

**ISLT 2012**

*Proceedings of the 8<sup>th</sup> International Symposium*

*On*

# **LOWLAND TECHNOLOGY**



September 11 – 13, 2012  
Bali, Indonesia

## **ORGANIZED BY**

Civil Engineering Department, Hasanuddin University  
International Association of Lowland Technology  
Institute of Lowland and Marine Research, Saga University

---

***Proceedings of the International Symposium on***

**LOWLAND TECHNOLOGY 2012**

PEER REVIEWED

---

**Editors-in-Chief:** *L. Samang, S. Pallu and T. Harianto*

**Associate Editors:** *S. A. Adisasmita, R. Djamaluddin and M. A. Abdurrahman*

Published by:

**Civil Engineering Department, Hasanuddin University**

Tamalanrea, Makassar 90245, Indonesia

Tel: 62-411-587636

Fax: 62-411-580505

Email: [office@civileng-unhas.org](mailto:office@civileng-unhas.org)

URL: <http://www.eng.unhas.ac.id/civileng-unhas.org>

Every paper published in the proceedings was peer reviewed by two referees in the appropriate professional field.

The Department of Civil Engineering Hasanuddin University is not responsible for the opinion expressed by various authors in their contributions presented in the Proceedings.

**ISBN :978-602-95227-1-6**

Printed in Indonesia

---

COVER PHOTO ( FRONT ) SUNSET AT LOSARI BEACH, MAKASSAR (courtesy of A.Y. Baeda): LAKE OF HASANUDDIN UNIVERSITY, PURA ULUN AT BEDUGUL LAKE ( BACK )

# International Symposium on Lowland Technology

## ISLT 2010

**Organizing Committee**, Chairman: Prof. H. Araki (Japan)

Prof. D. T. Bergado (*Thailand*)  
Prof. K. Koga (*Japan*)  
Prof. J.-C. Chai (*Japan*)  
Prof. M. S. M. Kumar (*India*)  
Prof. Y.-J. Du (*China*)  
Prof. W. Liengcharernsit (*Thailand*)

Prof. S. Hayashi (*Japan*)  
Dr. A. Moqsud (*Japan*)  
Prof. K. Hokao (*Japan*)  
Mr. K. Ogata (*Japan*)  
Dr. F. H. M. van de Ven (*Netherlands*)

**Organizing Secretary:**

Dr. M. Azizul Moqsud (Japan)

**International Advisory Committee**

Prof. M. R. Madhav (Chair, *India*)  
Prof. H. B. Poorooshasb (*Canada*)  
Dr. M. Alfaro (*Canada*)  
Prof. J. P. Carter (*Australia*)  
Dr. C. Don (*Vietnam*)  
Dr. D. Eom (*Korea*)  
Prof. T. Y. Gan (*Canada*)  
Prof. M. E. Grismer (*USA*)  
Dr. J. Han (*USA*)  
Dr. O. Hoes (*Netherlands*)  
Prof. Y. Hosokawa (*Japan*)  
Prof. C. Hua (*China*)  
Dr. S. Karnchanawong (*Thailand*)  
Prof. T. Katsumi (*Japan*)  
Prof. Y. Kawakami (*Japan*)

Prof. C.-H. Koh (*Korea*)  
Prof. G.-X. Li (*China*)  
Prof. S.-Y. Liu (*China*)  
Prof. J. R. Lund (*USA*)  
Prof. Y. Nakamura (*Japan*)  
Prof. K. Ohgushi (*Japan*)  
Prof. M. Ohtsubo (*Japan*)  
Dr. K. Omine (*Japan*)  
Prof. A. Sridharan (*India*)  
Prof. T. Tingsanchali (*Thailand*)  
Dr. N. Vongtanasunthorn (*Thailand*)  
Prof. L. Xu (*China*)  
Prof. K. Yasuhara (*Japan*)  
Prof. N. Yasufuku (*Japan*)  
Prof. H.-H. Zhu (*China*)

**Local Technical Committee**, Chairman: Prof. L. Samang (Indonesia)

Prof. M. Selintung  
Prof. M. S. Pallu  
Prof. H. Parung  
Prof. W. Tjaronge  
Dr. T. Harianto (Co-Chair)  
Dr. S. Burhanuddin  
Dr. A. B. Muhiddin  
Dr. R. Djamaluddin  
Dr. S. A. Adisasmita  
Dr. A. Thaha  
Dr. S. Pamulu

Dr. A. Amiruddin  
A. Abdurrahman, MEng (Secretary)  
St. Hijraini, MEng  
M.I. Ramli, MEng  
M. Hustim, MEng  
S. Hamzah, MEng  
F. Elvira, MEng

## Foreword

In many countries, its capital and major cities have been developed in low-lying area exposing to various stresses from nature and human treats. As a result, natural lowlands are turned into highly vulnerable area in safety, economic and environmental aspect. New record of the highest temperature and precipitation in many region of the world has challenged the knowledge and technology for protecting life, property, and ecological system in lowlands.

To achieve “Sustainability of Lowland to Climate Change and Natural Disaster”, not only main themes as for previous ISLT like Geotechnical & Geo-environmental Engineering, Water & Environmental Engineering and City Planning and Management, but also new themes on Coastal Engineering and GIS Application for Lowland Management are concerned in the 8<sup>th</sup> International Symposium on Lowland Technology (ISLT2012).

In this year, the word “Lowlands” has brought together more than 100 researchers and engineers in related fields from 15 countries to share their great experience on coping with various problems in lowlands. Six outstanding speakers are invited to give one special lectures: Prof. D. T. Bergado (Miura Lecture); two invited lecture: Prof. D. A. Suriamihardja and Prof. W. Wangsadinata; and three keynote lectures: Prof. S. L. Shen, Prof. J. C. Chai and Dr. Olivier Hoes.

This symposium is organized by International Association of Lowland Technology (IALT) and Institute of Lowland and Marine Research (ILMR), Saga University with cooperation of Department of Civil Engineering, Hasanuddin University, Indonesia. I would like to extend my sincere appreciation to Prof. M. Madhav, the President of IALT, Prof. H. Araki the Chairman of the International Advisory Committee and Organizing Committee for their support.

I sincerely wish to express my gratitude to the International and Local organizing committee and all other staff of ILMR for their great contribution. Finally, I would like to thank all the authors for their participation. Without all of you, the symposium will never be successful.

Lawalenna Samang  
Local Chairman of ISLT2012

## President's Address

Institute of Lowland Technology (ILT) founded in 1991 and renamed as Institute of Lowland and Marine Research has come a long way. Apart from undertaking research and education in the specific areas relevant to problems and issues of lowlands all over the world but especially in the Asian Region, a major activity has been the conduct of International Symposia on Lowland Technology fondly referred to as ISLT. These Symposia offer a great opportunity for researchers, academics, policy makers, etc., who all are interested in studying the various issues of planning, development and management of lowlands to meet once in two years to exchange ideas and developments and to share knowledge for the common benefit of all. The need for interactions is felt continually with natural disasters striking almost all countries of the region. The saddest has been the catastrophic earthquake off the coast of Japan last year. The vulnerability of coastal areas has been once again exposed with the disastrous ten to twelve meter high Tsunami. Similar events in the other regions especially in Indonesia remind us all the need for continued research and study of coastal lowlands.

Following the successful conduct of ISLTs in Saga, Bangkok and Busan, the 8<sup>th</sup> Symposium in the series is a wonderful opportunity to meet in the picturesque island of Bali thanks to the great efforts of Prof. Samang, Dr Triharianto, Mr Abdurrahman, etc. The five major themes of „Geotechnical/Geo-environmental Engineering“, „Water & Environmental Engineering“, „City – Urban Planning & Management“, „Coastal Environmental Science & Engineering“ and „GIS Application for Lowland Management“ with twenty seven subthemes would cover all or most of the relevant topics of interest to everyone. Prof. Bergado, the eminent researcher and personality has been invited to present the third Miura lecture. With several keynote and invited lectures the event promises to offer the best occasion to interact and get intellectually stimulated.

ILT and ISLT have been successful because of the foresight of the founders, in particular, Prof. Norihiko Miura. They have been fostered and nurtured by eminent personalities such as Prof. Poorooshab, Prof. Hayashi, and the members of the Councils all these years. I would like to place on record the help, support and cooperation received from the Executive President Prof. Araki, Secretary General Dr Azizul Moqsud, Prof. Bergado, the conference organizers for the success of the symposium.

Wishing the Symposium a be great event to be remembered and cherished and looking forward to meet you all,

*Madhav Madhira*

President, IALT

## List of Reviewers

The Editors would like to thank the following individuals for their assistance in refereeing submitted papers for ISLT 2012.

