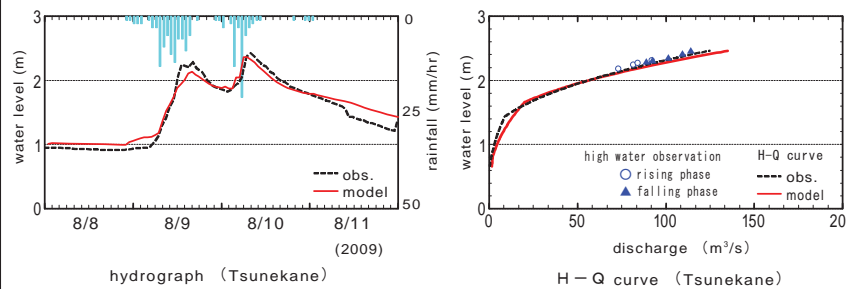


Fig.2 Comparison between H-Q curve made from runoff model and observed flow rate

## Content:

A method for establishing stage-discharge rating curve ( $H-Q$  curve) in a flood event was discussed, which used a runoff model to the rainfall data and the water level data observed in a basin. A quadratic function that represented the  $H-Q$  relation in the river channel was built into the runoff model. When the observed water level hydrographs during a flood event was reproduced by the model, the  $H-Q$  curve was established. (Fig.1)

The method was applied to some water level and flowing quantity observation stations in Shikoku in West Japan. The established  $H-Q$  curve was compared with the  $H-Q$  curve based on the runoff observation. The error margin of the established  $H-Q$  curve and the observed was about 10% or less. (Fig.2)

The proposed method can be used to verify and adjust the observed  $H-Q$  curve that may lead to an unsatisfied water budget of rainfall and discharge for the basin.

**Keywords:** stage-discharge curve(H-Q curve), runoff model, rainfall data, water level data, water budget

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### 1) 36 factor keywords and an example of the analysis

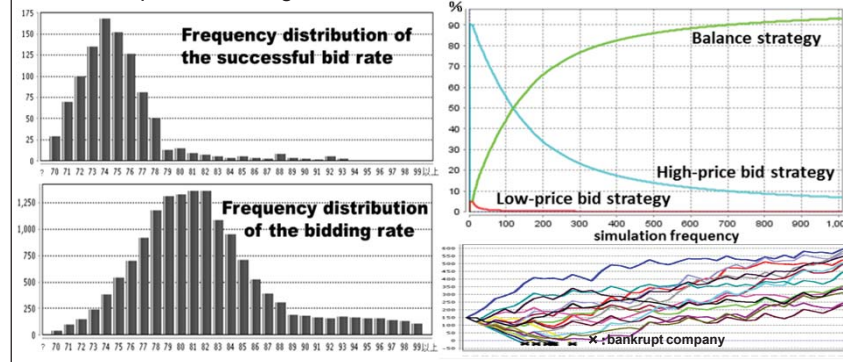
	日本 (2010)	米国 (論文 1, 1988)	英国 (論文 2, 1993)		日本(全国)	日本(中層)	日本(大手)
A	工事の種類	Type of job	Project type				
B	工事の場所	Location of project	Project location				
C	工事の難易度	Degree of difficulty	Risk involved owing to the nature of the work				
D	工事の規模	Size of job	Project duration				
E	材料・機材費の変動リスク	Type and no. of equipment required/available	Risk in fluctuation in material prices				
F	設計・積算の完成度	Designer's/EI/Design quality	Completeness of the documents				
G	工事の支払い条件	Project cash flow	Project cash flow				
H	ソフトウェアの確保	Rate of return	Rate of return				
I	財源工率の確保	Need for work	Need for work				
J	発注者の評判	Owner	Owner/promoter client identity				
K	契約の種類	—	Type of contract				
L	入札の力	—	Tendering method (selective, open)				
M	入札の準備期間	Duration	Tendering duration				
N	入札の理由	Time of bidding (reason)	—				
O	設計変更・追加工事等可能性	Degree of hazard (safety)	Degree of hazard (safety)				
P	同種プロジェクトの将来可能性	—	—				
Q	競争相手の数	Competition	Number of competitors tendering				
R	競争相手の競争力	Your strength in the industry	Competition/ones of competitors				
S	当該工種の過去の実績	—	—				
T	過去の経験(完結工事)	Overall economy (availability of work)	—				
U	現在の市場全体の動向	—	—				
V	現場労働者の雇用条件	Labour environment	Availability of labour				
W	下請けの必要性	Portion of work to be subcontracted	Portion subcontracted to nominated subcontractor				
X	下請け確保の可能性	—	—				
Y	会社の経営状況、財政目標	—	—				
Z	競争相手の競争力	Current workload	Current work load				
aa	企業費用見積りの確実性	Uncertainty in the estimate	Reliability of company cost estimate				
ab	資格保有職員のタイプと数	Availability of qualified staff	Availability of qualified staff				
ac	発注者の確保可能性	Type and number of supervisory persons available	Type and number of supervisory persons available				
ad	一般管理費等の確保	General overhead	General (office) overhead				
ae	資金調達の確保	Capital requirement/availability	—				
af	発注者の確保	—	—				
ag	発注者の確保	—	—				
ah	発注者の確保	—	—				
ai	発注者の確保	—	—				
aj	発注者の確保	—	—				

