



CiSTUP News Letter

Centre for infrastructure, Sustainable Transportation and
Urban Planning, Indian Institute of Science, Bangalore, INDIA

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A Vehicle for Analytical Thinking to Improve the Unique Urban Issues



MESSAGE BY PROF. P. BALARAM

President of CiSTUP Executive
Council & Director of IISc.

It is heartening to note that CiSTUP has been regularly coming out with its NEWSLETTER every four months since the first issue which was published in November 2009. The centre has

successfully completed its first three years with a variety of activities covering all the theme areas and the Newsletter since then has efficiently & effectively disseminated the information to a larger audience. I have been following the events that were reported in the Newsletter and observed that within this short span of three years the centre has focused on all the key areas that have been envisaged at the time of its **conceptualization**.

I am sure in the days to come the centre will grow to become a centre for excellence in bringing out synergy in advanced research and practical application. This NEWSLETTER has been providing valuable information and insight to the stakeholders of the center, students, researchers, and other related professionals. I convey my heartiest Congratulations and best wishes to the team of CiSTUP for carrying out an excellent work.



MESSAGE BY PROF. T.G. SITHARAM

Chairman CiSTUP
Indian Institute of Science
Bangalore-560012

Newsletters meant to disseminate information to all stakeholders should attract attention, evince interest in reading and this should be followed by desire for action. In line with this thinking, this NEWSLETTER lists all the 41 research projects funded by CiSTUP to the Faculty. A brief abstract of the work carried out/being carried out is listed in the following pages. The ideas/new concepts brought out by these projects can be made use by the concerned and implement it for the benefit of the society at large. The pdf copies of the detailed reports are available at CiSTUP website or based on individual requests hard copies of the reports will be sent. Many other projects carried out by our planners, the events organized at the centre, and the other events where our scientists have participated are also presented in this newsletter.

A joint initiative of Centre for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), Indian Institute of Science and the Ride A Cycle Foundation with support from EMBARQ India, MapUnity and Gubbi Labs saw the launch of 'NAMMA CYCLE' project which is an unique initiative in increasing connectivity and creating environmentally friendly mode of public transportation within the Institute campus. This coupled with the other project of e-mobility, which is still under

discussion, will bring in an eco-friendly & pollution free transport to the campus. Of the several methods suggested for reducing air pollution, namely higher usage of non-motorized transport, usage of public transport, use of alternate fuels and so on, switching to electric mobility is also one important change in curbing the vehicular exhaust. E-mobility using electric carts has been proposed and the proposal is with the institute and once introduced, I am sure this will provide an improved mobility options for campus users and also to improve campus environment and air quality by reducing the dependence on private motorized modes of travel.

Through this Newsletter I also extend a Warm Welcome to the new members who have joined the centre as planners / associate faculty during the last few months. These new members with their rich experience/capabilities will be making huge contribution in making the centre do an excellent work in the thrust areas of the centre.

As per the institute's policy and desire, the M.Tech (transportation and infrastructure engineering) an academic activity is now completely with the Department of Civil Engineering. Hope that the Department of Civil engineering along with the coordination from CiSTUP with stakeholders will deliver this programme to BMTC, KSRTC and others in a better way. Through this NEWSLETTER we extend a warm welcome to Prof. Govindan Parayil, Director, UNU-IAS at Yokohama, Japan and Vice Rector, UNU University, Tokyo for a visit to CiSTUP and Indian Institute of Science in the month of October 2012.

The center has been regularly bringing out these NEWSLETTERS ever since September 2009, thus we have successfully completed three (3) years since the publication of our First NEWSLETTER. Wishing you all a very Happy reading and I welcome your feedback.

Event

Flag-off of “NAMMA CYCLE” on 6th August 2012

CiSTUP in collaboration with Ride – a – Cycle Foundation, EMBARQ and Gubbi labs is executing the Namma Cycle Campus Bicycle Initiative project within the Institute campus. The Flag-off of this event was done on 6th August 2012 in the presence of **Shri. Shankarlinga Gowda, IAS Commissioner BBMP, Dr. N. Mohandas, Registrar, IISc Dr. Ashwath Narayan, MLA Malleswaram.** The partners to this initiative **Dr. Ashwin Mahesh, CEO Mapunity, Sri. Sanjay Sridhar, EMBARQ, India and Sri. Rajesh Mani from TI Cycles** were also present on this occasion. **Chairman CiSTUP, Prof. T.G. Sitharam** welcomed the gathering and gave a brief about the initiative.

The launch of this unique initiative in increasing connectivity and creating environmentally friendly mode

of public transportation was very well attended by the faculty and students of IISc. This is a joint initiative of Centre for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), Indian Institute of Science and the Ride A Cycle Foundation with support from EMBARQ India, MapUnity and Gubbi Labs.

This Namma Cycle idea was born during a discussion with **Mr. Murali** of the Ride A Cycle Foundation. Once it was found acceptable to IISc the discussions were carried forward and got the other agencies to support this initiative. All this started in late January 2012 and the project could take off within a span of six months. The flag-off coincided with the commencement of this academic year at the Institute.

Photos taken on this occasion and the coverage in the media are given in the following pages.



Successful completion of the First M.Tech (T & IE) course from CiSTUP

CiSTUP is proud to announce the successful completion of the First M.Tech (T & IE) which commenced in 2010. All the students have completed their masters in flying colors.

All the students were felt that the academic studies and experience at IISc has been enriching and exciting. They were very grateful that they could get an opportunity to study with and learn from excellent students, faculty members, visionaries making them better persons and professionals.

The outgoing M.Tech students of 2010-2012 batch expressed their thanks to all the CiSTUP faculty, planners, students and office staff for supporting their academic activities throughout their stay at IISc. They have arranged a Thanksgiving function followed by Lunch on Thursday, 28th June at CiSTUP.



In their farewell address they thanked one and all for the support provided during the two years.



List of names of 1st batch M.Tech students - 2010

1. Anil Kousik N.P
2. Hari Kishore. B
3. Kaushal Shamji Maru
4. Sahodar Gade
5. Sri Vishnu.S
6. Varun Raturi
7. Ashalatha.K
8. Bhagyalakshmi. M. Awati
9. Rajesh. S
10. Lakshmana .S
11. Satisha. B.M



Article that appeared in Newspaper

Thursday 5 July 2012

News updated at 10:02 AM IST

'Commuter train is the track to take for future'

Bangalore, June 30, 2012:

Bangalore is urbanising on an unprecedented scale and a large number of rural people are expected to migrate mainly to the Bangalore Metropolitan Region (BMR) area. The urbanisation process has defined more urban sprawl and a complex transport pattern that present a formidable challenge for urban transport policy-makers.

Addressing traffic problems seems to be the guiding principle of urban transportation policies. Rail transit is a necessary component of a contemporary urban transportation system. Bus, rail, metro, mono rail and suburban rails have all got different uses for commuters.

A variety of transportation strategies such as metro rail, mono rail, LRT, high-speed rail connectivity to the airport and commuter rail have been proposed in Bangalore. Rail transit at grade has the potential to improve the environment, serve the poor, and reduce congestion. To combat the traffic, many alternatives to rail corridor such as signal-free road corridors, expressway expansion to the airport, development of underpasses and flyovers are continuously looked for.

A strong and established Indian Railways network exists in Bangalore as a backbone. It is very ideal to exploit this network.

Due to this expanding growth, both in terms of economic activity and urban sprawl, Bangalore gets more population influx and more commuting. Urban planning mechanisms should disperse this population and commuting to new areas and decongest the BBMP areas. Urban rail transit is one such system with existing local rail systems providing passenger service within and around the urban or suburban areas as far as Tumkur, Mandya, Ramanagaram, Doddaballapur, Chikkaballapur, Bangarpet, Hosur, Anekal, etc.

The commuter should be able to travel about 100 km in 1.5 to 2 hours. Only then can the suburban areas get developed fast and pressure on Bangalore eased. Using a rail system on surface with existing infrastructure is a supply-oriented transportation development strategy. This also improves the basic transportation modes such as buses, non-motorised transport, including biking and walking. These are the modes that the vast majority of travellers, particularly the urban poor, depend on.

The surface rail systems such as the suburban rail system in Mumbai are generally cost-effective, and the common man's choice. With a dedicated system, rail is a faster and high-capacity transit.

Rail promotes superior urban form and will attract new riders. It is very necessary to develop a commuter rail system using the existing network of the Indian Railways' backbone and integrate the new metro system and the existing systems of public transport by buses for a supportive overall urban transport policy. This could also create a transit-oriented development with a long-term sustainable financing. The commuter rail system can have the same capacity as metro systems and still have the scope for running long-distance trains in the same rail network at a much reduced cost.

The challenges for Bangalore rail system are enhancing the existing capacities of the rail systems using newer technologies, some of the infrastructure, including coaches and signaling systems, and increasing the rate of return on the demand and pricing of rail-based transportation system.

This is possible with PPP projects and needs to be done constituting a special purpose vehicle (SPV) to be floated by the State government with support from the Indian Railways. This agency should have a provision for private equity, but it is necessary to provide viability gap funding for such public transportation project to make it successful.

The challenge is also to come up with an appropriate fare policy, revenue-sharing policy with a forward-looking structure of the SPV itself. There is enough scope for exploring the potential of the existing rail network with innovative methods of financing, execution, operation, maintenance and management, as compared to newer costly alternatives like metro rail, mono rail and dedicated corridors.

The commuter rail network in Bangalore can be executed in a shorter period with much less investments, if both the government of Karnataka, the government of India and the Railways in particular work together. With the available rail routes, newer rail technologies and information and communication technologies, more innovative intelligent transportation solutions are possible for increasing the capacity and meeting the growing needs of travellers with increased benefits in Bangalore.

Prof T G Sitharam

(The author is the chairman, Centre for Infrastructure, Sustainable Transport and Urban Planning (CiSTUP), the Indian Institute of Science, Bangalore)

1. A. Title of the Proposal:

Development of an eco-friendly electric car



B. Name of the Faculty:

Prof. Anindya Deb, CPDM.

C. Summary of the Project:

The Proposed research involves the following:

- a) Development of new design technology involving large-scale usage of aluminum in vehicle body resulting in an easily recyclable, lightweight and fuel-efficient car platform with zero carbon emissions;
- b) Validation of crash performance of the vehicle using advanced nonlinear contact-impact simulations; and
- c) Prove-out of the design concept with a road-worthy electric car prototype with complete body shells.

2. A. Title of the Proposal:

Retrofit Parallel Hybrid Drive



B. Name of the Faculty:

Prof. K. Gopakumar, Centre for Electronic Design & Technology.

C. Summary of the Project:

The electric vehicles in general have an electric motor as one of the prime movers that propel the wheels. Based on the number of distinct energy sources that are mount on the vehicle, the electric vehicles may be classified as (i). the zero emission vehicles or just electric vehicles (EVs) and (ii) the low pollution vehicles or hybrid electric vehicles (HEVs). Most electric vehicles use rechargeable batteries for the energy storage. The batteries are the only source of energy for the EVs. A hybrid-electric vehicle, on the other hand, combines an electrical energy storage system with multiple on board power sources. The hybrid electric vehicle can be broadly classified into the series hybrid and the parallel hybrid. In the series hybrid structure, there is only one torque source or the prime mover connected to

the wheels. An electric motor, either a DC motor or an AC motor, is generally used as the prime mover that is connected to the wheels. However, the energy to drive the prime mover is obtained from multiple energy sources of different types. As the prime mover is an electric motor, energy sources that are not electric in nature will have to be converted to electric energy. A energy converter is normally used to convert to the electric form. Battery is the common electric energy source that is used as a buffer to store the energy in the electric form. Another energy source that is commonly used is the internal combustion (IC) engine driven by petrol/diesel. As the IC engine develops energy in the mechanical domain, it is converted to electric energy through a generator.

In the case of the parallel hybrid structure, there are two or more torque sources or multiple prime movers that are connected to the wheels. One of the common prime mover that is connected to the wheels is an electric motor. Another common prime mover that is connected to the wheels is the IC engine. Here the hybrid energy sources are directly connected to the wheels and work in parallel through torque addition. This paper discusses the parallel hybrid structure and its suitability for retrofitting to existing vehicles.

The electric propulsion system can be connected either to the present non-driven axle or to the driven axle itself by designing an appropriate transmission. It is important to note that the change over from the petrol fuel to electric should be seamless. Retrofitting is and important driver for this. Therefore, it would not be inappropriate to consider retrofitting electric propulsion to existing automobiles. This would lead to a seamless shift from the petrol vehicles to electric vehicles.

3. A. Name of the Proposal:

Structural Assessment of Existing Road Pavement using Field and laboratory experiments



B. Name of the Faculty:

Dr. P. Anbazhagan, Civil Engineering.

C. Summary of the Project:

Improving and maintenance of transportation infrastructures is major task in any urban centre in

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developing countries. These transportation facilities are playing a major role in infrastructures development, economical growth and people/ industrial agglomerations. Most of urban centers are improving transportation infrastructures, in particular, roads by better maintenance and augmentation, rather than new construction. In general, maintenance of road network in city/urban center consumes almost 80% of cost in total transportation infrastructure expenditures. This may be due to the lack of scientific/ technical knowledge for road condition assessment, maintenance and repairs. Road maintenance is a major issue in Indian cities, even in Bangalore, Karnataka, where most scientific research institutes and information technology companies are located.

In this study, an attempt has been made to characterize existing pavement section by field and laboratory experiment and there by assessing the condition of the same, for better maintenance and repair work. Non destructive field experiment of Ground Penetration Radar and seismic refraction will be carried out in the existing roads. From the same location, the undisturbed in situ samples will be collected by core cutting. Index and engineering properties will be measured in the laboratory using in situ samples. These properties will be compared and correlated with field experimental results. Two major purposes of this research is firstly to characterize the existing pavement layer using the properties of thickness and modulus and secondly to compare and correlate modulus from seismic refraction and lab test to ground penetration radar. This can be used to evaluate other pavements and to identify problematic locations for pretreatments.

Major Recommendation:

In this study an attempt has been made to assess pavement condition using non destructive testing and compare with in situ measurements. Conventional method of pavement condition rating has been attempted in selected roads by visual survey. Selected 31 locations are classified as per pavement condition rating scale. Non destructive tests of MASW and GPR have been carried out in selected locations and thickness, stiffness and dielectric constants are measured. In the selected locations in situ bitumen core samples are collected and thickness, bulk density, bitumen content and gradation parameters are measured. By comparing all the results the following conclusions are arrived from this study.

- It was shown that a GPR can detect layer interfaces if a significant contrast in the dielectric constants exists between the two considered layers.
- Pavement thickness estimated by GPR is comparable with actual drilled borehole core samples. The time domain technique showed that thickness of pavement can be estimated with an error of about 9%.
- Borehole data gives accurate thickness of pavement if bitumen concrete is intact, but it is time consuming and costly when compared to GPR.
- MASW is an effective tool to measure the stiffness of pavement. Higher frequency fundamental mode of dispersion curves dominates at the shallowest depth range to locate asphalt and base layer.
- GPR is an effective method to estimate thickness and heterogeneity in the bitumen concrete with short time.
- Thickness cannot be measured using MASW accurately and strength cannot be measured in GPR. Combining both methods can help to assess pavement condition accurately.

4. A. Name of the Proposal:

Quantification of Damage for Residual Life Assessment of Reinforced Concrete Infrastructures



B. Name of the Faculty:

Dr. J M Chandra Kishen , Department of Civil Engineering.

C. Summary of the Project:

Concrete is the most commonly and widely used structural material, used in the construction of infrastructures such as bridges, flyovers, airport runways etc. structural concrete contains internal flaws in the form of micro-cracks as an inherent property. Under service load condition or due to environmental degradation, these micro-cracks have the tendency to grow into a dangerous discrete crack leading to structural failure. While a lot of money is spent on repairs and retrofitting of aged structures, no measures have been implemented to take

stock of the present structural condition so as to estimate the residual capacity or residual life of structures at present day levels of loading or at enhanced load levels so as to judiciously allocate funds for various works. Hence, it becomes important to assess the condition of the aged and damaged structure. This could be done by formulating quantifiable damage indicators and the present proposal is developed to perform this task.

In this work, an attempt is made to quantify the degradation of flexural stiffness in terms of a global damage index defined for the entire beam. The primary objective is to obtain an analytical correlation between local damage parameter and the global damage index. Following the shadow of continuum damage theory, local damage parameter (e.g. crack length, crack tip opening displacement (CTOD), crack mouth opening displacement CMOC) can be considered as observable variables whose evolution can be noticed experimentally. The information gathered from the local damage variables can further be used to compute the global damage indicator. In the present case damage is assumed to appear in the form of discrete crack near the principal tensile zone due to fatigue loading.

Furthermore, the relative crack depth and the crack tip opening displacement (CTOD) are used as parameters to define local damage measure. The measured CTOD is converted into equivalent tensile strain and a new local damage indicator is defined. Knowing the fatigue crack propagation curve or the progressive increase in local damage, a finite element formulation is used to incorporate this local effect into the global stiffness of the member. A cracked beam element would be used to model and capture the stiffness degradation due to continuous crack propagation within a finite element framework. The minimum Eigen value of the global stiffness matrix of damaged beam is compared with the undamaged minimum eigen value, to quantify the stiffness degradation index. Experiments would be performed on beams with a known level of damage for verification of the analytical models.

Major Recommendation:

In this study, it is shown that multiple cracks can be represented as an equivalent single crack using damage index. The damage index, defined using the minimum eigen value of the stiffness matrices is independent of the size of the specimen for geometrically similar specimens. An energy based equivalence approach is proposed to model multiple discrete cracks in the form of a distributed

damage zone. The stiffness reduction factor is computed using both fracture mechanics and damage mechanics theories and the results show that both the theories agree well with each other. Treating the multiple cracks as an equivalent single crack highly simplifies the complexity involved in modeling multiple cracks in concrete structures. By representing multiple cracks as an equivalent damage zone, that is reducing the modulus of elasticity of that zone, the modeling becomes much simpler as there is no need to consider the stress concentrations occurring at the crack tip and hence more efficient.

5. A. Name of the Proposal:

Urban Water Supply and Management



B. Name of the Faculty:

Prof. M S Mohan Kumar , Civil Engineering.

C. Summary of the Project:

Development of the city distribution model for water supply using the GIS data gathered by the BWSSB and using EPANET as the drive engine. An attempt will also be made to understand the role of groundwater in sustenance of the supply to a ward or zone vis-a-vis water supplied by BWSSB. By knowing the water supplied by BWSSB to a city ward or zone (through metering and knowing the population in a ward, the water utilized by the community using groundwater as resource will be assessed. Such assessment of the utility of groundwater is a source for sustainability is very important from the angle of long term water utility in the city.