Prof. H. Araki

Dr. W. Liengcharernsit

Prof. L. Samang

Dr. T. Inohae

Dr. T. Harianto

Dr. O. A. C. Hoes

Dr. A. B. Muhiddin

Dr. D. Suetsugu

Dr. R. Djamaluddin

Dr. A. Thaha

Dr. S. A. Adisasmita

Prof. S. Asuri

Prof. H. Yamanishi

Prof. S. Pallu

Dr. N. Vongthanasunthorn

Prof. M. Selintung

Dr. M. Kinashi

Dr. M. Azizul Moqsud

Dr. T. Hino

Dr. B. Setiawan

Prof. W. Tjaronge

Prof. H. Parung

Dr. S. Pamulu

# CONTENTS

## SPECIAL LECTURE

THE MIURA LECTURE <i>D. T. Bergado</i> .....	1
---	---

## KEYNOTE LECTURES

STATE OF PRACTICE OF JET GROUTING IN SHANGHAI: FROM TECHNOLOGY DEVELOPMENT TO SCIENTIFIC RESEARCH <i>S. L. Shen, Z. F. Wang, Y. S. Xu and Y. H. Kum</i> .....	13
CONSOLIDATION THEORY AND DEFORMATION ANALYSIS UNDER VACUUM LOADING <i>J. -C. Chai and T. Hino</i> .....	21
ACT OF DESPAIR OR FULL-FLEDGED EXPERIMENT: RETROSPECTIVE RESEARCH ON THE 1945 WIERINGERMEER FLOOD <i>O.A.C. Hoes, R. W. Hut and M. Boomgaard</i> .....	31

## PART 1

### GEOTECHNICAL/GEOENVIRONMENTAL ENGINEERING

#### CHAPTER 1 : PROPERTIES OF SOILS (1)

LABORATORY AND FIELD STRENGTH OF CEMENT SLURRY TREATED ARIAKE CLAY <i>Y. Igaya, T. Hino and J.-C. Chai</i> .....	40
EXPERIMENT ON FIBROUS PEAT SUBJECTED TO REDUCTION OF WATER CONTENT <i>N. E. Mochtar and M. K. Wardani</i> .....	46
CONSOLIDATION BEHAVIOR AND MICROSTRUCTURE OF BOTTOM SEDIMENT IN ISAHAYA BAY <i>R. Jia, T. Hino, T. Hamada and J.X. Nie</i> .....	51
PREDICTION FOR CBR UNSOAKED VALUE TO CBR SOAKED VALUE AND INDEX PROPERTIES OF CLAY-SAND MIXTURE OF PEKANBARU SOILS <i>S. A. Nugroho, M. Yusa. and S. R. Ningsih</i> .....	59
COMPARATIVE STUDY OF DETERMINATION OF LIQUID LIMIT BY PERCUSSION CUP, CONE, AND <i>K<sub>o</sub></i> -STRESS METHODS <i>H. B. Nagaraj, A. Sridharan and B. V. Madhu</i> .....	66
BASIC STUDY OF THE FUNDAMENTAL BEHAVIOR OF ARIAKE MARINE CLAY <i>F. Usman, T. Hino, T. Negami, T. Harianto and R. Jia</i> .....	75

## CHAPTER 2 : GROUND IMPROVEMENT AND GEOSYNTHETICS (1)

PHASE ANALYSIS OF SEDIMENT DEPOSITION FROM FLOODING OF THE JOBARU RIVER USING GEOSLICER <i>T. Hino, T. Ichihara, K. Ohgushi, R. Jia and T. Harianto</i> .....	82
CHARACTERISTIC OF UNCONFINED COMPRESSIVE STRENGTH OF SANDY CLAY STABILIZED BY CEMENT MIXTURE SUGAR-PALM FIBERS <i>P. Suroso, L. Samang, W. Tjaronge and T. Harianto</i> .....	90
MICRO-STUCTURAL CHARACTERISTICS OF LIME STABILIZED BENTONITE <i>A. Eisazadeh, K.A. Kassim and H. Nur</i> .....	94
EFFECTS OF LIME MIXING ON COMPRESSIVE STRENGTH OF COMPACTED LIME-MIXED QUARRY DUSTS <i>K. Nagai, D. Suetsugu and H. Hara</i> .....	98
THE DEWATERING PROPERTIES OF DREDGED CLAY MIXED WITH STEEL SLAG <i>J. Tajiri, K. Kasama, Y. Kasugai, K. Zen and G. Chen</i> .....	102
BEHAVIOR OF FIBROUS PEAT SOIL STABILIZED WITH RICE HUSK ASH (RHA) AND LIME <i>F. E. Yulianto and N. E. Mochtar</i> .....	106

## CHAPTER 3 : LAND SUBSIDENCE

BEARING CAPACITY OF REINFORCED FOUNDATION BEDS ON SOFT NON-HOMOGENEOUS GROUND <i>K. Rajyalakshmi, Madhira R. Madhav and K. Ramu</i> .....	111
EXPERIMENTAL TESTS AND NUMERICAL ANALYSES OF A SCALED SHALLOW FOUNDATIONS AT THE EDGE OF TRASS-SAND SLOPE WITH DR = 50% <i>H. Wibowo, Y.A. Pranata and C. Stevanus</i> .....	116
PHYSICAL AND NUMERICAL MODELLING OF THE MITIGATION OF SETTLEMENT DUE TO FOOTING INTERACTION IN CLAY <i>R. Effendi</i> .....	122
ANALYSIS OF REINFORCED SOIL WALL CONSIDERING STRESS DEPENDENT ANGLE OF SHEARING RESISTANCE <i>S. K. Karthik, G. V. N. Reddy, M. R. Madhav and B. Umashankar</i> .....	131
EFFECT OF SALT ON THE HYDRAULIC CONDUCTIVITY AND COMPRESSIBILITY OF THE TWO SOIL-BENTONITE MISTURES WITH DIFFERENT BENTONITE CONTENTS <i>A. K. Mishra, M. Ohtsubo and T. Higahshi</i> .....	136



## CHAPTER 4 : GEOENVIRONMENTAL ISSUES IN LOWLAND AREA

THE SUCTION PROFILE OF UNSATURATED CUT-SLOPE AT DIFFERENT HYDRAULIC CONDUCTIVITY DURING LOW INTENSITY RAINFALL <i>Khalid Mahmood and Jin Man Kim</i> .....	143
LONG-TERM INVESTIGATION OF SULFIDE CONTENT OF TIDAL MUD OF ARIAKE SEA <i>S. Amamoto, D. Suetsugu, H. Hara and K. Katae</i> .....	147
PHASE CONCEPT STUDY OF MUDFLOW INITIATION AT THE CIWIDEY TEA PLANT IN INDONESIA <i>Shannon Hsien-Heng Lee and B. Widjaja</i> .....	152
PORE-SIZE DISTRIBUTION OF LIME-TREATED SOIL UNDER SEAWATER <i>H. Hara, D. Suetsugu and S. Hayashi</i> .....	156
A NEWLY DEVELOPED CLIMATE CONTROL APPARATUS TO INVESTIGATE EVAPORATION BEHAVIOR <i>J. Teng, N. Yasafuku, Q. Liu and K. Omine</i> .....	161
THE INFLUENCE OF PLASTICITY INDEX ON THE SITE RESPONSE <i>M. Khari, K. A. Kassim and A. Adnan</i> .....	167
SITE CHARACTERIZATION OF TAYTAY, PALAWAN, PHILLIPINESS RAINFALL TRIGGERED SHALLOW LANDSLIDE <i>C. A. Bacosa, E. T. Calo and A. J. Reyno</i> .....	173

## CHAPTER 5 : PROPERTIES OF SOIL (2)

PERFORMANCE VARIATION DUE TO AIR VOID DISTRIBUTION IN OPEN-GRADED FRICTION COURSE PAVEMENT (OGFC) <i>N. A. Qureshi, I. A. Qureshi and S. M. Jamil</i> .....	184
UPSCALING SOIL WATER RETENTION FUNCTIONS USING PARTICLE SIZE DISTRIBUTION <i>S. Liu, N. Yasafuku, Q. Liu, K. Omine and H. Hemanta</i> .....	189
GCL/GM AND CLAYEY SOILS INTERFACE SHEAR STRENGTHS <i>A. Saito, K. Sari and J. -C. Chai</i> .....	199
EFFECT OF CONCRETE WASTE AS STABILIZATION MATERIAL ON CBR VALUE AND SWELLING POTENTIAL OF EXPANSE SOIL <i>M. W. Tjaronge, I. Maricar, A. B. Muhiddin and M. Sutiono</i> .....	204
DISPLACEMENTS OF GPA IN NORMALLY CONSOLIDATED SOFT SOIL (UNDRAINED MODULUS INCREASING WITH DEPTH) <i>B. Vidyaranya, M.R. Madhav and M. Kumar</i> .....	208

THE STRENGTH PROPERTY OF SLAG-MIXED AND DEWATERED CLAY <i>T. Takeshita, K. Kasama, Y. Kasugai, K. Zen, G. Chen</i> .....	214
---	-----

STUDY ON CLAY LINER CHARACTERISTIC OF SANITARY LANDFILL <i>A. Zubair, L. Samang, and A. Kamal</i> .....	218
--	-----

## **CHAPTER 6 : GROUND IMPROVEMENT AND GEOSYNTHETICS (2)**

CONSTRUCTION OF A LONG RAILWAY EMBANKMENT SUPPORTED BY THE PILED RAFT ON CLAY DEPOSITS <i>S. G. Han, S. O. Song and S. K. Kim</i> .....	227
---	-----