### 2) An example of the statistical analysis of the bidding data

Dependent Variable: log(predetermined) = 8344

	Standardizing Coefficient			Collinearity-related statistic			Standardizing Coefficient			Collinearity-related statistic		
	$\beta$	t	p value	Tolerance	VIF	$\beta$	t	p value	Tolerance	VIF		
C		10.620	0.0000 ***				10.842	0.0000 ***				
log(WIN)	0.988	539.941	0.0000 ***	0.996	1.004	0.988	540.518	0.0000 ***	0.996	1.004		
PARTICIPAN	0.048	26.283	0.0000 ***	0.998	1.002							
PRE PARTICIPANTS						0.051	27.966	0.0000 ***	0.995	1.005		
UNIT × 2007	-0.002	-0.844	0.3988	0.994	1.007	0.000	-0.057	0.9547	0.994	1.007		
UNIT × 2008	-0.003	-1.641	0.1009	0.992	1.008	-0.002	-0.974	0.3301	0.990	1.010		
UNIT × 2009	-0.004	-2.107	0.0352 **	0.993	1.007	-0.005	-2.680	0.0074 **	0.993	1.007		
UNIT × 2010	-0.005	-2.811	0.0050 ***	0.994	1.006	-0.007	-3.588	0.0003 ***	0.993	1.007		
R		0.9874					0.9877					
R-squared		0.9749					0.9755					
Adjusted R-squared		0.9749					0.9755					
S.E. of regression		0.0301					0.0296					
Durbin-Watson test		1.5656					1.5755					

### 3) An example of Multi-Agent Simulation: MAS result



### Content:

Public procurement system such as Overall-Evaluation dynamically has been changed on public works in Japan. However some characteristics of Bidding-Strategy and procurement system have not enough clarified.

We analyze the influence that the change of the public procurement system gives to the Bidding-Strategy of the construction company.

1) Question paper survey of Japanese construction company's bidding behaviors : In order to know the consciousness of Japanese construction company's bidding behaviors, a question paper survey is conducted which is similar to three previous experiential study papers of U.S. and U.K. The questionnaires are made to unique to Japanese domestic circumstances. The main questionnaire is the importance evaluation to 36 factor keywords in two situations: one is for the determination of participation in and, another is the price determination (percent markup) for the bid.

2) Monitoring bidding data : In this study, we try to monitoring bidding data between accumulated estimation method and the unit price estimation method. The bidding data were special period. It has two patterns to method of calculating predetermined. As a result, in the case of accumulated estimation method increase participants and decrease win bit rate. The other way around, decrease participants and increase win bit rate. So we make a revolve equation to method of calculating an estimate price and check the effect of the unit price estimation method. We showed that the unit price estimation method has effect of decrease predetermined.

