

PAPER NO 1
NUMERICAL MODELING OF STEEL STRUCTURES IN FIRE CONDITIONS
USING IMPROVED APPLIED ELEMENT METHOD

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Steel structures are widely used for buildings due to the advantages of high strength, good ductility and fast fabrication and erection. However, unprotected steel structures suffer serious damage or even collapse in a fire disaster due to the progressive deterioration in both strength and stiffness of structural steel with increasing of temperature. To protect life and reduce fire damage to property and financial loss, a steel structure must be designed to have the ability to sustain the applied design loads without the occurrence of excessive deflection or even failure in structural members for a specified period of time in the case of a fire. In this paper, the Improved Applied Element Method (IAEM), which was originally developed as an effective analysis technique of large-scale structures up to complete failure under different hazard loads, has been progressively developed to carry out modeling the behavior of plane frame steel structures in fire. The paper presents the methodology of a new approach for thermal analysis of the large deflection behavior of steel structures at elevated temperatures. IAEM has been developed to cover both geometric and material nonlinearities, including the changes to material properties as temperatures increase. Rigorous treatments of thermal analysis in plane frame steel structures are illustrated. The effectiveness and validation of the proposed approach are demonstrated by comparison its results with those previously obtained by benchmark experiments or by other independent computer software. The IAEM is a useful tool to perform intensive parametric studies aimed at a deeper understanding of the behavior of steel structures under elevated temperatures. Moreover, it is considered the first implementation of the thermal analysis in the field of Discreet Element based approaches (276).

PAPER NO 2
**STUDY ON THE WIDE-AREA LIFELINE NETWORK FOR AN EMERGENCY
IN THE CENTER OF TOKYO WITH UTILIZING THE DEEP UNDERGROUND
SPACE**

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Our research group has been working on projects related to the utilization of deep underground spaces. We have proposed several projects since the 1970s and examined their effectiveness. An outline of the latest project that aims at effective utilization of deep underground for urban safety will be presenter in our paper

In 2001, the law on Deep Subterranean Utilization went into effect in Japan. In Japanese civil law, land ownership theoretically encompasses the space from the sky to the deep underground. According to the law, a space that is deep enough underground does not violate the rights of private above-land ownership. The kinds of environmental problems and urban disaster mitigation facing Tokyo are now becoming global problems, and technological city planning should be encouraged. We focus on the deep underground space as the last precious unused space, that the Mega city Tokyo has left to it.

The area of Tokyo has been defined by a 60-km radius, but this is currently rapidly growing to become a 100km radius. With this expansion, all of the infrastructure, such as the electric power network, the communications network, the water supply, drainage, and gas pipelines, have extended without order or preconceived plan, just tending to follow the outward sprawl of the city. It is difficult to maintain such a complicated infrastructure network. In particular, in an emergency, it would be not possible to back up the metropolitan network where the infrastructure consists of numerous congested routes.

We have proposed a deep underground space network project to alleviate problems in Tokyo regarding both disaster prevention and urban environment improvement. The underground system is composed of a vertical tunnel that connects the surface of the earth with the deep underground base, and a horizontal tunnel that joins each of the underground bases. The horizontal tunnel is a multipurpose underground conduit. We

will show in our paper that the deep underground space network project has considerable potential to enhance disaster prevention especially in terms of helping and assisting the disaster victims, who are stuck in the center of Tokyo after earthquake disaster.

PAPER NO 3
AN INNOVATIVE SEISMIC STRENGTHENING METHOD FOR
UNREINFORCED MASONRY STRUCTURES USING PP-BAND MESHES

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Rapid urbanization and city grow are common features worldwide. This phenomenon is transforming city skylines due to the remarkable increase of high-rise buildings and infrastructure. In spite of this, numerous existing structures are and will be used in the future. Many of these buildings are made of seismic vulnerable materials, such as unreinforced masonry, posing a great danger to urban development in seismic prone regions. The potential risk that these structures represent to human lives in large metropolis is aggravated by the high concentration of people. Therefore, increasing their seismic resistance is imperative.

In order to effectively promote seismic retrofitting, one of the key issues is to enable inexpensive technical solutions which could be executed without highly skilled labor. In this context, this paper discusses an innovative strengthening technique for unreinforced masonry structures using polypropylene band (PP-band) meshes embedded in a mortar overlay. These bands, which are commonly used for packing, are resistant, inexpensive, durable and worldwide available. The PP-band meshes are easily attached on both sides of the wall and connected with wires passed through holes drilled in the wall. In this way, the structure disintegration under seismic loads is prevented.

In order to verify the suitability of the proposed method, a series of masonry walls, with and without retrofit, were tested under in-plane loads. The test results are presented and discussed in the paper. Although the retrofitted wall peak strength was almost the same as that of the bare wall, its post-peak strength became much larger and sustained for lateral drifts over 2%. The structure seismic capacity improvement, through ductility increase, reduced the total collapse probability. Even if collapse occurred, the time required for it is longer, allowing the users to evacuate and consequently reducing the number of casualties due to earthquakes.

PAPER NO 4
INTEGRATED EARTHQUAKE SIMULATION USING ADVANCED
NUMERICAL METHODS AND
GEOGRAPHICAL INFORMATION SYSTEM

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The advancement of computer technology and sciences enables us a large-scale numerical computation. As one of such, the authors have been simulating the whole processes of earthquake, i.e., three phases of earthquake waves (fault mechanics, wave propagation through crust, wave amplification near ground surface) and dynamic responses of structures and buildings of various types which are located in a city. With the aid of recent geographical information system, a compute model can be constructed for a city of hundred-meter scale; a structure model is automatically made for each building or infrastructure, and a suitable analysis method is applied to calculate the dynamic behavior of each model for given strong motion. This paper presents the current state of this integrated earthquake simulation. The simulation is controlled by a computer system which combines numerical methods and GIS. As an example, a computer model of Kobe city is presented. Some discussion is made on the usefulness of such large-scale simulation, in order to form a common recognition of possible earthquake hazards among citizens, government officers and earthquake engineers.

PAPER NO 5
CASE STUDY OF THE REPAIR OF A MAJOR BRIDGE AND
SOME THOUGHTS ON REPAIR MATERIALS

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Rehabilitation of reinforced concrete bridges prematurely or otherwise damaged, continue to be a major problem throughout India. The problem is more serious in the coastal areas and is aggravated further in a highly polluted city like Mumbai. In order to maintain the continuous traffic flow on any existing bridge, the repair methodology assumes great importance.

A unique case in point here is the repair to the Gopal Krishna Gokhale (GKG) bridge, connecting by road the S. V. Road and the Western Express Highway in a suburb of Mumbai. This was constructed around 35 years back with composite structure consisting of reinforced concrete and structural steel supported on concrete columns. During that time in order to maintain the flow of continuous traffic the bridge road width was maintained to be 90 feet.

