The 1st ASEAN CIVIL ENGINEERING CONFERENCE
Ambassador City Jomtien Hotel, Pattaya, Thailand
March 12-13, 2009

Organized by

Department of Civil Engineering, Chulalongkorn University
Department of Civil Engineering, Burapha University

FINAL PROGRAM

March 12, 2009 (Thursday)

Time	Program of Activities	Room
09:00-09:30	Opening ceremony ***Assoc.Prof.Dr.Boonsom Lerdhirunwong*** *Dean, Faculty of Engineering, Chulalongkorn University* ***Asisst.Prof.Dr. Wirogana Ruengphrathuengsuka*** *Dean, Faculty of Engineering,Burapha University* ***Assoc.Prof.Dr.Phoonsak Pheinsusom*** *Head, Department of Civil Engineering, Chulalongkorn University*	Laemchabang Room
09:30-10:00	Keynote speaker #1 "Development of Geotechnical Engineering at Chulalongkorn University" ***Assoc.Prof.Dr.Supot Teachavorasinskun*** *Department of Civil Engineering, Chulalongkorn University*	
10:00-10:30	Keynote speaker #2 "Research Activities in Civil Engineering at NUS" ***Prof.Dr.Somsak Swaddiwudhipong*** *Department of Civil Engineering, National University of Singapore*	
10:30-11:00	Coffee break	
11:00-12:15	*Invited and research papers: parallel session 1* • Transportation Engineering "Application of Advanced Modelings for Transportation Modal Choice toward Improvement of Urban Mobility" ***Prof.Dr.Seiichi Kagaya,*** *Hokkaido University* • Geotechnical Engineering • Structural Engineering • Construction Engineering and Management	Room 1 to 4 (see session details)
12:15-13:30	Lunch	
13:30-15:00	*Research papers: parallel session 2*	Room 1 to 4 (see session details)
15:00-15:30	Coffee break	
15:30-16:45	*Research papers: parallel session 3*	Room 1 to 4 (see session details)
18:00-21:00	Welcome dinner	Mabtapud Room

ASEAN FOUNDATION AUN/SEED-Net JICA

March 13, 2009 (Friday)

Time	Program of Activities	Room
09:00-09:30	"Update on AUN/SEED-Net Project Activities" ***Ms. Kanchana Patanasakdikul**, Program Officer* ***Mr. Sakae Yamada**, Program Coordinator* *JICA Project for AUN/SEED-Net*	Laemchabang Room
09:30-09:45	Coffee break	
09:45-11:45	Discussion: future collaboration on ACEC and implementation plan of AUN/SEED-Net	Laemchabang Room
11:45-12:00	Closing ceremony	
12:00-13:00	Lunch	

ASEAN FOUNDATION AUN/SEED-Net JICA

Session Details

	Room 1	Room 2	Room 3	Room 4
Session 1 11:00-12:15	**TRP**	**GEO**	**STR**	**CM**
Lunch	Lunch	Lunch	Lunch	Lunch
Session 2 13:30-15:00	**TRP**	**ENV/OTH**	**STR**	**CM**
Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
Session 3 15:30-16:45	-	-	**STR**	**STR**

Room 1 = U-tapao Room
Room 2 = Banbung Room
Room 3 = Laemchabang Room
Room 4 = Sriracha Room

ASEAN FOUNDATION AUN/SEED-Net JICA

Session 1 (11:00 – 12:15)

Room 1: Transportation Engineering
Session Chair: *Assist. Prof. Dr. Saksith Chalermpong (CU)*

11:00 – 11:30 AM	Application of advanced modeling for transportation modal choice towards improvement of urban mobility *Seiichi Kagaya, Katia Andrage*
11:30 – 11:45 AM	The evaluation of rigid pavement structures using analytical method and "ELCON" program case study: Padalarang – Cileunyi toll road *B. S. Subagio, H. Rahman, S. S. Wibowo, T. Ferdian*
11:45 – 12:00 PM	On-street parking inventory in the city of Manila *A. M. Fillone, M. C. R. Paringit*
12:00 – 12:15 PM	Effect of non-lane based traffic flow on road capacity by micro-simulation track transportation *H. S. O. Palmiano*

Room 2: Geotechnical Engineering
Session Chair: *Assist. Prof. Dr. Siam Yimsiri (BUU)*

11:00 – 11:15 AM	Liquefaction potential assessment using SPT data *J. R. Dungca*
11:15 – 11:30 PM ✓	Finite element modeling of the behavior of soft ground improved by vertical drains under embankment combined with vacuum preloading *T. A. Tran, T. Mitachi, P. Vo*
11:30 – 11:45 PM	A comparison study of maswm, downhole and boring method for Vs profile determination *S. Seng, T. Boonyatee, H. Tanaka*
11:45 – 12:00 PM	On the numerical implementation of hyperplasticity non-linear kinematic hardening modified cam clay model *D. Apriadi, S. Likitlersuang, T. Pipatpongsa, H. Ohta*

ASEAN FOUNDATION AUN/SEED-Net JICA

Room 3: Structural Engineering
Session Chair: *Prof. Dr. Somsak Swaddiwudhipong (NUS)*

11:00 – 11:15 AM	Utilization of an agricultural waste (rice husk ash) to produce high strength concrete *H. B. Mahmud*
11:15 – 11:30 AM	Modeling the stress-strain relationship of high strength concrete made of local aggregates *B. A. Lejano*
11:30 – 11:45 AM	Seismic performance of a precast concrete column with threaded mechanical splices *P. Mounnarath, A. Ruangrassamee*
11:45 – 12:00 PM	Influence of recycled fired- clay bricks for aggregate replacement in concrete *B. H. A. Bakar, M. A. H. Elflah*

Room 4: Construction Engineering and Management
Session Chair: *Assoc. Prof. Dr. Shinei Takano (HOK)*