3) Simulation model focused on Biding-Strategy: This study attempt to analysis for a system dynamics and mechanism of Overall-Evaluation by developing new simulation model focused on Biding-Strategy, to propose some improvement scenario.

Keywords : Public procurement, Bidding-Strategy, bidding data

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Photo 1 : F3 class tornado attacked Tsukuba on May 6, 2013



Photo 2 : a house damaged by Tornado

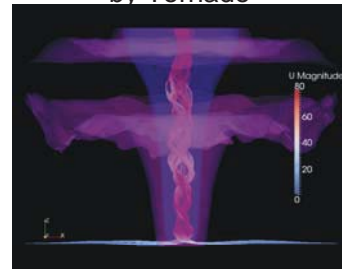


Fig.1 : Tornado-like flow generated by LES

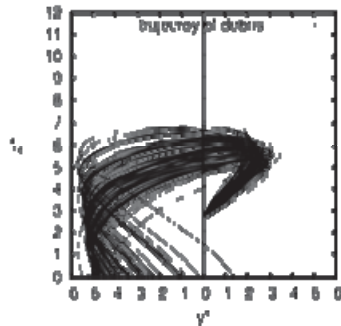


Fig.2 : Trajectories of windborne debris in Tornado-like flow

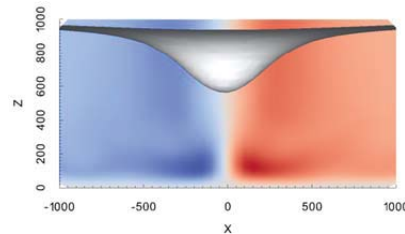


Fig.3 : Funnel cloud reproduced in numerical tornado-like flow

## Content:

Tornado is one of the most dangerous meteorological phenomenon that cannot be ignored. Tornado occur regardless of the location with serious damages. (Photo 1 and 2) In order to assess the risk of Tornado disaster, flow structure of tornado, behavior of windborne debris, and aerodynamic force on buildings should be clarified. Therefore it is necessary to investigate tornado-like flow generated by experimental or numerical method. We have generated tornado-like flow by the developed tornado simulator and LES (Fig.1). In addition to the extremely strong wind, windborne debris also plays an important role to increase the risk in tornado. On the other hand, in order to estimate the strength of real tornadoes accurately, it is necessary to create a Japanized EF-scale and understand the relation between the characteristics of tornadoes and its appearance by funnel clouds or windborne debris. Therefore, we have developed a method to simulate the 6 DOF motion of 3D debris in tornado-like flow (Fig.2) and have investigated the appearance by funnel cloud (Fig.3).

Keywords: Tornado, Windborne debris, Funnel cloud, LES, Tornado simulator, Wind Engineering

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# A New Approach for Combining Simple Soil Investigation and Wide-Area Ground Response Analysis

Associate Professor **Atsushi Mikami**

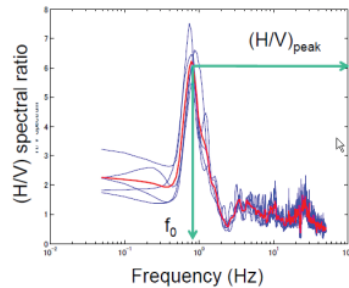


Fig.1 H/V spectral ratio

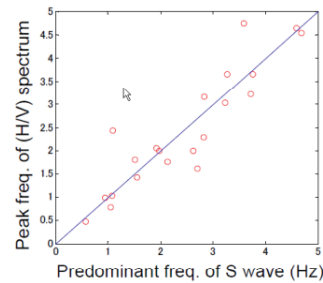
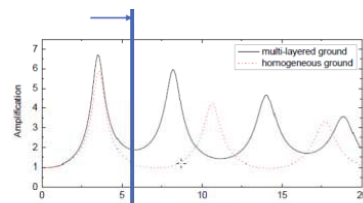
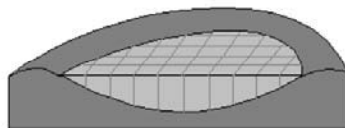