Over the period as time took its toll, deterioration process due to various conditions began and slowly the dawn of the millenium saw this bridge in an structurally shabby condition. Decades of impudent interference with the structure alongwith environmental ingress reduced this important road link into a dilapidated structure.

The bridge had developed cracks in the main girders, decks and columns. Heavy water leakages were observed. Chunk of concrete were falling on the western approach deck exposing the deck reinforcement steel. Also the parapet walls on the bridge were heavily deteriorated and damaged.

The concerned authorities soon realised the need to structurally upgrade this bridge in order to preserve the flow of city. *But the task to repair this bridge while keeping all the other elements around the bridge to be functioning, in the city like Mumbai which never sleeps was stupendous.*

Here was a bridge spanning across the Continuous flow of Mumbai's western railways local trains (from below) having a rail traffic of about 2 trains passing per minute.

With such continuous inflow of trains (from below) and exceedingly more vehicle traffic on the bridge itself (on top) which connects the two main roads was a skilful task to be undertaken.

The complete repairs had to be carried out maintaining the flow of traffic and yet not compensating on the quality of the repair where time was also to be maintained. This has undergone repairs recently.

With this condition and the location constraints it became necessary to evolve a planned repair methodology which could yield the maximum effectiveness both in terms of quality and quantity. Certain proposals were formatted and various tests were required to be carried out before the actual proceeding could begin.

Based on the reports and the actual site conditions, working strategy and the use of repair materials to achieve the desired results within the time constraints was an extremely important task and heart of repair.

This paper in detail exposes all the important and vital parameters which involved the repair methodology and the choice of indigenously selected repair materials which contributed to save this structure and keep the pulse of the city racing.

PAPER NO 6
CASUALTY OCCURRENCE MECHANISM INDUCED BY TRAIN ACCIDENT
DURING AN EARTHQUAKE

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Damage to railway facilities is reported in the past earthquakes. Especially in the 1995 Hyogo-ken Nanbu Earthquake, totally thirty-two railway bridges were collapsed, and eight of which occurred at the San'yo super express line line. Fortunately the train accidents caused by the damage to bridges have not been reported so far. Although the large earthquake that strongly affects the train behavior hardly occurs, the effect of the accident to the society is unpredictable once such large earthquake will occur. In this study, we modeled a train and passengers in the train as distinct elements and simulated their behavior by DEM. The impact force acted on the human body is computed and compared with the results from the experiments done by the automobile engineering field. It is found that the velocity of 80km/h is a transition speed for both behaviors of trains and damage to passengers.

PAPER NO 7
SEISMIC BEHAVIOR OF URBAN HIGHWAY TUNNEL IN VICINITY OF
EMBANKMENT

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A new construction of the highway tunnel is planned in Osaka, Japan. The features of this structure are that it is a semi-underground structure and in the vicinity of the existing embankment. The steel sheet piles will be installed on the both sides of the tunnel during the construction. The seismic responses of both the highway tunnel and the embankment may decrease due to the large stiffness of steel sheet piles. The sheet piles, however, are usually removed after the construction and their effects on the seismic responses are not cleared yet. Thus, effects of the steel sheet pile on the seismic behavior of the semi-underground highway tunnel and the embankment are discussed in this paper.

The three-dimensional dynamic finite element technique is used to calculate earthquake responses. Our analysis is composed of two steps. First, the earthquake ground motions are inputted below the bottom of the finite model spontaneously. Second, the input ground motions are applied along the longitudinal direction with time delay and the propagation effects of seismic waves are considered.

It is concluded that the steel sheet pile installed the both side of the tunnel have effects that make the residual displacement and the rocking of structure decrease. Furthermore, it is cleared that the effects of the sheet pile are strongly affected by the propagating velocity of the seismic wave.

PAPER NO 8
TELE-OPERATED SURVEILLANCE ROBOT

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“Technology makes mistakes and tries to correct them”. Man started the industrial revolution, it resulted in betterment of his life standards in one aspect, but on the other hand it also resulted in hazardous Global warming and Green house effect. Man made weapons of Mass destruction, which threaten the existence of the world itself. The important question is that can we just stop everything and get back to primitive ways of life. The answer would definitely be NO. The thing we can do is *reverse Engineer* the Problem and try to minimize its impact or find an *alterative solution* for the problem. The ultimate aim of this project is to find in a small way an alternative solution so that man can evade himself from the effects that he caused for himself.

Tele-operated surveillance Robot was designed with keeping in mind to counteract the hazards caused by chemicals. The Robot is a mobile independent unit with toxic gas sensor attached to its end so that it keeps us informed about possible gas hazard. There is a surveillance camera attached to it so that the operator could see around the place. The Robot is controlled by the computer through wireless network. As additional feature the Robot is made Tele-operated, i.e., the operator can control the Robot via the Internet from any corner of the world.

PAPER NO 9
THE CROSS-CUTTING CAPACITY DEVELOPMENT PROGRAM

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Building capacities in support of disaster risk reduction in complex environments by shifting the current disaster management process from response-oriented to risk-preventive appears to be a better link between natural disasters and sustainable development.

The main goal of this initiative is to influence government policies in favor of disaster reduction and provide the ability for a continued implementation effort. In close collaboration with city authorities and local practitioners and researchers, Disaster Risk Management Plans and Strategies will be put together.

A comprehensive path to reach the expected outcomes could be summarized as follows:

- Collection, systematization and analysis of current knowledge and practice regarding Disaster Risk Management
- Assessment of current disaster risk management sound practices
- Identification of gaps in knowledge and practice
- Risk assessment
- Training and institutional strengthening and
- Communication.

A network of 19 megacities around the world, acting under the umbrella of the Earthquake and Megacities Initiative (EMI), within the context of the Cluster City Program (CCP) and the Cross-Cutting Capacity Development Program (3CD) would be

brought into play to generate on a first phase, an Electronic Knowledge Database, a Manual of Sound Practice and a Manual of Implementation for Disaster Risk Management Plans.

EdM has a research program that combines frontier research on earthquake disaster mitigation for urban regions, comprehensive understanding of disaster processes that involve "physical," "societal" and "information" agendas in order to develop a database for disaster management. With this perspective, EdM has committed itself to the first phase of this project which includes the Current Practice Assessment and the Systemic Training.

The purpose of this short paper is to introduce some of the preliminary findings on how different megacities from around the world are dealing with disaster risk management issues. It looks at different variables like the legal and institutional framework, their resilience capacity, the risk identification and hazard assessment ability, their management capacity and land use and planning. It particularly refers to sound practices available in each one of them that are worth sharing with others, to improve DRM capacity.

PAPER NO 10
A COMPARATIVE STUDY ON THE DISCLOSURE OF
INFORMATION
ON POTENTIAL SEISMIC HAZARD RISK WITH LANDS AND
STRUCTURES
NEAR ACTIVE FAULTS IN US AND JAPAN

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Studies on probabilistic seismic hazard along major active faults and troughs are published in Japan. Active faults with high seismic hazard potential are sometimes located in densely inhabited areas. Controlling the land use through disclosure of information related to seismic hazard near active faults is necessary in order to mitigate potential structural damage due to a coming earthquake.