11:00 – 11:15 AM	Design-build project delivery – a case study *F. J. Germar*
11:15 – 11:30 AM	Study on the effectiveness of construction safety regulation in Indonesia *B. W. Soemardi, A. Fajri, S. Wulan* ✓
11:30 – 11:45 AM	A study of Vientiane industrial park development *P. Phimphachanh*
√ 11:45 – 12:00 PM	Learning from Thailand e-auctions practice towards government e-procurement *B. Hasiholan, S. Budinugroho, S. Takano, T. Tongtong*
12:00 – 12:15 PM	Classification of high-rise building projects using self-organizing map in Fort Bonifacio, Taguig city *J. M. C. Ongpeng, R. S. Gallardo*

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Session 2 (13:30 – 15:00)

Room 1: Transportation Engineering
Session Chair: *Prof. Dr. Bambang Sugeng Subagio (ITB)*

13:30 – 13:45 PM	Development of standardized designs of JPCP for rural roads in Thailand *P. Jitviriyavasin, K. Vongchusiri*
13:45 – 14:00 PM	The role of information on privatised transit market plus congestion charging *M. Wichiensin*
14:00 – 14:15 PM	Development of motorcycle equipment unit (MCU) for motorcycle-dominated traffic *C. C. Minh*
14:15 – 14:30 PM	Improved hierarchical criterion weighting for GIS-multiple criteria site suitability model *M. S. S. Ahamad, R. Ahmad*
14:30 – 14:45 PM	Spatial-hedonic analysis of office rents in Bangkok rail transit corridors *K. Wattana, S. Chalermpong*
14:45 – 15:00 PM	Evaluation of frequency of transit use for the case of Manila and Bangkok mass transit system *S. S. Wibowo, S. Chelermpong, S. Kagaya*
15:00 – 15:15 PM	An experimental study of price incentives towards sustainable travel behavior changes *K. Choocharukul, P. Seraneeprakarn, K. Sriroongvikrai*

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Room 2: Environmental Engineering/Others
Session Chair: *Assoc. Prof. Dr. Adrian Law Wing-Keung (NTU)*

13:30 – 13:45 PM	Development and testing of a solar still as source of potable water in coastal areas *M. A. Tanchuling, A. Buenaventura, K. Palaganas*
13:45 – 14:00 PM	Stochastic assessment of DNAPL waste source zone architecture in non uniform homogeneous saturated aquifer system *S. Rodphai, A. Putthividhya, V. Likhitruangsilp*
14:00 – 14:15 PM	Advective-diffusive and hydraulic trap modeling in two layer soil system *A. A. Mahouti*
14:15 – 14:30 PM	Hydrogeochemical interaction of groundwater and surface water in Jatibarang landfill area, Semarang city, Indonesia *P. Xaixongdeth, H. Hendrayana, D.P.E. Putra, K. Jinno*
14:30 – 14:45 PM	The effect of water level in the surge tank on the water hammer, application for the penstock of a voung hydropower *T. Nguyen, H. P. Nguyen*
14:45 – 15:00 PM	Pipe network rehabilitation using multiobjective population-based incremental learning *K. Sriworamas, S. Bureerat, V. Plemkamol, T. Vangpaisal*
15:00 – 15:15 PM	Bridge piers protection against riverbed degradation *Istiarto*

Room 3: Structural Engineering
Session Chair: *Prof. Dr. Hilmi Bin Mahmud (UM)*

13:30 – 13:45 PM	Tsunami loading on a bridge deck with perforations *P. Lukkunaprasit, T. L. Lau, A. Ruangrassamee, T. Ohmachi*
13:45 – 14:00 PM	Damping evaluation of cable with practical bilinear dampers *N. Hoang*
14:00 – 14:15 PM	Dynamic response of poroelastic medium to moving loads *B. Yooyao, T. Senjuntichai*
14:15 – 14:30 PM	Modeling of interfacial cracks in 1-3 piezocomposites *Y. Sapsathiarn, T. Senjuntichai, R. K. N. D. Rajapakse*
14:30 – 14:45 PM	Chloride resistance of portland cement mortar with fly ash, limestone powder and expansive additive *A. Rerkmahalikhit, T. Sumranwanich, S. Tangtermsirikul*
14:45 – 15:00 PM	A study on the chloride diffusion coefficient of concrete structures exposed to marine environment of Thailand *T. Sumranwanich, P. Juleang, C. Wattanalamlerd, S. Tangtermsirikul, A. Wongkaew*

Room 4: Construction Engineering and Management
Session Chair: *Assoc. Prof. Dr. Fernando J. Germar (UPD)*

13:30 – 13:45 PM	Risk assessment in a construction project using a fuzzy AHP approach *T. Thipparat*
13:45 – 14:00 PM	Integration model between safety assessment and construction scheduling to predict project duration *N. Kaewsri*
14:00 – 14:15 PM	An exploration of contractors' problems in Cambodia *J. Noppadon, T. Tongthong, P. Menghour*
14:15 – 14:30 PM	Integrating knowledge management system and decision support system to improve quality standard of visual inspection *V. Peansupap, C. Laofor*
14:30 – 14:45 PM	Assessing risk in bored pile construction by neurofuzzy system *P. Pawan*
14:45 – 15:00 PM	Investigation of problems from direction flow in construction work processes *L. N. Thach, V. Peansupap*

Session 3 (15:30 – 16:45)

Room 3: Structural Engineering
Session Chair: *Assist. Prof. Dr. Watanachai Smittakorn (CU)*

15:30 – 15:45 PM	Chloride penetration into plain concrete using various cements under flexural cyclic load and tidal environment *T. V. Mien, B. Stitmannaithum, T. Nawa*
15:45 – 16:00 PM	Effects of bridge parameters on distortion-induced fatigue in multi-girder steel bridges *M. S. Hidayat, A. Lenwari*
16:00 – 16:15 PM	Initial shape analysis of cable-stayed bridges during construction by the cantilever method *S. Phongsawat, W. Smittakorn*
16:15 – 16:30 PM	Mechanical behavior of offshore pipeline using nickel slag aggregate and fly ash as partial cement substitute *S. Soegiri*
16:30 – 16:45 PM	Bridge weigh-in-motion for truck load monitoring in Thailand *D. Dounsuvanh, P. Pheinsusom, Y. Sato*

