International Conference on

Civil Engineering Aspects for Sustainability

ICONCES 2020

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International Conference on

Civil Engineering Aspects for Sustainability

IConCES 2020

EDITORS
Dr. V. Srinivasa Reddy
Dr. V. Mallikarjuna Reddy

28th-29th Feb, 2020

Organized by

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GOKARAJU RANGARAJU
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Late Sri Gokaraju Rangaraju Garu

Great Visionary and our Guiding Spirit

ABOUT THE INSTITUTE

Gokaraju Rangaraju Institute of Engineering and Technology (GRIET) is a premier institute of engineering, established in the year 1997 under the patronage of the Gokaraju Rangaraju Educational Society. The college is approved by AICTE and is affiliated to JNTUH, The mission of GRIET is to achieve and impart quality education with an emphasis on practical skills and social relevance. Autonomous status is awarded to GRIET by UGC. All the UG Programs are NBA accredited, GRIET is having NIRF Rank (179). The institute is accredited by NAAC with 'A' grade. GRIET is having SIRO Recognition by DISR.

DEPARTMENT OF CIVIL ENGINEERING

The Department of Civil Engineering is established in the year 2008, with an intake of sixty students which is further increased to 120 students from the academic year 2009. It is a fast growing discipline in tune with the infrastructure growth. The department has Master's programme in Structural Engineering, established in the year 2014 with an intake of eighteen students which is further increased to 30 students from the academic year 2017. M. Tech (Structural Engineering) Programme is accredited by NBA

ABOUT ICONCES 2020

Civil engineering is undergoing rapid changes driven by globalization. Due to the rapid urbanization, environmental change, safety and security concerns are impacting the global environment. To cope up with these changes, construction industry demands scientific advances in the field of Structures, Environmental, Transportation and Geo-tech etc. Obviously, such technical advancements demand civil engineers to acquire more knowledge than in the past. And also construction industry is the most responsible for Green House emissions. In this context, the Department of Civil Engineering at GRIET Hyderabad is organizing "International Conference on Civil Engineering aspects for Sustainability (IConCES 2020)". The main objective of IConCES 2020 is to bring Academicians, Industry Experts, Researchers and Engineers on one stage to discuss their works in the area of Civil Engineering.

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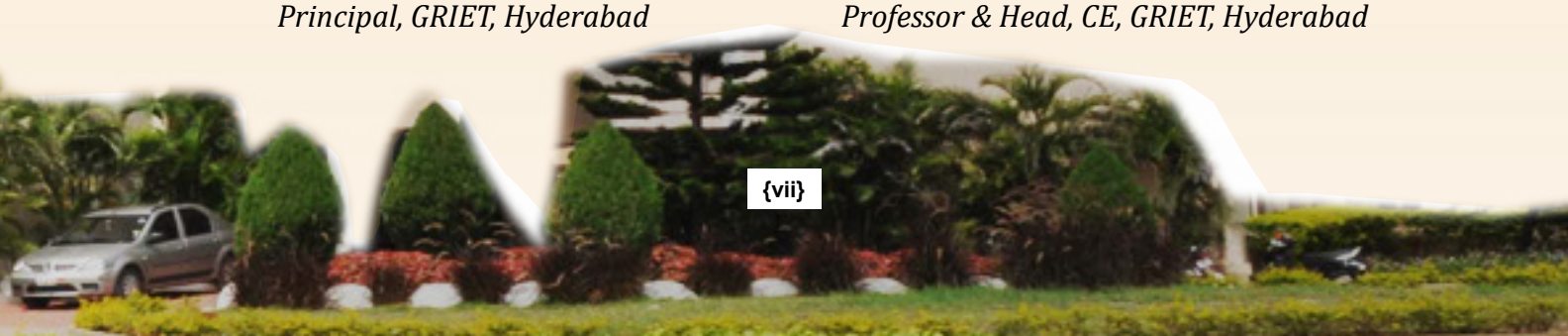

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Dr. Jandhyala N. Murthy
Director

Message

I am delighted that Department of Civil Engineering, Gokaraju Rangaraju Institute of Engineering and Technology is organizing an ***International Conference on Civil Engineering Aspects for Sustainability (IConCES 2020)*** during February 28–29, 2020.