Several seismic prone countries in the world have active fault zoning systems or control systems for land use and structure construction. California State, US, established the Alquist-Priolo Earthquake Fault Zoning Act in 1972. This law requires the State geologists to establish Earthquake Fault Zones around the surface traces of active faults and to issue appropriate maps. Local governments must regulate most development projects within these zones. When the property of houses located in an Earthquake Fault Zone is transferred, the potential buyer must be informed of this fact before the transaction is completed. The Seismic Hazards Mapping Act enacted in 1991 additionally requires issuing maps including areas prone to liquefaction and earthquake-induced landslides.

In this research, the possibilities of information disclosure act related to potential seismic hazard risk with lands and structures near active faults in Japan were discussed. The Alquist-Priolo Earthquake Fault Zoning Act in California was hypothetically applied to Japan. The number of people and dwellings potentially affected by active faults were estimated. Next, the annual number of houses transactions in fault zones which require seismic hazard disclosures to the buyers was also estimated. Finally, the effects of expanding fault zones were verified.

PAPER NO 11
**EVALUATION OF EARTHQUAKE CAUSED DAMAGES USING NON-LINEAR
DYNAMIC NUMERICAL ANALYSIS**

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The complex socio-economic development of the world has led to a dramatic increase of losses due to natural and anthropogenic catastrophes, earthquakes, floods, and nuclear accidents, etc. It has been estimated that within the next 50 years, more than a third of world's population will live in seismically and volcanically active zones. The ever-increasing earthquake caused cost and casualties in past several decades has warranted commitment of researchers, insurance sectors and emergency management agencies towards reducing the earthquake disasters. In Japan, most of the residential houses are made of timber, which have higher risk for earthquake caused damage and human injuries due to ground shaking and fire followed the earthquake. This paper present earthquake caused damage evaluation of wooden houses using non-linear dynamic analysis and damage variation with the joint strength. Wooden structures consists of interacting components (or subassemblies) such as walls, floors, roof, and a foundation that are fastened together by nails, bolts, steel straps, and/or cleats forming a three-dimensional, highly indeterminate system. However a common observation from several test data is that the hysteresis trace of wood subsystem or subassembly is governed by the hysteretic characteristics of primary connections. These connections (joints) are modeled as a combination of spring and dashpots and the wooden houses are analyzed for seismic loadings. The behavior of the wooden houses shows a large variation in low joint strengths and it becomes less in higher value of the joint strengths. A damage evaluation index has proposed based on these results and observation. A simplified methodology has proposed to estimate the human injuries using numerical analysis. These proposed methods are compared with the statistical data of past earthquakes in Japan.

PAPER NO 12
SUSTAINABLE DEVELOPMENT OF WATER SUPPLY, SANITATION AND
WASTE MANAGEMENT:
A CHALLENGE TO URBAN SLUM DWELLERS IN DHAKA (BANGLADESH)

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The new ethic of ‘Sustainable Development’ in basic urban facility like land, water supply, sanitation, proper drainage system for waste disposal is now being supported by a number of technologies to achieve it in reality. Most of the developing countries’ urban slums receive few or no facility. Albeit there are several cost-effective basic infrastructure/services from the slum improvement providers (both public and private) but the poor situation of urban facilities still prevails in these settlements. That is because after providing these basic infrastructure services, within a very short time most are either fully ruined or is in a very shocking condition. The problem is particularly acute in the capital of Bangladesh - Dhaka, where about 3.3 million out of total Dhaka’s population 10 million live in the slum/squatter settlements within abject physical and environmental conditions like: out of the total slum dwellers about 20 percent have land-access, about 30 percent’s houses blessed of piped water supply, only 20 percent have sanitation access and 10 percent receives proper waste management facilities. Due to slum’s legality few excellent facilities has introduced to cover one/two sector without any incorporation. Lack of integration might result in a sudden devastating impact to part of the urban region including adjacent environment. Against this backdrop, there is one option ‘sustainable development’ can play vital role for slum dwellers’ to provide their elementary needs through an integration of both technical and managerial. This paper is divided in three parts, firstly starts with the existing situation in context of non-slum area and in second part identification of the responsible factors to achieve the development has done. The main discussion is devoted to the Dhaka slum’s water supply, sanitation and waste management system and finally come up with the possible solution to cope the challenges behind sustainability.

PAPER NO 13
PEDESTRIAN SPEED-FLOW MODEL ON ESCALATORS AND STAIRCASES
IN SINGAPORE MRT STATIONS

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Pedestrian flows in underground rail stations are usually heavy during the peak hours and could result in serious congestion, especially if the escalators, staircases and walkways are not adequately built to cater to such a demand. During an emergency, such congestions would also pose safety problems to the passengers. Maintenance of good speed and flow conditions in the station is essential to coping with emergencies.

This study was conducted to examine pedestrian flow characteristics at underground railway stations. Video recordings of pedestrian movements were carried out in Somerset Mass Rapid Transit (MRT) Station in Singapore to collect volumetric flow data of pedestrians on staircases and escalators and their travel times on these facilities. The collected data is then used to calibrate travel time functions and develop speed-flow relationships for these two facilities. The study shows that the walking speed at capacity on staircases is 27.0 m/min, which is relatively slower than that in Hong Kong and London underground stations. However, the corresponding speed on the escalators, 37.5 m/min, is higher than those found in London stations.

PAPER NO 14
**VULNERABILITY ASSESSMENT OF EXISTING ENGINEERED
STRUCTURES USING RVS AND NDT TECHNIQUES**

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Bangladesh is an earthquake-prone country. Although, a large part of the urban building stock is engineered but the quality of the construction is unsatisfactory. Luckily, the recent major earthquakes have occurred away from the city. The history of the region indicates that there is a strong possibility of major earthquakes occurrence that could cause extreme devastation. In fact recent studies demonstrated that even moderate earthquakes could be fatal in populated, unplanned cities. General public and the engineering community are becoming more and more aware of the situation. However, neither the possible extents of seismic damage of existing buildings are known nor there is any guideline for their strengthening measures. Even the performance of the engineered buildings under a seismic event is questionable, as enough work has not yet been done in this field. The methodology for conducting a successful insitu investigation includes: strategic planning, preliminary visual inspection, loading assessment, material property evaluation and load testing techniques. The single most sought after material property used for the evaluation of residual load capacity and structural adequacy of deteriorated concrete structures is the insitu concrete strength. The present study aims at assessing the seismic vulnerability of some of the existing engineered buildings of Dhaka City using Rapid Visual Screening Technique (FEMA 154) and also to quantify the insitu strength of existing buildings by carrying out non-destructive tests. Finally using the collected insitu information seismic performance of those engineered buildings will be assessed by structural modelling.