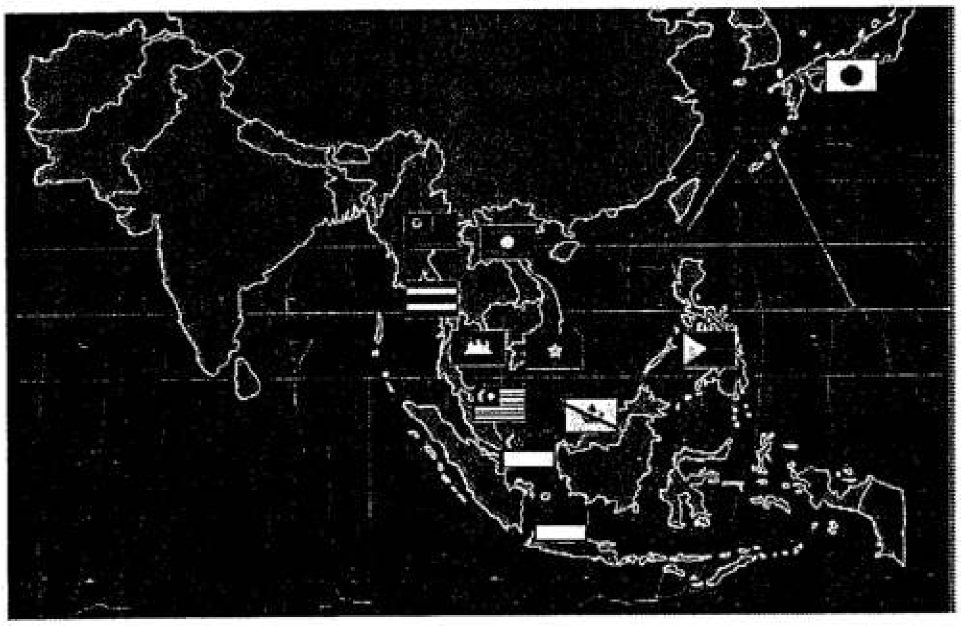
Room 4: Structural Engineering
Session Chair: *Assoc. Prof. Dr. Bernardo A. Lejano (DLSU)*

15:30 – 15:45 PM	Evaluation of concrete appearance quality *V. Han*
15:45 – 16:00 PM	Prestressed loss in PC girder using self-compacting concrete under Cambodian environment *V. Seng*
16:00 – 16:15 PM	Elaboration of ultrasonic pulse velocity (UPV) equipment in the detection of concrete strength and crack width *H. Priyosulistyo, B. Nugreho, S. Jepriani*
16:15 – 16:30 PM	Finite element analysis of gypsum-board fire insulation systems for fiber reinforced polymer *F. E. Ayurananda, T. Pothisiri*
16:30 – 16:45 PM	Assessment of modal pushover analysis procedure for seismic evaluation of buckling-restrained braced frame *A. H. Nguyen, C. Chintanapakdee*

ASEAN FOUNDATION AUN/SEED-Net JICA

Compendium of Abstracts

The First ASEAN Civil Engineering Conference



Organized by
Department of Civil Engineering
Chulalongkorn University

Department of Civil Engineering
Burapha University

Pattaya, Thailand
December 3-4, 2008

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MESSAGE FROM FACULTY OF ENGINEERING, CHULALONGKORN UNIVERSITY

It is my great honor and pleasure to welcome all participants to the first ASEAN Civil Engineering Conference. This conference is jointly organized by the Department of Civil Engineering, Chulalongkorn University and the Department of Civil Engineering, Burapha University. With the theme "Civil Engineering Innovations for Regional Development," I hope that we will learn and share new, exciting, and cutting edge ideas in the field of Civil Engineering for the development of our region. I am sure we can look forward to fruitful discussion during the conference and future research collaboration.

I would like to take this opportunity to acknowledge JICA, AUN/SEED-Net, ASEAN Foundation, and the Commission of Higher Education for their supports in making this conference possible.

Thank you.

Assoc. Prof. Dr. Boonsom Lerdhirunwong
Dean of Engineering
Chulalongkorn University

MESSAGE FROM FACULTY OF ENGINEERING, BURAPHA UNIVERSITY

On behalf of the conference organizing committee, I would like to welcome you to the city of Pattaya, whose beautiful beach environment makes the city as one of the major tourist cities of Thailand. Pattaya city is located in Chonburi Province which is also the home of Burapha University. In fact, Burapha University is approximately 40 km to the north of Pattaya.

Burapha University is a major public university in the Eastern Seaboard Area of Thailand. The name of Burapha University means "University of the East". The university was first established since 1955. There are 17 faculties and colleges, including Faculty of Engineering.

The Faculty of Engineering was set-up in 1994 and currently has 5 departments, namely Industrial Engineering, Chemical Engineering, Civil Engineering, Mechanical Engineering, and Electrical Engineering.

Burapha University is honored to be a co-host of the 1st Asean Civil Engineering Conference which is an annual regional conference among Asean countries and outsides. It is a very special occasion because this is the first conference of its series. The conference has been supported by many organizations, namely AUN/Seed-Net-JICA, the Commission of Higher Education of Thailand, Chulalongkorn University, and Burapha University. I would like to share an appreciation for the hard working of the organizing committee from both co-host institutes. I hope that this conference will embark even more intensive research collaboration among our Asean countries and, with continuing support from the aforementioned organizations, major accomplishment is not far from reach.

Asisst. Prof. Dr. Wirogana Ruengphrathuengsuka
Dean, Faculty of Engineering
Burapha University

MESSAGE FROM DEPARTMENT OF CIVIL ENGINEERING, CHULALONGKORN UNIVERSITY

It is my great pleasure to welcome all of you to the first ASEAN Civil Engineering Conference. This regional conference aims to be a venue for faculty members, researchers and students of the AUN/SEED-Net's member institutions, Japanese Supporting Universities, and other professionals to share the most updated technology and research of regional interest.