Major Recommendation:

Bangalore city water distribution network is modeled by using EPANET from source to all ground level reservoirs. As the water supply is intermittent there is huge variation of pressure and flows at different nodes and pipes respectively. Nonlinear Dynamic Inversion controllers with Proportional Integral Derivative features are used to achieve the target flows by throttling of the valve. It was a challenging task to model the inflow system as the water distribution network is very large and the city has large undulating terrain. Flow has been converged to a steady state system in all levels of throttling by satisfying the mass

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balance at each junction. The network is calibrated by suitable valve throttling with a minimum error between the observed (flow meter reading) and simulated flow. The quantity of groundwater extracted from each zone of the city is also calculated from the available data. It was observed that huge quantity of groundwater is used which is approximately 65% of the piped water supply. The model prepared can be used as a decision support system and by using the same concept equitable water supply can be achieved in any other similar cities also.

6. A. Name of the Proposal:

Sustainable use of Sewage-fed Urban Water Bodies



B. Name of the Faculty:

Dr. H N Chanakya, Centre for Sustainable Technologies.

C. Summary of the Project:

Bellandur and Varthur tanks have been studied to some extent and they appear to treat sewage flowing into it to an acceptable extent in one season and not in others. When lakes carry out this function all the year round, they substitute expensive and poorly functional sewage treatment plants, contain the pollution within urban fringes, enable recycling of wastewater and help ground water recharge to finally capture N&P into algal and other aquatic biomass to allow them to be recycled in agriculture. This can greatly reduce urban fresh water demand, overcome current pollution issues, facilitate nutrient recycling and make urban life sustainable. We seek to continue abovementioned study such that the optimum approach to the above is evolved and make its applicability throughout Karnataka and in a large part of India. The project would involve repeating current studies to confirm above observations and understand key factors and evolve mechanisms that can make their application to cities sustainable.

Major Recommendation:

The lakes in Bangalore as Bellandur and Varthur with the present water holding capacities are able to remove the COD and BOD upto 60% and nutrients upto 50% with a water residence time of 5-6 days. The seasonal studies

showed higher treatment activities during the periods where there is an absence of macrophytes. The abundant algal communities mostly the chlorophytes growing in these lakes are sufficient to provide the oxygen 44 required by the bacteria for degradation of organic matter purify water. The functioning of these water systems can be optimised by a careful feed rate management and altering the microphyte activities for a sustainable wastewater treatment and water reuse. Large open surfaces for algal growth would render rapid DO dissolution into the system making the oxidative activities efficient to curb organic and treat higher organic loads. From the studies it was found that an additional detention unit is required at the downstream of Varthur lake, that could bring down the organic content as well as the inorganic nutrients below the tertiary treatment levels.

Optimisation of such already existing manmade lake systems would pave a way for a sustainable management of water systems in cities of India with efficient water recycle and reuse at the same time drawing nutrients in the form of algal biomass for other application as manures, proteins, biofuels etc.

7. A. Name of the Proposal:

Construction Waste Potential Resource for Building Products: A case study of Bangalore city



B. Name of the Faculty:

Prof. B. V. V. Reddy, Civil Engineering.

C. Summary of the Project:

Indian construction industry is one of the largest in terms of volume of raw materials/natural resources consumed and volume of construction materials/products manufactured. Large variety of materials are manufactured and consumed in the building industry. It has been estimated (in 1991) that 22% of green house gas (GHG) emission is contributed by the construction sector alone in India. Energy and raw materials are essential for the production of building materials and products. There is a great emphasis on reducing the capital energy

(embodied energy) and energy for maintenance of the buildings. Promotion of green building concepts is over emphasized in the present context of climate change mitigation. Other major problems faced by the Indian construction industry are the extraction and use of raw materials in an unsustainable fashion. For example use of fertile soil for brick production, mining of river beds for sand, crushing of stone/rock outcrops for coarse aggregates, etc have reached alarming proportions. Sustainability of the present mode of production and consumption of building materials and currently adopted construction practices is questionable. There is an urgent need to examine the use of solid wasters from the industries, mines and construction sector to augment the huge growing demand for construction materials. The proposed study aims at assessing the quantity of construction wastes generated in the Bangalore Metropolitan city and establishing its suitability for fine aggregates in mortar and concrete.

The proposed study aims at assessing the quantum of construction wastes generated the Bangalore Metropolitan city and testing It's suitability for the fine aggregates in mortar and concrete. The survey involves number of trucks loads of construction waste generated on a monthly basis, assessing the nature of construction waste (like broken bricks and mortar debris, concrete, surkhi concrete, flooring tiles, etc. and already recycled bricks, steel, stones and timber). Information on current mode of construction waste disposal and the distances involved will also be elicited.

The second part of the project involves collecting samples of construction wastes which are suitable for the production of fine aggregates. Disintegrating/powdering the wastes and characterizing the physical properties. Tests planned on mortar and concreters using the powdered construction waste as fine aggregates include properties of mortar and concrete in fresh and hardened state. Flow/workability, water retentively, strength and elastic properties two grades of mortars (M1 AND M2) will be examined. After mix design for M20 and M30 concrete using powdered construction waste fine aggregates, the strength also will be assessed.

Major Recommendation:

The study revealed several interesting features on sand from the demolition wastes. Nearly a million tones of demolition waste is produced annually by the construction activity in the Bangalore metropolitan region, apart from the huge quantities of such accumulated waste. Demolition wastes are nearly free from plastics and other organic matter.

Sand from crushed demolition wastes can be used for the masonry mortars and concrete. Mortar compressive strength and masonry bond strength greatly improves when the fine aggregates from demolition wastes were used instead of river sand.

Compressive strength of concrete marginally falls when the river sand is replaced by sand from crushed demolition wastes (like crushed mortar and crushed masonry). However, there is scope for exploring the characteristics of concrete using sand from mixture of different types of demolition wastes.

8. A. Name of the Proposal:

Domestic Water Pricing for Demand Management.



B. Name of the Faculty:

Dr. P Ramachandran ,Management Studies.

C. Summary of the Project:

The objective is to study the response of individual households to the existing increasing block rates. Specifically we seek to answer questions which includes: (1) Has the increasing block rates been effective in communication the real cost of water? (2) Does the existing block rates promote conservation? (3) Have the consumers changed their consumption pattern in the long run (habit formation)? At a micro level (household) we seek to determine the price elasticity of demand for water and determine if it is different for the various sections of the consumers.

Since the last 50 years residential water demand has been studied extensively using econometric methods. In this study we propose to combine cross-section with time-series data in a panel-data approach. This method has the advantage of overcoming multi co linearity and makes it possible to control for unobservable heterogeneity of the cross-sectional units. The cross-sectional units representing differences in socio-economic characteristics of consumers is essential since it is a known fact the consumer behaviors are influenced by these factors.

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9. A. Name of the Proposal:

Probabilistic and Deterministic Seismic Hazard Assessment of Karnataka State and Microzonation of Tier II cities for Urban Planning



B. Name of the Faculty:

Prof. T. G. Sitharam, Civil Engineering.

C. Summary of the Project: The evaluation of seismic hazard for any region will require the estimation of Peak Horizontal Acceleration (PHA) values at rock level. The two methodologies adopted in the seismic hazard analysis are the deterministic Seismic Hazard Analysis (DSHA) and the Probabilistic Seismic Hazard Analysis (PSHA). In PSHA the hazard parameters will be evaluated by considering the uncertainties involved in the earthquake occurrence process.

In the proposed research the seismic hazard analysis will be carried out based on the PSHA and DSHA methodology. The study area will be divided into small grids of size 5km x 5 km and the hazard parameters will be evaluated at the centre of each of the grid points. For the seismic hazard analysis, the linear seismic sources modal and the attenuation relation proposed for south India by Raghu Kanth and Iyengar (2007) will be used.

The seismic Hazard evaluation using deterministic method will consider the worst scenario of seismic hazard. The PHA values obtained in the deterministic analysis can be taken as the upper bound hazard levels for the region.

There are lots of uncertainties involved in the seismic hazard analysis. The DSHA analysis won't consider these uncertainties while evaluation the hazard. Hence a probabilistic evaluation of the seismic hazard will be done by incorporation all these uncertainties. The uncertainties considered in the analysis are (i) magnitude recurrence rate (ii) hypocentral uncertainty (iii) uncertainty in the attenuation relations. Since PSHA considers all these uncertainties, it is one of the most widely used techniques for the hazard evaluation.

The maps showing the spatial variation of PHA values for the entire study area will be prepared based on DSHA and PSHA methods. In addition to this the response spectra for the tier II cities in Karnataka will also be developed for

different site classes as a part of this work. The site class at any location can be obtained from an MASW survey and based on this the response spectrum corresponding to the respective site class can be selected. This will help the designers to get the response of the structure for a given earthquake. Microzonation of the tier II cities such as Bellary, Mysore and Gulbarga in Karnataka based on the spatial variation of PGA values will also be evaluated and presented as a part of this work. These details will be of great help for the planners while developing the master plan for these cities.

Discussion/Summary of work carried out (Explaining Deliverables, Implementation etc. with List and future direction.)

SPECIFIC AIM / OBJECTIVES OF THE PROJECT:

- The main objective of the study is to identify and map linear seismic sources in the state of Karnataka
- Collection of earthquake events occurred in the state and surrounding area from different agencies
- Preparation of seismotectonic atlas for Karnataka state showing all the linear seismic sources and the earthquake events.
- Carrying out probabilistic seismic hazard analyses to evaluate peak horizontal acceleration at the bed rock level for the entire Karnataka state.
- Estimation of the peak ground acceleration at surface level for different site classes by considering the site effects.
- Probabilistic evaluation of SPT and CPT values required to prevent liquefaction.

Major Recommendation:

Major conclusions from the hazard studies are given below.

- Spatial variations of PGA values from probabilistic are shown in this report.

From probabilistic analysis, places in Bidar district have hazard values ranging above 0.14g for a return period of 475 years and 0.3g above for a return period of 2500 years. Moreover from the site response studies, this region is expected to have a PGA value up to 0.25g for 475 year return period and 0.55g for 2500 year return period. These regions are very much close to Latur fault that has produced an earthquake of magnitude 6.1 in 1993.

- Places between Bangalore and Mysore also found to have significant value of PGA of above 0.1g and

for critical case it can go up to 0.25g also. Hazard at ground level by considering results from different site classes, can have value 0.25g for 475 year return period and 0.4g for a return period of 2500 years.

- Analysis also shows for Mangalore – Udupi regions, a hazard value up to 0.08g at rock level for return period of 475 year and can go up to 0.2g for 2500 year return period above. Hazard at the surface level is expected to have 0.1g to 0.15g for 475 year return period and 0.2g to 0.25g for 2500 year return period.
- Hazard analysis also points out interior regions in Karnataka having low hazard value of around 0.04g for both return periods. Kaiga, which is the location for nuclear power plant has the least value of hazard, compared other cities. Hence it's best suited for critical structures like nuclear structures.
- Response spectra of some important cities in Karnataka are also presented.
- From probability analysis a hazard curve is also presented for each city in Karnataka. Using this hazard curve, hazard value for any return period can be estimated.
- The PHA values obtained in the present study matches well with the values obtained by other researchers for different parts of the study area
- Liquefaction hazard analysis shows that Bangalore – Mysore region and the Bidar region has the highest liquefaction. In these regions, SPT value of more than 10 for 475 year return period and 15 for 2500 year return period is required to prevent liquefaction at 3m and 6m depth. CPT values, to prevent liquefaction in these areas are also high at 3m (9 to 13 MPa) and 6m depth (8 to 11MPa).
- Regions near Mangalore – Udupi have moderate liquefaction hazard and required SPT value of more than 5 for 475 year return period to 10 for 2500 year return period is required to prevent liquefaction at 3m and 6m depth.
- The interior parts of Karnataka have the lowest liquefaction hazard, with required SPT value of less than 5 for 475 year return period and more than 5 for 2500 year return period is required to prevent liquefaction at 3m and 6m depth.

MAJOR ACIEVEMENTS

- Identify and map linear seismic sources in the state of Karnataka is done
- Earthquake events occurred in the state and surrounding area from different agencies were collected and compiled
- Preparation of seismotectonic atlas for Karnataka state showing all the linear seismic sources and the earthquake events was done
- Probabilistic seismic hazard analysis was carried out to evaluate peak horizontal acceleration at the bed rock level for the entire Karnataka state.
- Peak ground acceleration at surface level for different site classes by considering the site effects was done using nonlinear site amplification technique
- Probabilistic evaluation of SPT and CPT values required to prevent liquefaction for the entire state of Karnataka was done

10. A. Name of the Proposal:

Development of Dedicated Spectrometric Reagent Kits and Cookbook for Pollution Monitoring of Bangalore Lakes and Water Bodies



B. Name of the Faculty:

Dr. J. R. Mudakavi, Chemical Engineering.

C. Summary of the Project:

A majority of the water quality monitoring parameters are based on spectrophotometry. Spectrophotometric methods are based on the reaction of analyte with a chromophoric reagent to produce a colored species with well defined spectral characteristics. Absorbance at the max is a function of the concentration according to Beer Lambert's law.

Spectrophotometry is the most economical and cost effective technique. It is a well defined chemical system which is highly matrix dependent. Therefore sensitivity, selectivity and specificity of the method are dependent upon the concomitants and their individual colour reactions with the chromophore.

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Bangalore is the fastest growing Metropolitan city in the whole of Asia attracting a multitude of people from various ethnic backgrounds. A variety of industries located in and around Bangalore releases effluents in the water bodies. Further a variety of chemical influents generated from modern lifestyles are affecting the water quality. Important among them are complexing agents, CDTA, DTPA, surfactants, pesticides, N,P,K nutrients and micronutrients, leachates etc. Consequently analytical methods for water quality parameters based on spectrophotometry need reevaluation.

In view of the modifications required for methods based on spectrophotometry for lake and river water monitoring, it is proposed to develop ready made reagent kits and a corresponding methods manual (cook book) to facilitate quick analysis of the lake and river waters of Bangalore.

11. A. Title of Proposal:

Integrating Hawkers and Vendors in Pedestrian Policy and Facility Design Guidelines for Bangalore City



B. Name of the Faculty:

Dr. Ashish Verma, Civil Engineering &

Dr. Anjula Gurtoo, Management Studies.

C. Summary of the Project:

Street vendors have been a characteristic feature of Indian cities and towns from time immemorial. However, there has been limited attempt in India to integrate them into any formal infrastructure policies like stall and allocation and market design policy or pedestrian policy and road facility design guidelines. The government of Karnataka is keen to pursue a formal integration policy for street vendors and hawkers. Some of the triggers for this initiative are the Supreme Court judgment on Sodhan Singh versus NDMC, 1986 and the Central Ministry of Housing and Poverty Alleviation policy 2009 on street vendors following the guidelines of this Supreme Court judgment.

Within the above context, a detailed analysis was carried out, taking the case example of the city of Bangalore, in order to explore integration of the street hawkers and vendors into this formal infrastructure system. Specifically the objectives of the study were:

- To explore pedestrian policy guidelines for Bangalore city that considers and integrates provisions for hawkers and street vendors.
- To explore facility design guidelines for Bangalore city that considers and integrates provisions for hawkers and street vendors.

To meet the first objective of exploring the pedestrian policy guidelines, surveys were conducted, of vendors/hawkers and their customers; in different area types, namely, residential, commercial and industrial; at different times and nature of the day, namely, morning and evenings; and weekends and weekdays. The total sample size for street vendors/hawkers was 871 and for the customer was 779. The surveys clearly revealed the pattern of vending, the work related operational issues and concerns, and the 'entrepreneurial' nature of their work. Some of the significant results were:

- The nature of the social set up and work preference revealed that 72% of the respondents preferred to continue with vending as their primary business. Reasons were two fold, a) family tradition, and b) low set up cost.
- Their work requirements varied with different types of localities and the choice of location was critical for business. The location was selected according to the demand for the goods they sold, ease of access to raw material and ease of access to transportation. Pavements and footpaths important locations, as they got better profits.
- The space requirements revealed that about 77% respondents wanted fixed space, of area of about 4-6 sq ft.
- More than 75% of the respondents wanted formal government recognition, under some formal government institutional structure and a formal government designated space to do business. Furthermore,
 - 76% wanted a sign board to display personal information
 - 47% desired to join a vendor organization
 - 25% wanted to join a government association

The customer survey reflected 83% of the respondents positively accepting the presence of hawker on pedestrian facilities as it was very convenient, time saving, and convenient for purchase of fresh and cheap goods.

However, 53% did not feel secure in the presence of street vendors.

To meet the second objective of exploring the facility design guidelines, a detailed study of pedestrian characteristics like speed, density and flow rate was initiated. This study involved a quantitative assessment of the pedestrian facilities, identification of study area (area of peak pedestrian flow with hawkers and vendors along the walkway), data collection of pedestrian movement using video graphic surveys, and microscopic pedestrian simulation using Vissim.

The study area was categorized into three, commercial, residential and industrial. The data collection for the study area was classified into two, namely, Footpath Inventory Survey, and Pedestrian data collection using video graphs.

The footpath inventory survey comprised of various geometric details of the study area, namely, width of the carriageway, width of the footpath, footpath surface condition (raised/continuous/smooth/cracks or bumps), total length of the study stretch, length of stretch occupied by hawkers, the area occupied by hawkers, land use on both sides of the road, and used for pedestrian movement.

The microscopic pedestrian simulation was carried out for two scenarios.

- The existing pedestrian condition
- Capacity analysis-Level of Service assessment for pedestrian facilities

The existing pedestrian condition is simulated using the real time data obtained from the data collected. The model is then calibrated and validated to check the effectiveness of it with the real time pedestrian movement. A certain set of parameters like speed, density, flow were observed from the video and is compared with the simulation model results for the purpose of validation. The results from this simulation model would then be useful for calibrating various LOS criteria for an improved pedestrian movement incorporating the hawkers and vendors in the facility. The LOS criteria used in this study were obtained from HCM 2000.

The main pedestrian policy design guidelines, based on the outputs of the survey, are given below. The overarching objective is derived from National Policy on Street Vendors 2009 which states "Provide and promote a supportive environment for earning livelihoods to the street vendors, as well as ensure absence of congestion and maintenance of hygiene of public spaces and streets".