PAPER NO 15
DEVELOPMENT OF SLOPE FAILURE DISASTER MANAGEMENT SYSTEM
IN URBAN AREA
—THE UTILIZATION OF EXISTING DATA TOWARD “E-MUNICIPAL
GOVERNMENT”

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Slope failure disaster management system in Yokohama, Japan, is under development using existing municipal government data and GIS, in order to improve steep slope management activities. Three basic methodologies for predicting dangerous slopes and sand covering areas are proposed in this study.

1. Specifying steep slopes and sand covering areas in large city areas automatically using DEM (Digital Elevation Models) and LandUse data using GIS raster and vector analysis.
2. Forecasting dangerous areas for slope failure with rainfall data using GIS. As a provoking cause for collapse, collapse records and rainfall data observed at 98 points in Yokohama every 15 minutes are analyzed.
3. Statistical analysis of the possibility of slope failure disaster, using steep slope inventories by municipality, and multivariate analysis: Quantification Theory Type II. Relationships between collapse and the slope's factors (primary cause for collapse) are analyzed.

By combining these three methodologies, a “Real-time evaluation system against slope failure disaster” can be completed.

As a conclusion of this paper, a prototype system was developed. This system consists of two components:

1. A Slope Information Management System for effective daily support of steep slope management activities by integrating municipal data related to steep slope management (inventory, collapse record, and precipitation). All data are linked to the map. Searching, retrieving, and updating “Steep Slope data” are allowed, and can be shared by the Internet.
2. Real-time Slope Failure Prediction System for response activities after a collapse by accumulation and analysis of slope failure records and precipitation data. The system development environment is as follows: OS: Windows XP; DB: Geodatabase (SQL Server2000 by MS); GIS Engine: ArcObjects by ESRI; Digital Map: Digital Mapping by Municipality of Yokohama; Analysis Software: Excel Statistics 2000.

PAPER NO 16
URBAN FLOOD MODELING IN LOWER MEKONG BASIN USING A
DISTRIBUTED SURFACE-RIVER MODEL

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Flooding is a very severe problem for many countries of the world and the situation is getting aggravated due to the change of hydrologic cycle globally resulting from the effect of climate change and landuse degradation. The magnitude and frequency of flooding are increased in many ways. As a result, concern has grown among the water managers in mitigating the flooding problem in great extent. An early warning system is considered as an achievable non-structural measures for reduction of losses of life and damage due to floods. To develop such a system, there is need of integration of airborne and space borne resources, numerical weather prediction model and distributed flood simulation model.

In this paper, a case study on application of a distributed hydrologic model in the lower Mekong River basin for flood simulation has been presented. The distributed hydrological model used here is a combined surface-river flow model which solves the one-dimensional (1-D) unsteady flow equation for river channel flow and two-dimensional (2-D) flow equation for each grid of the floodplain simultaneously to calculate the flood inundation parameters in the basin. The calculations of flow from river channel to flood area caused by flood levee failure or overtopping of levee, flow from flood area to river channel such as sluice, pump etc., moreover, condition of basin or river channel, are done by using some suitable equations in conditions. The GIS based datasets are used in model development. The study area is the Cambodian floodplains of the Mekong River. In preliminary, the simulation has been carried out for the flooding condition of 2000 and 2002. The results from these model simulations are presented here. Based on the performance of these simulations, it is aimed to improve the model further to fit for the Mekong basin. Finally, the model will be associated as a tool for flood warning system for the basin in future.

PAPER NO 17
URBAN BUILDING INVENTORY FROM VHR REMOTE SENSING IMAGERY
FOR EARTHQUAKE RISK ANALYSIS IN BANGKOK

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Bangkok, the capital city of Thailand, is one of the mega cities in Asia and a regional hub. The city has a very high economic growth and is going through changes as new buildings and other structures are built. Bangkok is considered free of seismic risk. Recent studies shows that the risk due to distant earthquakes needs to be evaluated because of high population density and construction of concrete structures considering a little or no seismic loading. It is imperative to update the building and infrastructure inventory to evaluate seismic risk and to establish proper management plans for disaster reduction. Therefore, very high resolution (VHR) satellite images are used to develop an inventory for building and infrastructures located in the region considering their spectral, spatial and contextual properties. Seismic risk due to scenario earthquake is evaluated using the HAZUS methodology and inventory data obtained from image analysis in combination with the existing database. Scenario results are presented for an earthquake in the region.

PAPER NO 18
ICUS AND AIT COLLABORATION ON URBAN SAFETY RESEARCH

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With the rapid economic development in the last few decades, there has been a phenomenon growth of high-rise buildings and other infrastructure in Mega cities in Asia. However, this growth of infrastructure is not adequately balanced by the appropriate measures for their maintenance and management and that has led to a deterioration of urban infrastructures and resulted in urban disasters in many cities. Recently, the issue of urban building and infrastructure maintenance has been sensationalized by Mass Media in Japan after several incidents of falling of blocks from concrete structures, such as bridges, tunnels, in different parts of Japan. The frequency of floods in Asia has doubled in the last 30 years. The rate of increase of urban flood frequency is more prominent in the last 10 years, especially, the recent three years statistics show rapid increase of floods in Asian cities. The recent developments of various advanced technologies including Remote sensing, GIS and other computational tools have generated scopes and motivation to focus on devising appropriate methodologies for management and maintenance of urban buildings and infrastructures for sustainable development of the Asian mega cities with adequate safety and security.

The International Center for Urban Safety Engineering (ICUS), a research center established in April 2001 at the Institute of Industrial Science of the University of Tokyo, Japan, focuses on research and developments in the field of urban safety engineering including maintenance and management of infrastructures with new technologies from an international point of view. ICUS gives particular emphasis in collaborative research with international organizations particularly in Asian region. To strength its collaborative research efforts, there have been several activities undertaken by ICUS. One of the most significant steps for expanding its collaborative activities is establishment of a Regional Network Office for Urban Safety (RNUS) in Thailand. RNUS was established on

October 29, 2002 at the School of Civil Engineering (SCE) of the Asian Institute of Technology (AIT) to work in areas of mutual interest of SCE and ICUS for the advancement of urban safety engineering utilizing advanced engineering tools. AIT is a regional international and non-profit institute with a vision of becoming a leading and a unique regional multicultural institution of higher learning, offering state of the art education, research and training in technology, management and societal development. ICUS and SCE of AIT signed an agreement towards developing joint research programs and cooperate in developing strategies for tackling issues related to urban safety through RNUS.