I would like to thank several people and parties who make this conference possible. First, I thank Dr. Boonsom Lerdhirunwong, Dean of Faculty of Engineering, Chulalongkorn University and Dr.Wirogana Ruengphrathuengsuka, Dean of Faculty of Engineering, Burapha University. I thank all member of organizing committees from both Chulalongkorn and Burapha Universities. I acknowledge the generous supports from JICA, AUN/SEED-Net, ASEAN Foundation, and the Commission of Higher Education, Ministry of Education. I would also like to thank Mr. Sakae Yamada, the AUN/SEED-Net program coordinator..

Finally, I wish you find this conference stimulating and productive. Also, I hope that your time will be well spent exploring all that Pattaya has to offer.

Thank you,

Assoc. Prof. Dr. Phoonsak Pheinsusom
Head, Department of Civil Engineering
Chulalongkorn University

MESSAGE FROM DEPARTMENT OF CIVIL ENGINEERING, BURAPHA UNIVERSITY

On behalf of Department of Civil Engineering, Burapha University as a co-host of the organizing committee for the first ASEAN Civil Engineering Conference, we would like to extend our warmest welcome to all of you to the conferences in Pattaya, Thailand.

This conference has previously grown from its inception as an annually exclusive workshop, Field Wise Seminar, among departments of civil engineering in AUN/SEED-Net member institutes to an open conference emphasizing the application of civil engineering innovations to our regional development. This year conference would be considered as the first significant step of becoming a fully international conference in the future with more papers submitted and accepted from outside the AUN/SEED-Net member institutes. Also this conference will benefit to our current AUN/SEED-Net students and young staffs who graduated from the program as a forum to participate and exchange their research results and ideas.

It is not an easy job to put together such a conference, and we would like to thank all members of the organizing committee for their hard works. Our thanks also extend to all AUN/SEED-Net member institutes, this conference would not be possible without your enthusiastic collaborations and contributions.

Again, welcome to the conference and Pattaya, we wish you all productive conferences ahead and a most enjoyable stay in Thailand.

Assist. Prof. Dr. Arnon Wongkaew
Head, Department of Civil Engineering
Burapha University

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BRIDGE PIERS PROTECTION AGAINST RIVERBED DEGRADATION

Istiarto

Department of Civil and Environmental Engineering, Gadjah Mada University, Jl. Grafika 2 Kampus UGM, Yogyakarta 55281, Indonesia, email: istiarto@ugm.ac.id

Abstract: Some bridge piers in Yogyakarta Special Province of Indonesia have since the last decade faced serious problems due to riverbed degradation. A bridge collapsed in 2000 and two bridges have been experiencing extensive riverbed fluctuation since the last five years. Groundsill is an effective structure to control riverbed and gives protection to bridge piers. However, Provincial Road Authority faces shortage of fund and lack of technical consideration that prevent them from constructing technically sound groundsill. Groundsills that had been constructed to protect the aforementioned two bridges collapsed, and as a consequence, riverbed degradation intensifies. This paper discusses recent experience in protecting bridge piers against riverbed degradation; both good and bad practices are presented and discussed.

Keywords: bridge piers, degradation, local scour

1. BRIDGE PIERS AND RIVERBED DEGRADATION

Yogyakarta, located in south central Java at some 500 km east of Jakarta, has several rivers. These rivers have been experiencing riverbed degradation, notably since late 80s. Some bridge piers have been threatened by this riverbed degradation. The foundations that support the pier have lost some of their bearing capacity due to riverbed degradation. Three bridges, namely Srandakan, Kebonagung, and Kretek are examples of bridges that face such problem. Srandakan Bridge collapsed in 2000 due to this riverbed degradation. A new bridge has been constructed with a groundsill at the downstream side to protect the bridge against riverbed degradation. The other two bridges, Kebonagung and Kretek, lost their protecting groundsills in 1997 and 2007, respectively, and were in danger ever since.

Most of the rivers in Yogyakarta originate from or at least have tributaries in Mount Merapi, an active volcano, located in the north of the Province, and flow to the Java Sea in the south. In the past, these rivers had experienced opposite phenomenon that is riverbed aggradations due to extensive sedimentation by materials from Mount Merapi eruption. Lava and other volcanic material accumulate and deposit at the mountain top. These materials serve as sediment source. These materials flow along with rainwater down to rivers during heavy rain, known as lahar flood. Checkdams and other similar structures have been extensively constructed along the upstream river reach to control lahar flood. Sediment supply to the downstream reach is maintained. The checkdams do not entirely block sediment. Sediment supply is supposedly maintained through flow over checkdam crest or slit-openings of the checkdam body to keep sediment transport equilibrium along the river. Sand mining, however, is suspected to alter the equilibrium between sediment supply and transport. Uncontrolled sand mining, whose quantity exceeds sediment supply, significantly reduces downstream sediment supply. As a direct consequence of this reduced supply, erosion takes place along rivers and riverbed degradation is observed.

Riverbed degradation creates problems, not only endangering bridge piers, but may also lowering water level that prevents river water from entering irrigation intake or pump station, and reducing foundation capacity of hydraulic structures (weir, dikes, levee, revetment, etc). Some records in Srandakan Bridge before its collapse show that riverbed degradation during 90s reached 3 meters. This figure also was observed in Kretek Bridge after its groundsill breach. Such degradation depth significantly reduces foundation bearing capacity, especially in cases where the bridge foundation is not a pile type.

2. GROUNDSILL AS BRIDGE PIERS PROTECTION AGAINST RIVERBED DEGRADATION

Groundsill is a common structure for preventing riverbed degradation. It is a weir-type structure across a river. But unlike weir whose function is to raise water level, groundsill is not intended to do so. Groundsill is intended to confine riverbed on its upstream side to its crest elevation, thus preventing riverbed degradation and stabilizing riverbed on its upstream side. This function is achieved by blocking sediment transport below the groundsill crest from passing through. When a portion of sediment is deposited on the upstream side of a groundsill, sediment transport equilibrium is altered. As a consequence, there will be erosion or riverbed degradation on the downstream side of the groundsill. It is, therefore, a common practice to have a series of groundsills along the river reach where riverbed stabilization is intended.