Civil engineering field has been experiencing tremendous development in usage of technology and alternate materials. A shift in paradigm is visible in construction industry where academicians and practitioners preach and practice sustainability and smart concepts. High efficiency in usage of human resources and materials, low impact on environment are built into during all phases of design, construction and maintenance of any civil engineering effort.

This event will witness the participation from the students, research scholars, academicians and practicing engineers of Civil Engineering. This conference will encourage gaining the new insight into various civil engineering aspects for sustainability. It is indeed a laudable endeavor on part of Department of Civil Engineering, GRIET to invite eminent personalities from the field of civil engineering providing an ideal platform to share their knowledge and experiences.

I extend a warm welcome to all the participants and speakers and wish the conference a grand success.

Director
DIRECTOR
GOKARAJU RANGARAJU
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Dr. J. Praveen
Principal

Message

I am glad to announce that Department of Civil Engineering, Gokaraju Rangaraju Institute of Engineering and Technology is organizing an ***International Conference on Civil Engineering Aspects for Sustainability (IConCES 2020)*** during February 28–29, 2020 to ring out various civil engineering aspects for sustainability.

Sustainable engineering is the process of designing or operating systems such that they use energy and resources sustainably, in other words, at a rate that does not compromise the natural environment, or the ability of future generations to meet their own needs. Sustainability in civil engineering includes many different aspects like energy systems and technologies, building service engineering or management of resources. Several factors, such as functionality, area efficiency, energy demand, technical systems, materials, etc., influence the environmental load of a building. When planning a complex building, people with different competences and skills are needed to optimize different elements to find a suitable, holistic solution. In engineering, incorporating sustainability into products, processes, technology systems, and services generally means integrating environmental, economic, and social factors in the evaluation of designs. While the concepts of engineering for sustainability may seem simple in the abstract, converting the concepts into the quantitative design tools and performance metrics that can be applied in engineering design is a challenge growing populations and affluence, around the globe, have put increasing pressure on air and water, arable land, and raw materials. Concern over the ability of natural resources and environmental systems to support the needs and wants of global populations, now and in the future, is part of an emerging awareness of the concept of sustainability.

"Engineers in the 21st century will need to design for energy efficiency, mass efficiency, and low environmental emissions. Both short and long-term steps are needed to reduce fossil resource consumption and approach zero waste generation from engineered processes and products. The process of designing and/or operating systems in a way that reduces energy, waste, and use of toxic materials, calls for senior leaders in engineering management to continue to recommend and refine the steps necessary to ensure sustainability for organizations, people, and the planet.

I wish this conference would be a grand success and welcome all the delegates and eminent speakers to this conference.

J. Praveen

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Dr. V. Mallikarjuna Reddy
HOD & Convener, IConCES 2020

Message

It is my great privilege and honor to welcome you with open arms to the ***International Conference on Civil Engineering Aspects for Sustainability (IConCES 2020)*** organized by the Department of Civil Engineering at Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, Telangana during February 28–29, 2020. We are very much pleased to note the overwhelming response for our invitation from the authors for this conference.

The concept of sustainability is taking a more prominent role in civil engineering and construction curricula all over the world. Sustainability has environmental, economic and social dimensions; however, there is a tendency for the social dimension to receive less focus than the other two. Certainly, with their technical backgrounds and training, the majority of civil engineering and construction students are better prepared to understand and contribute to the environmental and economic dimensions of sustainability. Yet, an understanding of all dimensions is necessary to provide optimal, sustainable solutions to technical problems. A civil engineer is always concerned with four aspects, namely, Quality, Productivity, Safety and Economy (QPSE). In this changing environment the specifications for meeting the QPSE requirement are becoming more and more complicated. A multitude of threats confront us in our effort to achieve sustainability. Civil engineers have always been looking for innovative tools and techniques for solving the challenging problems that they face during planning, analysis, design and construction of civil engineering structures. This conference aims to confabulate the civil engineering aspects for sustainability. Eminent people of various Universities from India and Abroad will discuss their ideas about the theme of the conference. The conference will discuss about the innovative, economic, environmental and social measures that can be applicable in the construction industry.