Fig.2  $\frac{1}{4}$  wavelength rule

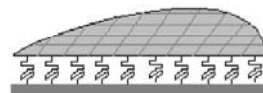


← Fig.3 Site response by equivalent model

↓ Fig.4 Quasi-Three-Dimensional model

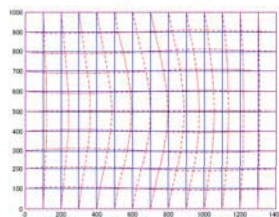


Irregularly-bounded 3D ground



Two dimensional plane supported by springs

3D FEM (0.7618Hz)



Q3DGM (0.8608Hz)

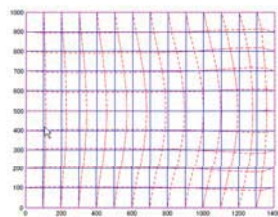


Fig.5 Comparison of simplified model with FEM

## Content:

This study proposes a method of combining simple soil investigation with microtremor measurement and simple ground response analysis. From the microtremor measurements conducted only on a ground surface, horizontal to vertical spectral ratios are calculated (Fig.1), accordingly predominant frequencies are evaluated in a wide area (Fig.2). Using these results while assuming the depths of the bedrock are known, a multi-layered soil deposit is replaced with an equivalent homogeneous ground that has the identical fundamental frequency underlain by bedrock. Showing that the simple soil model is suitable to be used in the low frequency range (Fig.3), the soil is attributed to further simplified soil model (Fig.4, Quasi-Three-Dimensional-Ground Model). Similar computational results are obtained for the dynamic analysis of multi-layered, irregular-shaped ground model between the proposed method and three dimensional finite element method (Fig.5). Hence, the proposed approach may be rational and cost effective when ground response analysis needs to be applied to a wide area.

Keywords: H/V spectral ratio, simplified ground model

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# Non-Destructive Testing for Concrete Structure

Associate Professor Takeshi, Watanabe

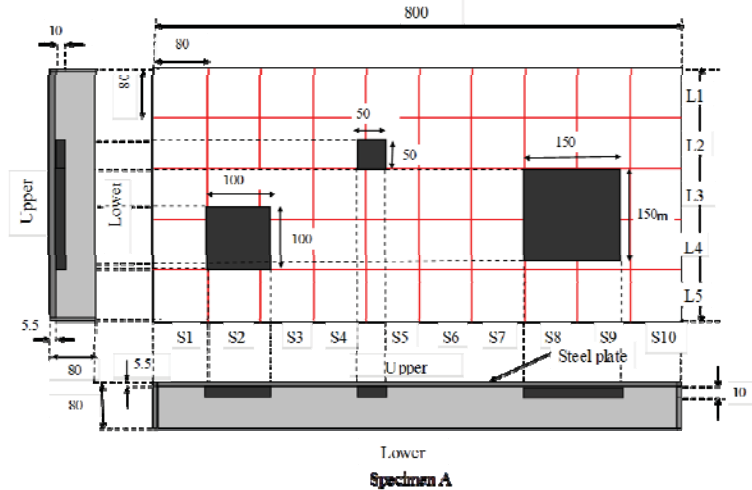


Fig.1 Specimen of steel-concrete composite

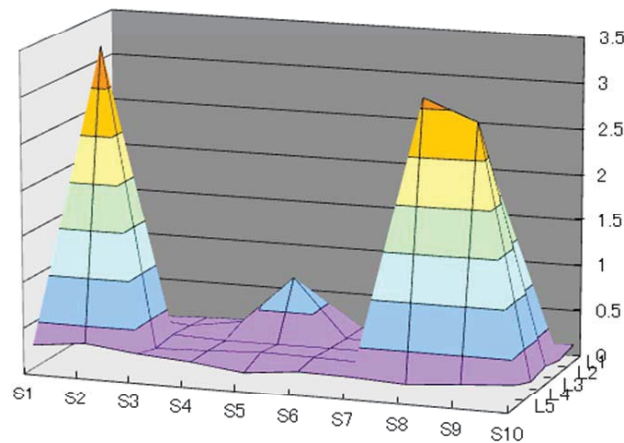


Fig.2 Visualization of defect in the specimen

## Content:

Maintenance of concrete structure is important for civil engineering. Non-destructive test is powerful tool to identify defect and damage of structure. In addition, there are increasing hybrid structure and repaired structure. Non-destructive test is expected to evaluate condition of the structures.