Groundsill crest in normally positioned on or close to the riverbed and thus below water surface. However, in rare cases, there are groundsills whose crest is somewhat far from the riverbed (see Figure 1). These are found where riverbed had occurred and the groundsill is expected to recover the riverbed to its original elevation.

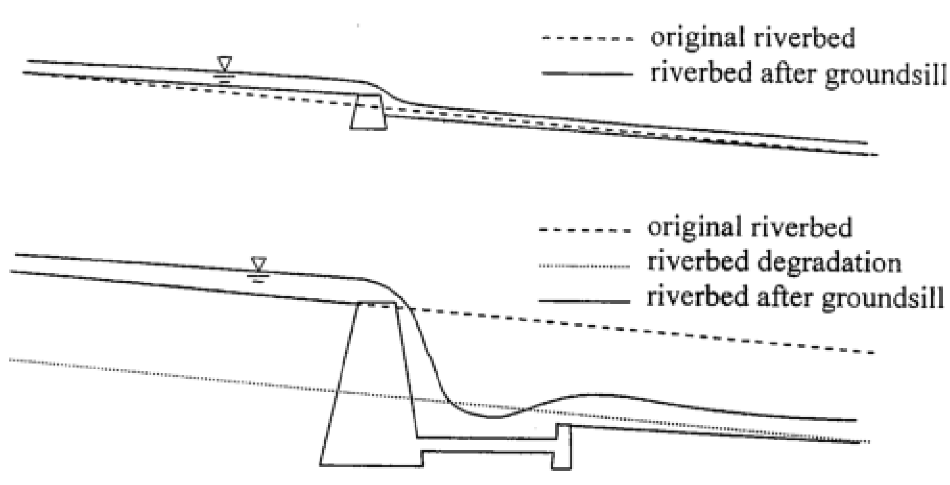

Figure 1. Common Groundsill with Crest Close to The Original Riverbed (Upper Figure) and High Groundsill (Lower Figure)

When groundsill is used to protect bridge piers against riverbed degradation, it is constructed on the downstream side of the bridge. Its crest is commonly set to that of pier base or foundation pile cap. When the groundsill is constructed at the same time with bridge construction, the groundsill crest is normally on the same level with the original riverbed elevation. However, in the three cases that are presented in this paper, the groundsills were constructed after riverbed degradation took place. The groundsills height was forced to be high so that they could put back the riverbed to the level of the bridges pile cap. The groundsill would be much smaller and less expensive had it been constructed before riverbed degradation.

In addition to riverbed degradation, another phenomenon that is sometimes observed is local scour around bridge pier. Due to pier presence, flow around bridge pier is altered that forms a vortex known as horseshoe vortex. This is believed as the main agent that erodes solid materials around bridge pier. A cone-type hole is formed around pier base whose maximum depth, in front of the pier, may reach 2.5 time pier diameter. The scour depth is a function of pier diameter, pier shape, pier orientation with respect to flow, bed material diameter, and flow velocity. Groundsill is not a countermeasure against local scour. Pier protection against local scour is obtained by replacing the bed material around the pier with riprap, putting collar around the pier, or installing pseudo piers in front of the protected pier (Graf and Altinakar, 1998).

3. SRANDAKAN BRIDGE PIER FAILURE

Srandakan Bridge was constructed during Dutch colonial era, in 1929, crossing Progo River, the biggest river in Yogyakarta. The bridge was originally for light train transporting cane to sugar factory from a nearby cane plantation. Since 1950s, the bridge was transformed into public transportation bridge after some structural improvement. The bridge is 59×9-meter long and is supported by 58 double-piers. Each double-pier is supported by 8 concrete piles. In April 2000, two of its piers (Piers #25 and #26) failed; their elevation went down by 1.40 meters (see Figure 2).

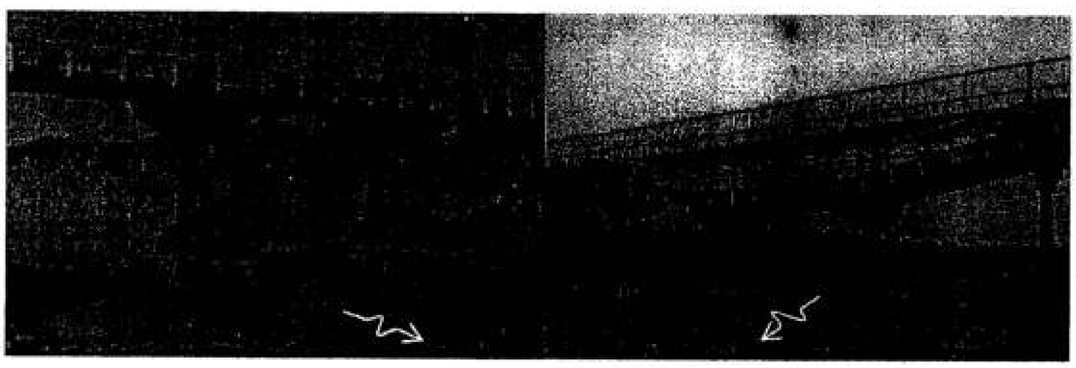

Figure 2. Srandakan Bridge Before and After Pier Failure

Riverbed data before the bridge pier failure show that during 90s the riverbed elevation lowered by about 3 meters due to riverbed degradation. Bridge pier protection had been implemented during late 90s. The protection was done by putting gabion blanket around each pier and rip-rap apron on the downstream side (see Figure 3). Groundsill was not there at that time. Groundsill, in fact, had been proposed but was not opted due to insufficient funding.

Gabion blanket was not a good protection against riverbed degradation for many reasons: a) it does not stop riverbed degradation, b) it reduces cross-sectional area of the flow and thus increases flow velocity, c) it intensifies local scour bridge around piers. Riverbed degradation can be controlled by reducing transport capacity of the flow. This can be achieved by reducing flow velocity or increasing sediment supply. Gabion blanket around bridge piers, on the other hand, increases flow velocity since it blocks a portion of the cross-sectional area. The bridge span between piers was originally 9 meters. Gabion blanket structure had it narrowed to 7 meters on top and 1 meter on the bottom. Smaller cross-sectional area results in higher flow velocity and larger sediment transporting capacity of the flow. Gabion blanket had made pier diameter larger. Local scour around bridge pier increases with larger pier diameter. It was observed that the gabion blanket and the riprap apron were destroyed by flood during rainy season following its construction. They were put back during the following dry season. In the rainy season of the following year, failure of the bridge piers occurred. Thus, the gabion blanket had not only failed to protect bridge piers against riverbed degradation, but had also provoked deeper riverbed degradation and local scour.