I hope that the participants will enjoy the outstanding conference program of the International Conference on Civil Engineering Aspects for Sustainability (IConCES 2020) at the Department of Civil Engineering of Gokaraju Rangaraju Institute of Engineering and Technology that we create for them.

I wish all the participants a successful Conference and a pleasant stay in our campus.

May this conference be enriching, fruitful and memorable.

Convener

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BIODATA OF KEYNOTE SPEAKERS

Resources and Materials: A Historical Perspective and Comparison of Oriental and Occidental Attitudes on Higher Education

Dr. Laksmi N. Reddi
Dean of Engineering,
New Mexico State University USA

Dr. Reddi has served as dean of the University Graduate School and professor in the Department of Civil and Environmental Engineering at Florida International University. He has been director of the Academy of Graduates for Integrative Learning Experiences (AGILE) at Florida International University and has held numerous other administrative appointments throughout his career. From 2007–2011, he served as department chair and the Gerry and Ruth Hartman Professor in the Department of Civil, Environmental, and Construction Engineering at the University of Central Florida. From 2000–2007, he was head of the Department of Civil Engineering at Kansas State University, also serving as a professor in the department from 1999–2007. He was an associate professor in civil engineering at Kansas State University from 1995–1999 and an assistant professor in civil engineering there from 1992–1995. From 1989–1992, Reddi was an assistant professor in the Department of Civil, Environmental, and Coastal Engineering at Stevens Institute of Technology in Hoboken, New Jersey. He did his bachelor of technology in civil engineering from Jawaharlal Nehru Technological University in India, 1982, a master of science in civil engineering from The Ohio State University, 1984, and a doctor of philosophy in civil engineering from The Ohio State University, 1988. Dr. Reddi's academic career has been highly interdisciplinary in terms of both teaching and research. He embraced diverse teaching assignments at both undergraduate and graduate levels, and received numerous awards and recognitions, not only for his teaching, advising/mentoring, and research, but also for his administrative skills. He secured extramural funding of about $15 million from sponsors at all levels–federal (NSF, NASA, FHWA, EPA) and state agencies, regional centers, and local industries; and have enjoyed steady stream of NSF funding for more than two decades. His funded activities include basic and applied research, tech transfer and outreach, integrated research and education, and interdisciplinary research spanning about fifteen disciplines within and outside engineering. The research and outreach centers initiated by him, and the corporate and alumni academies established by him, continue to attract millions of dollars of federal, state, and local funding. Dr. Reddi authored/co-authored/edited 8 books and more than 120 technical articles representing several interdisciplinary themes in engineering. His book on integrative learning for STEM students is published in 2016. In his ongoing research on biomimetic systems of sustainable engineering and energy efficiency, he has established a collaborative network of researchers from Africa, America, Asia, and Europe, with core group of investigators from South Korea, France, US, India, and UK. While at Kansas State University, he received the Engineering Research Excellence Award and Presidential Award for the Outstanding Department Head. A two-time recipient of the James Robbins Teaching Award, Dr. Reddi is also a chapter honor member of Chi Epsilon, and Eminent Engineer of Tau Beta Pi. A Fellow of ASCE (American Society of Civil Engineers) and AAAS (American Association for Advancement of Science), Dr. Reddi was designated as "Distinguished Alumnus," by the Ohio State University in 2005. Engineering Societies of Central Florida honored him with the Engineering Leadership Excellence Award in 2010. He served on the Board of Directors of Florida Engineering Society and served on the GRE and TOEFL Boards of Directors within the Educational Testing Service (ETS).