Recently, recycle concrete and self-healing concrete are studied. For clarifying quality of these concrete, we try to use nondestructive method.

Our laboratory results are shown as follow,

- PC grout condition
- Detection of defect in steel-concrete composite by Impact test
- Check rebar corrosion condition by UT
- Evaluation of self-healing effect of fly-ash concrete by UT

Keywords: <Concrete, NDT, By-product, Durability >

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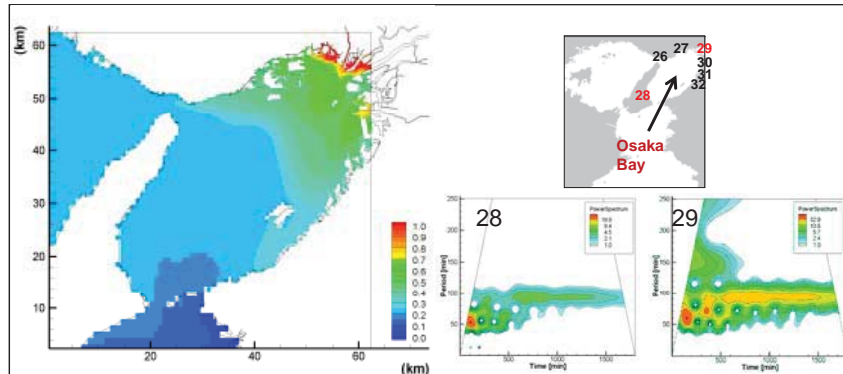


Fig.1 An example of water quality simulation (T-N)

Fig.2 An example of Tsunami resonance analysis

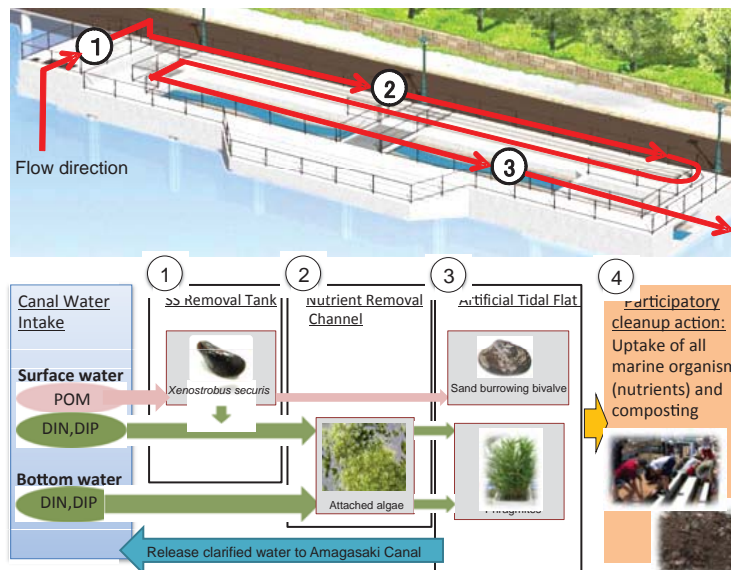


Fig.3 Structural configuration of the water-quality-improvement-plant in Amagasaki Canal

## Content:

He is Physical and Chemical Oceanographer, Ecologist and Tsunami researcher – doing his Master's in Marine System Engineering at Osaka Prefecture University, Japan and his Ph.D in Coastal Hydrodynamics Modeling at Osaka University, Japan. His research applies a baroclinic flow model, ecosystem model (Fig.1) and Tsunami model (Fig.2) to manage a coastal environment. Also, he have joined a public project for developing a biological purification techniques for eutrophic coastal waters (Fig.3).