- For the guidelines two kinds of hawking/vending is included, namely, based on nature of goods sold (perishable, material oriented versus non-perishable, service and material oriented) and based on type of selling (mobile and static)
- Hawking zones (pedestrian path and non-pedestrian path) for static vendors are recommended.
- **Regulation and monitoring** can have 3 possible approaches:
 - Option A: market regulation approach (USA, Canada, Czech Republic)
 - Option B: formalization and growth approach (Denmark, Italy, Armenia, Peru, Bolivia, and Ecuador)
 - Option C: business venturing approach (UK, Kenya, Germany, Belgium, France and Netherlands)
- **Essentials for effective regulation**
 - Formation of town vendor committees (TVC) which includes members as specified in the national policy
 - Kiosk/work station/marked area with pucca shed for business transactions
 - Formal recognition through identity cards
 - Service support such as skill upgrade, training in managerial skills like communication, service strategies and operations management.
- **Economics**
 - A broad strategy of "collective operations or clusters" for long-term growth, like formation of location wise groups (cluster collectives), and formation of a network group (cluster cooperatives).
 - Financial assistance to be channelized through the Micro, Small and Medium Enterprises Development Act 2006.

Major Recommendation: Pedestrian facilities in India have become of utmost importance and focus in recent times. Policy makers comprehend that streets in metropolitan cities, where people of different social backgrounds reside on their work, should be designed in a manner that accommodates the needs of each category of people. Our study focuses on the importance of accommodating the low income groups who rely on selling cheap goods for their livelihood, the street hawkers and vendors. Any person travelling across the major cities in India would confront such a group of people. So the

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existence of such a community of vendors is an inevitable part of the metropolitan culture in India. Be it food, clothes, household items, leather products, books, electronic goods, they are all sold at a cheap rate to support the low income class of people. The quality of the goods sold by them is unimportant as long they serve the purpose of the needy. As these vendors cannot afford to rent a place for vending they use suitable open and free space available for profitable vending.

Attempts were made to understand the socio-economic conditions among the street vendors and policy guidelines were proposed to suitably accommodate them in the pedestrian facility available. By accommodating the hawkers and vendors along the footpaths, no compromise was made on the facility to be provided for the pedestrians. Giving due importance to the prevailing grievances faced by the pedestrians in Bangalore city, with the design standards adopted from IRC and HCM 2000 we proposed a set of design guidelines that can improve the overall efficiency of the existing pedestrian facility. Two study stretches from each of the commercial, industrial and residential zones were studied and the analysis carried out.

Our work is an attempt to throw light on the cheapest and the most environment friendly mode and encourage more people to use it. Only if deliberate attempts are made to build an excellent facility for the pedestrian community, will there be harmony that can bring about a system that coexists with the all other transportation modes.

Ultimately any transportation facility would be efficient only if all modes co-exist with each other. Walk mode will be attracted by people only if it is safe, comfortable, convenient and well connected to other transportation facilities. Through the recommended policy for integrating the hawkers and vendors in the pedestrian facility in the selected study regions of Bangalore city, the prevailing disorder and confusion among the pedestrians can be eliminated to the great extent.

12. A. Title of Proposal:

A Multi-Objective Transit Trip Itinerary Planning System Using GIS for Bangalore City



B. Name of the Faculty:

Dr. Ashish Verma, Civil Engineering.

C. Summary of the Project:

The Present work on transit trip itinerary planning system design focuses on pre-trip planning by urban public transport users in developing countries like India, where the various modes of public transport in a city generally have differential level of service and are not integrated properly. The work also attempts to provide more flexibility to the users while planning a trip through a multi-modal transit system, and to imitate their natural tendency to attach differential importance to various legs of a trip (walking, waiting, travel time etc.). The above considerations will be introduced in the design; by developing a path finding algorithm for a multi-modal transit network of Bangalore city considering Generalized cost (GC) approach, and by developing the design in a GIS platform.

Major Recommendation:

This report presents a multi-Objective GC based PIS design for multimodal transit system that integrates GIS processing, network analysis, user interfacing and database management. The proposed PIS answers user queries like optimum path based on time, cost, distance, or GC and other related information for making a trip. It is implemented on a multimodal integrated transit network developed through past work for the city of Bangalore in India. The following conclusions/contributions can be drawn from the present work:

- So far, most of the approaches for transit PIS design consider either the direct cost incurred during travel or the in-vehicle travel time as a parameter to find the optimum path for making trip. An assumption that users are simply aiming to minimize their money costs, when in fact they attach great significance time saving or vice versa, may lead to errors in trip planning.
- The GC based PIS design for trip itinerary planning is suitable for the Indian scenario, where the various modes of transport are generally not harmonized, and the transfer time from one mode to another may be very large. It also imitates the natural tendency of public transport users to attach differential importance to various legs of trip walking, waiting, travel time, etc. While planning for it.
- In the present work, a unique PIS design suitable for Indian conditions, for multimodal transit

system is proposed. The same has been applied on commercially available GIS software Trans CAD. It will answer user queries taking into account a multi-objective GC based approach.

- A mathematical formulation is developed and proposed to obtain optimum path, on a multimodal transit network, based on GC and subject to constraints for path viability and maximum waiting time.
- A working model of transit PIS, to demonstrate its applicability, is developed and tested on a real world transit network of Bangalore city, India

To summarize, the major challenges in developing proposed PIS lies in the acquisition of large data, data accuracy, realistic representation of transit network in space and time, development of user friendly interface, proving flexibility in pre-trip planning to the user and proving easily comprehensible and realistic outputs for the user in real time. Effective PIS can be guaranteed if the aforementioned challenges are met successfully.

13. A. Title of Proposal:

Use of Plastic Wastes in Sub-grade Road Construction



B. Name of Faculty:

Prf. G.L.S. Babu, Civil Engineering.

C. Summary of the Project:

Over the last few decades there has been a steady increase in the use of plastic products resulting in a proportionate rise in plastic waste in the municipal solid waste in large cities and Bangalore is no exception. There is a need to examine the reuse of plastic waste in road construction and in particular in subgrade and sub base materials.

Plastic-waste materials are produced plentifully such as polyethylene terephthalate (PET) plastic bottles, polypropylene(PP) of plastic sack, and polypropylene (PP) of carpet. But such materials have been used little for engineering purposes, and the overwhelming majority of them have been placed in storage or disposal sites. These plastic wastes can be cut into pieces and mixed with soil and the behavior of the soil is similar to fiber reinforced soil

and the response of the plastic waste mixed soil can be examined using the framework of fiber reinforced soil. Preliminary experiments show that addition of plastic waste pieces lead to an improvement in strength response and there is a need to do detailed studies in this direction.

For this, the following aspects will be examined in the project. They are a) review of the studies on the use of plastic waste in road construction, b) Experimental studies on plastic waste mixed soils for use in road applications. Strength, volume change and permeability behavior will be studied in detail c) analysis of data and development of analytical methods for design d) dissemination of knowledge to stake holders and conduct field trials if possible.

All the above objectives have been nearly fulfilled and a few results have been published in the Journal of Waste Management. Results of the work have also been presented in the Conference on "Modern Trends in Pavement Engineering held on 15th July 2011, where many stakeholders of CiSTUP participated.

Major Recommendations

Experimental investigations have been carried out on flyash mixed with plastic waste and geogrid waste and their effect on the seepage potential and piping resistance is studied. The following are important finding of the present research. The present study reveals that the addition of discrete and randomly distributed fibre inclusions in fly ash is an effective method in improving the piping resistance of the fly ash and is cost effective. Flyash blended with geogrid waste shows and improved resistance to the piping phenomenon compared to the plastic waste blended with flyash due to the higher shear resistance offered by the geogrid waste compared to the plastic fibre. The upward seepage rate is decreased for fly ash composites due to decrease in void ratio and the blocking of pore spaces of fly ash by fibres replacing fly ash solids. The upward seepage rate has a marginal decrease with increase of the fibre content. For the steady state seepage case performed on the sheet pile wall constructed with a fly ash mixed with plastic and geogrid waste can effectively restrict soil particles movement and the resistance to the piping is improved. A similar case was also analysed on plastic waste mixed sand for a cofferdam seepage problem, and even in this case, the addition of plastic waste was found to increase the overall stability against piping.

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14. A. Name of the Proposal:

Damage Assessment of Reinforced concrete bridge beams using acoustic emission method

B. Name of the Faculty:

Dr. R. Vidya Sagar, Civil Engineering.



C. Summary of the Project:

b-value analysis of AE and AE energy analysis will be used to identify damage in a reinforced concrete (R.C) beam member in bridge. Acoustic emission (AE) testing is a well known method for damage identification of field bridges. The actual cracks developed in the structure can be identified when the cracks are active. The b-value based on Gutenberg-Richter formula will be calculated from the frequency-amplitude plots of acoustic emission released during the fracture process of a bridge beam and cyclic load will be applied on the R.C. bridge beams. The strains in steel and concrete will be compared with the b-values which are computed using the AE released during the crack propagation in a R.C. beam. The observations made in the present research proposal may have some important practical applications to detect the condition of the structural members of a bridge.

15. A. Name of the Proposal:

Damage assessment, repair and retrofit of reinforced concrete girders and columns using fiber reinforced polymer composite and cementations materials



B. Name of the Faculty:

Prof. Ananth Ramaswamy, Civil Engineering.

C. Summary of the Project:

The present study proposes to experimentally evaluate the performance to experimentally evaluate the performance of repaired/retrofitted structural concrete elements and sub-assemblages damaged using different repair schemes including those based on use of FRP plates

or wraps, UHPERC elements, textile reinforcements etc., to restore the capacity of damaged structural concrete elements. Non destructive techniques will be used in these studies in the first instance to develop methods to establish the nature and extent of damage. The damage assessment will then be used to evolve alternate repair schemes based on the different materials and procedures available for repair. No-destructive methods will be used to assess the suitability of the repair implementation and the durability of the repair will be assessed under different environmental conditions.

Analytical models, to assess the contribution from different elements in the various repair schemes, such as FRP in the different retrofit methods and UHPFRC and textile reinforcements as repair material, will be studied, a finite element model that accounts for both the constitutive properties of the primary structure in its damaged state and that of the repair material will also be formulated and used in this study to assess the different repair schemes. Mechanistic engineering procedures to interpret extent of damage, and quantifiable benefits emerging from different repair procedures will be an outcome of this study and will be useful to the practicing engineer. Sustainability of the repair/retrofit scheme will be assessed.

It is expected that know how developed in this study will assist practicing engineers in assessing existing infrastructure and in arriving at informed decisions on repairing or strengthening them.

Major Recommendation:

The study examined the efficacy of using CFRP wrap as a repair on mechanically loaded (monotonic or cyclic) or thermally loaded (high temperature and exposure time) and damaged concrete and found that even one wrap was adequate to substantially enhance the strength of the damaged concrete through the confinement introduced.

Specific conclusions drawn in the study are:

Concrete Cylinders of 25MPa and 35MPa cylinder compressive strengths subjected to monotonic loading:

- 1) The undamaged cylinders with 1 layer of CFRP wrap failed at a higher value of stress than the corresponding control cylinders by sudden rupture of CFRP. There was a strength increase of 40% and 28.5% for undamaged concrete cylinders with CFRP wrap of 25MPa and 35MPa cylinder compressive strengths respectively when compared to the control concrete

cylinders due to good confinement provided by the CFRP.

- 2) The damaged cylinders repaired with 1 layer of CFRP wrap failed at a value of stress less than the undamaged CFRP wrapped cylinders but greater than the stress value corresponding to the control concrete cylinders had failed at, as observed in Fig. 5 for 25MPa cylinder compressive strength and Fig. 6 for 35MPa cylinder compressive strength cylinders respectively. These observations show that, good confinement provided by the CFRP to the concrete in compression was the reason for the original compressive strength being restored for the pre damaged cylinders after repair. These pre damaged cylinders after repair with 1 layer of CFRP wrap failed with crackling sound of concrete enclosed within the CFRP, and by slow opening of CFRP which opened by tearing vertically.

Concrete Cylinders of 25MPa compressive strengths subjected to cyclic loading:

- 1) The control cylinder without CFRP wrapping failed at 16,970 number of cycles.
- 2) The undamaged CFRP wrapped cylinder failed at higher number of cycles (24,023 cycles) when compared to the fatigue life of the control concrete cylinder (16,970 cycles) for the same loading range accounting to nearly a 41% increase in the fatigue life due to good confinement provided by the CFRP to the concrete.
- 3) The damaged cylinder repaired with CFRP wrap failed at 10,377 number of cycles after repair with sufficient warning before failure by cracking sound of concrete and slow opening of CFRP which opened by tearing vertically. This same cylinder was priorly damaged upto 10,000 cycles with excess cracks before CFRP repair. Though this cylinder being extensively damaged with cracks did not fail immediately after application of cyclic loading and performed reasonably well due to confinement provided by the CFRP accounting to nearly a 40% drop in the fatigue life after repair when compared to the fatigue life of the control cylinder.
- 4) Concrete cylinders exposed to a temperature of 550 deg C for 4 hours had developed many cracks due to thermal damage and the fatigue life of these cylinders without CFRP was 14,700 cycles accounting to nearly a 13.37% drop in the fatigue life when compared to the fatigue life of the control cylinder. Another set of companion cylinders which were exposed to 550 deg C

for 4 hours wrapped with CFRP after cooling exhibited a fatigue life of 20,900 cycles accounting to nearly a 23.15% increase in the fatigue life after repair when compared to the fatigue life of the control cylinder. On the whole the enhancement in the strength and fatigue life of pre damaged cylinders was due to good confinement provided by only 1 layer of CFRP wrap to the concrete showing that the repair was effective.

16. A. Name of the Proposal:

Assessment of Seismic Performance of Reinforced Masonry Building Models through shock table and shaking table tests



B. Name of the Faculty:

Dr. KS Nanjunda Rao, Civil Engineering.

C. Summary of the Project:

It is well known that un-reinforced masonry buildings are the most vulnerable during an earthquake. The walls of the building which are perpendicular to the direction of ground motion, called as "cross walls", will be subjected to out-of-plane lateral load. Such walls will bend in both horizontal (bending axis vertical) and vertical (bending axis horizontal) directions. The masonry bonding adopted in construction has continuous bed joints in the horizontal direction whereas the joints are staggered in the vertical direction resulting in higher (2-3 times) flexural strength of the wall for bending in horizontal direction than in vertical direction (1). The earthquake resistant provisions of IS 4326:1993 [2] for masonry buildings in India essentially consists of providing horizontal reinforced concrete (RC) bands at plinth, lintel and roof levels and vertical reinforcement at corners and junction of walls and at jambs of door and window openings. The structural action of horizontal RC bands in resisting shear and bending of the cross walls in the horizontal direction and connecting the different walls for integral action of the building is quite clear. A field survey conducted to understand the behavior of buildings after the Bhuj earthquake [3] showed out-of-plane collapse of un-reinforced masonry walls due to bending in the vertical direction. From this it is clear that the existing earthquake resistant provisions for un-reinforced masonry are

inadequate particularly in preventing out-of-plane flexural collapse of walls due to bending in the vertical direction. This issue can be addressed by providing reinforcement in the vertical direction (perpendicular to the bed joints of the masonry). This concept of reinforcing masonry is called as “containment reinforcement”, which is well suited to masonry. Use of ductile materials has been universally recognized as one of the best approaches to earthquake resistant design of structures. Even reinforced brickwork shows limited ductility due to its low compressive strain capacity. This is similar to what happens in conventional reinforced concrete. Concrete, however, can be made more ductile using the concept of ‘confined concrete’ [4]. It is not easy to replicate this concept in masonry due to its inherent mode of construction.

In this investigation it is proposed to test three masonry building models using shaking table and shock table developed at the department of Civil Engineering, IISc. Two similar building models will be tested one each using shaking Table and Shock Table to evaluate and calibrate shock table test with the shake table test. These tests will also be used to assess the seismic performance of the new earthquake resistant feature namely the containment reinforcement. The third masonry building model having confined masonry as an earthquake resistant feature will be tested on the shock table to evaluate its performance vis-à-vis the containment reinforced masonry building model.

Major Recommendation:

Behaviour of masonry buildings during earthquakes based on post earthquake survey is presented in chapter 1. A critical analysis of the failure patterns brought out the inadequacies in the provisions of current BIS codes of practice for earthquake resistant design. Need for reinforcing masonry in the vertical direction and introducing an additional horizontal RC band at sill level is discussed. Various possible ways of reinforcing masonry in the vertical direction along with their structural efficiency is discussed. It was concluded that reinforcing masonry at the surface or close to the surface on both faces is preferable from structural efficiency point of view.

In chapter 2 an assessment of characteristics of shock table motion is presented. Same parameters as that used for characterizing earthquake ground motions has been evaluated for shock table motion. An analytical model for shock table motion has been developed. Modification to the shock table by introducing springs of different stiffness on the reaction beam side to increase the duration

parameter and to reduce the silent period has been suggested. Shock table motion and its parameters have been obtained analytically for two different configurations of spring assembly. One of the configurations (configuration A) of spring assembly has been implemented and the experimentally measured shock table and its parameters have been compared with the analytical model.

Details of the building model with containment reinforcement have been presented in chapter 3. Experimental modal analysis has been performed on the building model and its natural frequencies have been determined. The natural frequencies so obtained have been compared with natural frequencies of the building model determined through finite element analysis. Response spectrum of shock table motion for various angles of release of the pendulum has been computed and the same has been compared with design response spectra for zone 3, 4 and 5 of BIS code of practice. Behavior of the building model when the shock table is subjected to various angles of release of the pendulum has been analyzed.

Chapter 4 provides details of construction of the building model to be tested on a shake table. Behavior of the building model when subjected to Uttarakashi earthquake ground motion with suitable scaling has been analyzed

- An attempt has been made to characterise the shock table motion in terms of same parameters as that used to characterise earthquake ground motion.
- It is found that duration of shock table motion is considerably small when compared to strong motion duration of earthquakes. Acceleration time histories of shock table show silent periods between two successive hits. Hence modification in the form of spring on the reaction beam side has been proposed.
- Analytical model for the modified shock table shows that
 - (i) The silent period between two successive hits is reduced
 - (ii) The dominant frequency and bandwidth of the excitation depends on spring stiffness and table mass for Configuration-A. For Configuration-B a relatively wide Fourier spectra (Large Bandwidth) is observed. Spectra of Configuration-A has similar features as that of near field earthquake whereas Spectra of Configuration-B has similar features as that of far field earthquake.