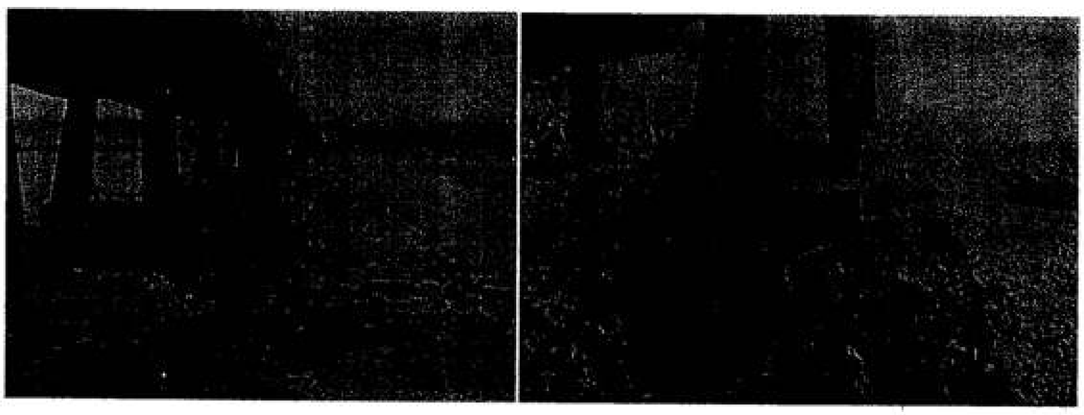

Figure 3. Gabion Blanket around Bridge Piers (Left Figure) Which Was Easily Damaged by Flood (Right Figure).

A new bridge was constructed downstream of the old one in 2005 and was completed in 2006. Learning from the experience, a groundsill had been erected in 2004 at the downstream side of the new bridge (see Figure 4). The crest of this groundsill was set at the same elevation as that of the pile-cap's base of the old bridge. This makes the groundsill height to about 3 meters. Within 2 years after its completion, sediment has filled river reach upstream of the groundsill and the riverbed has recovered to the desired elevation.

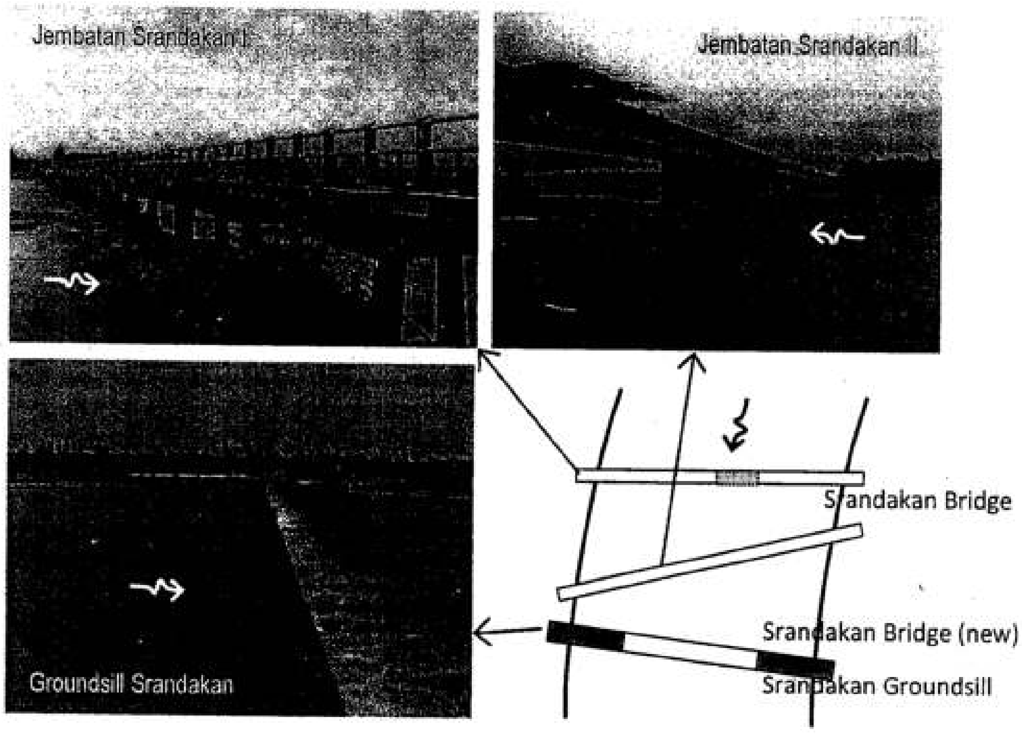

Figure 4. Current Situation at Srandakan Bridge

4. KEBONAGUNG GROUNDSILL AND BRIDGE PIER PROTECTION

Kebonagung Bridge crosses the same river as Srandakan Bridge and is located at 7 km to the upstream direction. Measurement data in 2006 showed that riverbed degradation at this site had left the 8-meter deep bridge foundation to about half that was still below riverbed. The groundsill that had been constructed to control riverbed degradation had been damaged and rehabilitated several times. In the 2007 rainy season, flow completely destroyed the groundsill (see Figure 5). Local scour was also detected in front of the bridge piers. Monitoring data of the scour depth, however, are not available. Photograph taken after a short small flood indicates a scour depth of about 1 meter deep in one of the piers (see Figure 6). Scour depth in the pier that lies in the talweg, however, cannot be seen since it is below water surface.