PASSIVE PRESSURE ON RETAINING WALL WITH ROTATIONAL MOVEMENT MODES WITH ANISOTROPIC SAND AS BACKFILL <i>A. B. Muhidin and I. Ishibashi</i> .....	233
---	-----

EFFECT OF CREEP OF GRANULAR PILE ON RESPONSE OF GRANULAR PILE REINFORCED SOFT GROUND-EFFECT OF AREA RATIO <i>S. Kandru, M. R. Madhav and E. C. N. Peter</i> .....	245
---	-----

ANALYTICAL SOLUTION FOR CONSOLIDATION OF SOILBAG CONSIDERING REAL FORM AND IMPEDED BOUNDARY <i>B. Niu, X. W. Tang, X. L. Chen and H. Y. Wang</i> .....	251
--	-----

COMPARISON OF POLYESTER GEOGRID AND STEEL GRID FOR VERIFICATION OF MODIFIED K-STIFFNESS WORKING STRESS METHOD ON HARD FOUNDATION <i>P. Baral, S. Duangkhae and D.T. Bergado</i> .....	256
---	-----

GREEN ENERGY FROM RICE PLANT MICROBIAL FUEL CELL IN ARIAKE SOIL <i>M. A. Moqsud, K. Omine, M. Hyodo and Y. Nakata</i> .....	263
--	-----

## **PART 2 WATER/ENVIRONMENTAL ENGINEERING**

### **CHAPTER 1 : GROUNDWATER CONTAMINATION AND MANAGEMENT**

BASIC STUDY ON WATER QUALITY MANAGEMENT IN THE RESERVOIR OF THE ISAHAYA BAY LAND RECLAMATION PROJECT <i>Y. Mitsugi, N. Vongthanasunthorn, Y. Misima, K. Koga, H. Araki and P. Ittisukananth</i> .....	267
---	-----

DEVELOPMENT OF PHOSPHORUS RECOVERY SYSTEM USING NLDH <i>K. Nakahara, H. Araki, Y. Mishima, Y. Matsuo and T. Turuhashi</i> .....	274
--	-----

EFFECT OF CALCIUM AND MAGNESIUM IONS ON PERFORMANCE OF UASB SYSTEM <i>S. Karnchanawong and S. Boonarsa</i> .....	280
--	-----

TSS VALUE AND ITS ROLE AS A BENCHMARK OF THE TAILINGS MANAGEMENT BY PT FREEPORT INDONESIA IN MODIFIED AJKWA DEPOSITION AREA, TIMIKA, PAPUA <i>B. K. Susilo, E. Sutriyono, R. H. Susanto and B. Setiawan</i> .....	286
INFLUENCE OF RAINFALL PATTERN ON THE PREDICTION OF CONTAMINANT DISPERSION IN GROUNDWATER <i>B. Kitikas, U. Duangduan and S. Sirivithayapakorn</i> .....	291
EXPERIMENTAL MODEL OF INFILTRATION BEHAVIOUR IN ORGANIC SOIL <i>H. Arfan</i> .....	294
INTEGRATED LAKE WATERSHED MANAGEMENT AS A FRAMEWORK TO ACHIEVE A SUSTAINABLE DEVELOPMENT OF LAKE YURIRIA, MEXICO <i>S. Silva, A. Bernal, M. Ortiz and G. Cuevas</i> .....	301
RESOURCES CLIMATE MANAGEMENT IN ANTICIPATION OF THE IMPACT OF THE CLIMATE CHANGE FOR RICE PLANTING PATTERN IN NORTH SUMATRA <i>K. E. Ramija and S. F. Batubara</i> .....	308
<b>CHAPTER 2 : WATER RESOURCES AND WATERSHED MANAGEMENT (1)</b>	
FOOD WEB STRUCTURE IN URBAN DRAINAGE CHANNEL AND ITS CONJUCT DITCH <i>K. Hiramatsu, T. Sakaida, K. Yonebayashi, E. Ichion, T. Onishi and S. Nishimura</i> .....	316
NUMERICAL SIMULATION AND ANALYTICAL VALIDATION FOR TRANSIENT TEMPERATURE DISTRIBUTION IN AN AQUIFER THERMAL ENERGY STORAGE SYSTEM <i>S. Ganguly, N. Seetha and M. S. M. Kumar</i> .....	322
RESPONSE AND MEASURES TO STRONG INTENSITY RAIN FALL OF SAGA LOWLAND <i>H. Araki, Y. Mishima, K. Yano, S. Ikari and S. Srinivasulu</i> .....	331
WATER FOOTPRINT OF THAILAND'S FOOD INDUSTRY: CASE STUDY OF RICE NOODLES PRODUCTIONS <i>P. Ittisukananth</i> .....	335
GREEN ROOF AS A POTENTIAL SUSTAINABLE STRUCTURE FOR RUNOFF REDUCTION <i>H. Kasmin and S. Musa</i> .....	341
ANN BASED PREDICTION AND SENSITIVITY ANALYSES OF MAXIMUM DRY UNIT WEIGHT AND OPTIMUM MOISTURE CONTENT VALUES OVER A LARGE RANGE <i>S. Srinivasulu, V. Padmavathi, H. Araki, S. Borzooei and M. R. Madhav</i> .....	346

### CHAPTER 3 : WASTEWATER TREATMENT AND WATER PURIFICATION

EFFECT OF OZONATION ON ORGANIC COMPOUNDS IN BREWERY WASTEWATER <i>P. Suwanvitaya and S. Jodpimai</i> .....	353
TURNED WINDROW COMPOSTING FOR ZERO DISCHARGE OF MULBERRY PULP WASTEWATER <i>B. Jolanun and C. Chiemchaisri</i> .....	358
THE WATER QUALITY AND MANAGEMENT PLAN OF BATUR LAKE BALI INDONESIA <i>I W. Arthana and I W. Restu</i> .....	363
PREDICTION OF DISSOLVED IRON (FE) CONCENTRATION USING INTEGRATED HYDRODINAMIC AND WATER QUALITY NUMERICAL MODEL ON BARAMBAI TIDAL SWAMP RECLAMATION CHANNEL <i>R. Riduan</i> .....	372
APPROPRIATE TECHNOLOGY IN PROVIDING CLEAN WATER FROM WASTEWATER OF SASIRANGAN <i>Q. Sholihah , R. Setyaningrum and L. Marlenae</i> .....	377
POTENTIAL RISKS AND RETURNS OF USING SHALLOW GROUND WATER FOR SECONDARY CROPS ON LOWLAND PADDY FIELDS IN INDONESIA: CASE STUDY IN SOUTH SULAWESI <i>D. Useng, M. Achmad, Suhardi , A. Munir and Darmawan</i> .....	381
APPROPRIATE TECHNOLOGY WATER SUPPLY USING WATER HYACINTH AND BLADYGRASS AS A BIOMASS FILTER ON DIAMOND MINING WATER CEMPAKA DISTRICT BANJARBARU <i>R. Setyaningrum , Q. Sholihah and L. Marlina</i> .....	389

### CHAPTER 4 : WATER POLLUTION IN RIVER AND LAKE

STRUCTURE OF MACROINVERTEBRATES IN OXBOW LAKES DIFFERED BY CONNECTIVITY WITH THE LOWLAND LYNA RIVER (CENTRAL EUROPE) <i>K. Obolewski, K. G. Lewczuk, A. Strzelczak, S. Kobus and J. A. Dunalska</i> .....	394
THE IMPACT OF THE CLIMATE ON THE EFFECTIVNESS OF THE LAKE RESTORATION BY THE HYPOLIMNETIC WITHDRAWAL METHOD <i>J. A. Dunalska, G. Wisniewski, K. Glinska-Lewczuk and K. Obolewski</i> .....	406
EVALUATION AND OPTIMIZATION OF HANDEEL AS PUBLIC WATER CANALS ON BANJARESE TRADITIONAL TIDAL PADDY RICE FIELD SYSTEM <i>M. A. Noor, N. Helda and Y. F. Arifin</i> .....	412
STUDY ON THE HABITAT DISTRIBUTION OF ILYOPLAX DESCHAMPSI IN A TIDAL AREA OF THE USHIZU RIVER, JAPAN <i>K. Nishimura and H. Yamanishi</i> .....	418

DEVELOPMENT OF MATHEMATICAL MODELS FOR FLOOD ROUTING IN THE UPPER PING RIVER BASIN, NORTHERN THAILAND <i>A. Kamsai, P. Ittisukananth and W. Liengcharernsit</i> .....	423
--	-----

## **CHAPTER 5 : WATER RESOURCES AND WATERSHED MANAGEMENT (2)**

EFFECTIVENESS OF COLLABORATION-BASED WATERSHED MANAGEMENT: THE OREGONIAN WATERSHED COUNCILS EXPERIENCE <i>S. Silva, P. Kay, M. Ortiz, A. Bernal and C. Gutierrez</i> .....	432
---	-----

SIMULATION OF GROUND WATER CONTOUR AT COASTAL AREA SOUTH SULAWESI <i>A. Munir, Syamsuddin, C. Suhardi and M. Achmad</i> .....	440
--	-----

ESTIMATING WATER RESOURCES EXPORT FROM MOUNTAINS DAM WATERSHED INTO SAGA PLAIN, JAPAN <i>C. Supit and K. Ohgushi</i> .....	455
---	-----