- (iii) Bracketed duration is increased for both the configurations when compared to shock table assembly without spring.
- (iv) There is reasonably good comparison of table motion time histories and parameters between analytically predictions and experimental measurements.
- There is good comparison between natural frequencies obtained from experiments and finite element analysis.
- Damping ratio has been found to be 13.35%
- Response spectra of shock table motion time history of 5 to 15 degree angle of release of pendulum is found to be comparable to design response spectra suggested by BIS for seismic zones 3, 4 & 5.
- The provision of vertical containment reinforcement has prevented collapse of the building model thus satisfying earthquake resistant design philosophy.
- The natural frequencies of the first four modes of the building model obtained from experiments based on FRFs of measured strains on masonry are found to be in good agreement with the natural frequencies determined through finite element analysis.
- Response spectra of shake table motion time history corresponding to Uttar Kashi earthquake has been compared with design response spectra suggested by BIS for seismic zones 3, 4 & 5. The response spectra of input motion 1 and 2 are at the level of design spectra for zone 2 and that of input motion 3 is between design spectra for zone 3 and 4.

17. A. Name of the Proposal:

Development of a novel electric van for mail deliver and pick-up



B. Name of the Faculty:

Prof. Anindya Deb, Centre for Product Design & Manufacturing.

C. Summary of the Project:

It is well known that un-reinforced masonry buildings are the most vulnerable during an earthquake. The walls of the building which are perpendicular to the direction of

ground motion, called as “cross walls”, will be subjected to out-of-plane lateral load. Such walls will bend in both horizontal (bending axis vertical) and vertical (bending axis horizontal) directions. The masonry bonding adopted in construction has continuous bed joints in the horizontal direction whereas the joints are staggered in the vertical direction resulting in higher (2-3 times) flexural strength of the wall for bending in horizontal direction than in vertical direction (1). The earthquake resistant provisions of IS 4326:1993 [2] for masonry buildings in India essentially consists of providing horizontal reinforced concrete (RC) bands at plinth, lintel and roof levels and vertical reinforcement at corners and junction of walls and at jambs of door and window openings. The structural action of horizontal RC bands in resisting shear and bending of the cross walls in the horizontal direction and connecting the different walls for integral action of the building is quite clear. A field survey conducted to understand the behavior of buildings after the Bhuj earthquake [3] showed out-of-plane collapse of un-reinforced masonry walls due to bending in the vertical direction. From this it is clear that the existing earthquake resistant provisions for un-reinforced masonry are inadequate particularly in preventing out-of-plane flexural collapse of walls due to bending in the vertical direction. This issue can be addressed by providing reinforcement in the vertical direction (perpendicular to the bed joints of the masonry). This concept of reinforcing masonry is called as “containment reinforcement”, which is well suited to masonry. Use of ductile materials has been universally recognized as one of the best approaches to earthquake resistant design of structures. Even reinforced brickwork shows limited ductility due to its low compressive strain capacity. This is similar to what happens in conventional reinforced concrete. Concrete, however, can be made more ductile using the concept of ‘confined concrete’ [4]. It is not easy to replicate this concept in masonry due to its inherent mode of construction.

In this investigation it is proposed to test three masonry building models using shaking table and shock table developed at the department of Civil Engineering, IISc. Two similar building models will be tested one each using shaking Table and Shock Table to evaluate and calibrate shock table test with the shake table test. These tests will also be used to assess the seismic performance of the new earthquake resistant feature namely the containment reinforcement. The third masonry building model having

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confined masonry as an earthquake resistant feature will be tested on the shock table to evaluate its performance vis-à-vis the containment reinforced masonry building model.

Major Recommendation:

All task underlined in the project proposal have been thoroughly completed and the electric mail-van is ready for delivery to IISc. The vehicle is currently undergoing trial runs inside the campus. It is equipped with a set of new sealed deep-cycle lead-acid batteries and a separately-excited DC traction motor. At present, an external charger is required for charging the battery pack. The batteries have to be topped up periodically with distilled water using a single filling point. The vehicle has been driven at maximum speeds of up to 50-60 kmph inside the campus. It has been found to be extremely stable in turning maneuvers. The steepest slopes inside the campus including the tunnel under the CV Raman Road can be easily negotiated by the vehicle. Further trials are in progress to determine the mileage that can be obtained when the batteries are fully charged. The expected range is around 80 km.

18. A. Name of the Proposal:

Studies on the Performance and Emission Characteristics of different Straight Vegetable Oils (SVO) as fuels in a Diesel Engine for Urban Transportation



B. Name of the Faculty:

Dr. RT Naik, Chemical Engineering.

C. Summary of the Project:

Vegetable oils have been found to be a potential alternative to diesel fuel in compression ignition (CI) engine. The proposed work has been focused at identifying methods for using SVOs in CI engines; evaluation of optimal blending ratio of some selected SVOs with ethanol, orange oil and Lubrizol, with respect to optimal engine performance and emission norms compliance. The selected SVOs would be blended with ethanol, orange oil and Lubrizol from 5% to 25% and the tests would be carried out in a stationary CI engine for

various engine performance parameters and engine emissions against varying engine loads, heat release rate, and cylinder pressure would be studied against the crank angle. Results would be analyzed and suitable blend of all fuels would be identified. The expected outcomes are in the line of comprehensive comparison of various SVOs with suitable blending, optimum blending ratios, etc. for improving the urban air quality from vehicular pollutions.

19. A. Name of the Proposal:

Transition metal oxide coated windows as natural Air-conditioners



B. Name of the Faculty:

Prof. K.B.R. Verma, Materials Research Centre.

C. Summary of the Project:

A major component of world's energy is being spent on heating, cooling, and lighting of buildings. In our country, we spend large part of energy on lighting and air conditioning. The main reason for air-conditioning is that the windows of our buildings permit a large amount of solar energy to enter, apart from conduction through and radiation by the walls. One of the possibilities of reducing the amount of solar radiation (the IR part) entering a building would be to reflect away this radiation effectively. A partial solution for this would be to coat the walls and the window panes with IR-reflecting materials. In the proposed project, we intend to deposit transition metal oxides such as VO₂, ZnO, WO₃, etc., with suitable dopants, on glass substrates via a microwave irradiation-based synthesis route. Indeed, this facilitates in situ synthesis of nanocrystallites of the aforementioned materials and deposits them on glass substrates. Where required, these samples will be subjected to ex situ heat treatment in order to visualize the changes that are likely to occur in the nano/microstructures of the coatings which influence their optical transmission/reflection characteristics. The as-deposited and heat-treated samples will be characterized for their X-ray structural and micro structural studies. The optical reflection properties, especially in the required wavelength range, will be studied.

Discussion/Summary of work carried out (Explaining Deliverables, Implementation etc. with List and future direction).

Transparent heat mirrors have optical properties which enable them to have high transmission in the visible and high reflection in the IR regions, which can be accomplished using

1. Multilayer's of dielectric / metal or dielectric / metal / dielectric films

Dielectric
Metal
Dielectric
Glass

2. The intrinsic optical properties of electrically conducting films such as silver, Au and Cu which have high IR reflectance with relatively low visible absorption.
3. Certain semiconducting materials that are intrinsic and extrinsic which exhibit high IR reflectance.

Noble metals are not generally very stable under hot and humid conditions.

Multilayer films of the following combinations have an advantage over the doped semiconductors interms of broad wavelength tunability associated with good spectral selectivity. $\text{SiO}_2/\text{Al}/\text{SiO}_2$, $\text{Al}_2\text{O}_3/\text{MO}/\text{Al}_2\text{O}_3$, $\text{TiO}_2/\text{Ag}/\text{TiO}_2$, $\text{Bi}_2\text{O}_3/\text{Au}/\text{Bi}_2\text{O}_3$ and $\text{Al}_2\text{O}_3/\text{Cu}/\text{Al}_2\text{O}_3$. However, these cannot be used in tropical countries because of their high visible transmittance. It is intended to fabricate both mono and multilayers of various oxides on glass substrates.

In the present project, we have prepared V_2O_5 , TiO_2 , ZnO , PVC/TiO_2 and MoO_3 nano/ micro crystalline powders and thin films. The results are discussed in appropriate sections.

20. A. Name of the Proposal:

Structural Health Monitoring of Underpass made from Precast RCC boxes



B. Name of the Faculty:

Prof. S. Asokan, Instrumentation & Applied Physics

C. Summary of the Project:

FBG sensor packages have been developed for measuring strain, displacement and load, which are important for SHM applications. From the experimental tests, it can be concluded that the developed sensor packages are comparable to the best in class of the electrical sensors available in the market in terms of accuracy, stability and the level of manual intervention required. The instrumentation and methodology are evaluated by experiments undertaken in laboratory. The work shows that FBG sensing technology can be routinely applied in the lab and on construction sites by trained personnel. The results obtained and the experience gained will be utilized for the SHM of prefabricated underpasses, in the second year of the project. In this context, permission has been obtained from the Institute to instrument and study the underpass next to CSIC.

21. A. Name of the Proposal:

Characterization of Rail Track Ballast Fouling Using Ground Penetration Radar and Field Sampling.



B. Name of the Faculty:

Dr. P. Anabzhagan, Civil Engineering.

C. Summary of the Project:

Due to globalization and rapid urbanization, Indian Railways are facing challenges in terms of faster passenger and heavier freight trains from other modes transportation. A lack of substructure reengineering / characterization has resulted in maintenance cycles becoming more frequent and increasingly expensive. Early and accurate assessment of rail track substructure characterization will facilitate rail engineers to undertake cost-effective maintenance at suitable interval. At present, the current assessment is usually very time consuming, expensive and not accurate enough. This project will focus on fouling measurements in southwestern rail tracks using non-destructive technique of ground penetrating radar (GPR) to arrive at suitable cost effective maintenance strategy.

Research Projects Supported by Cistup

22. A. Name of the Proposal:

Demand Management and Strategies for Improvement of Market Share of KSRTC on Selected Routes.



B. Name of the Faculty:

Prof R. Srinivasan, Management Studies.

C. Summary of the Project:

Though KSRTC is the main player in Karnataka; there are other private players who are operating on a number of routes which include interstate transportation, tourism and services within the state. In the light of all these, KSRTC has not been able to capitalize the potential market though it has state of the art buses.

Taking into consideration the strategies and operations of competitors, strategies will be suggested to KSRTC for improved impact. Keeping in mind the core competencies of KSRTC, strategies will be suggested to bridge the identified gaps for improved demand management / market share.

23. A. Name of the Proposal:

Valuation of Ecological Functions and Benefits of Bangalore Urban Wetlands



B. Name of the Faculty:

Dr. D. SANNADURGAPPA, Centre for Sustainable Technologies.

C. Summary of the Project:

The effect of urbanization has taken some heavy toll on the Beautiful lakes in Bangalore. Most lakes in the Bangalore region were constructed in the Sixteenth century by damming the natural valley systems by constructing bunds. The lakes in the city have been largely encroached for urban infrastructure and as result, in the heart of the city only 17 good lakes exist as against 51 healthy lakes in 1985. Urban development has caused 16 lakes getting

converted to bus stands, Golf courses, playgrounds and residential colonies, and few tanks were breached under the malaria eradication programme. The major threat to the Bangalore Wetlands from siltation, solid waste pollutants, sewage, pollutants resulting from washing clothes, trapa cultivation, encroachment, increasing population, weeds and eutrophication, boating, agricultural waste, idol and tadjia immersion, and hospital waste on account of excessive use by large numbers of stakeholders (Sanna Durgappa et al., 2006). In recent years, the Management of Lakes traditionally done by the government agencies witnessed experimentation by the Lake Development Authority with a limited public-private sector participation in respect of three lakes, which has proved controversial and resulted in almost a reversal of the policy. The lakes have also served to replenish ground water resources in the vicinity, which are tapped through wells for drinking water (Bennett, J. W. 1993). Most of the lakes and tanks were man made for purposes of drinking water, irrigation and fishing needs and they have also favorably influenced microclimate of the city.

The growing population pressures and human interference have led to degradation of this Wetland. There are numerous threats, which face this fragile urban ecosystem and threaten its very existence in fact. Hebbal Lake. Located in north Bangalore, along Bellary Road. Area nearly 150 acre. It is a natural lake. Ulsoor Lake is 1.5 sq. km lake is dotted with islands, extending over an area of 125 acres. The picturesque lake is located on the Northeastern fringes of the city. These wetlands provide a number of other direct and indirect benefits to the population living in the city.

To reap these benefits, different types of anthropogenic activities are performed in and around wetlands. As a consequence, water quality deteriorates and the habitat is disturbed. Moreover, to derive greater short term, often private benefits, wetlands are often converted to other uses. The interaction between a wetland ecosystem and the economy has contrasting effects, both in terms of benefits as well as degradation. Wetland ecosystems, support a large biodiversity (flora and fauna). Besides, wetlands yield various products, which give substantial economic returns (Sanna Durgappa et al., 2007). These conversions not only distort the food chain of the wetland ecosystem, but also deprive the beneficiaries who were users of the wetlands in their non-converted state.

24. A. Name of the Proposal:

Urban sprawl in Tier-II Cities of Karnataka: Analysis of Patterns, Process and Environmental Sustainability



B. Name of the Faculty:

Dr. TV Ramachandra, Centre for Ecological Sciences.

C. Summary of the Project:

This study intends to explore the spatial analytical methods to identify both general trends and more subtle patterns of urban land changes in the Tier II Cities of Karnataka. Based on remotely sensed land cover data, landscape metrics will be computed. Both the remotely sensed data and landscape metrics will be used to characterize long-term trends and patterns of urban sprawl. Land cover change analyses will reveal that over the past three decades the significant increase of built-up land (if any) in the study area. The spatial and temporal heterogeneity of the land cover changes will allow the identification of fast and slow sprawling areas. The landscape metrics will be analyzed beyond jurisdictional levels to understand the effects of the built-up expansion on the surrounding environment.

The interpretation of the built-up patch density metrics will help to identify different stages of urbanization. Land consumption indices (LCI) will be devised to relate the remotely sensed built-up growth to changes in housing and commercial constructions as major driving factors, providing an effective measure to compare and characterize urban sprawl across jurisdictional boundaries and time periods.

Thus, this study will systematically explore and compare the trends and patterns of urban sprawl across Tier II cities in Karnataka. The adoption of this approach is based on three considerations:

- First, socioeconomic driving factors in relation to urban planning activities usually are more closely associated with jurisdictions rather than other spatial units like census units or watersheds.
- Secondly, for a regional study, jurisdictional units are sufficiently large to embrace diverse land cover types

in order to effectively reveal trends and patterns of urban growth. This condition may not be met with other spatial units like census blocks or tracts.

- Thirdly, there were insufficient research efforts using remote sensing imagery to identify spatiotemporal patterns of landscape effects of urban growth, especially as comparing these patterns at different jurisdiction scales.

25. A. Name of the Proposal:

Performance Evaluation of Geosynthetic Reinforced Unpaved Roads



B. Name of the Faculty:

M.S. Madhavi Latha Gali, Civil Engineering.

C. Summary of the Project:

The investigations will focus on understanding the performance of Geosynthetic reinforced unpaved roads through systematic series of experiments and numerical simulations. Laboratory CBR (California Bearing Ratio) tests on reinforced and unreinforced soil-aggregate systems will be carried out, varying the type, quantity, form and location of reinforcement, water content of the soil and thickness of aggregate layer to understand the effect of all these parameters on the bearing resistance of soil-aggregate systems. Large scale cyclic triaxial tests will be carried out on reinforced subgrade materials to understand the influence of reinforcement on the cyclic loading response of the subgrade. These tests will be simulated in FLAC (Fast Lagrangian Analysis of Continuum) program and parametric studies will be carried out to bring out the effects of different parameters on the cyclic load bearing capacity of unpaved roads. Field tests with a vehicle passing over the unreinforced and reinforced unpaved roads will be carried out to compare the relative performance and the traffic benefit ratio of various Geosynthetic reinforced roads. Finally design guidelines will be given based on the experimental and numerical studies.

Research Projects Supported by Cistup

26. A. Name of the Proposal:

Underground Construction in Urban Areas: Field data Analysis and Monitoring, Numerical Simulations and Validation.



B. Name of the Faculty:

Prof. T.G. Sitharam, Civil Engineering.

C. Summary of the Project:

The use of underground space in urban area is essential due to scarcity of land in the densely populated/inhabited areas and environmental concerns. The lack of appropriate survey and instrumentation for understanding safety and stability of the underground structures has always made the design a challenging task. Significant progress made in the field of geological and geotechnical investigations, the availability of powerful computers and numerical models for simulating real field conditions and above all the introduction of excavation technologies like tunnel boring machines in all type of ground have created the conditions for taking a quantum leap in this area.

Underground space in modern urban areas contains a wide range of underground structures, most of which are so essential to human life and they are called "lifeline" facilities. These include pipelines for water, Sewage, gas, electricity and telecommunication, subways, roads, storage tanks, parking lots, common utility tunnels etc. The stability of these is one of the most important subjects in the underground constructions and it depends on the surrounding material. The majority of the underground structures in the urban environment will be in the form of tunnels.

The evaluation of the mechanical behavior of the ground is very significant in the case of urban tunneling. In the case of utilization of underground space, it is required to develop realistic constitutive models for materials such as soil, rock and jointed rock mass consisting of discontinuities like joints, fissures and fractures. The excavation of the underground structure in spite of its depth disturbs the soil and rock masses. These results in the settlement of the ground surface in urban area will affect the safety of the existing buildings. In urban tunneling, the major concern is the control of ground stability and deformations since this results in surface settlement. The precise assessment of these factors is very essential in urban environment. Numerical modeling has

become one of the most powerful tools in understanding the response of underground tunnels. Numerical methods are being used for solution of underground space problem requiring analysis, design, construction and maintenance.

The present study aims at analyzing the stability of these underground structures and the effect of construction (excavation) of these structures to adjacent structures. These analyses will be carried out based on the available geotechnical and geophysical data of the site along with a stress model. This work will throw light on how to select engineering properties and appropriate constitutive model for geomaterials met at the underground sections. The analysis will be mainly done using numerical modeling techniques which are based on discrete element modeling (DEM) and finite element modeling (FEM).

Jointed rock mass with large variation in its properties (highly heterogeneous and anisotropic) involve many uncertainties in prediction and estimation of both its equivalent properties and deformation surrounding the medium. Attempt will be made to use the practical equivalent continuum model developed at IISc for jointed rock mass to understand behavior of underground openings in such materials. This is also very relevant as the rock mass is invariably jointed in-situ and might get further fissured to blasting activities around the openings.