Infrastructure for Sustainability: Opportunities for Civil Engineers in India

Prof. V.S. Raju
Formerly: Director,
IIT Delhi & Professor and Dean, IIT Madras

Prof. V.S. Raju was Director of IIT Delhi during 1995–2000. He holds the degrees of bachelors in Engineering from Andhra University, Masters from IISc Bangalore and Doctorate from Germany. During his academic career of 42 years, his other responsibilities include Member (Part time), Telecom Regulatory Authority of India, Head of the Department, Chairman Estate and Works, Dean of Industrial Consultancy and Sponsored Research at IIT Madras. During this period, he was extensively involved in academic, sponsored research and consultancy. He was also Chairman, Naval Research Board, DRDO, Government of India, Chairman,Research Council– Central Road Research institute and Member of several Boards and committees dealing with technical education and research in the country. He is a fellow of the Indian National Academy of Engineering and was its honorary secretary. The Federal Republic of Germany honored him with the Commander's Cross, the highest award given to a foreigner. He was also on the Boards of companies.

Sustainability in Civil Engineering

Sri A. Krishna Murthy
Former Director General (WALAMTARI)
Engineer-in-Chief (Retd.) Irrigation Dept, Govt. of Telangana

Worked in Irrigation Department of Govt. of Andhra Pradesh from 1969 to 2006 (37 years), in various capacities as Asst. Executive Engineer, Deputy Executive engineer, Executive Engineer, Superintending Engineer, Chief Engineer, Engineer-In-Chief and retired as Director General WALAMTARI (Water And Land Management Training And Research Institute) Hyderabad.

1. During the above period in charge of:
   a. Survey, Design, Construction of Major, Medium, Minor Irrigation, Lift Irrigation Projects in A.P.
   b. Preparation of Detailed Project Reports, Finalization of Tenders of irrigation, Building, Roads, Water supply Projects.
   c. Training of in-service Engineers of Irrigation dept., on all the technical matters pertaining to planning, design, construction of Irrigation projects.
2. After retirement worked in the following organizations:
   a. Ramky Enviro Engineers Ltd, Hyderabad from Aug. 2007 to Sept. 2008, in charge of planning of Municipal Solid Waste management Projects.
   b. Megha Engineering & Infrastructure Ltd Hyderabad, from Nov. 2008 till date in charge of monitoring of construction of Lift Irrigation projects, Drinking Water Supply Projects.
   c. Guest faculty to ESCI (Engineering Staff College of India, Hyderabad) on the topics pertaining to Tenders, contract management
   d. Guest faculty to WALAMTARI (Water And Land Management Training And Research Institute, Hyderabad) on topics pertaining to planning and construction of irrigation projects.
   e. Guest faculty to few engineering colleges.
   f. Chartered Engineer of Institution of Engineers (India).
   g. Licensed Engineer of GHMC.
   h. Registered Valuer with Income Tax Dept.

Conflict Early Warning System for Uncontrolled Intersections Based on the Active Safety Concept

Dr. Digvijay S. Pawar
Assistant Professor,
Department of Civil Engineering, IIT, Hyderabad

Digvijay S. Pawar is an Assistant Professor in Transportation Engineering in Department of Civil Engineering at IIT Hyderabad. He received his Masters and Doctoral degree in Civil Engineering from IIT Bombay, India in 2015. He completed his Bachelor of Engineering from Walchand College of Engineering, Sangli, India in 2009. His research interests include traffic operations, behavioral modeling, traffic and pedestrian safety, intelligent transportation systems and statistical modeling and classification techniques. His doctoral research focused on Performance evaluation and safety analysis of intersections and midblock street crossings in India. He was awarded for Excellence in Thesis Work for the Year 2014–2016 for the outstanding research contributions from the Indian Institute of Technology Bombay and Best Ph.D. Thesis on urban mobility in cities of developing countries from CODATU-2017. He has published in a number of leading journals, including Transportation Research Part C, Transportation Research Part F, Transportation Research Record, ASCE, Journal of Safety Research, Safety Science, and Transportation Letters.