NUMERICAL MODELS ANALYSIS ON THE USE OF SAND COLUMNS AT RECHARGE RESERVOIR <i>A. Azis, S. Pallu, A. Thaha, A. Sumakin and Sugiharto</i> .....	462
--	-----

ANALYSIS OF WATER SUPPLY NETWORK PLANNING IN DISTRICT OF RANTEPAO SUBDISTRICT OF NORTH TORAJA <i>J. Patanduk and Denny C. S.</i> .....	469
---	-----

ANALYSIS ON SOIL ABSORPTION OF TELKOMAS REGION, BIRINGKANAYA DISTRICT, MAKASSAR CITY <i>M. Selintung and J. Patanduk</i> .....	474
---	-----

AN INTEGRATED RAINFALL, HYDROLOGICAL AND FLOOD INUNDATION MODEL FOR KOTA TINGGI, MALAYSIA CATCHMENT <i>M.R.M. Adib, T.Wardah, A.Noratina, I.H.Lokman, M.B.Saifullizan, D.Rokiah, A.Junaidah</i> .....	481
--	-----

## **PART 3 CITY/URBAN PLANNING AND MANAGEMENT**

### **CHAPTER 1 : URBAN DESIGN AND DEVELOPMENT PLANNING (1)**

A STUDY ON EFFECT FACTORS OF THE LOCATION OF DESIGN SERVICES COMPANIES- A CASE IN HANGZHOU <i>S. Luo, X. Hu and B. Sun</i> .....	506
---	-----

RESPECTING THE HISTORICAL SPIRIT AND EXPLORING THE CONTEMPORARY CONNOTATION---TAKE THE REBUILDING XILING IN XIIX WETLAND OF HANGZHOU, ZHEJIANG, CHINA <i>J. H. Wu and F. Chen</i> .....	510
--	-----

A FORECAST OF ZHOUSHAN URBAN DEVELOPMENT BASED ON THE BACKGROUND OF "ZHOUSHAN ARCHIPLEAGO <i>R. Zhang and L. Xu</i> .....	517
LABOR MANAGEMENT INFORMATION SYSTEM IN CONSTRUCTION PROJECT <i>M. Tanubrata, S. K. Yefta and F. H. Halim</i> .....	521
GIANT SCALE IN NEW DEVELOPED URBAN DISTRICTS <i>N. P. Hu</i> .....	527
TRANSFORMATION MECHANISM AND THE CULTURAL CONNOTATIONS OF CONTEMPORARY SELF-BUILT HOUSING IN HANGZHOU <i>Z. Bo and H. Yong</i> .....	532
A STUDY ON PREFERENCE FOR FINAL RESIDENCE TAKING INTO CONSIDERATION THE NECESSITY OF NURSING-CARE: A CASE STUDY IN LOCAL REGION, HITACHI-CITY <i>M. Kinashi</i> .....	537
THE INFLUENCE OF CLIMATIC FACTOR ON BUILDING STRUCTURAL DESIGN AND HOUSEHOLD ELECTICITY CONSUMPTION IN BANGKOK AND ITS VICINITY, THAILAND <i>C. Pratchayawutthirat, W. Gao and P. Iamtrakul</i> .....	543
<b>CHAPTER 2A : COASTAL AND WATER FRONT PLANNING</b>	
IMPACT OF URBAN DEVELOPMENT TO COASTAL BANTIK SETTLEMENT IN MALALAYANG, INDONESIA <i>P. P. Egam, N. Mishima and T.Y.W. Subroto</i> .....	554
ECONOMICAL ANALYSIS OF TRAFFIC CONGESTION IN DHAKA CITY <i>T. Khan</i> .....	561
REVITALIZATION OF URBAN WATERFRONT A STUDY FOR THE REGENERATION OF HANGZHOU HISTORICAL DISTRICT "CANAL PARADISE" <i>Y. Hong, C. Hua and H. Yan</i> .....	568
NEW TOWN PHENOMENON AND ITS CHARACTERISTICS IN PLANNING AND DESIGN OF THE YANGTZE RIVER DELTA MEGALOPOLIS <i>Y. Zhou, K. Wang and L. Xu</i> .....	574
AN OPTIMIZED INVESTMENT METHODOLOGY FOR SUSTAINABLE REHABILITATION OF ROAD INFRASTRUCTURE IN LOWLAND AREAS <i>M. Yadollahi, R. M. Zin and A. Adnan</i> .....	580
DRIVING CYCLE OF PASSENGER CARS ON HETEROGENEOUS TRAFFIC SITUATIONS : CASE STUDY ON AN URBAN ROAD IN MAKASSAR, INDONESIA <i>S. H. Aly, M. I. Ramli and T. Sumi</i> .....	586

## CHAPTER 2B : URBAN DESIGN AND DEVELOPMENT PLANNING (2)

RESTRUCTURING AND PRESERVATION OF HISTORICAL BUILDING AND ENVIRONMENT :- A CASE OF RESIDENTIAL IN WESTLAKE , HANGZHOU, CHINA <i>T. Tanachawengsakul , D. Jia , P. Iamtrakul , Y. Ishimaru , K. Hokao and W. Jie</i> .....	592
LABOR MANAGEMENT INFORMATION SYSTEM IN CONSTRUCTION PROJECT <i>M. Tanubrata , S. K. Yefta and F. H. Halim</i> .....	604
INVESTIGATING THE LOW-INCOME SETTLEMENT IN AN URBANIZATION AND URBAN FORM A CONSEQUENCES OF BANGKOK GROWING CITY, THAILAND <i>U. Shummadtayar , H. Kazunori and P. Iamtrakul</i> .....	610
TOURISM ORIENTED RURAL COMMUNITY PLANNING FROM THE PERSPECTIVE OF URBAN-RURAL INTEGRATION A CASE STUDY OF RURAL CONSTRUCTION IN ANJI, ZHEJIANG <i>P. -W. Sun, Z. Wang and Y. He</i> .....	620
THE SPACE PLANNING AND DESIGN OF COMMUNITIES UNDER NEW TOWNS CONSTRUCTION PROGRAM IN NORTHERN ZHEJIANG PLAIN, CHINA <i>Z. Qian , Z. Wang and L. Wang</i> .....	626
RESEARCH OF CO2 EMISSION OF CAMPUS BUILDINGS BASED ON LIFE CYCLE ASSESSMENT ---- TAKING ZHEJIANG UNIVERSITY FOR EXAMPLE <i>H. X. Ang , C. Wei. and Q. L. Juan</i> .....	631
REVIEW ON PEOPLE'S LIFESTYLE AND ENERGY CONSUMPTION IN ASIA COMPARISON STUDY OF INDONESIA, THAILAND, AND CHINA <i>D. Novianto , G. Weijun , C. Pratcayawuthirat and J. Yanqi</i> .....	635

## CHAPTER 3A : URBAN DESIGN AND DEVELOPMENT PLANNING (3)

SUB-URBAN LOW-LYING AREA CONVERSION DUE TO THE HOUSEHOLD EMERGING IN COLOMBO METROPOLITAN REGION OF SRILANKA <i>GPTS Hemakumara and R. Rainis</i> .....	642
TRANSITION OF AGRICULTURE AREA IN TO SUSTAINABLE INDUSTRIAL CITY <i>A. Cahyaningsih</i> .....	648
RESEARCH OF ZHOUSHAN CORRIDOR PLANNING BASING ON THE CULTURE RESOURCE <i>L. Huang, Y. He, F. Wen and P. Shen</i> .....	655
SUBURBAN COMPOSITE LANDSCAPE CORRIDOR DESIGN STUDY OF DINGHAI DISTRICT IN ZHOUSHAN <i>F. Wen, Z. Wang and Y. He</i> .....	659

THE CHARACTERISTIC ANALYSIS OF HISTORIC DISTRICT REVIVAL IN SANJIANGKOU: A CASE STUDY ON TIANYI SQUARE AND THE OLD BUND <i>S. Ye and X. Lei</i> .....	664
ON THE CITY SPACE PATTERN AND ORGANIC RENEWAL DESIGN OF JINGNING, ZHEJIANG PROVINCE <i>X. Xiaodi and Z. Yuheng</i> .....	670
EVALUATION AND ANALYSIS OF FIRE SAFETY PERFORMANCE IN COMMERCIAL COMPLEX <i>J. Shi</i> .....	677
RURAL PLANING IDEAS UNDER THE CONCEPT OF "CITY SLOW" <i>N. Shuwen, W. Zhu, T. Yiqi and W. Ling</i> .....	686
LAND USE AND POPULATION CHANGE DYNAMICS IN NORTH-EASTERN CEBU CORRIDOR <i>H. Zanoria , A. Diola , R. Villavelez and O. Mana</i> .....	692
 <b>CHAPTER 3B : TRANSPORTATION PLANNING FOR SUSTAINABLE DEVELOPMENT (3)</b>	
SUSTAINING FUTURES OF URBAN MASS TRANSIT IN BANGKOK <i>P. Iamtrakul</i> .....	709
POROUS ASPHALT,,S CONTRIBUTION ON ROAD SAFETY AND ENVIRONMENT <i>N. Ali , M. I. Ramli and M. Hustim</i> .....	719
THE OPERATION EFFECTIVENESS EVALUATION OF HANGZHOU QIANJIANG NEW CONSTRUCTION RIVERSIDE WALKING SPACE BASED ON POE ANALYSIS <i>Y. Lu and L. Xu</i> .....	725
ANALYSIS ON NEW CHARACTERISTICS OF DEVELOPMENT ZONE IN YANGTZE RIVER DELTA REGION OF CHINA <i>C. Zhiyu and X. Lei</i> .....	732
RESEARCH OF THE MECHANISM OF THERMAL BRIDGE IN SELF-INSULATION SYSTEM IN HOT SUMMER AND COLD WINTER AREAS <i>N. D. Jia , B.J. Ge and C. D. Ying</i> .....	741
A STUDY ON EFFECT FACTORS OF THE LOCATION OF DESIGN SERVICES COMPANIES- A CASE IN HANGZHOU <i>S. Luo , X. Hu and B. Sun</i> .....	744
REVITALIZATION OF URBAN WATERFRONT A STUDY FOR THE REGENERATION OF HANGZHOU HISTORICAL DISTRICT "CANAL PARADISE" <i>Y.Hong , C. Hua and H. Yan</i> .....	750
ANALIZING THE LEVEL OF SERVICE OF THE JAKARTA ROAD NETWORK <i>E. Tambunan</i> .....	756