The deformation near the tunnels may cause failure of the tunnel as well as adjoining structures. More over the determination of stress levels associated with the yield of wall due to excavation is important. Since the ground behavior is not properly understood, it is necessary to estimate the behavior pattern of the support and reinforcement for tunnels through numerical modeling. The stress and displacement variation around the tunnel and the failure pattern around the tunnel will be studied using both FEM and DEM.

For numerical modeling finite or discrete element methods can be adopted. Finite element method assumes that the rock mass is a continuous medium. Generally rock masses contain discontinuities which can be taken into account by discrete element method. Discrete element method represents rock mass as an assembly of particles joined together by breakable bonds. This proposed project will also try to review different methods available to analyze the seismic stability of underground structures (particularly of tunnels). Attempt will be carried out to develop/ demonstrate the capability of both FEM and DEM based models in predicting the deformation behavior around the underground openings in geomaterials. Studies will be carried out both under static and seismic loading conditions.

27. A. Name of the Proposal:

Use of Solid Waste to enhance properties of problematic soils of Karnataka



B. Name of the Faculty:

Prof. P V Sivapullaiah, Civil Engineering.

C. Summary of the Project:

Many soils in India, more particularly in Karnataka pose serious problems for infrastructure development projects because of their unfavorable properties. One such soil is expansive soil called black cotton soil which swells and shrinks; and another is dispersive soil which loses strength and poses serious erosion problems. On the other hand large quantities of waste materials are generated in the industrial world. Land and ground water contamination is a serious issue associated with the disposal of various waste materials. Further the disposal of most of the huge quantities of waste materials requires considerable land space. Use of these materials not only overcomes their disposal problems but also achieves economy. Some of the prominent industrial waste materials are fly ash, blast furnace slag, red mud, lime sludge, rock flour, construction debris, etc. This proposal aims to explore the use of these materials for ground improvement by stabilizing the problematic soils such as expansive and dispersive soils. The leaching concerns from the stabilized soils have to be evaluated from appropriate leaching tests.

28. A. Name of the Proposal:

A Knowledge Management Model for the Bangalore Namma Metro Project.



B. Name of the Faculty:

Dr. Parameshwar P. Iyer, Management Studies.

C. Summary of the Project:

Research focus: The main component of KM lies in the organization of the knowledge flow required by the organization (Devenport and Prusak, 1998; Nonaka,

1998). In the construction and infrastructure industries, the typical characteristics of product uniqueness, on-site production, ad-hoc organization of the project teams, and rather high attrition rates, make it difficult to capture and store knowledge (especially tacit knowledge) existing within the individuals in the organization (Clough, et al, 2000).

The present research study has been initiated with the following line of thinking: In a large infrastructure project, such as the Bangalore Metro Project (BMP or locally known as Namma Metro, meaning "our Metro"), there are several different stakeholders, ranging from the government, other owners under the Public Private Partnership (PPP), the contractors and construction managers, the financiers and investors, the regulators and State legislators, the public citizens and businesses (especially those affected by the construction and allied disturbances and distractions in the immediate vicinity of the Metro aligned path). The roles of these stakeholders are not well defined, and consequently, the planners and implementers of BMP, are not clear about their information.

Results: This research study will adopt a combination of the quantitative and qualitative approaches, and has used the Bangalore Metro Project (BMP) as a case study (Krishnaswamy, et al, 2005). We have designed a draft questionnaire that has been administered to the selected categories of stakeholders of the BMP. This study will categorize the different internal and external stakeholder in the BMP; ascertain their participatory roles; and examine their information and knowledge needs. Simultaneously, this study will look at various IT and KM options available in the technology space, relevant to BMP in Bangalore. Based on the mapping of the stakeholder roles and knowledge needs to the available IT and KM options, we will generate a feasible solution.

29. A. Name of the Proposal:

Effect of embedment, preload and consolidation on the Bearing Capacity of Shallow Embedded Pipelines in Urban Sprawl.



B. Name of the Faculty:

Prof. Tejas Gorur Murthy, Civil Engineering.

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C. Summary of the Project:

This research will generate a bearing capacity type equation for pipelines founded on clays and sands, at shallow depths in urban sprawls. It brings together the recent improvements in algorithms in finite element analysis to produce a comprehensive parametric study of the bearing capacity of shallow buried pipes using two ends of the soil spectrum, namely clean sands and soft clays. The boundary conditions chosen in these finite element analysis will be benchmarked with plane-strain shallow footings founded on a rigid perfectly plastic material. A commercially available off the shelf FE code will be used in this analysis (ABAQUS) with suitable modifications for user defined subroutines. A parametric study of the size of the pipeline, soil parameters and depth of embedment will be made.

Major Recommendation:

Finite element analyses have been used to investigate the improvement of the vertical bearing capacity of a pipeline founded on the soft clayey soil, with application of a long term vertical loads. These vertical loads can be envisioned as partial service of the pipeline (fractional filling of the pipeline) over long times to allow consolidation of the clay. Due to this consolidation, an increase in the bearing capacity is seen over long time periods which increase with the magnitude of preload. The effect of the depth of embedment of the pipeline is also investigated in this research, with higher depths of embedment showing a substantial increase in the bearing capacity.

With these findings from the FE analysis, it may be concluded that a sufficient embedment would not only anchor the pipeline, but would also increase the bearing capacity of the clay-pipeline system. Additionally, in designing the pipeline for long service periods, the long term loading, which causes settlement of the underlying clay needs to be considered. It is conservative to ignore consolidation strengthening in design, however, this may lead to a non optimal design solution.

30. A. Name of the Proposal:

Development of Bio-Hybrid Three-wheeled Auto Rickshaw for urban Transportation



B. Name of the Faculty:

Dr. R.T. Naik, Mechanical Engineering.

C. Summary of the Project:

Electric Motor Vehicles, like Reva car or E-Bikes, fill a niche market but cannot meet the typical long distance requirements of transit city and suburban routes because current energy storage systems, such as batteries, cannot provide sufficient energy. At present urban and suburban transportation in Asia and Africa completely rely on Auto Rickshaws. Large cities in Asia and Africa millions of auto-rickshaws offer their taxi services.

These three wheelers cause severe air pollution and produce large amounts of green house gases (CO₂). The drivers of these vehicles constitute mainly the lower income groups in society who earn around Rs.75-125 per day. In the year 2009 there are about 4 million petrol-and diesel powered three wheelers. If we assume that an auto rickshaw runs approximately 50-60 Km/day with a fuel consumption of 25-30 Km/l, then the fuel consumption is approximately 2 liters per day. The corresponding CO₂ emissions amount to 5 Kg per day. If a hybrid system replaces the conventional drive train, then that would save fuel of at least 40%, then the total amount of CO₂ reduction for 1 million Auto Rickshaws would be 2 million Kg per day. If the CO₂ reduction would be traded on the European market, then the saved CO₂-emissions against 25 Euro/1000Kg Would be worth approximately 50 thousand Euro, and on a yearly basis (assume 300 days in operation per year) approximately 15 million Euros or 100 crores of Indian rupees.

31. A. Name of the Proposal:

Design for Thermal Comfort Using Ventilation and thermal Mass



B. Name of the Faculty:

Prof. Jaywant H. Arakere, Mechanical Engineering & CPDM

C. Summary of the Project:

In the types of climate obtained in Bangalore, the conditions are moderate throughout the year. Except during the months from March to May, when the daytime peak temperatures exceed 35 degrees C, the conditions

are comfortable, and any conditioning of the air (heating or cooling) is not required. Even during the summer months, the night-time temperatures are around 25 degrees C, and it is possible that these lower temperatures may be used for daytime cooling.

The temperature and humidity conditions inside a building or room are determined mainly by the loads due to i) direct (through windows etc) and indirect (through walls) solar radiation, ii) people and iii) appliances and lighting and by the heating or cooling due to interaction with the ambient through air exchange and conduction across walls. An additional cooling is obtained from exposed surfaces at night, which can be significant in the absence of clouds, by radiation to the night sky.

The main aim of the project is two-fold: i) numerical simulation to explore use of thermal mass for storing heat/cold from the diurnal temperature variations, and ii) experiments in a existing classroom of the Mechanical Engineering Department at IISc.

32. A. Name of the Proposal:

Management and Technology of Urban solid waste leachate



B. Name of the Faculty:

Dr. H.N. Chanakya

C. Summary of the Project:

- Study and document SW leachate generation pattern from collection to landfill stages at various cities in Karnataka and document management and hazard occurrences
- Study the seasonal variability of the landfill and composting leachates at various cities of Karnataka and carry out a detailed compositional analysis to understand the change in volume , organic, inorganic content that would be useful in designing novel /effective treatment process.
- Design and operate the functioning of a lab scale (5l) bioreactor for the treatment of the composting and landfill leachates. Operate under various types of fluctuating loading regimes, stresses and overloads to determine functionality, robustness and potential for up-scaling from the performance data

- Study the removal of salts and heavy metals from the leachate during the anaerobic digestion processes
- Analyze the design, operation and performance for potential to scale up.

33. A. Name of the Proposal:

Benchmarking Bangalore city for sustainability: An Indicator-based approach



B. Name of the Faculty:

Dr. P. Balachandra, Management Studies.

Prof. B. Sudhakara Reddy, Indira Gandhi Institute of Development Research Film City Road, Goregoan (E) Mumbai 400 065

C. Summary of the Project:

The key research hypothesis the project tries to investigate is whether the present pattern of urban development in India in the creation of mega cities is sustainable. This would be carried out by performing an indicator-based evaluation of Bangalore city, one of the emerging megacities of India against a sustainable mega city from a developed country (London or Singapore). For this investigation, a benchmark sustainable indicator-base would be developed using the indicator values from a city, which could be categorized as a sustainable megacity based on its performance against different indicators. The proposed study will have the following specific objectives: (i) developing sustainable urban indicator variables spanning all the relevant sectors of a typical megacity, (ii) developing a benchmark sustainable indicator-base for a selected megacity (e.g., London or Singapore), (iii) by adopting the same methodology and same indicators develop the database for Bangalore city in India, (iv) comparing and evaluating the indicator data for Bangalore with the benchmark indicator database using a “gap analysis” approach, and (v) suggesting appropriate policy measures and implementation strategies to bridge the identified gaps to attain the goal of sustainable urban system. The household, industrial, commercial and transport activities are proposed to be examined in the context of resource utilization and benefit sharing. The project outcomes are expected to contribute to the design of policies, tools, and approaches essential for planning in order to attain the goal of sustainable development and the social cohesion of metropolitan regions.

34. A. Name of the Proposal:

Retrofitting of masonry in compression, flexure and shear with FRP.



B. Name of the Faculty:

Dr. KS Nanjunda Rao, Department of Civil Engineering.

C. Summary of the Project:

Masonry structures constitute a significant portion of the building stock worldwide. Performance of unreinforced masonry structures has been far from satisfactory during earthquakes. In the last century (1900 – 1999) it is reported that 65% of fatalities attributed to earthquakes have been caused due to collapse of masonry buildings [1]. Use of new technologies and materials for both restoring and reinforcing masonry structures is technically and economically very interesting. In this context in the last two decades there has been a significant growth in the use of fibre reinforced polymer (FRP) composites as construction material. There have been considerable research investigations in the last decade on exploring the possibility of using FRP for retrofitting concrete structures. Attempts are currently in progress in exploring the feasibility of using FRP for retrofitting masonry structures as well. The walls of the building which are perpendicular to the direction of ground motion are called as “cross walls” and those which are parallel to the direction of earthquake are called as shear walls. The cross walls will be subjected to out-of-plane lateral load and shear walls will be subjected to in-plane lateral load along with gravity load. Cross walls will bend in both horizontal (bending axis vertical) and vertical (bending axis horizontal) directions. The masonry bonding pattern adopted in construction has continuous bed joints in the Horizontal direction whereas the joints are staggered in the vertical direction resulting in higher (2-3 times) flexural strength of the wall for bending in horizontal direction than in vertical direction [2]. The earthquake resistant provisions of IS 4326:1993 [3] for masonry buildings in India essentially consists of providing horizontal reinforced concrete (RC) bands at plinth, lintel and roof levels and vertical reinforcement at corners and junction of walls and at jambs of door and window openings. The structural action of horizontal RC bands in resisting shear and bending of

the cross walls in the horizontal direction and connecting the different walls for integral action of the building is quite clear. In case of buildings with R C slab roof, the roof slab provides diaphragm action to the building and a significant portion of the inertial load gets transferred to the shear walls. A field survey conducted to understand the behavior of buildings after the Bhuj earthquake [4] showed both out-of-plane collapse of unreinforced masonry walls due to bending in the vertical direction and damage to shear walls in the form of “X” type of cracks or horizontal sliding cracks. From this it is clear that the existing earthquake resistant provisions for un-reinforced masonry are inadequate in preventing out-of-plane flexural failure of cross walls and damage to shear walls leading to collapse of buildings.

In the case of reinforced concrete framed buildings, masonry walls serve the purpose of division of spaces and hence they are treated as non-structural, as they are not intended to resist gravity loading. However, the masonry walls encased within the RC frame called as infill masonry cannot be treated as non-structural as the RC frame will transfer load to in-fill masonry when subjected to lateral loads as during earthquakes or due to wind loads. In such situations it would be beneficial to design the in-fill masonry to resist in-plane lateral load and state of stress in masonry will vary in different regions of the wall. Masonry will be subjected to compression, tension and shear loading. The inclination of loading axis with the bed joint of the masonry will vary from 0° to 90°. In this investigation it is proposed to address the above concerns by attempting to strengthen masonry in compression, flexure and shear by bonding FRP fabric externally to masonry.

35. A. Name of the Project:

Cleaner Cities and Greener Biodiesel: Enhancing Productivity and Economics of Small-scale Biodiesel Units



B. Name of the Faculty:

Dr. HN Chanakya, CST.

C. Summary of the project:

Biodiesel production, especially the decentralized small-scale model that has been adopted in India, is generally

less efficient and generates a lot of wastes that can become environmentally sensitive. This project envisages to

- a. recover about 10-30% liquid biodiesel wastes back from the liquid wastes generated from transesterification in small-scale biodiesel plants (Pongamia and Jatropha)
- b. convert the solid residues of oil extraction through biomethane to provide for process heat, electrical power and overall reduction of C-footprint (this will be needed for KSRTC/BMTC to reduce C-footprint and accrue larger emission reduction accounting)
- c. Evolve a process to convert dirty glycerol, a waste product, to biogas (truly green biodiesel with no environmental toxicity/low environmental footprint).
- d. Make the overall process a zero-waste (and negative emission) systems

36. A. Name of the Project:

Evaluation of Municipal Solid Waste (MSW) characteristics of a typical landfill in Bangalore



B. Name of the Faculty:

Prof. G.L. Sivakumar Babu, Department of Civil Engineering.

C. Summary of the Project:

Engineering behaviour of the waste body controls many aspects of landfill lining system design and performance, including stability issues and integrity of the geosynthetic and mineral lining components. The response of MSW in terms of stability, settlement and stability under flow and circulation of leachate depends on the engineering properties. Knowledge of shear strength is required in order to assess waste slope stability. Mechanisms resulting in settlement of waste include physical compression and creep, raveling and decomposition due to biodegradation of organic components. The above engineering properties will be evaluated using detailed experimental programme. For this, the following aspects will be examined in the project.

1. Literature review on waste characteristics.

2. Collection of data pertaining to waste characteristics in one landfill in Bangalore using laboratory testing, also collect data from literature on properties and variations.
3. Analysis of data of laboratory/field test results.
4. Analysis using constitutive model.
5. Report preparation.

37. A. Name of the Project:

Design and development of a constant switching frequency Hysteresis PWM controlled motor drive for variable speed electric vehicle applications, with fast dynamic performance.



B. Name of the Faculty:

Prof. K. Gopakumar, Chairman DESE & Prof. L. Umanand, DESE.

C. Summary of the project:

1. Constant switching frequency Hysteresis PWM controlled motor drive. In this work, a current error space vector (CESV) based hysteresis controller for a 12-sided polygonal voltage space vector inverter fed induction motor (IM) drive is proposed. An open-end winding configuration is used for the induction motor. The proposed controller uses parabolic boundary with generalized vector selection logic for all sectors. The drive scheme is first studied with a space vector based PWM (SVPWM) control and from this the current error space phasor boundary is obtained. This current error space phasor boundary is approximated with four parabolas and then the system is run with space phasor based hysteresis PWM controller by limiting the CESV within the parabolic boundary. The proposed controller has increased modulation range, absence of 5th and 7th order harmonics for the entire modulation range, nearly constant switching frequency, fast dynamic response with smooth transition to the over modulation region and a simple controller implementation. **Error! Reference source not found.** shows a power circuit of a VSI fed IM drive to generate the 12-sided voltage space phasor shown in Figure 2. An open-end winding induction motor is fed from two inverters using asymmetrical DC link

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voltages. Vector V1 is obtained by switching ON S1,S4,S6 of inverter-of inverter-2, indicated in Figure 2 by (100,0'1'0'). Similarly other vectors in the 12-sided voltage space diagram are obtained. This circuit can be controlled by voltage-control or current control principle. In the VC-SVPWM based inverter, the switching frequency is constant and the dwell times of the active and zero voltage vectors are decided based on the volt-second balance principle.

38. A. Name of the Project:

Mechanically Flexible Sensor Tape/Sticker with Analog Processor and Electronic Communication for Centralized Monitoring of Bus Diagnostics



B. Name of the Faculty:

Dr. Sanjiv Sambandan, Department of Instrumentation & Applied physics.

C. Summary of the project:

The sensor is a polymer based mechanically flexible patch that senses vibration and pressure and can be extended to monitor gas exhaust composition, temperature etc. –The patch gathers data and electronically stores it in an on board memory. This data can be accessed by a central monitoring unit either wirelessly or by wire.

- By clever design we build in an analog processor (not based on MOSFET) which delivers useful information such as Fourier transform of Vibrations etc.

39. A. Name of the Project:

Development of a Robust, Low Cost Traffic Measurement System



B. Name of the Faculty:

Dr. G R Jayanth, Department of Instrumentation & Applied physics.

C. Summary of the Project:

With burgeoning growth of cities and small towns within Indian and more specifically Karnataka, there is an urgent need to re-novate the transport infrastructure to keep pace with this growth. These should be guided by reliable data about the vehicular and pedestrian traffic that use the roads. However, in many semi-rural and developing parts of India, state-of-the-art vehicle measurement and classification systems cannot be deployed owing to reasons such as high cost, necessity for additional infrastructure and poor road conditions. We propose to develop inexpensive measurement systems that can reliably measure and store data about a host of vehicular parameters and pedestrian traffic. The systems are optimally designed to minimize errors due to misalignment and uneven roads. Furthermore, the systems work at all times of the day and are light-weight, portable and require minimal extra infrastructure for their deployment.