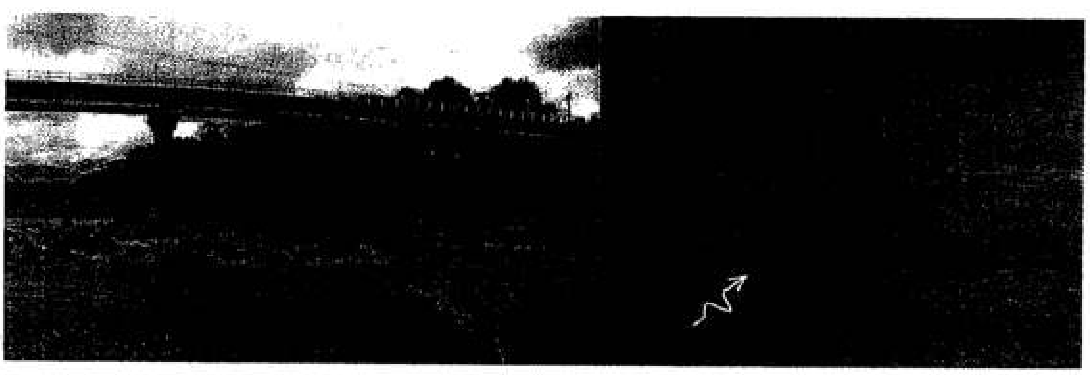

Figure 5. Kebonagung Bridge Showing a Partially Destroyed Groundsill at Its Foreground (Left Figure) and Completely Destroyed Groundsill (Right Figure)

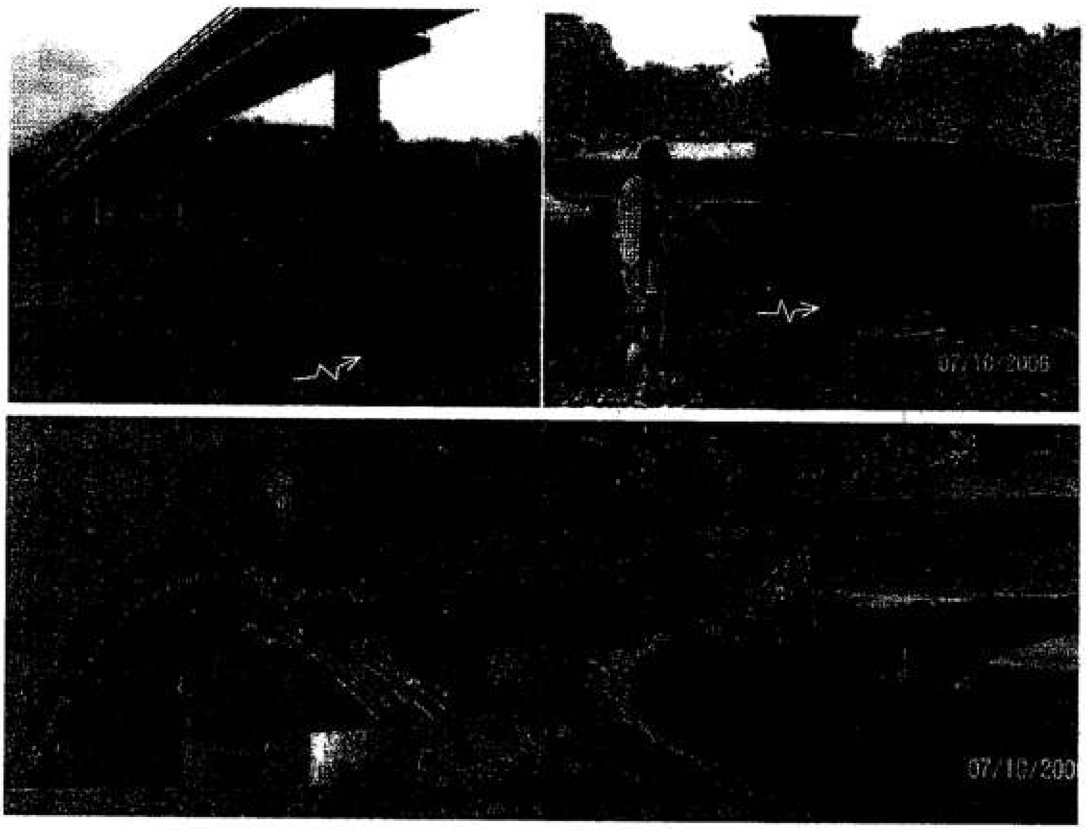

Figure 6. Effect of Riverbed Degradation (Upper Figures) and Local Scour (Lower Figures) around Kebonagung Bridge Piers

A 3.5-meter high concrete groundsill was proposed to replace the old one. A concrete apron was provided at the upstream side to give sufficient length to seepage path so that piping would be avoided. A stilling basin was also provided at the downstream side to dissipate the kinetic energy of the flow over the groundsill crest.

Due to lack of funding, however, the groundsill proposal was not implemented. On the other hand, the need for immediate pier protection is evidenced or otherwise the bridge would be in danger. Having a limited budget, the choice of the protection was limited. The Provincial Road Authority decided to put gabion on the riverbed around the bridge piers. Considering the experience at Srandakan Bridge, the gabion was maintained at close to the original riverbed elevation (see Figure 7). By doing that, the structure does not act either as a groundsill or weir that would otherwise have to withstand forces exerted by flow. The structure does not reduce flow cross-sectional area and the flow velocity will not be altered. The sediment transporting capacity of the flow is thus expected to remain unchanged.

The gabion is considered to be a temporary protection. In the long run, groundsill needs to be constructed in order to control the riverbed degradation. It shall be noted also that the groundsill does not protect the bridge piers against local scour. The Provincial Road Authority has proposed to install pseudo piers in front of the bridge piers to reduce local scour depth.