## CHAPTER 4 : CREATIVE RESTRUCTURING AND PRESERVATION OF URBAN ENVIRONMENT

AMPHIBIOUS URBANIZATION AS A FLOOD MITIGATION STRATEGY FOR LOW-LAND AREA <i>M. A. Nekooie, M. I. Mohamad and Z. Ismail</i> .....	762
IMPLEMENTATION OF THREE_DIMENSIONAL URBAN SYSTEM IN THE REGENERATION OF HANGZHOU CITY CENTER <i>Z. Yingsheng, Z. Yijun and G. Yujiang</i> .....	769
ECOLOGY, PRODUCTION AND LIVING: RESEARCH ON THE PLANNING AND CONSTRUCTION OF RURAL FEATURES BASED ON THE EPL SYSTEM <i>C. Xu, Z. Chai and Y. Gao</i> .....	773
THE STATUS QUO OF LOW-CARBON CBD DEVELOPMENT IN CHINA <i>M. Zhiyuan and X. Lei</i> .....	781
ECOLOGICAL MATERIALS -- FOAM GLASS, THE PROPERTIES AND THE APPLICATION IN MODERN ARCHITECTURE <i>F. Wang and W. Li</i> .....	786
AN ALTERNATIVE APPROACH FOR CLARIFYING ELDERLY PEOPLES ACTIVITY AND DESIRABLE LAYOUT OF URBAN FORM <i>T. Inohae, T. Nagaie and K. Hokao</i> .....	792
SOUNDSCAPE TIMING DESIGN IN CHINESE CLASSICAL GARDENS-- A CASE STUDY OF GEYUAN GARDEN <i>G. Min and G. Jian</i> .....	800

## CHAPTER 5 : STRUCTURAL ENGINEERING AND ECO-MATERIAL

PRELIMINARY STUDY OF THE UNIQUE TOPOGRAPHY AS MITIGATION AGAINST TSUNAMI HAZARD <i>U. Fadly, B. K. Eddi and H. Septiana</i> .....	809
MERAPI VOLCANIC ASH AS AN ECO-MATERIAL OF CONCRETE FILLER <i>I. Bali and F. Sitorus</i> .....	815
FLEXURE BEHAVIOR OF RC BEAMS STRENGTHENED WITH CERP GRID <i>A. A. Amiruddin</i> .....	819
CONDITION ASSESMENT OF REINFORCED CONCRETE BUILDING <i>W. Wuryanti</i> .....	826
FLEXURAL CAPACITY OF CRACKED CONCRETE BEAMS STRENGTHENED USING GFRD SHEET <i>R. Djamaluddin, T. Harianto and A. M. Akkas</i> .....	832

THE RESEARCH OF RURAL SPATIAL FORM BASED ON THE PRINCIPLE OF ECO-FEEDBACK MECHANISM--TAKING ZHEJIANG PROVINCE AS AN EXAMPLE <i>W. Tao and W. Zhu</i> .....	839
SIMULTANEOUS MODELLING EFFECT OF JOB DESIGN AND ORGANIZATIONAL CULTURE ON THE EMPLOYEE'S PERFORMANCE OF INFRASTRUCTURE CONSULTANT SERVICES IN INDONESIA <i>N. Hamid</i> .....	845
 <b>CHAPTER 6 : TRANSPORTATION PLANNING FOR SUSTAINABLE DEVELOPMENT (2)</b>	
ENVIRONMENTAL ASSESMENT TOOL FOR SINGLE LANDED HOUSE AS AN APPROACH TO MANAGE RAPID URBAN HOUSING DEVELOPMENT <i>V. Fauzianti</i> .....	854
THE CHOICE OF CONSTRUCTION LAND IN COASTAL CITIES BASED ON SCENARIO PLANNING <i>Y. Gao, W. Li and W. Yu</i> .....	859
A STUDY ON THE CHANGES OF WATERWAY IN CENTRAL AREA OF HANGZHOU BASED ON THE HISTORICAL MAPS <i>X. Bing and W. Hui</i> .....	868
LEACHABILITY OF HEAVY METALS FROM FIRED CLAY BRICKS INCORPORATED WITH CIGARETTE BUTTS <i>A. A. Kadir and A. Mohajerani</i> .....	874
A BUILD-OPERATE-TRANSFER MODEL PROPOSED FOR DEVELOPMENT OF INDONESIAN AIRPORTS <i>S. Hamzah and S. A. Adisasmita</i> .....	881
THE RESEARCH IN LANDSCAPE STYLE DESIGN ALONG CRANE CREEK RIVER IN JINGNING, ZHEJIANG PROVINCE <i>W. Jieqiong and Z. Yuheng</i> .....	887
CALCULATION METHOD RESEARCH OF ENERGY CONSUMPTION AND CO2 EMISSION OF BUILDINGS IN ZHEJIANG PROVINCE BASED ON LIFE CYCLE ASSESSMENT <i>Z. Yun, Y. Yan, G. Min and G. Jian</i> .....	893
THE CONTROLLING AND PREVENTING STRATEGIES OF ACID RAIN POLLUTION BASED ON ECOLOGICAL INFRASTRUCTURE PLANNING: A CASE STUDY OF TAIZHOU CITY <i>J. Wang, J. Jiang and C. Zhang</i> .....	904

**PART 4**  
**COASTAL ENVIRONMENTAL-SCIENCE AND ENGINEERING**

**CHAPTER 1 : PROTECTION, PREVENTION OR MITIGATION OF COASTAL ENVIRONMENTS**

INFLUENCE OF UNDERWATER SILL LAYOUT AGAINST FLOW PATTERNS IN ORDER TO REDUCE SEDIMENTATION IN NAVIGATION CHANNEL AND BASINS <i>T. E. Bhakty, T. S. Putri, N. Yuwono, R. Triatmadja and B. Triatmodjo</i> .....	912
RHEOMETRIC CHARACTERIZATION OF THE FLUID MUD FORMING POTENTIAL OF A BAY MUD <i>F. Samsami, Y. P. Khare and A. J. Mehta</i> .....	917
LEARNING MEDIA OF RUBBLE-MOUND BREAKWATERS DESIGN <i>O. Pattipawaej, Sinatra and K. T. Tanamal</i> .....	922
THE MANGROVE CONSERVATION APPROACHED FROM PEOPLE SIDES IN LAGOON OF SEGARA ANAKAN <i>P. Sudjono and Z. Perdana</i> .....	930
FLUIDIZER SYSTEM DESIGN FOR MAINTENANCE DREDGING: A CASE STUDY ON THE RIVER MOUTH SURROUNDING BANTAENG COASTLINE, INDONESIA <i>M. A. Thaha, N. Yuwono and R. Triatmadja</i> .....	936
NATURAL SUCCESSION VEGETATION AREA CHARACTERISTICS IN THE TAILINGS DEPOSITION AREA OF PT FREEPORT INDONESIA AT PAPUA INDONESIA <i>Y. Windusari, Z. Dahlan, I. Yustian and P. Puradyatmika</i> .....	944
ACCUMULATION OF HEAVY METALS IN COASTAL SEDIMENT; CHONBURI TO PATTAYA COAST LINE <i>S. Khuntong , W. Sudprasert , P. Sittipo 1 and S. Treerat</i> .....	951

**CHAPTER 2 : MONITORING AND MODELLING IN ESTUARIES AND COASTAL AREAS**

A STUDY ON IMPACT OF STORM SURGE BY TYPHOON PAT (T198513) IN SAGA LOWLAND AND SURROUNDINGS USING HYDRODYNAMIC NUMERICAL MODELLING <i>A. K. T. Dundu and K. Ohgushi</i> .....	961
MODELING SEDIMENT TRANSPORT FOR BAU-BAU ESTUARY, INDONESIA <i>A, Asri, M. A. Abdurrahman and St. Hijraini</i> .....	969
STUDY ON DISSOLVED SILICA IN THE ARIAKE SEA USING THE FINITE VOLUME MODEL <i>N. Vongthanasunthorn, Y. Hamazaki, Y. Mitsugi, and K. Koga</i> .....	973
SHORELINE BEHAVIOUR AROUND THE INLET OF IMAGIRE-GUCHI <i>A. S. Mustari, S. Kato and S. Aoki</i> .....	979