His final research goals are as below;

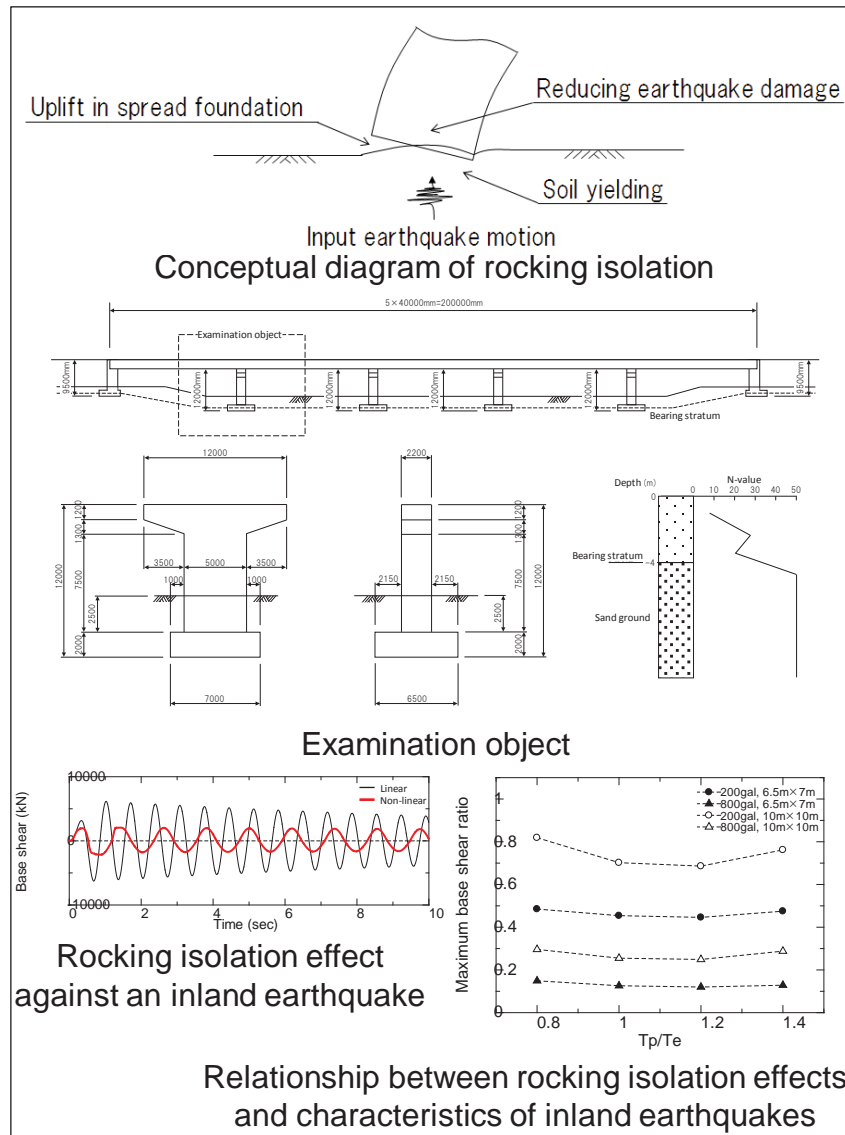
1. development an integrated coastal environmental model to assess not only environmental impact but also social impact.
2. finding out a way to achieve sustainable coastal environmental restoration in Japan and other courtiers.

Keywords: Ocean Model, Biological Purification

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Rocking isolation is technology for reducing earthquake damage of superstructure by accepting uplift in spread foundations. I study applicability of rocking isolation to highway bridges.

I have studied rocking isolation effects from a viewpoint of energetics to clarify the mechanism and effectiveness of rocking isolation against inland earthquakes like 1995 Hyogo-ken Nanbu earthquake which are important events in evaluating seismic performance of structures.

In the future, I will study effectiveness of rocking isolation against Nankai Trough earthquake which is predicted to occur in the near future with high probability and create the prediction equation to use in practice.