Planning for Road Network, Land Use and Environment for Road Safety and Sustainable Infrastructure

Dr. Er. Ar. S.P. Anchuri
Visiting Professor, School of Planning & Architecture (SPA)-JNAFAU, Hyderabad
Vice-President (South), Structural Engineers World Congress (India)
Chief Consultant, ANCHURI & ANCHURI, Begumpet, Hyderabad

S.P. Anchuri, well known as Artist, Architect and Structural Engineer, Triple graduate & triple post graduate from reputed institutions in Civil Engineering, Architecture and Architectural Engineering, Business Administration, Structural engineering & Concrete construction management respectively. He has one Ph.D. in Structural Engineering from JNTUH and he is further doing research work on integrating architecture and structure to achieve optimized forms for efficient tall buildings. Dr. Er.Ar. Anchuri is chief consultant of Anchuri & Anchuri a 25 years old consultancy firm having offices in Hyderabad, Amravati and Vizag. Designed more than 1200 + buildings with integrated architectural and structural design approach. He is Technical Advisor for RMCMA (India) since 2010 and also a Visiting Faculty member at SPA, Hyderabad & SV College of Architecture, Madhapur. He is member of board of studies for various Institutions, guided more than 50 UG and PG students in their practical training and Thesis works. He is associated with many national and International professional bodies. Presently Dr. S.P. Anchuri is Vice President of SECW-Structural Engineers World Congress-India, GC member of ICI, Member of board of Governors-ASCE-India Section. Organized successfully many technical events including National and international Seminars, Workshops, etc. More than 400 Television Episodes were made with Mr. S.P. Anchuri on Various topics related to building industry. Few to name are “Shobhodayam” by Gemini TV, “Home Sweet Home” by Zee TV, presently Sri Nilayam on ETV AP & TS which is telecasted on every Sunday at 6.30 PM. Published number of articles in Newspapers, presented more than 75 Technical Papers in National and International Conferences, Seminars and Workshops. He is ECBC Expert and the first TPA for ECBC for Telangana, the first state in the country to implement ECBC in January 2018. He is involved in more than 30 major non-residential projects as ECBC consultant. He is also the first TPA in AP involved in few major projects.

Contents

FULL PAPERS

ABSTRACTS

Infrastructure for Sustainability: Opportunities for Civil Engineers in India

V. S. Raju
Formerly: Director, IIT Delhi & Professor and Dean, IIT Madras
E-mail: rajuvs_b@yahoo.com

SYNOPSIS

The 21st century challenges and crucial issues for India are briefly highlighted. Infrastructure is the key to sustainable development. Large scale investments in all sectors (Electricity, Roads and Bridges, Ports and Airports, Oil and Gas, Telecom, Railways, Irrigation and water supply, Sanitation and health care, etc.) are envisaged. Vision 2025 for India envisages investment in the infrastructure of INR 102 lakh crore. In addition, by 2030, INR 50 lakh crore are to be spent in Railways alone. Details of the investments sector wise are briefly mentioned. In addition, the urban sector and the rural sector which includes irrigation and agriculture and social infrastructure (e.g., Higher Education) will see significant investments. In all these developments, civil engineers have a major role to play.

21ST CENTURY CHALLENGES AND ISSUES

The world's future is in human hands as we are the dominating creatures of this planet right now. Our world is confronting certain challenges and crucial issues upon which we have to focus on. Some of them are:

a. Population Explosion and Poverty.
b. Depleting Natural resources.
c. Environmental degradation.
d. Widening inequalities in wealth and access to resources.
e. Social tensions, endemic youth unemployment.
f. High impact of technology on society, commerce, education, entertainment and lifestyles.
g. Demand for mass education.
h. Globalization.

ADDITIONAL CHALLENGES FOR INDIA

In addition to the above mentioned challenges and issues, India, as a developing country is facing the following crucial issues.

1. Population below poverty line: 23 % in 2018.
2. However rapid progress in the last two decades.
3. Reduction in number of poor people: 45 % in 1994 to 23 % in 2018.
4. Improvements in infrastructure, Ex: 1300 million cell phones in 2019.
5. Very good chance to catch up with the developed world.