MODELING OF WAVE INDUCED CURRENT AND BEACH MORPHOLOGY CHANGE <i>Tamrin, D. Kardana N and S. Pallu</i> .....	986
--	-----

**PART 5**  
**GIS Application for Lowland Management**

LANDSLIDE SUSCEPTIBILITY MAP USING BIVARIATE STATISTICAL ANALYSIS, A CASE STUDY IN BOGOTA <i>A. H. Sourı, A. Abedini and S. Parang</i> .....	991
REMOTE SENSING IMAGE-BASED ANALYSIS OF THE URBAN HEAT ISLAND IN DENPASAR, INDONESIA <i>Abd. R. As-syakur , I W. Nuarsa, I W Arthana, M. S. MahendraI, I W. S. Adnyana, I N. Merit, R. Suyarto, and K. A. Lila</i> .....	997
MEASURING LAND SUBSIDENCE OF MAKASSAR CITY USING DINSAR OF JERS-1 IMAGES <i>I. Alimuddin , L. Bayuaji , J. T. S. Sumantyo and H. Kuze</i> .....	1005
TRACE ELEMENT SPATIAL ABUNDANCE MAPPING IN GROUNDWATER OF PARAVANAR SUB BASIN, TAMIL NADU, INDIA USING GIS TECHNIQUE <i>S. Aravindan, K. Shankar and B. Poovalinganganesh</i> .....	1010
A STUDY ON ECO-ENVIRONMENTAL CHANGES OF WETLAND RESOURCES OF HAKALUKI HAOR IN BANGLADESH BY USING GIS TECHNOLOGY <i>M. J. Uddin , A. S. M. Mohiuddin and S. T. Hossain</i> .....	1021
WEB-GIS DATABASE MODEL APPLIED IN POLDER BANGER <i>S. Darsono</i> .....	1026
ELASTO-PLASTIC BEHAVIOR OF RC FRAMES COMPOSED OF TUBED REINFORCED CONCRETE SHORT COLUMNS AND SPANDREL WALLS <i>Nasruddin and A. Kawano</i> .....	1030
FLOODWATERS AT THE TALLO RIVER FLOWS USINGGEOGRAPHIC INFORMATION SYSTEMS (STUDIES CASE MAKASSAR CITY) <i>M. P. Hatta, M. S. Pallu and I. Hadi</i> .....	1040
MAPPING THE LOCATION OF ARTERIAL ROAD CONGESTION AND HIGHWAY PERFORMANCE – BASED QUANTUM GIS OPEN SOURCE IN MAKASSAR CITY, SOUTH SULAWESI <i>S. Rauf, S. A. Sasmita , St. Hijraini and A. R. Djamaluddin</i> .....	1044
EFFECTS OF ORGANIC ACID TREATMENT ON CHEMICAL AND MECHANICAL CHARACTERISTICS OF TIDAL MUD OF ARIAKE SEA <i>K. Katae, D. Suetsugu , H. Hara and S. Amamoto</i> .....	1051
ESTIMATION OF WEAKZONES USING GEOSTATISTICAL APPROACH ON DEPOSITION AREA LEEVE <i>B. Setiawan, F. Hadinata, Z. G. Fad and U. S. Minaka</i> .....	1055

ESTIMATION OF GHG EMISSION ON URBAN SOLID WASTE MANAGEMENT USING EVENT TREE ANALYSIS APPROACH <i>F. Hadinata, D. P. Apriadi and B. Setiawan</i> .....	1060
KENAF WOVEN LIMITED LIFE GEOTEXTILES (LLGS) REINFORCEMENT INTERACTION BY PULLOUT AND DIRECT SHEAR TESTS <i>S. Artidteang, D. T. Bergado, T. Tanchaisawat and S. Chaiyaput</i> .....	1066
AN ANALYSIS OF FACTORS AFFECTING THE QUALITY OF SERVICE AND SATISFACTION AND THEIR IMPACT ON THE LOYALTY OF PUBLIC TRANSPORTATION USERS IN SULAWESI <i>L. B. Said</i> .....	1072

## EVALUATION AND OPTIMIZATION OF HANDEEL AS PUBLIC WATER CANALS ON BANJARESE TRADITIONAL TIDAL PADDY RICE FIELD SYSTEM

M. A. Noor<sup>1</sup>, N. Helda<sup>2</sup> and Y. F. Arifin<sup>3</sup>

**ABSTRACT:** Handeel is a Banjarese local term for public water canals, which actually came from dutch language “andeel”, means a straight line canal made by a group of people/society/village community, had a function in delivering water from rivers to a paddy field. The system has established since the era of dutch colonialization, then treated and modernized by Indonesian government during 1970’s. Unfortunately, even though the system has implemented for 40 years, the current development of this tidal irrigation system were stack or rise very slowly. Since then it is necessary to evaluate the base characteristics of the existing canal system, ie. Hydraulic capacity, tidal paddy field type, hydrotopography, and probability for implementing advanced methodology in farming system. After the basic problem found, then continued with the optimization on existing Handeel to improve the best benefit for farmers. The study area covers about 20 Handeel as secondary/tertiary canal system in anjir Tamban Primary System which supply water distribution to 3000 hectares paddy fields. The study gives the information about the lack of important water structures ( levees, folders, control boxes, culverts, etc.) as the main cause of Handeel problem. The second problem is about the soil property which still poor even though the land has already washed and leached from the poisonous matter such as sulfate acid with tidal movement through paddy field. And the third is caused by poor water management as excess from the first reason.

**Keywords:** Handeel, canals, tidal paddy field

### INTRODUCTION

The 3000 hectares of Survey, Investigation and Design (SID) for Public Handeel site plan in the tidal reclamation area is located on geographical coordinates of : 3°13’ to 3°16’ South Latitude and 114°21’ to 114°25’ East Longitude . The site plan of the net 3400 hectares lies at the southwest of the area which is known as Pulau Petak delta. It is river estuary lowland which covers about 240 thousand hectares of tidal swamp area, which is bounded by Barito River system in the east, Kapuas River in the west and the Java Sea in the South. Specifically, Public Handeel scheme area is located in the east of Kapuas River, with Anjir Tamban Canal as Primary System and some of secondary canals (North Secondary Canal and South Secondary Canal).

Traditional planting method are conducted by Banjarese people which take place in the area that extend out over the land 5 km far away from the edge of the tidal river. Initially, there were a lot of natural canals along the tidal river, which have interval ranging from 200-700 m.

Banjarese farmers, in the beginning, tried to upgrade the canal function (known as Handil) to be improved drainage canal as well as the supply canal to provide water for their farming land. This upgraded canal system has been reached 2 km effectively into the land. Unfortunately, in the next development, the water level limit was too high so that it is impossible to plant the crop in the rainy season.

Swamp Reclamation Project which was organized by the Dutch Government since 1910 (East Indies Government), was indicated by the construction of big connecting canal (known as Anjir Serapat) which connects Barito River and Kapuas River with two purposes: as a land drainage and transportation means, respectively. In 1955, Anjir Tamban was built by the Indonesian Government.

After that, Banjarese farmers made numerous small canals which lie vertically to that Anjir with the same interval as natural canals.

---

<sup>1</sup> Lecturer at Civil Eng. Dept., Eng. Faculty, Lambung Mangkurat Univ., Banjarmasin, Kal-Sel, INDONESIA

<sup>2</sup> Lecturer at Civil Eng. Dept., Eng. Faculty, Lambung Mangkurat Univ., Banjarmasin, Kal-Sel, INDONESIA

<sup>3</sup> Lecturer at Civil Eng. Dept., Eng. Faculty, Lambung Mangkurat Univ., Banjarmasin, Kal-Sel, INDONESIA

Tabel 1: Dates of Construction of Swamp Reclamation Project.

Scheme	Year
Lahan Spontan	.....
Anjir Serapat	1915
Anjir Tamban	1955
Anjir Talaran	1969
Barambai	1969
Belawang	1975
Sei Muhur	1976
Tabunganen	1977
Sakalagun	1978
Seluang	1979
Puntik Terantang	1981
Puntik Danda Besar	1981

OBJECTIVES

The objective of SID project for Public Handeel is to make a detail design of Rehabilitation Plan of Swamp Reclamation Network which covers :

Identify the potencies and the constraints appear on the location consist of technical, agriculture, social-economic and environmental aspect respectively. Then, try to formulate the development plan for supporting the farmers' welfare and to provide job opportunities in accordance with the neighbouring area.

Evaluate the existing canal network, whether natural or man made canals and to plan drainage/irrigation canal network for the development of the previous objective.