The results of the study allow appropriate applications of rocking isolation and they are expected to reduce earthquake damage of highway bridges.

Keywords: Highway bridge, Spread foundation, Rocking isolation

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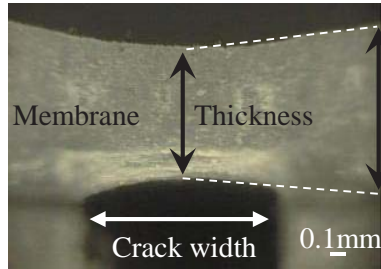
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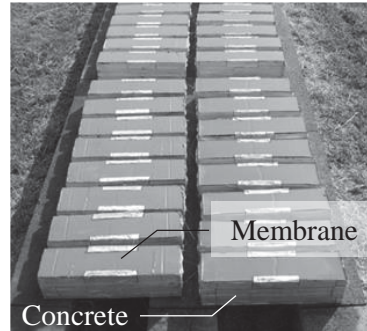


# Protective Performance of Waterproofing Membrane Against Carbonation of Concrete Substrate

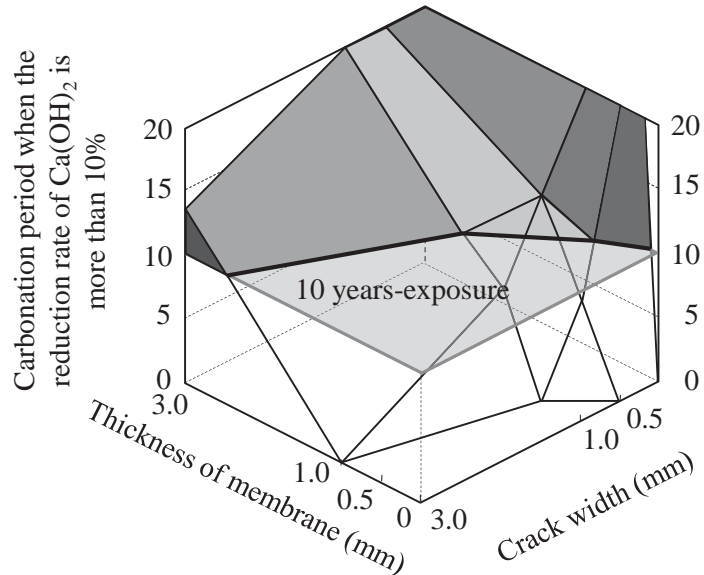
Assistant Professor Masayuki Tsukagoshi



Substrate  
The behavior of membrane at crack area



Exposure test for specimens



Carbonation resistance of waterproofing membrane  
(Threshold value of  $\text{Ca(OH)}_2$  reduction rate: less than 10%)

## Content:

Recently, deterioration of concrete structures has become a topic of a great interest because of the continuously increasing cost of repairs and maintenance. When a concrete is in use, deterioration is accelerated by various factors. A corrosion of reinforcing steel in particular has been cited as the primary factor that influences durability. Fundamentally, the interior of concrete is generally highly alkaline, which prevents reinforcing steel from corroding easily. However, carbon dioxide in air permeates into the concrete and carbonation occurs with calcium hydroxide present in the concrete.