40. A. Name of the Project:

Carbon nanotubes based flame sensor



B. Name of the Faculty:

Dr. Abha Misra, Department of Instrumentation & Applied physics.

C. Summary of the Project:

Carbon nanotubes (CNTs) have shown outstanding performance in various areas of research using their multifunctional characteristics. High mechanical strength and structural flexibility of CNTs demonstrated their capability to fabricate large area thin film, which could provide sensing characteristics, for example gas, strain and temperature sensors. Since, CNT film consists of intrinsic isotropic material properties over large area of the films, which can be utilized to integrate/assemble into a portable structure. In the proposed work, I am interested in fabricating optical flame sensor based on CNT films. CNT films show high thermal conductivity in air, which make CNT sensor suitable for using under ambient conditions. The ease of coating the CNT surfaces with metallic films provide an optical reflectivity of the films for the shorter to longer wavelengths without significant

scattering in reflectance mode. These reflected radiations will be sensed using optical scheme. In addition, partial absorption (non reflected radiation) of thermal radiation into CNT substrate will also provide a change in thermal conductivity, which shows the detection/sensing capability of the CNT films coated with the reflective material.

41. A. Name of the project:

Assessing resource and energy demand attributed to modern urbanizing transitions in rural dwellings



B. Name of the faculty:

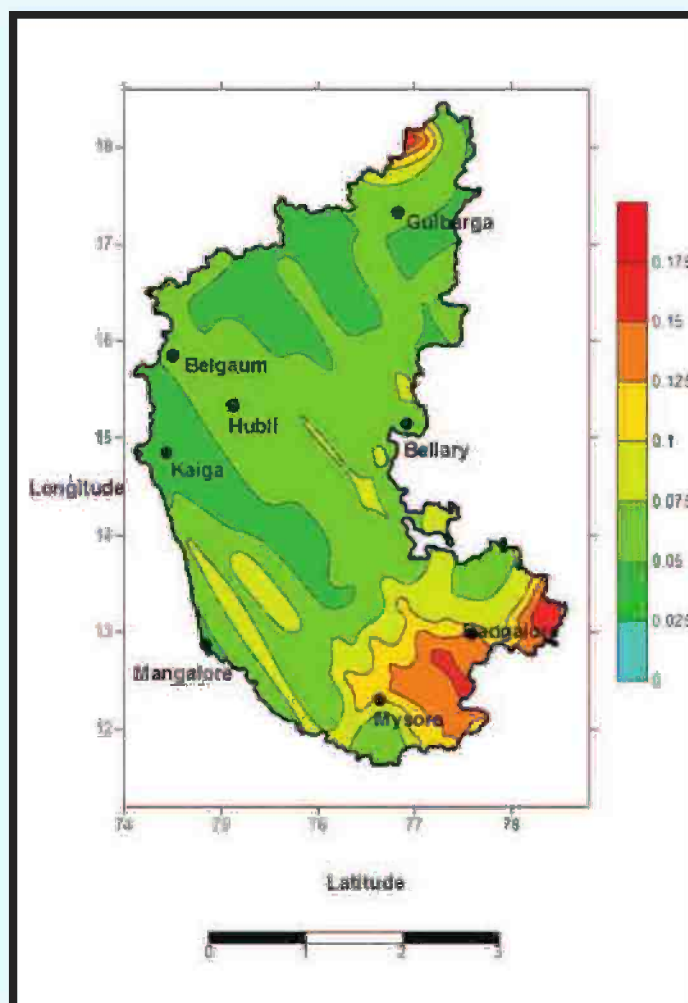
Prof. Monto Mani / Prof. B. V. Venkatarama Reddy / Prof. H. I. Somashekar, CST.

C. Summary of the project:

Urbanization primarily refers to a transition from an organic low- density vernacular living environment to an organized modern economy and infrastructure intensive living environment. The former are generally termed rural villages/towns and primarily supports agriculture and allied activities, the latter are termed as Cities (Tier I, II, III...) or Metropolis that are primary drivers of the economy, support retail, industry, real-estate, BPO, IT, etc. and centres of power - political, economy, science and technology. While cities are envisaged to be characterized by streamlined planning, zoning and building regulations, standardized (and tested) materials (resources), electricity-use intensiveness, rural areas are characterized by local material and skill dependence, reliance on biomass for energy, unreliable electricity supply and an increasing aspiration to modernize, i.e. urbanize. In recent decades, with increasing population and urban growth, it is no longer feasible to distinctly separate urban issues from rural ones, viz., rural-urban migration, urban waste disposal in fringe (rural) localities, rural energy and building materials demand (from urban areas), urban-rural transport infrastructure, etc. The built-environment is responsible for the single largest share of resource and energy consumption and demand.

Rural habitations, in India have thus far lived off the land with very negligible demands on energy and process-

materials for sustenance. But, with the booming economy, increased affordability and exposure to urban lifestyles, the aspirations of rural habitations is akin to 6 middle-income urbanites. As habitations respond to the aspirations of its inhabitants, a silent but steady transition is evident from traditional local-materials based buildings to urban non-local high-process material based buildings, viz., zero-energy to high-energy. With global urban population expected to grow from 47% share in 2000 to 70% share in 2050 (Zhang and Cooke 2010), the envisaged resource and energy demand would be mindboggling. It is important to note that India's rural population amounts to nearly 68%. Modernizing rural habitations carrying urban aspirations is likely to result in an unperceived but significant resource and energy footprint, and subsequently influence urban-rural dynamics, in terms of resource and energy demands. The objective of the current proposal is to systematically ascertain and quantify the resource and energy implications attributed to these transitions.



Spatial variation of PGA value from
Deterministic Analysis for Karnataka.

Projects of our centre

LIST OF PROJECTS CARRIED OUT BY M.TECH 1ST BATCH

Sl. No	Title of the Project	Name of the student	Organization Name	Remarks
1	Intelligent Transportation system for public transport in Mysore framework, plan and impact	Ashalatha.K	Ci.E, IISc	Thesis submitted
2	Functional Review of BMTC: An Operator Point of View	B.M. Sathisha	Ci.E, IISc	Thesis submitted
3	A Functional evaluation of Traffic and Transit Management Centers (TTMC's) in Bangalore	Bhagyalakshmi.M. Awati	Ci.E, IISc	Thesis submitted
4	Performance evaluation of Urban state road transport undertakings	Hari Kishore.B	Ci.E, IISc	Thesis submitted
5	Application of Dynamic fares and Revenue Management for Premium services of KSRTC	Rajesh.S	Ci.E, IISc	Thesis submitted
6	The Measurement and Evaluation of Performance of Premium bus services in Bangalore Metropolitan Transport Corporation (BMTC)	S. Lakshmana	Ci.E, IISc	Thesis submitted

Other 5 project details are not available at Cistup

LIST OF ONGOING PROJECTS AT CISTUP

Sl. No	Title of the Project	Name of the Author	Organization Name	Remarks
1	1. Web-GIS Platform for Seismic Induced Landslide Monitoring & Warning. 2. Last Mile Connectivity Study for Bangalore in PLASMA software platform. 3. Modelling Bangalore Traffic Datasets in VISSIM. 4. Traffic simulation for underpasses in Bangalore using VISSIM	Devanjan Bhattacharya	Planner at Cistup	Ongoing project
2	1. Status of Bus bays and bus stop in Bangalore 2. Foot over bridges in Bangalore	Dr. Gururaja KV	Planner at Cistup	Ongoing project
3	1. A feasibility study report on Under passes and bi passes in and around Bangalore. 2. Problems and consequences of traffic and transport problems in St.Johns Hospital campus, Koramangala, Bangalore	Dr. Harish. M	Planner at Cistup	Ongoing project
4	Driving Manual For Karnataka	Kadambari Badami	Planner at Cistup	Ongoing project
5	Assessing extent of inequality variation within Bangalore Urban Agglomeration	Keya chakraborty	Planner at Cistup	Ongoing project
6	1. Smart Transportation & Mobility Solutions. 2. Safe Traffic & Easy Transportation. 3. B-TRAC Project (Bangalore Traffic Improvement Project)- Impact & Evaluation Study. 4. Traffic Impact Assessment Study on Sarjapur Road. 5. Mapping of all Accident Locations in Bangalore City along with other relevant information using GIS.	Lokesh Hebbani Ramesh Narayanappa	Planner at Cistup	Ongoing project

Projects of our centre

Sl. No	Title of the Project	Name of the Author	Organization Name	Remarks
7	A Study of the Auto rickshaw System in Bangalore City	Radha Chanchani	Planner at Cistup	Ongoing project
8	1. Land Planning and Management for Housing Development in Bangalore. 2. User study and Mapping of Foot over Bridges in Bangalore	Sayali Borole	Planner at Cistup	Ongoing project

LIST OF OTHER PROJECTS / WORKSHOPS AT CiSTUP

Sl. No	Title of the Project	Investigator	Organization Name	Remarks
1	A Review of Biomass Equations and its Utility for Assessing the Potential for Carbon Stocks	Prachi Ugle	CiSTUP, IISc	Report
2	A Study on Travel Characteristics of Commuters Using Two Wheelers	D. Manjula Minakshi Goswami, Prof. T.V. Ramanayya	CiSTUP, IISc	Report
3	Carbon Sequestration Potential of Urban Trees	Prachi Ugle	CiSTUP, IISc	Report
4	CiSTUP World Café Social Experiment on IISc Infrastructure: The Final Report for further action and distribution	Dr. Parameshwar. P. Iyer	MS, IISc	Round Table Discussion Report
5	Essentials in urban lake monitoring and management	Dr. T.V. Ramachandra	CISTUP	Workshop Proceedings
6	Foss 4G: Workshop on open source Geo spatial tools	T.V. Ramachandra MS Mohan Kumar Prof. T.G. Sitharam S Narendra Prasad	OSGeo CiSTUP KSCST	Workshop Proceedings
7	Geosynthetic lining solutions and related issues	G.L. Sivakumar Babu K.P. Pradeep S. Sireesh	ASCE IS SR	Conference proceedings
8	Mitigation Air Pollution from Transportation Sources for the City of Bangalore	Mahesh Kashyap Dr. KV Gururaja Prof. T.G. Sitharam	CiSTUP, IISc	Report
9	Mobility Study Bangalore, India - High Potential research projects I India in the area of mobility - ACATECH	Prof. Dr. Jorg Schonharting (TRC) Prof. T.G. Sitharam	Acatech, Germany CiSTUP, IISc	Report
10	Project Roadeo-Project Report	Arutra Paul Arjun S Bhat Nischit Bharadwaj Sameera Shroff	R.V. College of Engineering & CiSTUP	B.Tech Project Report
11	Recommendation for Traffic and Transit Management Centre (TTMC), Koramangala	Dr. M. Harish Dr.K.V. Gururaja, Prof. T.V. Ramanayya, Prof. Anantharamaiah & Prof. T.G. Sitharam	CiSTUP, IISc	Report
12	Report of Transportation Study Tour to Tier-II Cities-Bellary and Gulburga	Dr. Ashish Verma Rahul Goel	CiSTUP, IISc	Report

Projects of our centre

Sl. No	Title of the Project	Investigator	Organization Name	Remarks
13	Report on Bangalore Development Authority's Proposed Signal Free Cprrodpr from Water Tank (100' Road) Junction to Agara Lake (Jakkasandra) Junction in Koramangala	Mr. Harish. M Mr. Lokesh Hebbani Prof. T.G. Sitharam	CiSTUP, IISc	Report
14	Traffic Assessment Study @ Mantri Square Mall, Malleshwaram, Bangalore	Radha Chanchani Fagun Rajkotia	CiSTUP, IISc	Report
15	User Needs Study: Living lab on Bangalore Mobility and ICT Research for Smart City Solutions	Prof. KB Akhilesh, Prof. T.G. Sitharam Minakshi Goswami, D. Manjula	MS, IISc CiSTUP, IISc	Report
16	Report on "Genetic Algorithm and their Applications in Transportation Planning	Ms. Rajani Hegde Prof. D. Nagesh Kumar	CiSTUP, IISc	Report
17	Micro-Scale Change Detection in Wetlands Using QGIS: A Case Study of Belgaum City	Shridhar M. Samant Dr. Gururaja K. V	CiSTUP, IISc	Report
18	Development of a Model for Simultaneous Feeder Buses Route Generation and Schedule-Coordination with rail on an Identified Rail Corridor	Parag Raipuria Dr. Ashish Verma	CiSTUP, IISc	Report
19	A Comparison of Artificial Intelligence technologies used in Vehicle Actuated Traffic Signals and Proposal of an On-Surface Sensor Technology	Jay Nalin Kapasi Prof. T. G. Sitharam	CiSTUP, IISc	Report
20	1. Modelling of an Integrated Urban Mass Transport System and 2. Peer Review on - Inception Report of DULT	Ms. Sushma Sreenivas Dr. Ashish Verma	CiSTUP, IISc	Report
21	1. Urban Footprint Dynamics in Indian Metropolis 2. Project Report of Urban Sprawl Analysis of Gulbarga, Hubli and Dharwad City and 3. Development of Digitized Seismotectonic Map of India in Context of Current Status of Earthquake Engineering in India	Ms. Priyadharshini J. Shetty Ms. Shashikala	CiSTUP, IISc	Report
22	Transport Planning of IISc Campus Bangalore	Ms. Shreya Ural	CiSTUP, IISc	Report
23	Campus Infrastructure System	R. Usha Kalpana Prof. T. G. Sitharam	CiSTUP, IISc	Report
24	Report on "Genetic Algorithm and their Application in Transportation Planning	Ms. Rajani Hedge	CiSTUP, IISc	Report
25	Pavement Engineering Laboratory	Mr. Rajasekhara Bangaru	CiSTUP, IISc	Report
26	Pavement Engineering Laboratory	Mr. Rajasekhara Bangaru	CiSTUP, IISc	Report
27	Report on the Hubli-Ankola Railway Line	Gururaja K V Deepak Baindur	CiSTUP, IISc	Report
28	Planning Sustainable Urban Transport System	Deepak Baindur	CiSTUP, IISc	Report
29	Opportunities for emergency vehicle preemption in Bangalore	Dileep Kadambi Prof. T.G. Sitharam Deepak Baindur	CiSTUP, IISc	Report
30	Mumbai lunch box delivery system	Deepak Baindur Rosario Macario	CiSTUP, IISc	Report
31	Public Participation for IISc infrastructure representing the needs, usages, and effectiveness of knowledge management techniques in an infrastructure project	Swathi. K.J	CiSTUP, IISc	Report

Experts' opinion as it Appeared in DNA Newspaper on Implementation of Lane Discipline

Published on August 3, 2012

LANE DISCIPLINE

A myth for city of Bangalore



T.G. Sitharam

Chairman,
Center for Infrastructure, Sustainable Transport and
Urban Planning (CISTUP), IISc.

A ceremonious beginning to the lane discipline programme by the Bangalore traffic police is a welcome gesture. Three hard questions will come to my mind but they are hard reality. One is where are the lanes?. Do we have lanes which are continuous for long stretches to ease the congestion. What is a lane for a two wheeler driver? We have 72% of all the vehicles are the two wheeler on the road. They even move on footpaths. The other is does our people including me has any patience to follow these lane discipline. The third question is how effectively and fairly, with existing number of police in the city can implement this in a complex mess we have created. Many of the planned infrastructural projects are delayed so much and they are bottlenecks at many places in the city. Parking on the roads is major problem.

Despite the traffic police's campaign to enforce lane discipline, motorists appear to be pretty cavalier about the effort. I may be too skeptical but the harsh reality is that In India in general and Bangalore in particular is the place where people cannot and will not learn the internationally acknowledged traffic rule, called Lane Discipline, unless police enforces a huge fine on erring drivers. Indian driver is a sample of aberration from a norm in the road and hardly deserves the ownership of a classy vehicles loaded with every information and communication technology and vehicle technology features of a transportation system. Alternative priorities such as a better and dedicated public transport system (both rail based and road based) is essential for the city. Buses should move at a faster pace than the four wheelers so that people do not bring their personal vehicles fearing the congestion. There is greater need of education among our drivers to have some patience and follow the lane discipline.

Technically, None of the codes mention a safe rule for stopping behind a vehicle in a queue of traffic, either at a minor junction, roundabout, traffic signal or in a traffic jam. Many guidelines talking about the "Driving the essential skills", seems to assume that we never need to stop behind traffic in a queue anywhere - it just doesn't mention Queuing Distance or that we may need to stop behind others in a queue. With very younger generation of drivers this is also one of the issue in the city of Bangalore, where in you always go back in a traffic junction and hit the vehicle which is just behind.

A regular Indian driver, including myself, is morally incompatible with a modern level of vehicle-to-human relationship on our roads which are congested heavily. It is a pity that we hear almost every day crushing of pedestrians by the big vehicles on the road. The fact is a fact – the commonplace traffic picture in Bangalore remains to be, beyond any controversy, a pattern of a serious mad behavior. I am truly sorry about this language!!

Go step by step to ensure people know benefits of lane discipline



Lokesh Hebbani

Transportation Programme Manager,
Center for Infrastructure, Sustainable Transport and Urban Planning
(CISTUP), IISc.

Lane discipline will definitely help to reduce the congestion, travel times, accidents and finally reduce the air pollution. Lane discipline can be implemented and enforced at all major intersections as well as on a stretch of any highways. Before we implement these new rules and regulations we need to do the following:

At all the major intersections (including the approach roads):

- 1) We have to make sure that we erect permanent overhead signboards (across the entire stretch of the approaching roads), which clearly indicate the

Experts' opinion as it Appeared in DNA Newspaper on Implementation of Lane Discipline

downward arrow on each lanes with destination (where it leads to).

- 2) In addition to overhead signboards, we have to mark the directional arrows (left, straight, right) on the pavement itself with pavement markings. The pavement lane lines should be painted so that they are clearly visible at night too.
- 3) To make it more visible during nights and rainy days, for about 600 feet before the intersection on the approaching roads, place raised pavement markers (RPM's) to separate the lanes going in different directions. This will supplement the already marked lane lines.