RESEARCH METHODOLOGY

For implementing the tidal swamp reclamation, it used abbreviation of SIDLACOM frequently. This abbreviation explains the stage of the swamp reclamation project in sequence as follows:

- S - Survey
- I - Investigation
- D - Design
- L - Land
- A - Acquisition
- C - Construction
- O - Operation
- M - Maintenance

For the swamp development projects, SID are the first 3 stages after the project identification. Usually, the project has been identified by government institute or private company. Project identification will explain the

project space boundaries, goals and types of the planned areal development and also covers investigation of particular subject or established plan works. The project can be the opening of new areas, undeveloped areas or rehabilitation and upgrade the existing canal network.

The activity of SID with Government funding, usually, are the responsibility of the Department of Public Works. They can give it all or some of it to the private organizations which are the technical consultants or private institutions.

During the SID process, important decisions were made which include the targeted constructions and the type of planned physical work. The decisions were made by consulting with other institutions involved in the areal development, also with the community.

The order of the SID process are shown here:

- Preliminary
- Field Survey
- Data Analysis
- System Planing
- Report

All the criteria and specification are in the correspondence with the hydraulic means.

RESULTS AND DISCUSSIONS

Public Consultation Meeting

Location:

Darul Mu'minin Mosque, Tamban Baru Tengah Village

The participants:

Coordinator of PPL BPP of Agriculture Department Tamban Catur District, Farmer Group Resprentatives from 4 villages at Tamban Catur District.

The results of the meeting are written below:

1. Tamban Baru Mekar village

- Many of Handil canals are blocked and grass growth
- People reject the dredging of the canal
- People hope for worm canal to be built
- Most of water gates are not operated
- People are not use water transportation.

2. Tamban Baru Tengah village

- People want the dredging and worm canals made
- People want water gate to be built in the downstream of the canal.
- Irrigation canals are not exist
- Water channels are built under the farmer road.

3. Tamban Baru Timur village

- People want the dredging dan street hardening
- Many people use water transportation
- Irrigation canals and water gates are functioning properly

- People want the improvement of the farmer road
- People want the solution of the plant disease
- 4. Tamban Baru Selatan village
- People want the solution for the water acidity
- People want the solution of the plant disease
- People want the dredging and the improvement of the farmer road
- The head of the village hope to make the canal longer than before.

**Water System Boundary**

Based on the lay-out of water system, the Public Handeel Water System can be defined as some stages as follows:

- Delta Water System: Delta Pulau Petak Water System
- Macro Water System: Anjir Tamban Water System
- Meso Water System: Public Handeel Water System
- Micro Water System: Handil Rice Field Water System

The Public Handeel Macro Water System in the study area is boundary with Jelapat Fork-like Water System, Tabunganen Fork-Liked Water System Lupak Primary Channel (A1-A4) as shown in Figure 1.

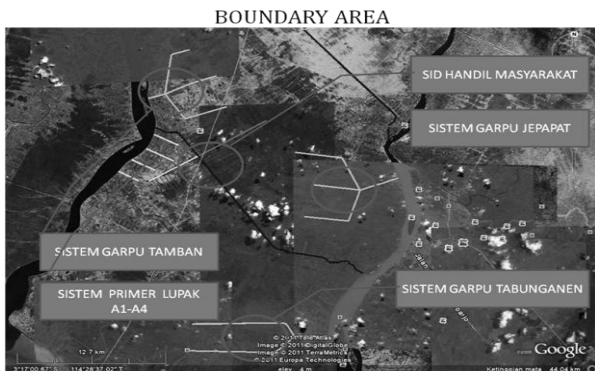


Fig. 1 Boundary Area of Field Study

**Macro Water System**

Handil Masyarakat Macro Water System which has 22 Handeels at the plan area is Anjir Tamban Primary Drainage System. Nevertheless, part of the drainage flow runs to neighbouring water system: to Lupak Primary Channel (A2 and A3) and Bukat Flow Water System.

On the stage of Anjir Tamban Primary Channel System, has experienced shallowness, primarily at the 1/5 from the mouth of Kapuas River (4/5 are empty into Barito River). The Major cause of the shallowness is dead flow zone, which has two river currents in the opposite direction. The total length of Anjir Tamban is approximately 25 kms.

The tidal movement predominantly in Anjir Tamban Ayunan is the inflow to the mouth of Barito River. The location of Public Handeel from the mouth of Kapuas River until the intersection of Anjir Tamban and Secondary Channel is about 5 Km, as can be seen in Figure 2.

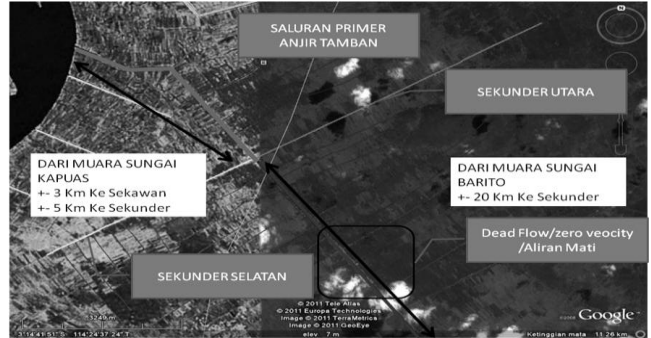
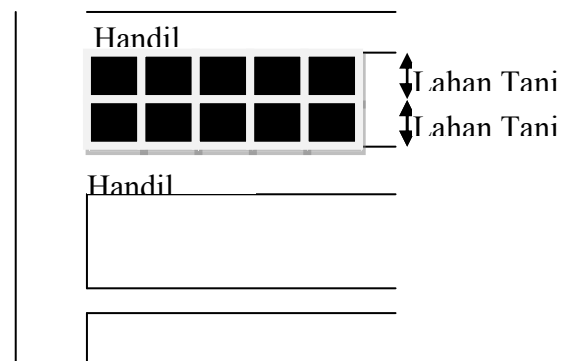


Fig. 2 Layout of Macro Water System

**Micro Water System**

Handeels at the plan location are in the stage of Meso/Micro Water System. The farmers' rice fields are usually water supplied from the handeels. Each of the paddy field has a tap channel directly into the handeel, and it is supplied at the right and the left of the handeel. Although the Handil Water System in Anjir Tamban ages more than 30 years, however, it has not shown the maturity stage and is not equipped with water control infrastructures. The solution of this problem is Controlled Water Management consists of some stages of design and plans. Solusi dari permasalahan ini adalah

Besides, the interval between two handeels is 200-300 in average, there are only two paddy fields between the two handeels which are only supplied by one handeel. In other words, the micro water systems are separated. Figure 3 shows the lay-out scheme of Meso/micro Water



System at the edge between two handeels.

Figure 3: Meso / Micro Water System



Hydrotopography Analysis

The next two figures are the results of the hydrotopography analysis of the study area.

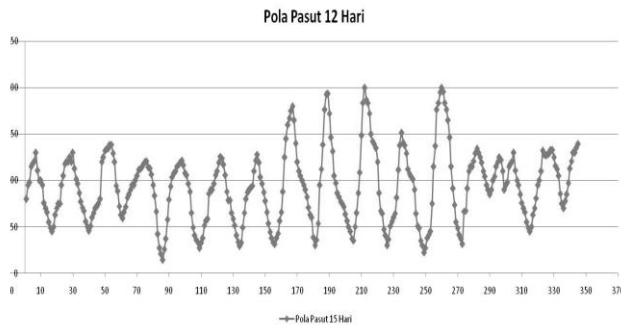


Fig. 4 Tidal Pattern from Field Study

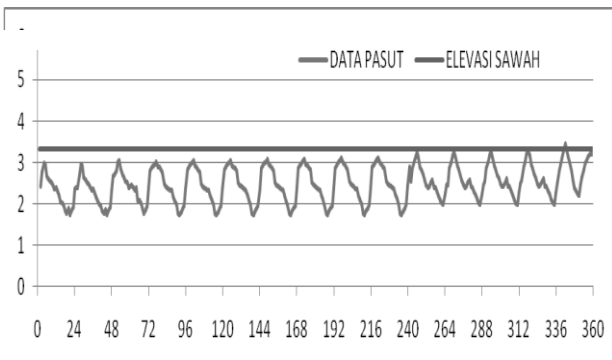


Fig. 5 Tidal Pattern from Field Study

From the overlay of the Tidal Data of some Handeel samples, it is known that based on the Class or the Land Type, the Handeels are in the Type A Class ( $\pm 4$  times the land is influenced by the tidal, whether in the dry season or rainy season).

Hydrological Analysis

- a. Climatological Data from Sungai Tabuk station are used, while Precipitation Data came from 3 stations: Anjir Pasar, Tamban, dan SMPK Kapuas Murung Palingkau.
- b. Climatological data from Sungai Tabuk station consists of temperature, sunshine duration, wind speed, evaporation and relative humidity.
- c. The average precipitation in Kapuas Regency is 174,6 mm. The highest average is 314.6 mm in January and the lowest is 43.0 mm in August respectively.
- d. The Average Evapotranspiration ( $ET_0$ ) is 6.217 mm/day. The highest  $ET_0$  is 7.987 mm/day in August and the lowest is 5.285 mm/day in May respectively.