PAPER NO 19
OPTIMAL IMPROVEMENT OF STORM SEWER SYSTEM FOR AN INNER
BANGKOK AREA

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Bangkok is frequently flooded due to combined effects of high runoff discharges from upstream, high tides, heavy local rainfall, and poor drainage and land subsidence. A study area of 3.5 km² was selected in an inner part of Bangkok. The study area is mostly residential consisting of buildings, pavements, and grassland and unbuilt areas. Because the sewers were too small and with small slopes, flooding usually occurred after heavy rainstorms. The selected urban storm sewer system was investigated to find an optimal improvement scheme to alleviate frequent flooding problems. The MOUSE model developed by the Danish Hydraulic Institute was utilized in this study. The model was successfully calibrated using two heaviest rainstorm data on 5 May 1990 and 7 June 1991. It was found that the storm sewer pipes were too small and inadequate. Moreover, the sewer system did not have enough pumping capacity and flood retention storage. The Bangkok Metropolitan Administration (BMA) proposed to construct a flood retention basin in the center of the study area to receive drainage of surrounding floodwater by gravity. The floodwater in the retention basin was proposed to be pumped out through large box culverts to Klong Bang Sue, the main drain canal. The effects of replacement of some small sewer pipes by larger ones were determined.

The storm sewer system was analyzed for improvement by considering probabilistic rainfalls and flooding depths. Fourteen different sewer systems of different pipe diameters, pumping locations and capacities, and flood storage retention areas were considered in each system. By considering Markov chain process, the transition probabilities of rainfall patterns from one day to the next and the steady state probabilities were calculated from the past data. Each rainfall pattern was characterized by rainfall depth, time to peak and maximum rainfall intensity. The MOUSE surface runoff model was run for seven different rainfall patterns. The computed runoff was used as input to

the pipe flow model. The pipe flow model with hydrodynamic flood routing was used to compute the flooding depths and flood discharges. The water levels in the manholes and the discharges in the sewer pipes were calculated to determine the hydraulic effectiveness of the improvement alternatives. The expected annual flood damages were computed based on the combination of seven different rainfall patterns and twelve initial flooding depths. An urban flood damage function, pipe cost model and pumping cost model from previous studies were applied. Considering the objective function of maximum annual net benefit, an optimization by simulation to determine the optimal sewer system was performed. Sensitivity analysis showed that the financial discount rate has a significant effect on optimal results while the Manning roughness coefficient has only a little effect.

PAPER NO 20
2D - EA FOR FACILITY ALLOCATION

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In world that is rapidly shrinking and where land is at a premium, proper use of land is of utmost importance. This demands that we allocate space to our facilities (residential buildings, commercial houses, recreational and entertainment centers, etc.) effectively. Genetic Algorithms have been used extensively for planning purposes. However, traditional approaches emphasized on the vector or one-dimensional approach.

A new algorithm for designing the layout of facilities is presented in this paper. The algorithm uses a 2 - dimensional genetic algorithm (GA), called 2-D Evolution algorithm (2D - EA), which employs GA common operators in 2-dimensional form. The present work makes use of geographical information system software to convert the image/ digital map in two-dimensional matrix that is used as chromosome to apply genetic algorithm. This work deals with the design and implementation of 2D - EA for optimal layout of facilities. Given a set of facilities and the site in which they are to be placed and the distance between each of the facility, the algorithm proposes solutions, which satisfies the distance constraints among the facilities. The algorithm generates an initial population and then calculates the fitness of the individuals of the population and by process of selection and crossover. It generates the next generation of individuals. Various functions which generates the initial population, calculate fitness and perform genetic operations have been implemented using **MATLAB**. This form is more suitable as compared to vector form of chromosomes due to the nature of the problem that is related to space allocation. Since 2D - EA can be applied directly on the remote sensed images/ scanned maps, the need for compression and possibility of 'dimension crunch' (loss of information suffered when converting images to vectors) does not arise. The method is demonstrated on a real life problem of campus facilities allotment. The paper concludes with the strength and limitations of proposed algorithm.

PAPER NO 21
URBAN SAFETY: FOR THE CITY DWELLERS, BY THE CITY DWELLERS IN
ASIAN MEGACITIES

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Today's mega-city in Asian context can be compared with dinosaur, one of the largest ever animal on earth ever. Strong apprehension is there, in near future, if corrective measures are not applied to these mega-cities they can be extinct species of human settlement like dinosaurs. Haphazard growth pattern coupled with uncontrolled population explosion are now a serious global concern. Natural or manmade disasters make them more vulnerable.

Policymakers, planners and programme developers are working on war-foot to create and maintain a safe environment. Situation of Asian mega cities are rapidly deteriorating due to extreme shortage of infrastructural facilities. The very purpose of city dwelling (i.e. safety and quality living) is being defeated at every steps. Not that effort is absent; new technological innovation/ developments are making the process smoother and more flawless. With easy communication (physical and informatics) sharing of experience from successful attempts are quite common today. But until and unless the common people would be involved in the process of problem solving starting from analysis to implementations of decisions, this is partly futile exercise. If the users feel changes made as worthy to follow, practice and pass on to next generation optimal success can be achieved. The scope of researchers has to be extended beyond planning and development of physical environment and use of new technologies like GIS etc. User's friendly technology or planning has to be initiated to take common people into the wing of development process. Many important information or research results never reach the target group.

In this paper the author would explore situations which could have been different provided bridging between planners/policymakers/ researchers and the common city dwellers was appropriate. Actually the gap is alarmingly widening and the knowledge are finding difficult to reach the target group. Dissemination of knowledge on behalf of

researchers and awareness and active participation from common city dwellers would definitely change the situation.

PAPER NO 22
SEISMIC BEHAVIOR OF REINFORCED CONCRETE PIERS
DETERIORATED BY CORROSION OF REINFORCEMENT

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The corrosion of reinforcement is the main cause of serious and rapid degradation of the performance of reinforced concrete structures. Apart from the problems on serviceability such as cracking and rust staining, corrosion on reinforcement causes significant deterioration in the static and dynamic behavior of the reinforced concrete structures leading to the reduction of their mechanical capacities.

The main objective of this research is to evaluate the seismic behaviors such as, stiffness, ductility and energy absorption of the piers deteriorated by corrosion of reinforcement. It is aimed to obtain the nature of degradation of these properties with increase in the loss of steel weight due to corrosion of reinforcement. Moreover, the combined effect of the axial load and the corrosion is also to be evaluated.

In the examination, an experimental study is carried out on twenty reinforced concrete piers with exactly same size and identical loading cycles while axial load, design method and corrosion condition were being varied. And, the following results can be obtained;

1. The seismic behaviors of reinforced concrete structures are seriously affected by corrosion of reinforcement, and the reduction rate of strength, ductility and total energy absorption with corrosion loss of reinforcement can be quantitatively evaluated by experimental equations.

2. Rate of degradation of ductility and energy absorption with corrosion loss is found to be much larger than that of strength. Therefore, even when only a slight reduction of strength of structure due to corrosion of reinforcement has been observed from static loading test, it should be considered that the corrosion is responsible for much larger reduction of ductility and energy absorption.