On any stretch of highway:

- 1) The principle of separation of traffic by speed works so well on surface streets with longer stretches. Vehicles with higher speeds should occupy the right lanes and vehicles with slower speeds should use left lanes.
- 2) You must drive on the left side of the road, except for passing, and you are only allowed to pass on the right. We could see that the higher speed limit, when combined with mandatory lane discipline, will definitely save lives. We can adopt laws such as "Keep Left – Pass Right" law.
- 3) Even here also before approaching major intersections, lane markings supplemented with overhead directional signs should be provided well in advance so that approaching traffic can stick to the lanes which lead them to their destination.
- 4) Buses and trucks must be restricted to left and middle lanes only (in a three lane stretch) of the road, and must be restricted to left lane only (in a two lane stretch) unless they are passing other vehicles.
- 5) All pavement lane markings should be clearly visible for the traffic to drive in their own lanes.
- 6) Well before changing the lanes, all traffic must show their turn signals (indicators). Violators should be fined.
- 7) Any pot holes should be filled and repaired so that we can prevent accidents and bottlenecks resulting from that. (Traffic police must make sure that BBMP does this as soon as possible).

Currently most of the bus stops are located just after (or before) the intersections, and when the buses stop to pick up the passengers they create bottlenecks for all

approaching directional traffic. Hence, bus stops must be located on approaching roads much before the intersections so that even if there is bottleneck due to the bus stop, it affects only that directional traffic only.

Since most of our major main roads are one ways, we have to limit access from these roads to some of the minor cross roads. Similarly only from some of these minor cross roads, access can be provided to the main road. This will help to reduce the weaving effect during which a car from left most lane wants to go the cross road at right, will try to cut across all the lanes and thus may cause accident and delays for all other traffic.

Once we do most of the recommendations that are detailed above, then we can launch the campaigns, to educate our traveling public with the concept, advantages and benefits of "Lane Discipline". This can be done through TV advertisements, or five-minute documentaries that can be played in movie theatres, colleges/schools, and on television channels.

A combination of making proper geometric changes to our roads, taking into consideration all safety aspects, and educating the public through awareness campaigns, besides strict enforcement of laws will definitely help make this program a success.

Both government agencies and traveling public must work with each other as a team for the success of such programmes.

Once this awareness campaigns are done with, then we can do a brief customer survey to see what percentage of traveling public is aware of this new law; and if we are satisfied, then we can launch this program on a trial period for two weeks to see the adherence of the public to the new laws and make any necessary changes/modifications to the signs & markings if needed.

Then we can fully launch it and enforce the laws. While enforcing the laws, we have to make sure we are operating and maintaining all the signs, markings in good conditions so that traveling public don't have any complaints. Strict enforcement through CCTV cameras @ intersections and on major highways, Traffic Police handheld cameras will help to reduce the violations. Most of the three wheelers (auto rickshaws) & two-wheelers (bikes, scooters etc.) who have tendency to change the lanes abruptly must be fined so that they follow the rules.

Report on the National Conference @ Chennai by Dr. Devanjan Bhattacharya & Dr. Harish. M.

CISTUP nominated Dr. Devanjan Bhattacharya & Dr. Harish. M, Urban Planners to the “**National Conference on Urban Mobility –Challenges, Solutions and Prospects**” which was conducted at IIT Madras Campus, Chennai from July 13-14, 2012.

This conference was conceived to capitalize on the synergies of the research activities carried out under the auspices of department of Electronics & Information technology (Deit Y) ,Ministry of Communications & Information technology (MCIT) and Ministry of Urban Development(MOUD)

The conference was organized by IIT, Madras, Chennai, CDAC, Thituvanathapuram in association with IIT, Bombay and IIM, Calcutta.

The UMCSP conference began on a sound note with many worthy dignitaries speaking about the current scenario in urban mobility, challenges and the way forward. Select speakers delivered keynote addresses setting the stage for the conference. Research works covering a wide spectrum of topics from ITS to Transport Systems Planning was covered through presentations. There were in total 9 technical sessions apart from a poster session and two plenary sessions. The technical sessions could be divided into two categories broadly speaking, IT enabled technologies and Policy, Planning and Administrative methodologies.

Technical presentations

The most direct and succinctly put forward view on the traffic and transportation situation in Chennai, which could be applied more generally to any part of India, was by the Traffic Commissioner himself who talked about Integrated Traffic Management System utilizing a dedicated wireless bandwidth and GPRS connectivity with the on-field monitoring and data collection devices. The proposal for integrating a Road Accident Database Management System through a WebGIS to a Central Control Room Server was also put forward which will be launched in the coming months.

Engineers from CDAC Trivandrum presented Intelligent Parking System development wherein sensors were put in parking lots to detect vacant slots and display that info outside. A Red Light Violation Detection System was also

presented. CDAC along with IITB are working on algorithm improvement on these traffic detection systems. IIM Calcutta was working on a framework for RFID based congestion control system together with CDAC.

Chennai Metro Rail Ltd. Began the presentation saying according to World Bank research papers all Mass Transit Systems are loss making bodies. Yet these are necessities so in the 12th Five Year Plan it has been proposed that all 2 m plus cities need RTS. There should be seamless merging of modes: train, metro, bus and that has been the priority of CMRL. It has been keen to launch integrated public ticketing system, payment e-cards like MORE and for security CCTVs.

ITS Architecture and Traffic Detection Technologies

In the presentation Advanced Inductive Loop Detector System for Laneless Traffic it was discussed how two inductive loops can be used to ascertain vehicle sizes. In the talk Real-time traffic counting system using video image processing the techniques for video analytical decision making for vehicle detection were discussed. These techniques were cost effective and accurate.

Next from SPA Delhi was presented Phased Development of ITS System Architecture for Traffic Management in India wherein it was suggested to undertake betterment of cities according to their stature as Tier I / II / III and that scope was greater in lower rung cities. The model for development for different Tiers was presented with case studies. Next came up a planning and engineering work by IBI Grp in Mysore titled Implementation Challenges in Mysore ITS Project where it was shown how the public bus fleet's 100 odd buses were GPS enabled and the continuous data feed was used to intelligently plan operations and display movement scenarios. Next presentation Parking Made Easy with ePark!! A Sparkling Technology by CDAC engineers focused on a system that would keep track of parking spaces and notify the availability. In future this could be availed as a service on mobiles and internet.

Traffic Flow and Operations

This session had part of the focus on VISSIM simulations for traffic deductions and the 1st such topic was Study on Traffic Flow Characteristics at work zones using Simulation which characterized parameters from work sites in metros like construction work for metro rail in Chennai and tried to model those in VISSIM and predict how to better manage the associated chaos. Next presentation focused on Traffic

Flow Modelling of the Delhi Gurgaon Expressway- An Empirical and a Simulation Approach which was to capture the heterogeneous nature of Indian traffic and propose a formula of predicting congestion. So a simulation was done in VISSIM with the existing restrictions and a model as near as possible to Indian road condition was approached.

Urban Road Traffic Safety - Evaluation and Tools

An interesting study was presented as An On-board Embedded System for Monitoring the Loss of Attention in Human Drivers using video and image of driver face and ocular parameters. If a certain percentage of eyelid was closed for more than a given duration that would be in critical zone. Another interesting talk given was that of Development of a Toolbox for Evaluation and Identification of Urban Road Safety Improvement Measures where it was proposed to include Evaluation as an E in the 4 E's of Transportation Engg making it the 5th E. And the case was put forward for that by way of parameters development and requirement analysis.

Public Transportation and APTS

In this session the topic of note was Evaluation of Bus Operations with ETM and GPS data where it was shown that there are selected algorithms that can parse through ticketing data from electronic ticket machines and along with GPS downloaded data these can be used for better fleet management, scheduling and even real time decision making. It was noted that with special devices attached to GPS and ETMs it was possible to transmit wirelessly through SIM cards.

Urban Transportation Planning-Advances and applications:

Development of Activity based models for forecasting the travel demand: This was made by consideration of various non-spatial parameters of particular area. It shows that there will be diminishing rapidly with increase in distance.

Transportation planning for the selected zones in Bangalore city: The GIS data base for transportation is based on the demography, socio-economic parameters in 30 wards of Bangalore city. The trip distribution for selected models on origin and destination has been correlated for the travel time and demand analysis.

Characterization of traffic:

Behavioral analysis of pedestrians while crossing roads at Intersection: For this study the gender based logit model and Binary logit model for individual and group crossing

behavior for pedestrians has applied while crossing the intersections. The outcome of this paper is the women take more time to cross the intersection.

Study of Traffic characteristic on a National Highway passing through Peri-Urban area in Agartala Tripura: The study is made on National Highways in Tripura by considering the volume counts of the type of vehicles movement entry in to the city. The Peri-Urban area in Agartala Tripura is a capital city and has commercial Medical, Educational, migration Industrialization, quality of life etc is more compared to other areas of the state. So the vehicle movement is more compared to other towns/cities of the state.

ITS Applications

Real-time transit planner was a topic of note presented by a team from IITB where the campus bus fleet were fitted with modified GPS and the route data downloaded for better route optimization and vehicle ETA and ETD. A Quantitative Comparison of Dynamic Traffic Assignment Modeling Packages for Heterogeneous Traffic Composition was a presentation wherein the comparison of modeling software was presented.

ATMS & ATIS

Intelligent Wireless Road Traffic signal Controller – described the synchronization of signals wirelessly instead of wired networks which were cumbersome and prone to breakdown and maintenance.

Design and evaluation of area traffic control system (SIMTAM and CosCiCost2G)- was an initiative of IITB, IITM and CDAC where traffic designs and models were being tried out for city wide traffic solutions including ITS, conventional transport engg and other hybrid solutions.

CONCLUSIONS and FUTURE

1. For Indian conditions one single approach could not do it but a collective utilization of ITS, Conventioanl Transportation Engg and Localised need based solutions was need of the hour.
2. Participation of all segments of society needed.
3. Educating the younger generations through such conclaves, opening the minds of engineers, scientists, bureaucracy through interactions mutually.
4. Encourage youngsters for taking forward developments to rural and semi-urban places and preparing beforehand for situations of expansion.

Report on the Seventh Annual International Conference on Public Policy and Management Societies in Transition held @ IIM Bangalore 16-18 August 2012.

CiSTUP nominated Ms. Keya Chakraborty & Ms. Sayali Anil Borole, Urban Planners to the **Seventh Annual International Conference on Public Policy and Management Societies in Transition held @ IIM Bangalore** which was conducted at IIM Bangalore from August 16-18, 2012.

The Seventh Annual International Conference on Public Policy and Management inaugurated by Ian Felton, Deputy High Commissioner of UK. During three days of the Conference there were in total 16 panel discussions, 11 paper panel sessions, 2 workshops, 4 group discussions and 6 plenary sessions. The plenary sessions could be divided into two broad categories viz. critical review on several books and discussions on works done by joint collaboration of UK-India Education and Research Initiatives (UKIERI).

Panel Discussions

- **Challenges facing Urban India:** The panel consists of Mr. Sabir Roy columnist, writer and senior editor. Subir discussed about role of institution and services provided by government to develop and maintain cities. He critically analysed on the institutionalization and rural-urban migration. He also highlighted planning issues, physical planning of the cities and their concerns. Mr. K. Jairaj, ex chief secretary to government of Karnataka and an IAS officer discussed about difficulties of government in delivering services and his experiences in the city. He expressed that government is more of reactive (always react to situation) than to innovate things. Mr. Kulwant Singh discussed specifically about water and sanitation issues of various cities of India. He discussed about infrastructure need and development with necessity of city management.
- **Employment:** Trends, Status, Way Forward: Prof I. Mazumder of CWDS and H. Swaminathan of IIMB presented a session on current issues regarding women work force. Both of them raised several problems regarding women workforce, un-identified women labors and inequality in their wages.

- **Right to Public Services and Citizen-Centric Approaches:** The panel discussed and introduced SAKAL Mission by government of Karnataka. Sakala is about guarantee services to citizens in specific time period. It focused on their pilot initiative and impedance during execution.
- **Transition to Markets and Rural Poor:** The panel majorly talked about penetration of companies to rural areas and reaction rural population to the same. The panel concluded with rural areas should be made aware of their participation at higher level and need higher amount of awareness for the same. The session also covered health and hygiene issues at rural areas and service delivery for the same. It focused on primary activity-Agriculture and various aspects of the same in rural areas.

Paper Panel Sessions

- **Public Private Partnership:** Professor P.P. Chatterjee of Apollo Hospital highlighted on importance of PPP model in public health care system. According to Prof Chatterjee, from long term perspective PPP model will provide proper information and efficient infrastructure regarding health related issues within public sector. Prof U. Sawhney of Punjab University suggested that Punjab govt. should invite PPP schemes for the entire development of Punjab economy, especially in the sector of agriculture. She also supported for using PPP model in improving the quality road networks and other infrastructure. Ms P. Dey from Planning Commission of India govt. provide useful information on how govt. is working with PPP model in various sectors at present and what are the obstacles for the same facing by the govt.
- **Middle Class in Transition:** The panelist was from varied age group and background. The experiences and work were vibrant. The topic discussed about role of working women in up-liftment of families and development of society. It discussed about role of women in development rural-urban areas and gender composition. The topic also considered development considering various aspects from evolution to IT age to Anna's movement. Various movements by middleclass at a scale of lakhs and millions in Nation, to bring in change and impact were studied. Many new areas like cyber raised voice, internet movements, their influence and effect.

- **Urban Policy Issues:** The implementation of JNnurm-BSUP in the Bangalore, need of the policy and critical analysis of guidelines, policy and their implementation was done considering few slums of Bangalore. The study of corruption, in various local authorities with their statistical data analysis in Bangalore was another paper discussed in the session. The study highlighted the authorities prone to corruption; citizens facing corruption and harassment due to demand and forces provoked them to participate in the crime.
- **Sustainability:** Prof S. Someswar from Columbia University identified the goals of sustainability. He also discussed on the several issues say, how to imply policies to achieve sustainability, problems related to maintain sustainability, and also several solutions for the same. Dr. U. Lakshmi of ISAM raised the issues regarding electronic waste and recommended for appropriate management program. On the otherhand, Mr. S. Hegde discussed the pros and cons of eco-tourism in India.

Workshops

- **Information and Services Delivery in Rural Areas:** The session covered completely the center found in all rural areas of Karnataka, where rural population is made aware of services, schemes, guidance and education. The design and 'e' part of it. The center has helped the rural areas to know more about the national and state services for them. The Citizen Delivery center focuses on peoples development and resource them with best possible.
- **NSSO Workshop:** P.C. Mohanan from NSSO presented the history of national sample survey through the years. Prof A. Mukherjee and H. Swaminathan from IIMB discussed on usefulness of NSSO data and how to handle the same. They have also shown how to decode various information from a sample data.

Group discussions

- **Centre of Excellence in Urban Governance:** In this interactive panel Mr. A. Ravindra from GoK presented governmental policies on property and tax. Prof A. Suraj of IIMB focused on legal framework for citizen centric urban governance. He suggested for community level representation rather than regional one. Prof. G. Ramesh discussed on real estate market – how it works and what are the legal procedures from govt. side.

Plenary sessions

- **Risk Participation and India:** Dr. R. Rajan from University of California presented an interactive session on expertise and environmental governance. During his session he discussed the role of scientific experts in environmental controversies in India and prospects of new pedagogical and institutional arrangements. Apart from this, he also discussed on regulation of the risks of bio and nano-technologies. Prof M. Kapur from NIAS, IISc and IIMB gave a worthy lecture on psychological causes and effects of inequality, poverty, and consequential imbalances of present society.

Conclusion

- At present data related problems has to be solved.
- Government authorities should focus on developing better e-governance practice and capacity building.
- Citizens should co-operative and participate actively and voluntarily to bring in change.
- Researchers suggested for taking of PPP model for different sectors of governance to improve infrastructure and efficiency as a whole.

A sustainable transport system [is] defined as one that

- allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations;
- is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy, as well as balanced regional development;
- limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and, uses nonrenewable resources at or below the rates of development of renewable substitutes while minimizing the impact on the use of land and the generation of noise.

— Source European arm of the Rand Corporation.

- CiSTUP ,IISc represented by its **Chairman Prof. T. G. Sitharam** is a party to the IP protection filed in respect of the project titled **"Uni-Tag Multi-ID-A Direction sensitive radio Frequency Identification System"** along with other team members of the project from Instrumentation Department of RV College of Engineering, Bangalore namely **Mr. Aritra Paul, Mr. Nischit Bharadwaj, Mr. Arjun Bhat, Mr. Sameera S and Mr. Venkatesh**. The project involves generating multiple messages from the same RFID-Radio Frequency Identification tag based on the direction of approach of the reader/vehicle (Movement).



- **Ms. Abhishikta S Pandit and Badrinath T from CiSTUP** were nominated to for participation in **Public Transport and Youth Parliament** held on **24th May 2012** in **Bangalore**.

In this UITP Seminar they gave a talk on "Doubling Public Transport Share: A thrust to make Public transport a choice for every citizen with special focus on Youth. **Both of them were selected for the Y4PT-UITP 60th World Congress to be held in Geneva from 23rd May 2013**. Congratulations to Ms. Abhishikta S Pandit & Mr. Badrinath T.

- The Eighth meeting of **CiSTUP RAAC** with the reconstituted members was held on 18th May 2012.
- **Planners at CiSTUP** have been regularly meeting every week and are having brain storming sessions on the various projects being carried out at CiSTUP.
- Research and Academic Advisory Committee 9th meeting on 18th September 2012
- Chairman, Prof. T.G. Sitharam visit to Biejing, China as an invited speaker in the EUTRAIN workshop from 2nd to 7th September, 2012.

Siemens Youth University Idea Contest

Prof. T.G. Sitharam, Chairman CiSTUP was invited to be a distinguished judge for the Siemens Youth University Idea Contest held on June 30, 2012 which was organized by Siemens Technology and Services Private Limited, Corporate Development Center India. Insightful questions raised by Prof. T.G. Sitharam were an enriching experience for the students.

This Siemens Youth University Idea Contest was well received and had 225 ideas. The contest realized its objective of giving engineering students across the country an opportunity to share their ideas.



Bicycle and Electrical Mobility for a Sustainable Transport: Green Working Model for Last Mile Connectivity and Reduced Air Pollution.

CiSTUP is making all out efforts for implementation of the above project within IISc campus.

Preamble

Non-motorised transportation (NMT) either walking or bicycling has always been environmental friendly and economically viable to the user. Walking and bicycling are the only two true sustainable modes of transport. Despite such obvious merits, NMT has been ignored by many policymakers while making infrastructure policy. To make NMT safer, attractive and economically viable one has to look at it as a combination of infrastructure investment, traffic management, and financial measures.