- e. In deciding whether precipitation data from 3 stations can be used or not, Homogeneity test (t-test) was used. Homogeneity test was done in order to know whether the series data which came from two gage stations were coming from the same population or not. Finally, 3 pairs of precipitation stations will be obtained.
- f. From t-test for precipitation data, for Anjir Pasar and Tamban Stations,  $t_{\text{calculated}} = 1.0912 < t_{\text{critic}}$ , where  $t_{\text{kritis}}$  for two sides t-test distribution with  $\alpha = 5\%$  and  $dk = 18$ , was given  $t_{\text{kritis}} = 1.734$ .
- g. From t-test, for Anjir Pasar and SMPK Kapuas Murung Palingkau stations,  $t_{\text{calculated}} = -0.3520 < t_{\text{critic}}$ , where  $t_{\text{kritis}}$  for two sides t-test distribution with  $\alpha = 5\%$  and  $dk = 18$ , was given  $t_{\text{kritis}} = 1.734$ .
- h. From t-test, for Tamban dan SMPK Kapuas Murung Palingkau stations,  $t_{\text{calculated}} = -0.9633 < t_{\text{critic}}$ , where  $t_{\text{kritis}}$  for two sides t-test distribution with  $\alpha = 5\%$  and  $dk = 18$ , was given  $t_{\text{kritis}} = 1.734$ .
- i. Frequency Analysis was done in order to get design precipitation value with some of Probability Distribution as follows:
  1. Gumbel Probability Distribution.
  2. Normal Probability Distribution.
  3. Log Normal Probability Distribution.
  4. Log Pearson Type III Probability Distribution.

Based on all probability distributions, it can be summarized that all probability distributions can be accepted, however, Gumbel probability distribution is the best distribution to analyze precipitation data on the study area.

Kala Ulang T (tahun)	Reduce Variated (Yt)	Faktor Frekuensi (k)	Hujan Rancangan ( $X_T$ ) mm
2	0.3665	-0.13550	95.017
5	1.4999	1.05796	114.451
10	2.2504	1.84813	127.318

Fig. 6 Gumbel Probability Results

Agriculture Soil Land Analysis

Agriculture Soil Survey is part of Public Handeel Survey, Investigation and Design for Kapuas Regency. This Survey is done to learn and to study about the potency and capability also land suitability in order to increase and develop farm enterprises for some selected commodity plants in the survey area. The outcomes of the survey were expected to give important suggestions that can be used for detail design of water system upgrading.

The method used in this survey referred to the technical guidance and relevant survey guidelines.

From the agriculture soil survey, it can be formulated the patterns of land use with always pay attention to the principle of land function conservation and regulations. This survey consists of some activities and methods as written below:

1. Inventory of soil characteristics, soil type and soil spreading with secondary data collection and direct observation in the field.
2. Inventory and localize exiting soil problems such as pyrite, acid sulphate soil, acidity, peat land (thickness and maturity stage)
3. Soil samples removal for analyzing in the laboratorium in order to get the description about soil characteristics, by seeing the components whether they can fertile or poison the soil. Finally, it can be used for soil classification and fertile soil analysis.
4. Problems identification in the survey area for agricultural cultivation and the suggestions to face them.
5. Table 2 presents the land suitability for plants as follows:

Table 2: Soil Properties

No	code	C	N	C/N	P <sub>2</sub> O <sub>5</sub> Bray
					I
		%		ppm	
1	0-30 cm	T	R	T	SR
	30-60 cm	T	R	T	SR
	60-90 cm	ST	R	ST	SR
	90-120 cm	ST	R	T	SR
2	0-30 cm	ST	R	T	SR
	30-60 cm	ST	R	ST	SR
	60-90 cm	ST	R	ST	SR
	90-120 cm	ST	R	ST	SR
3	0-30 cm	S	R	T	SR
	30-60 cm	S	R	T	SR
	60-90 cm	T	SR	ST	SR
	90-120 cm	T	SR	ST	SR
4	0-30 cm	ST	R	ST	SR
	30-60 cm	T	SR	ST	SR
	60-90 cm	ST	R	ST	SR
	90-120 cm	ST	R	ST	SR

Continued, Table 2

No	KTK	K-dd	Mg-dd	Ca-dd	pH
	me/100 gr				
1	R	SR	R	R	SM
	R	SR	S	SR	SM
	S	SR	R	S	SM
	R	SR	R	R	SM
2	R	SR	SR	SR	SM
	R	SR	R	R	SM
	R	SR	R	R	SM
	S	SR	SR	R	SM
3	R	SR	SR	R	SM
	R	SR	SR	R	SM
	R	SR	R	R	SM
	R	SR	R	R	SM
4	R	SR	R	R	SM
	R	SR	R	R	SM
	R	SR	R	R	SM
	R	SR	R	R	SM

Land Suitability

Land suitability evaluation referred to the Frame Work of Land Evaluation (FAO, 1976) with 4 categories: order, class, sub-class, and unit. In this work, the land suitability evaluation was done until only sub-class category which can be explained below:

Order	:	Reflecting kinds of suitability which are divided into two orders:
Order S	:	Suitable for long term and special use
Order N	:	Not suitable for special use
Classes	:	Reflecting degrees of suitability, with five classes of suitability, as follows:
Class S1	:	Highly suitable
Class S2	:	Moderately suitable
Class S3	:	Marginally suitable
Class N1	:	Currently not suitable
Class N2	:	Permanently not suitable
Sub-classes	:	Reflecting kinds of limitations. In each sub-class can have more than one limitation factor. Therefore, the dominant limitation factor has to be written in the front.

Land characteristics which will be used for land suitability evaluation are the average value that represents the land quality which is used by plant and crop for food. Some commodities that are going to

evaluate for the suitability covers: rice, pineapple, banana, sweet potato, cassava, orange, peanut, pumpkin, chili, watermelon, tomato, eggplant and spinach. Land suitability Classes were determined by using Technical Guidance for Land Evaluation of Agricultural Commodity from Soil Research Agency 2003.

Based on the test, it can be summarized that for each of rice field has the same land suitability for some plants and crops for food. Although according to land suitability analysis, the location in the study area are in class S3 (marginally suitable), however, they still can be managed by giving them organic and non-organic fertilizer and by selecting local variety that can face hard environment.

In particular, for Handil Indragiri, Handil Sumber Jaya and Handil Sekawan, not only the fertility problem but also the thickness of pyrite (FeS<sub>2</sub>) that can poison the plants. The making of drainage canals can cause the land dry faster so that it can accelerate pyrite oxidation process. Combination of water management by using water gate with lime addition can help in the farming development on the area with high pyrite content.

Based on the soil analysis on all SID rice field locations in Kapuas Regency, the results show low soil fertility. The major cause is relatively low base content, especially element of K, Mg and Ca. Low base content will tend to decrease the base saturation which is one of the variable that determines soil fertility status. The additional fertilizer which content element of K (KCl) and Ca/Mg (Dolomite) will increase the mineral for plants. Lime addition to the soil can increase the soil pH. Organic fertilizer which combines with microba such as bokashi is recommended since it is environmental friendly and support the government programme "Go Green".

Based on the soil analysis, it can be summarized as given below:

- From the Land Suitability Evaluation, in general, all location points are in Class S3 (marginally suitable), but they still can be managed not only by giving organic and non organic fertilizer but also by selecting local variety that can face the surrounding environment.
- The agricultural land problems for 3 locations (handil

indra giri, handil sumber jaya & handil sekawan ) are:

1. Low soil fertility (relatively low base content)
  2. The thickness of Pyrite that is less than 1 meter from soil surface.
- The solutions to answer the problems mentioned before are :
    1. Combination of water management with controlled water gates and lime addition to decrease the pyrite content.
    2. Giving combination of organic fertilizer micro-organism since it is environmental friendly and supporting government programme.

## REFERENCES

- Ankum, P., Koga, K., Segeren, W.A. and Luijendeijk, J.(1988). Lessons from 1200 years impoldering in the Netherlands. Proc. Int. Symposium on Shallow Sea and Lowland, Institute of Lowland Technology, Saga Univ. Saga: 102-108.
- Anonim (1976), A Frame Work for Land Evaluation, FAO Soils Bulletin 32.
- Loganatham, N., Balasubramaniam, A.S. and Bergado, D.T. (1993). Deformation analysis of embankments. J. Geotech. Engrg. ASCE. 199(8):1185-1206.
- Madhav, M.r. and Miura, N. (1994). Introduction. In: Miura, N., Madahav, M.R. and Koga, K.(Editors), Lowlands, Development and Management. A.A. Balkema, Netherlands and U.S.A.:31-37.
- Moustakas, N. (1990). Relationships of morphological and physicochemical properties of Vertisols under Greek climate conditions. Ph.D. Thesis, Agricultural Univ. Athens, Greek.
- Noor, M. (2004), Lahan Rawa: Sifat dan Pengelolaan Tanah Bermasalah Sulfat Masam, PT. RajaGrafindo Persada, Jakarta, Indonesia.
- Perkins, F.E. and Gunaratnam, D.J. (1970). Numerical Solution of Unsteady Flows in Open Channel. Hydrodynamic Laboratory, Report No.127, MIT, Cambridge, Massachusetts, U.S.A.
- Preissmann, A. (1961). Propagation des Intumescences dans les Canaux Etrivieres (Propagation of the Swellings in the Etrivieres Channels). First Congress of French Assoc. for Computation. Grenoble.