Key Words: *piers, corrosion of reinforcement, reinforced concrete structure, seismic behavior, ductility, energy absorption*

PAPER NO 23
SAFE MOBILITY AT DELHI - DMRC WAY

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One of the major areas of concern at all mega cities is the safe urban travel. The capacities of the road based systems to cater the ever growing demand of urbanites have reached beyond the saturation point and the result is the “urban mobility is a nightmare”. Cost effective high capacity metros are one of the best alternatives. DMRC has planned such a cost effective, safe, environment friendly system for Delhi and implemented within a short time and stands as a proving example for other developing countries.

Paper aims to present the strategies adopted by DMRC in

- Efficient planning of the project
- Safe construction practices adopted.
- Safest operation through best signal systems and rolling stock.
- Safe maintenance procedure being followed and
- Safe and environment friendly structures.

PAPER NO 24
PREDICTION OF ATMOSPHERIC POLLUTANT DISPERSION IN AN URBAN
AREA
BY WIND TUNNEL EXPERIMENT AND NUMERICAL SIMULATION.

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The aim of this study is to predict the concentration distribution of air pollution emitting from the elevated road near the ground level within urban area, when the atmospheric stability is variable. This study consists of wind tunnel experiment and CFD (Computational Fluid Dynamics) analysis. The equation of plume model, which is used in the simplified condition, is applied to the prediction of the characteristics of pollutant dispersion within an urban area, by using data from wind tunnel experiment. This will become the basis of the accurate prediction method of the concentration distribution by each hour. In addition, this data are used for validation of CFD analysis. CFD is conducted using the standard k-e model, and will be used for the real-time prediction of flow and pollutant dispersion in the future.

PAPER NO 25
DAMAGE OF MASONRY BUILDINGS IN SONLA EARTHQUAKE

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From 19/02/2001 to 05/04/2001 the series of earthquakes had occurred in Dien Bien Phu City (North Viet nam), where most of buildings are masonry. The paper presents typical damages of masonry buildings in Dien Bien Phu Earthquake and problems of their strengthening.

PAPER NO 26
AUTOMOBILE TRAFFIC GENERATED ATMOSPHERIC POLLUTION: NEED
FOR CONSIDERATION IN URBAN INFRASTRUCTURE PLANNING

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According to a recent study, megacities in Asia have reached alarming levels of atmospheric pollution due to rapid urbanization, enhanced industrial activities and increased emissions from automobiles. Delhi has been observed to be fourth most polluted city in the world in terms of concentration of suspended particulate matter in air and Mumbai, fourth highest polluted city in terms of nitrogen oxides concentration. Contribution of automobile traffic has recently been estimated to be about 72% of total air pollution in Indian megacities. In addition to material pollution, automotive traffic has been found to be one of the greatest contributors to ambient noise levels in Asian megacities.

Due to severe degradation in air quality, various types of physiological disorders are being reported in a significant proportion of exposed urban population. Consequently, the expenditure incurred on “health hazards due to automobile- traffic generated atmospheric pollution” has been estimated to be about U.S. \$ 200 millions per annum for a city like Dhaka. Automobile traffic is estimated to contribute more than 70% of total emission of hydrocarbons (C₂-C₉) in Korea. In Beijing and Guangzhou cities in China, automobiles have been found to contribute more than 80% of carbon monoxide and 40% of nitrogen oxides.

Automotive traffic also contributes to atmospheric burden of radiatively important trace gases such as carbon dioxide, methane and nitrous oxide. Chlorofluorocarbon emissions from automobile air-conditioners have a deep impact on climate at micro-, meso- and

macroscales. Light absorbing property of diesel particulate matter affects radiation balance of the planet Earth. Transportation sector is estimated to contribute about 26% of greenhouse gases and it is one of the fastest growing sources of such emissions.

In spite of various efforts like primary and secondary control measures, applied on individual automobiles, to meet the requirements imposed by different regulatory stipulations with the aim to curb the menace of automobile traffic generated material and energy pollutants, the improvements achieved in urban atmospheric environment has remained far from the satisfactory level. In fact, threats arising to human health from this source are not given appropriate weightage at the time of planning of surface transportation infrastructures in megacities.

Taking into account various reports in connection with different megacities in the world, the paper highlights the importance of this neglected aspect in urban planning. It emphasizes on an urgent need for inclusion of “vehicular traffic generated atmospheric pollution” as one of the factors in planning of urban infrastructures. Doing so will help in achieving congestion-free traffic flow along with smooth driving at the least polluting speed-range; an absence of formation of street canyons, which tend to retain various air pollutants by restricting wind movements; etc., and the population of megacities will experience enhanced level of safety to health from such deleterious pollutants. Consequently, the huge expenditure on account of “health hazards due to automobile-traffic generated atmospheric pollution” can be brought down significantly.

PAPER NO 27
THE NEED FOR AN INTEGRATED DISASTER MANAGEMENT STRATEGY
IN NORTH AFRICAN MEGACITIES:
A CASE STUDY OF ALGIERS (ALGERIA)

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As many other countries of the world, the northern African countries also suffer from environmental and geological problems, among others, the large cities and their suburbs. The capitals, particularly, represent gravitational poles constitute true economic metropolises of them, recording a considerable migratory flow in addition to one important demographic growth, a fast industrialization and an anarchistic urbanization, which make of it the receptacle of various sources of pollution, where ground, air and sea do not escape the consequences of these plagues. Furthermore, Algiers have had also suffered from storms, floods, landslides and earthquakes. Algiers in this research work, capital of Algeria, is taken as a case of study because it introduces most of the risks met in the other countries of North Africa. Algiers counts more than 3 million inhabitants for an area of 809.19 km². From the independence of Algeria in 1962, Algiers was found constituted of a dense urban fabric where various functional scales were overlapped. The town of Algiers experienced a significant development as well on the urban level as industrial and of this fact it is seen confronted with a degraded environment and a multiform pollution. The industrial sector and the factories established in urban fabric and its periphery are at the origin of the existing or potential sources of pollution in addition to the consumption of space.

PAPER NO 28
A EXPERIMENTAL STUDY ON COMPLEX DETERIORATION OF
CONCRETE USING GROUND GRANULATED BLAST-FURNACE
SLAG ON

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Recently, a complex deterioration due to plural deterioration factors has posed one of serious problems in RC structures. The effect on complex deterioration is not clear, especially as for concrete using ground granulated blast-furnace slag which, in Japan, commonly applied in coastal environment.

In this study, the experimental examination on the deterioration due to each/both salt attack and neutralization was carried out using mortar with substitution ratios of the slag by acceleration test. Furthermore, natural-potential of re-bar were also measured to examine its effectiveness as an index for the corrosion under complex deteriorative environment.