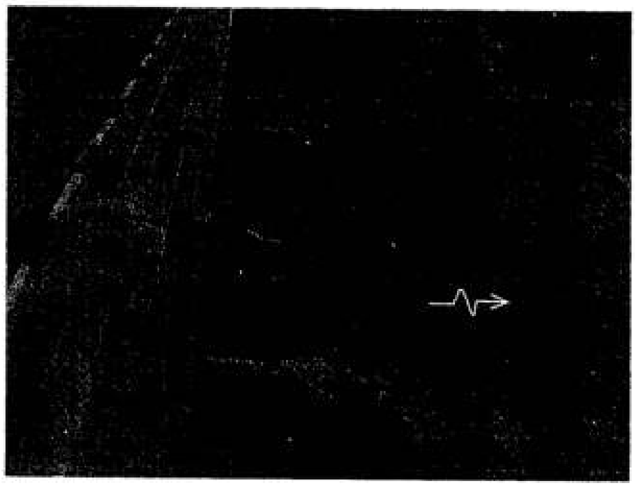

Figure 7. Gabion Mattress around Kebonagung Bridge Piers

5. KRETEK GROUNDSILL FAILURE

Kretek Groundsill was built in 2003 at about 100 meters downstream of Kretek Bridge and is intended to protect the bridge against riverbed degradation. The bridge crosses Opak River, the second biggest river in Yogyakarta after Progo River. In mid 2007, the groundsill breached and left a 31-meter wide opening at about the middle of the 185-meter long groundsill. Following the breach, the riverbed almost instantaneously went down by 3 meters (see Figure 8 and Figure 9). Opak River, like other rivers in Yogyakarta, experiences riverbed degradation. The Provincial Road Authority puts concern that the riverbed degradation shall be tackled so that the bridge is secured.

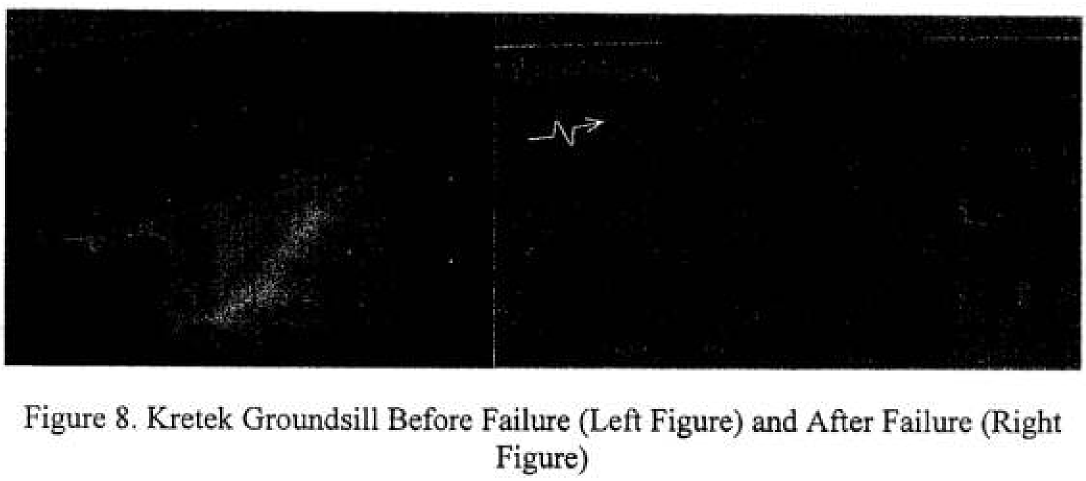

Figure 8. Kretek Groundsill Before Failure (Left Figure) and After Failure (Right Figure)

Figure 9. Riverbed Degradation at Kretek Bridge after Groundsill Breach

Kretek Groundsill is a step weir consisting of two rows of concrete sheet piles, being 7 meter long and 6 meter long for the upstream and downstream sections, respectively. The original design shows that the upstream sheet pile crest is 1.5 meters above original riverbed where as the downstream crest is 1 meter below that of the upstream one (Figure 10). Before the breach, the downstream crest in average was at about 2.5 meters from the riverbed. At the deepest part, the distance was estimated at about 3.9 meters. This indicates that the riverbed degradation at the downstream of the groundsill was about 2 to 3.5 meters. This situation had put the groundsill as a weak structure. There were seepage and most likely piping below the structure. During high flow, the kinetic energy of the flow over the crest hit the downstream riverbed and since there was no protection or energy dissipater, scour was likely to deepen. At the end, the sheet piles had lost their stability against overturning and sliding; breach was only a logic consequence. The breach provoked an immediate degradation at the upstream side of the groundsill. The riverbed now is 3 meters lower than that before the breach.

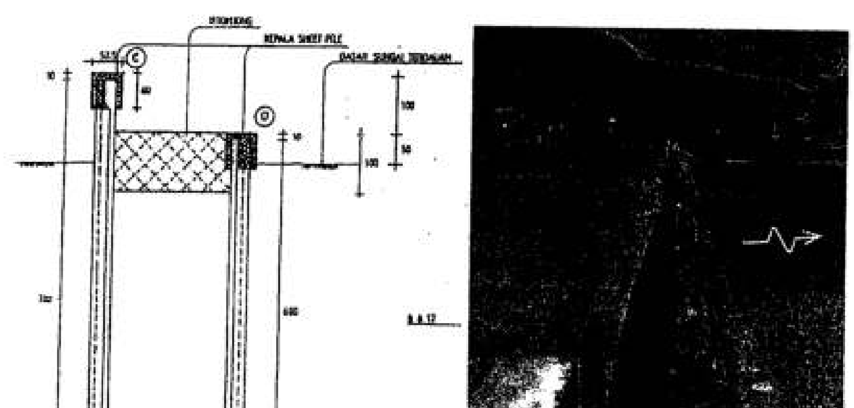

Figure 10. Kretek Groundsill Structure

The rehabilitation program of the groundsill includes installation of new sheet piles downstream of the old ones and a basin type energy dissipater. A gabion mattress was provided at the downstream toe of the energy dissipater. The gabion serves as toe protection and an early indicator should there be riverbed degradation at the downstream reach. When degradation takes place, the gabion will first be affected while the energy dissipater left unaffected. Necessary action can then be taken to restore the gabion and any anticipation to the riverbed degradation.

6. CONCLUSIONS

Three cases of bridge piers protection against riverbed degradation bring to the conclusion that bridge protection against riverbed degradation needs to be put on priority. Groundsill is an effective measure to control riverbed degradation. It cannot, however, prevent local scour around bridge piers. Groundsill may itself be prone to degradation, especially at its downstream side.

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