RAPID URBANIZATION

The urban population in India in 2011 was 380 million i.e., about 31 % of the country's population. It is projected that by 2030 about 40 % of the estimated country's population i.e., 590 million will be urban. Such dramatic growth in the urban population imposes tremendous pressures. For survival, total dependence on infrastructure development for the transport of essential goods, water and food, public transport, sanitation, etc. In addition, for trade and development, massive efforts are needed to develop Highways, Railways, Metros, Airports and Seaports, etc.

NEEDS OF RURAL AREAS

India's rural population is currently about 70 % of the country's population. In fact, Rural India has a significant share in contributing to the GDP. Unfortunately, certain basic needs of these areas have to be still met and significant investments are envisaged. Some of them are mentioned below.

a. Proper Drinking water and sanitation.
b. Irrigation and its modernization.
c. Employment generation.
d. Quality Health care and education.

INFRASTRUCTURE

Agriculture, infrastructure, manufacturing and services are the pillars of the Indian Economy. Infrastructure is the very basis of economic development. It is a key driver for development and provides vital support to productive sectors. The role of the private sector in financing infrastructure in partnership with the public sector is gaining universal acceptance - Evolution of Public-Private Partnership (PPP).

The fundamental needs of the people can only be met through proper infrastructure. India ought to invest in infrastructure to attain a phenomenal development of the nation. These include investments across electricity, roads & bridges, ports & airports, oil & gas, telecom, railways, irrigation and water supply, sanitation and health care, etc.

SOME OF THE EXCERPTS FROM VISION 2025 FOR INDIA

GDP is likely to grow at 5–6 % in FY20.To maintain the growth momentum, massive investments are required in infrastructure. India plans to invest about INR 102 lakh crore[1] in infrastructure by 2025. In addition, investments in Railways alone is about INR 50 lakh crore[2] by 2030.

INDIA'S VISION IN VARIOUS SECTORS OF INFRASTRUCTURE

India envisions a huge development in infrastructure by 2025. The focal points from the Vision 2025[3] are briefly presented in the following table.

Table 1: Brief Idea of Current Status and Vision 2025 of Various Sectors in Infrastructure in India

S. No.	Sector	Area	Current Status	Vision 2025
1	Road	NH length	~1.32 lakh km	~1.99 lakh km (1.5 times)
		Express ways	~1600 km	~20,000 km (12.5 times)
2	Energy	Total capacity	356 GW	619 GW (1.7 times)
		Renewable energy	22 %	39 % (1.8 times)
		Per capita electricity consumption	1200 kWh	1600 kWh (1.3 times)
		Renewable energy share in consumption	9 %	19 % (2 times)
3	Airport	Global ranking	3	2
		Number of operational airports4	107	200 (2 times) by 20405
		Airport capacity in million passengers6	317	500 – 600 (2 times)
4	Urban	Drinking water on their premises	25 %	100 %
		Treatment of municipal solid waste generated	25 %	100 %
		No of cities having metro rail transit system	11	>25 (2.3 times)
5	Irrigation	Area under Irrigation in million hectares	~68	~85 (1.25 times)
		River interlinking	No	Yes
6	Rural	Rural population having access to Pucca houses7	~ 66 %	~ 100 % (1.5 times)
		Households having access to piped water supply	18 %	100 % by 2024 (5.5 times)
		Open Defecation Free	90 %	100 %
7	Agriculture	Food grains damage due to lack of proper storage facilities8	10 %	Minimum / No damage
		Silo storage	7.25 lakh MT	Additional 100 lakh MT (14 times)
8	Social Infrastructure (e.g., Higher Education)	Gross enrolment ratio among 18-23 years age group9	26.3 %	40 %

EDUCATIONAL INFRASTRUCTURE

Enormous growth occurred in education at all levels during the last decade. The educational institutions and training facilities require huge building infrastructure, power, water and sanitation, etc. Quality of education is still a challenge faced by India due to the following reasons.

a. **Estimate:** Only 25% of the graduates are employable.
b. Acute shortage of Faculty.
c. Limitations on Infrastructure.
d. Lack of Interaction between Academia and Industry.