Key Words: *complex deterioration, ground granulated blast-furnace slag, salt attack, neutralization*

PAPER NO 29
" NEW TECHNOLOGIES FOR ENVIRONMENT IMPACT ON URBAN
SAFETY OF MEGA CITIES IN ASIAN
REGION " WITH SPECIAL REFERENCE TO INDIA

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As Asian countries economic development is very faster rate than in west, with in a past few decades, environmental degradation also happened in the same pace. Hence, environmental degradation included events like global warming followed by drought and flood, mass movement from village to mega cities are inevitable. Hence, we have to take measures to safeguard mega cities which possess a nations's economic infrastructures and human capital resources. Moreover, we could not separate mega cities and non-mega cities, however, now-a-days every family members or relatives in villages and small towns are linked with mega city family through improved communications and some improved transport system. These family ties are more strong in Asian countries than west. Non-mega city residents or non-resident foreign employees hard earned savings are now being invested in mega cities in the form of buildings and plots to yield higher returns than in non-mega cities and village area.

Definition of Safety :-

I like to adopt Prof. Shunji Murai's definition on safety. Safe city will be environmentally healthy, beautifully scenic, making people happy and comfortable, free from fear etc.

Based upon this definition, I am trying to present New Technologies for Environment

Impact on Urban Safety of Mega Cities in Asian Region.

To avert risks and ensure safe mega city in Asia, the following measures can be more useful.

1. Through alleviation of poverty programmes and better improved infrastructural facilities in villages, we can restrict inflow of people to mega cities.
2. Decentralisation / compartmentalization of mega cities public utility services including supreme court and high court branches in other cities.
3. Like human beings health check up, above 15 years old buildings may be compulsorily check up by qualified metro engineers at regular interval.
4. Upgradation of domestic airports to international airports of important provincial capitals. Similarly, upgradation of small ports in to major ports.
5. Compulsory insurance coverage to human beings, buildings and animals to minimize economic loss from disasters
6. Fire break systems in rivers, parks and provision of 3M² per head in park area to meet any emergency.
7. Dissemination of city's safety programmes through NGO's Women's self –help groups, medias, public sectors, private sectors, school curriculum and conduct Hazard map for school children.
8. For assured water supply to mega cities in drought prone areas, we may link or divert all major rivers. Through this venture continues employment will be available in villages.
9. Thermal and nuclear power plants may be shifted to 40KM and 400KM respectively away from city limit.
10. Maintaining strict Law and order situation with GIS & GPS facilities by the law enforcement authorities.
11. Pipe line, cable line etc laying work to be pre-planned and regulated in cities.
12. Restoring and maintaining of lakes and tanks are to be used as delaying floods system for both flash flood and volcanic eruption. Every city's background lakes and tanks encroachments to be removed and reclamation work may be undertaken with the help of GIS and digital technologies to carry more flood water.
13. Deep bore well practices to be curtailed. This may intensify severe damage in earthquake prone cities and the possibility of infiltration of saline water.

14. Harmful exotic plants like *Prosopis juliflora* which are spoiling city's river basin land and groundwater. Moreover some trees like *Azadirachta indica* and *Pongamia pinnata* can absorb poisonous gases from atmosphere.

15. As fossil fuel is pollutant, going to exhaust and causing global warming in mega cities, the Asian countries make take joint research to find alternate fuel from water which contains environment friendly fuel, hydrogen. This fuel can be used for power generation which is better than hydel, thermal and nuclear source

PAPER NO 30
RETROFITTING OF RC BEAM-COLUMN JOINTS USING FRP:AN
EXPERIMENTAL STUDY

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Much of the civil infrastructure is in need of repair or replacement as a result of damage caused by heavy use and exposure to the environment. There is additional demand on repair and retrofitting caused by natural disasters like earthquakes. The fiber reinforced polymer (FRP) are relatively new materials but they have already become important engineering materials. The properties of FRP's like high strength-to-weight and stiffness-to-weight ratios, corrosion resistance, light weight and potentially high durability make them very attractive for use in civil infrastructure. Their use has significantly increased in the retrofitting of concrete structures due to their tailorable performance characteristics.

When RC moment frames are subjected to lateral loads, inelasticity is concentrated in either beam or in the joint region depending not only on flexural capacity of the beam with respect to the column and joint shear strength, but also on the detailing of longitudinal reinforcement in the beam and transverse reinforcement in the joint. This results in undesirable features like limited overall ductility of the frame and poor seismic energy absorption. To improve the performance of such frames, the sudden degradation of strength and stiffness due to joint damage should be eliminated, because the joint is part of the column and its damage has a direct bearing on the overall response and stability of the frame. Many RC frame buildings suffered severe damage and/or collapse in recent earthquakes due to poor detailing of joint reinforcement (amount of transverse shear reinforcement in joints and anchorage of longitudinal beam bars in columns). It is therefore important to evaluate the performance of beam-column joints and to devise

suitable retrofitting techniques for improved seismic behavior of lateral load resisting moment frames.

A series of twelve beam-column specimens with different joint details were tested up to failure under reverse cyclic loading¹ under a previous testing program to study the effectiveness of the reinforcement details. This paper reports the findings of an experimental study on using glass fabric reinforced plastic (GFRP) composite to retrofit the series of exterior RC beam-column joint sub-assemblages which were tested earlier¹. Before retrofitting, the concrete in the region of failed joint was removed and redone after replacement of the broken stirrups. The effectiveness of retrofitting using GFRP composite for RC beam-column specimens with different details of (a) longitudinal beam bar anchorage and (b) transverse joint reinforcement, in improving the seismic performance of RC was studied. All the specimens retrofitted with GFRP composite showed improved strength and better energy dissipation characteristics under reverse cyclic testing when compared with original specimens. Among the retrofitted specimens, the performance of ACI standard hook for anchorage of the longitudinal beam bars and the suggested hairclip type transverse joint reinforcement were found to be best among all the specimens.

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PAPER NO 31
TECHNIQUES FOR MONITORING DEFORMATION IN LARGE
ENGINEERING STRUCTURES

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Construction of large engineering structures such as bridges, high-rise buildings, etc., are essential for the urban development of a nation. However, under excessive loading, they are subjected to deformation, thereby causing loss to lives and property. The security of these structures demands their periodic monitoring. In these civil structures, the deformations are the most relevant parameter to be monitored. Monitoring deformation pattern is often one of the most effective ways to understand the safety status of such structures. Results from monitoring measurements may lead to new discovery or help to expand our existing knowledge. Thus, the safety control of dams lies on the analysis of its structural behaviour, based on monitoring a large set of variables, which describes the actions (earthquakes, temperature variations, wind action etc) and corresponding stresses. For the purpose of monitoring and measuring deformation of dams, a number of methods have been developed.

Deformation monitoring methods have been broadly classified into physical and geodetic techniques. With the advancements in space technology, in the recent years, deformation monitoring and measurements have been done using Global Positioning System (GPS). With the advent of modern instruments, conventional geodetic surveying and physical methods has been overpowered by instruments like tacheometers, fiber optic deformation sensors, GPS etc.

This paper gives an overview of the physical methods and geodetic methods used in deformation monitoring and measurement. Deformation monitoring in bridges using fibre optic deformation sensors and tacheometers are described. The paper also gives a broad view of how GPS is used for deformation monitoring. A comparative study of physical method and GPS in cable-stayed bridges is explained. A case study on Koyna dam deformation monitoring using GPS is presented. The concept used here can be used in deformation monitoring of the other structures.