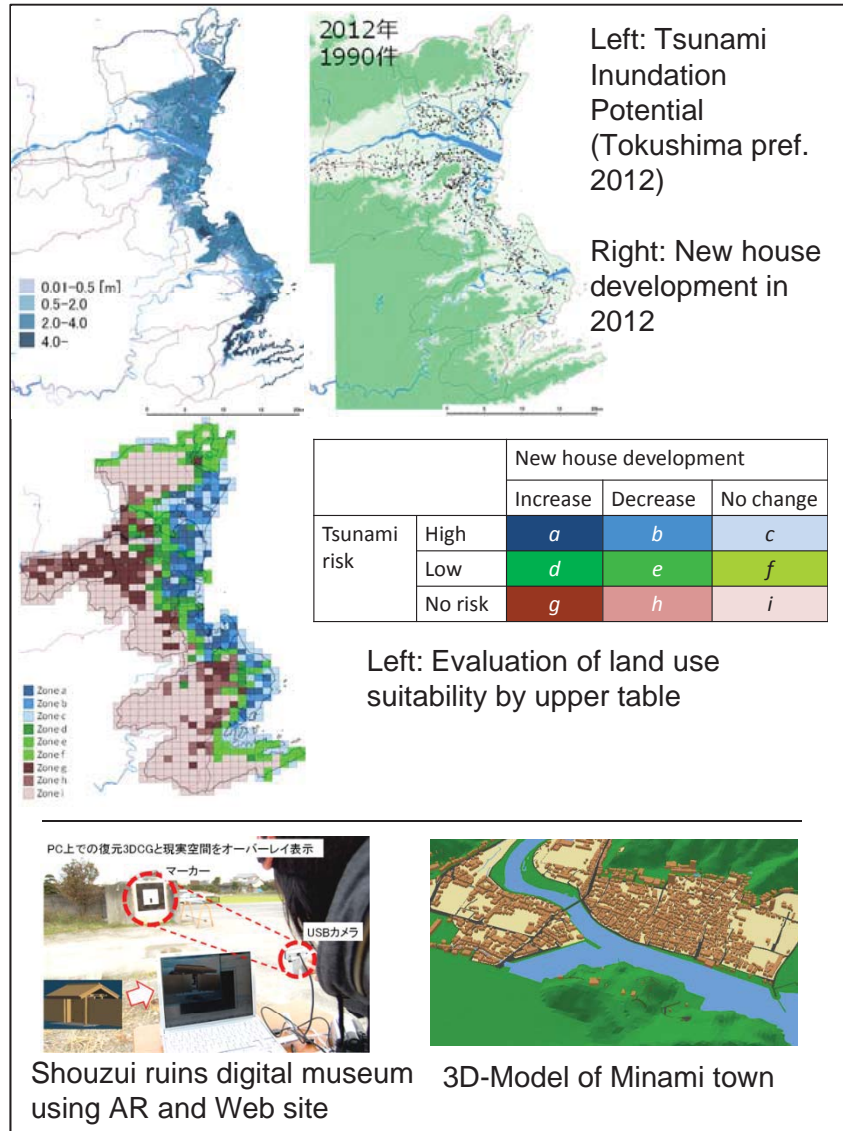
Hence, preventing infiltration of carbon dioxide by coating the concrete surface with materials such as finishing materials has been explored. However, it is difficult to eliminate generation of cracks in concrete; consequently, deterioration progresses deep into the substrate cracks and durability decreases. Therefore, when finishing materials are used to improve concrete durability, it is necessary to clarify whether the protective performance against carbonation follows the movement of a substrate even if cracks occur in the substrate after applying the finishing material. Furthermore, since majority of waterproofing materials are organic materials, deterioration is bound to occur when they are subject to sunlight, heat, and rainwater during use. Protective effect on the substrate decreases because of deterioration of the waterproofing material.

Therefore, this study targets the cracked area of the concrete substrate, and using outdoor exposure and carbonation acceleration tests, evaluates the protective performance of waterproofing membranes that deteriorate with aging. Then, numerical simulation results demonstrate various conditions required for carbonation protective performance of waterproofing membrane under long term exposure to outdoor conditions.

**Keywords :** Waterproofing Membrane, Carbonation of Concrete

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Sustainability is important concept of future urban planning and design. Visualization of past, present and future urban area by using spatial data related to natural disaster, crime, environmental conservation, regional revitalization is useful to discuss urban planning. GIS is powerful tool for urban planner. The purpose of this study is to propose the planning method for sustainable urban area using GIS.

(1) Planning for environmental consideration and disaster mitigation

--->Evaluation of land use sustainability

--->Urban growth simulation considering disaster mitigation and environmental conservation

(2) Planning support system for historical built-up area

--->3D model of historical built-up area

--->Consensus building for urban planning and design considering disaster mitigation and community revitalization using GIS

Keywords: Urban planning and design, GIS, Land use planning

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