Bicycles as a major NMT are one of the most desirable modes of transport in many cities. Age group of 25-35 dominates use of bicycles and overall mobility. Space requirement, cost, speed and flexibility of bicycles make them most preferred mode than bus. The disadvantages felt by the bicycle user included lack of bicycle friendly paths, danger of cycling, thefts and assaults, and the motorists' lack of respect for traffic laws. If these issues are taken care while developing a policy, there could be greater use of bicycle and thereby modal shift to NMT. It also very well known that shifting to bicycle would help in the reduction of greenhouse gas emission, hence it is considered as a sustainable urban transport mode. Bicycles are also considered as a good alternative for last-mile connectivity with other mode of transport.

In many of the studies carried out in recent years on bicycle utility, greater impediments on cycling or usage of bicycles will continue to be stronger unless bicycle infrastructure networks are sufficiently dense, continuous, and direct, and both links and intersections perceived as safe. Outcome of such study would recommend and implement desirable issues into the policy, so that master plan and/or management and infrastructure development plan of a city should create bicycle friendly streets and favorable environment for the bicycle user.

This Project Proposal of CiSTUP, IISc, Bangalore, namely higher usage of non-motorized transport, usage of public

transport, use of alternate fuels and so on, switching to electric mobility is also one important change in curbing the vehicular exhaust. Similar to NMT, the Electric mobility despite using energy (solar or hydro-electric power) are environmental friendly and less polluting compared to fossil fuel driven vehicles. Electric mobility are already in use in spatially large institutions (Infosys at Mysore), heritage sites (Ajanta in Maharashtra, Hampi in Karnataka) and Hotels (Taj in Bangalore) due to carrying capacity, reduced noise and air pollution and ease of use.

In the Department of Electrical Communication Engineering, Indian Institute of Science, sensors for measuring air pollutants namely CO₂, CO, NO_x and SO_x have been developed. These sensors measure air pollutants precisely and can be deployed on vehicles (Amrutur, 2011). Using these sensors one can easily compute the amount of air pollutants in an area. We will make use of these sensors in the proposed project before and after the implementation in the campus, in order to understand the actual level of variation of air pollutants before and after the implementation of the bicycles and e-carts. Well known bicycle sharing schemes across the world are Barclays Cycle Hire, London; Call a Bike, Berlin; . Electric mobility based on 'use and pay' mechanism would also ensure persistence of pollution free transportation mode beyond institutional financial support. The proposal looks at both bicycle and electric mobility in side Indian Institute of Science campus, so as to improve the mobility options of campus users, as well improving the campus environment and air quality by reducing the dependence on private motorized modes of travel such as cars and 2-wheelers. In the long run, with the project outcome, it will also be expanded to other parts of the Bangalore city (Jayanagar, Malleshwaram and so on) so as to provide better last mile connectivity and also achieve quality environment and reduced noise and air pollution. Bicycle mobility is done jointly with Raid-A-Cycle Foundation (RACF), EMBARQ, CiSTUP, Mapunity and Gubbi Labs. This project aptly named as NAMMA CYCLE was flagged off on 6th August 2012. The functional evaluation of these project will help in expanding the model to other places in the city and also in formulating better policy measure.

Bicycle and Electrical Mobility for a Sustainable Transport: Green Working Model for Last Mile Connectivity and Reduced Air Pollution.

Work Plan

1. Bicycle sharing in Indian Institute of Science (IISc) Campus-NAMMA CYCLE FLAGGED OFF ON 6th August 2012.

Bicycle usage has been an integral part of IISc campus having an area of over 400 acres. Majority of students, faculties and staff members use bicycles in the campus. However, regular maintenance and affordability makes it difficult for many of the students to use bicycles. Through the proposed programme, it will encourage students of IISc to use cycles for commuting in and around campus based on cycle sharing scheme. This removes the burden of cycle safety and maintenance from the user and provides users with a flexibility of choosing to walk or bicycle. The project aims to provide a community based public bicycle sharing system to solve the short-trip commuting needs of the people within the IISc campus and expanding to other parts of city in future.

2. EMobility in Indian Institute of Science Campus

The Indian Institute of Science is one of the premier educational research institutions in India with over 400 acres of lush green campus. It is a unique place amidst urban chaos of Bangalore with much serenity and green. Campus itself hosts 1799 four wheelers and 4453 two wheelers (Mr. Chandrashekar, security officer, as on 31

March 2012) for various faculty members, dependents, students and staff. With 19 gates to the campus, traffic flow is estimated at 450 four wheelers and 800 two wheelers in the peak hours (8am-11am). The movement of these many vehicles would definitely have an impact on the campus environment, more specifically to air and noise.

E-mobility in conjunction with bicycle sharing aims at Improving the mobility options of campus users, Improving the campus environment and air quality by reducing the dependence on private motorized modes of travel such as cars and 2-wheelers. When implemented in concert with other innovative modes of mobility such as the proposed bicycle sharing program, the E-Mobility system will go a long way towards achieving a campus free of private motorized vehicle. Using IISc E-mobility and bicycle sharing model, it can be implemented elsewhere in the city and to the country at much larger scale.

Proposed project involves research in operation of the E-mobility including, kind of vehicle, number of vehicle, Travel Pattern Analysis & Demand Assessment, Spatio-temporal distribution of Trips, service preference, routing, stops, hours of operation, service timing and frequency, pricing and ticketing, operation plans, staff, physical infrastructure and financial analysis.





South Asia and Asia-Pacific REGIONAL WORKSHOP

Thursday, 6th September 2012, 10:00 – 17:30

Beijing, China

Organised and sponsored by: ERTICO – ITS Europe & EUTRAIN

Chairman, CiSTUP, Prof. T.G. Sitharam was invited for giving a talk in the above event organized at Beijing, China on 6th September 2012. The main objectives of this workshop were:

- Identify themes of interest for international transport research cooperative work,
- Discuss the conditions and prospects for facilitating such research cooperation, and
- Agree on ways forward in research cooperation for all the targeted countries.

The title of the talk presented by Prof. Sitharam was **“EU-India Relations in Transport Research and Possibilities for Cooperation”**.

The other main speakers in this programme were :

Mr. Patrick Mercier-Handisyde, Head of the Urban Mobility Sector, European Commission, DG Research & Innovation ; Ms. Caroline Almeras, ECTRI Secretary General, EUTRAIN Coordinator; Prof. G.A Giannopoulos, Director, Hellenic Institute of Transport (HIT), Head of EUTRAIN Coordination office; Dr. Young-Jun Moon, Director, Centre for ITS & Olympic Transport Research The Korea Transport Institute (KOTI); Mr. Koichi Noguchi, Executive Director for Research Coordination, Public Works Research Institute, Japan ; Mr. Deng Xiaoyong, Deputy Chief Engineer of Beijing Transportation Research Centre ; Mr. Damien Hense, Projects Leader – Business Innovation, ARRB, Australia ; Mr. John Tunna, Director, Office of Research and Development Federal Railroad Administration, Department of Transport, USA ; Mr. Mats Rosenquist, Volvo Group Trucks Technology, Advanced Technology and Research – Asia, Shanghai, China .

The panelists for the panel discussions were: Prof. Pengjun Zheng, Director of The Maritime Faculty, Ningbo University, (China); Prof. Weida Xie, Institute of Railway & Urban Rail Transit, Tongji University (China) ;Mr. David Battett, GNSS Asia Representative ;Dr. K. Ravinder, Senior Scientist, CRRI, India ;Mr. Mong Kee Sing, President, ITS Singapore.

Abstract of the talk: Brief details about CiSTUP its mandate, vision, theme areas of research and the activities were presented to the audience. Then he

explained the multidisciplinary areas of the Indian Institute of Science. Followed by some Activities in India in terms of International cooperation:-

- Possibilities of Research & Innovation Cooperation with Europe: Awareness Raising and Information Campaign in India, 10-28 September 2012 – These are follow up meetings of 2011 meetings in India Organised by the S&T Counsellors of the EU Member States and the Delegation of the European Union to India
- EU-India Workshop on Co-operation in Road Transport R&D Nov 2004
- ACATECH GRIP-IT project on smart cities including smart mobility 2011-12 – (German Indian Partnership for IT Systems)
- Aus-Aid programme, Indo-UK programmes, CiSTUP-Volvo Research collaborations

The potential for scientific and industrial co-operation between India and the European Union in the field of land transport is great. Both sides are heavily involved in advanced research on fuel cell technologies and in the exploitation of new materials to make vehicles safer and cleaner. Both are exploring new concepts in road construction and traffic flow, and each aims to reduce its region's road fatality rates – India Need to reduce its fatality rates. It calls for building on synergies within the framework of scientific and technological co-operation, promoting contacts between research organizations and individual scientists for EU-India joint research.

The talk covered the common ground that is there in India and EU consultations like:

- India's transport sectors are poised for huge growth, but they also pose big challenges.
- The country's automobile and Freight transport (lorry industries) need advanced IT-based systems and capabilities, its road construction equipment and methods must be modernized to meet rising safety standards.
- India's extensive though colonial-era rail network needs a complete overhaul.

- For India, improving road safety is crucial.
 - Whereas the number of fatalities in most European countries hovers between one and two per 10,000 vehicles, in India the annual rate is 14.5. This is far higher than other low-income countries such as Mexico or Malaysia, where fatality rates per 10,000 vehicles are 4.6 and 5.6, respectively.
- This explains India's keen interest in new materials research, telematics, radar technology and satellite-based positioning capabilities, for collision-avoidance systems for cars and lorries – technologies of equal interest to EU industries.



Mentioned about EU-India Workshop on Co-operation in Road Transport R&D' held in Bangalore on 8-10 November 2004 which was organized by the European Commission's DG RTD Surface Transport Unit, Society for Innovation and Development (SID) and the Indian Institute of Science.

- Summed up the talk by calling for EU collaboration in Improved Mobility of 'People' rather than 'Automobiles' – NMT: Freight Transport : "Excellent Public transport " - increase the modal share of public transport system to 70% or double it by 2020"



Workshop Conclusions

The workshop consisted of two sessions, presentations and a panel discussion, to share experiences of international cooperation in speakers' and panelists' work and identify a number of issues that relate to the future practice in transport research. The main conclusions can be summarized in the following four areas:

- A. Main Drivers for international cooperation
- B. Themes and Topics of interest
- C. Mechanisms for International Cooperation
- D. Other issues.

Main Drivers for International Cooperation in Transport Research

In this area the representatives of governments, research organizations and industry gave their views and pointed to the main influencing factors answering – in fact – the question "why do we need Int'l cooperation".

The EU representative mentioned four main drivers as follows:

- ✓ Global challenges: the societal and other challenges that we are faced with are indeed global and thus we need approaches based on global cooperation;
- ✓ The need to achieve greater interoperability of networks and systems;
- ✓ The need to promote global standards and harmonization of procedures applicable to the global transport system; and
- ✓ The need to further facilitate the access to international knowledge and to the markets.

The representative of the US Ministry of Transportation presented a number of "strategic goals" or challenges which the US Department of Transportation has placed as its goals for Years 2010 – 2016

Smarter Cities Summit on September 13, 2012 at Hotel Leela Kempinski, Gurgaon, India.

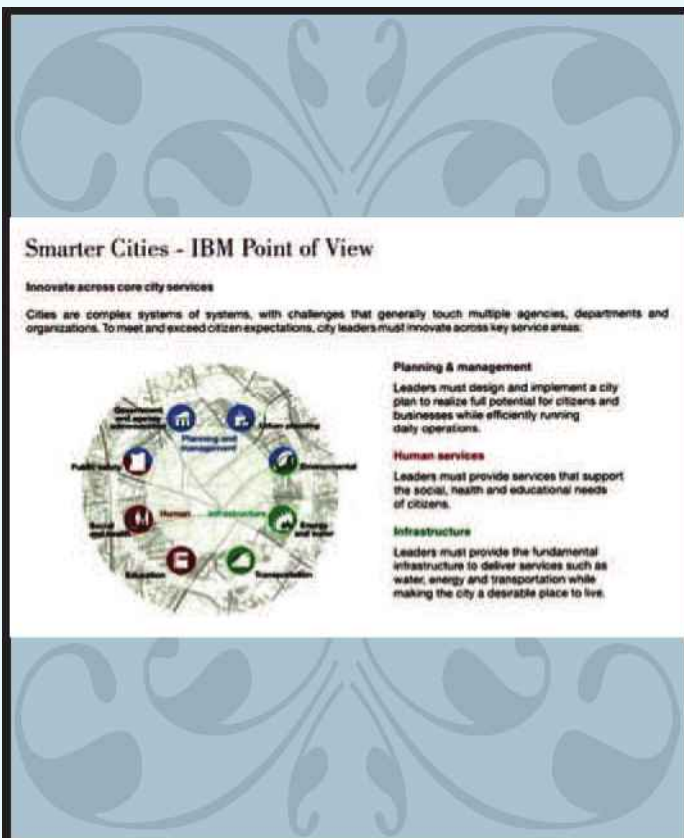
Prof. Sitharam, Chairman CiSTUP was invited to be part of a panel discussion with business and government leaders on “Smarter Transportation - The urban system of systems”, which was held between 2.45 pm and 3.30 pm.

IBM, in association with our media partner Mint, hosted the Smarter Cities Summit on September 13, 2012 at Hotel Leela Kempinski, Gurgaon, India. Their Chairman Samuel J Palmisano and other key IBM executives from around the world shared their views and experiences at the event.

This summit aims brought together forward thinkers to discuss and explore possibilities of creating a system of smarter governance, smarter transportation, smarter energy usage and smarter public safety for our nation. The discussions brought out innovative solutions towards creating sustainable urban centers in India

Prof. Sitharam shared his experience of building an innovative and sustainable transport system in cities and how similar initiatives can transform cities in India.

More details about the event can be had from www.ibm.com/smartercities/in.



Promoting EU-India Research & Innovation Collaboration

Awareness Raising and Information Campaign in India, 10-28 September 2012

At Bangalore on 12 Sep 2012, The Park

Mr. Devanjan Bhattacharya,

Urban Planner CiSTUP attended this campaign at Bangalore on 12th September 2012.

The conference was all about the EU member states acting together to promote research and innovation cooperation with India. It was started and hosted by the British High Commission on this particular day. The motto was to create research collaborations on larger scale, scope and impact, focus on common societal challenges, and enhanced synergies between India, the EU and its Member States. They were aiming for building a stronger and more sustainable cooperation with India, to better match the large scale of India and address major societal challenges of common interest, for presenting opportunities for cooperation in research & innovation with Europe at both EU and Member State level via a large awareness raising and information campaign throughout India.

- **Objective**

- Present the opportunities that exist at the national level, as well as the EU level, to further strengthen research and innovation cooperation with India

- **Targeted audience**

- Researchers and S&T students in India from both public and private sectors.

The sessions contained presentations from German Research Council, French Research Council, British Research Council, Swedish Research Council (with Bengaluru as a main research destination of various Swede companies eg ABB, Volvo we know) and their Indian presence in Delhi and Bangalore. Apart from all these regular presentations about statistics and publications, the interesting development came from an Organisation called EBTC : European Business and Technology Centre which aims at streamlining the entire process of bringing research, technology related business from EU to India. They are HQ'ed in Delhi and have office in Bangalore, supporting clean technology transfer from the research stage up to the product/service launch in the Indian market. Their salient contributions are :

European Business: EU companies seeking partnerships with Indian companies to develop collaborative projects and business with Indian organizations. European R&D and S&T Communities: European R&D and S&T institutions seeking to develop R&D programs with Indian institutions.

Prof. T.G. Sitharam

Chairman, CiSTUP



PLANNERS AT CiSTUP

1. Lokesh Hebbani

Transportation Planner-Grade1, CiSTUP

2. Ramesh Narayannapa

Transportation Planner-Grade1, CiSTUP

3. Dr. K.V. Gururaja

Urban Planner, CiSTUP

4. Dr. Harish .M

Transportation Planner, CiSTUP

5. Radha Chanchanai

Urban Planner, CiSTUP

6. Dr. Devanjan Bhattacharya

Urban Planner, CiSTUP

7. Sayali Boroli

Urban Planner, CiSTUP

8. Keya Chakraborty

Urban Planner, CiSTUP

9. Kadambari Badami

Urban Planner, CiSTUP



OFFICE STAFF AT CiSTUP

1. R. Chandrama

Senior Stenographer, CiSTUP

2. M.L.V Subramanyam

Administrative Officer, CiSTUP

3. S. Rajagopalan

Finance Executive, CiSTUP

4. Neetha. V. Ashtakar

Project Assistant, CiSTUP

5. Abhishiktha

Project Assistant, CiSTUP

6. Badrinath .T

Project Assistant, CiSTUP

7. Pratibha .R.N

Office Assistant, CiSTUP

8. Ambareesh .V

Office Assistant, CiSTUP

9. Selva Kumar

Office Helper, CiSTUP

10. Natesh

Office Helper, CiSTUP

People who were with CiSTUP

1. VISITING PROFESSOR

- Prof. C. Rajashekar Murthy
- Shri. Ashwin Mahesh

2. CiSTUP Senior Fellows

- Prof. T.V. Ramannaya
- Prof. K.M. Anatharamaiah

3. Planners who worked at cistup

- Mr. Deepak Baindur
- Ms. Manjula.D
- Ms. Fagun Rajakotia
- Ms. Meenakshi Goswami

4. Summer Interns

- Mr. Manoj
- Mr. Deeraj
- Mr. C. Kannan
- Ms. Richa Pandey
- Mr. K. Nanda Kishore
- Mr. Vijay Saini
- Mr. A. Dheeraj
- Mr. Subhadeep Rakshit
- Mr. Srirajan Thirumalai.
- Mr. Mohammed Fawaz
- Mr. Rochelle Alphonso
- Ms. Saira Jacob
- Ms. Sreepriya Ranginani.
- Mr. Arjun S. Bhat
- Mr. Nischit Bharadwaj
- Mr. Aritra Paul
- Mr. Sameera Shroff
- Mr. Tharun Deep V.
- Mr. Shreyas V Meda

5. Project Assistant

- Mr. S. Rajesh
- Mr. H.V. Santhosh Kumar
- Mr. Santosh .S
- Ms. Priyamvadha

CiSTUP places on record their valuable service and wishes them all the best in their future endeavors.



Contact Us:

Prof. T. G. Sitharam, Chairman
Centre for infrastructure,
Sustainable Transportation and Urban Planning
(CiSTUP)

Indian Institute of Science, Bangalore-560012,

Phone (Chairman): +91-80-2293-2521

Phone (Office) : +91-80-2293-2521/2043

Fax: +91-80-23468207

Email: chairman@cistup.iisc.ernet.in

Website Url: <http://cistup.iisc.ernet.in>