Key words: Structural deformation, Physical methods, Geodetic methods, GPS.

PAPER NO 32
**IMPORTANCE OF THE TRADITIONAL KNOWLEDGE SYSTEM WITH THE
ADVANCEMENT IN TECHNOLOGY IN THE FIELD OF ARCHITECTURE**

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Architecture and Building Engineering are the fields that are based on the traditional knowledge system. Tradition and innovation together makes the Architecture. The people of the earlier times were having deep knowledge of their respective fields. This knowledge was transferred from one generation to another, from father to son and the outcome was in the form of great buildings like Sun Temple at Konark and Taj Mahal at Agra that are still in their original condition after hundreds of years, whereas when we look at the buildings of the present days they are not that much stable as these earlier ones are. The main reason behind this is the knowledge system, the understanding of the materials, the knowledge of the structural system as well as aesthetics.

The ancient vision of the world of art and architecture was based upon hierarchy of values: a graded order defined with mathematical precision, interactions and mutual relations easily understood by all.

The Architect or master builder of that time, irrespective of education, knew that when he is building a house, he has to look on the whole mass and detail out the individual elements like doors windows, arches, columns etc. by means of proportion and ornamentation. Those people were having very good understanding of material and construction system. They were having sense of placing different materials at the suitable place. They were specialist in all fields like lighting, sanitation etc. In spite of having very less facilities, the placement of huge stones to such a height in the Pyramids, itself explain the knowledge system of that time and the technology they have. When we look on the present day buildings we find the lack of knowledge system in them. The understanding of material, its technology of placement and construction system and that is why we found that in the earthquake of Ahmedabad the major buildings that collapsed were not more than fifty to sixty years old, with new materials and new technology. Whereas the buildings that were more than hundred years old survived.

It is, therefore, proposed that new material and advance technology should be used with proper knowledge and understanding of their advantages and limitations. At the same time we should keep in mind the salient points of the so called 'old technology and materials'. A proper blend of the two is the need of the day.

PAPER NO 33
SUBSURFACE GEOTECHNICAL CHARACTERIZATION MAP OF
BANGALORE CITY
USING 3-DANALYST IN GIS

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The geotechnical characterisation of the subsurface in a city leads to understanding the ground conditions, area wise, and to obtain details of soil stratification and soil characteristics. This helps in proper planning in positioning important structures and conceiving suitable foundation systems . Further, the regions of liquifaction and areas of magnification effects in the ground due to earthquakes can be mapped. The paper describes the development of a detailed map (on a scale of 1:20000), containing 852 borehole data upto a maximum depth of 40 m (rock depth), generated in 3-dimension for Bangalore region based on Geographic Information System (GIS) model using 3-D Analyst Package. GIS model helps in data management, visualization, spatial analysis and decision support. The project aims at creation of database on the existing information about subsurface geotechnical information upto refusal or hard strata for Bangalore region. GIS model consists of soil stratification with their geotechnical properties along the depth at all the borehole locations. The final objective of this work is to develop seismic microzonation maps and liquefaction zonation maps based on the geotechnical properties in the region.

PAPER 34

ROAD SAFETY AUDIT - CHENNAI

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Tamil Nadu is experiencing a rapid rise in the number of motor vehicles on the road with an average annual growth rate of 12 percent since 1996. In 2002, the state had the third largest number of registered motor vehicles in India. In 2001, it had the second highest number of road fatalities and the highest number of record injuries. It is clear from these broad indicators that road crashes are a major issue affecting the social and economic wellbeing of the state. Trucks and buses (40%) and two and three wheelers (28%) comprise the bulk of vehicles involved in crashes.

Chennai is taken as a case study. The distribution of the three major categories of road users killed in Chennai during 2003 highlights three main groups such as Motorcycle riders (35%), pedestrians (34%) and Cyclists (14%). In Chennai the non-transport vehicles such as two wheelers and four wheelers (car and jeep) are rapidly increasing from every year. Two wheelers, Lorries and cars are involved in more number of accidents during the year 2003. Keeping in view the present and likely trend in accident situation in Chennai, accident characteristics, possible measures and resultant targets, and the likely changes in accident management, organisation structure and funding, the following goals of road safety are recommended to be achieved by taking appropriate road safety measures such as 20 percent reduction in the number of persons killed in road accidents while compared to the corresponding average figures for the period 2000-2003 and 10

percent reduction in the number of persons slightly injured in road accidents while compared to the corresponding average figures for the period 2000-2003.

Keeping in mind the type of risks involved, findings of the critical review of the accident situation in Chennai and experience gained in different countries the eleven issues such as Road infrastructure, Vehicle safety, Safer driver, Safe motorised two wheelers, Safer speed, Safety of children, Safety of pedestrians and cyclists, better enforcement, Emergency medical service, Research and HRD for road safety and Institutional and financial mechanism have been identified as thrust areas. The strategy and targets should be evaluated every three years and updated depending on the performance, the then prevailing conditions and needs.

PAPER 35

A RISK-BASED DECISION SUPPORT SYSTEM FOR INSPECTION AND MAINTENANCE OF CROSS-COUNTRY PETROLEUM PIPELINES

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Pipeline failure can have devastating effect on the health and livelihood of people living within the pipeline corridor. The existing method of pipeline health monitoring, which requires an entire pipeline to be inspected periodically, is unproductive. A risk-based decision support system (DSS) that reduces the amount time spent on inspection has been presented. This model not only reduces the cost of maintaining petroleum pipelines, but also suggests efficient design and operation philosophy, construction methodology and logical insurance plans.

The risk-based DSS uses Analytic Hierarchy Process (AHP), a multiple attribute decision-making technique, to identify the factors that influence failure on specific segments and analyzes their effects by determining probability of risk factors. The severity of failure is determined through consequence analysis. From this, the effect of a failure caused by each risk factor can be established in terms of cost, and the cumulative effect of failure is determined through probability analysis.

The technique does not totally eliminate subjectivity, but it is an improvement over the existing inspection method selection.

Key words: Inspection, maintenance, petroleum pipelines, analytic hierarchy process, probability analysis, insurance, design, construction and operations improvement.

PAPER 36

FEASIBILITY STUDY OF ROAD IN HIMALAYAS USING GIS- BASED HAZARD ZONATION

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The roads existing in the Himalayas are subjected to frequent avalanches and landslides, thereby causing fatal casualties and heavy damages to scarce man-made features. The applications of remote sensing in transportation has the potential capability to provide information that can reduce the risks involved. The present paper explores modern GIS in the planning process of routing and alignment of hill road network, since it proved to be beneficial in helping planners select the optimal location for road network by identifying the landslide and avalanche prone areas. All the necessary precautions to account for these can then be taken during the initial planning stage itself so as to minimize any possible future human or property losses incase of a calamity.