Possible Solutions

There is a lot of room to create high quality, globally benchmarked, technical educational opportunities in India, to meet Indian and global demand.

Networking

For optimum utilization of scarce resources and for mutual benefit: among academic institutions in the country, region and globally.

Academia–Industry Interaction

This is a must for quality education. It improves the overall quality of faculty and makes teaching more relevant. Relevant student projects associated with industries should be encouraged. The following ideas can enhance the Academia–Industry interaction.

a. Faculty to spend part of their vacation with the Industry
b. Persons from Industry to give special lectures to students; to serve as visiting faculty and teach part of a course
c. Joint guidance of student projects

Comparing India *vs.* China

GDP of China was 1.2 times that of India in 1982 whereas in 2002 it has grown to 2.6 times followed by 4.5 times in 2012. By 2002, China lifted 400 million people out of the poverty line resulting in a rate declining to 4.6%. Indian poverty rate reduced from 45% in 1994 to 23% in 2018. The poverty reduction rate in India is slow compared to china.

Implementations

Investments

Public investment is the key in addition Public-Private Partnership is also a priority. Implementation will be faster with better quality through PPP. Monetization of assets (e.g., disinvestment) is very crucial.

Additional Advantage of Demographic Dividend

India has a significant advantage because of its demography. The labour force in India is likely to increase by 32% over the next 20 years which is an advantage for us whereas labour force declines by 4–5% in most economies including China.

Entrepreneurial Skills

Indian government should continue encouraging Young entrepreneurs. Educational institutions have a key role in the emergence of young and dynamic entrepreneurs. Proper awareness about entrepreneurship should be developed among the youth. Faster decisions, quicker implementation, high aspirations are the key.

Success Stories:

- **IT Sector:** TCS, INFOSYIS, WIPRO
- **Telecom:** ≈1300 million Cell phones (January 2020) - Airtel, Vodafone, Idea, Reliance Jio.

OPPORTUNITIES AND CHALLENGES

Infrastructure deficit, Young workforce, Growth Momentum and Global Demand are the opportunities for our country. Domestic Construction capacity, technology absorption, land acquisition, skills shortage are the current challenges to be addressed by the country.

DO YOU KNOW?

At the time of Emperor, Akbar, (1556 – 1605) India was the richest economy in the world.

OUR RESPONSIBILITIES AS CITIZENS

To attain a phenomenal development both at a personal level and country level, one should have certain responsibilities which are mentioned below.

1. Have a positive attitude.
2. Be focused.
3. Have self-confidence.
4. Work towards continuous self-improvement.
5. Think also of common good.

CONCLUSIONS

India is on a phenomenal growth path. The core of this growth is sustainable infrastructure. Very substantial investments are envisaged in all the areas of the infrastructure in the next five years. The effective and efficient role of civil engineers is the key to the success of these initiatives.

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Sustainability in Civil Engineering

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Sustainability in general is defined as maintaining an ecological balance by judicious usage of natural resources. In civil engineering sustainability means restricted usage of natural resources for maintaining the ecological balance in the nature. In other words, lesser usage of construction materials directly available in nature like River Sand, Crushed Aggregates, Timber etc. The immediate need of the hour is, judicious use of these construction materials readily available in nature, to protect the environment and there by protect our future generations. Many alternate/economical construction materials are available for use in construction. But public in general are not aware of the availability / usability of these alternate construction materials. This article is to high light the availability of alternate construction material available for use in building construction which is a major infrastructure activity in the society. Due to excessive usage of River Sand no sufficient percolation is taking place in Rivers and there by the ground water is depleting. Similarly, due to excessive quarrying of granite for producing crushed aggregate, the mountains are disappearing which otherwise help in distribution of rainfall. Due to excessive usage of Timber for doors, windows etc the forests are depleting causing reduction in rainfall.

To quote few examples(a) crusher dust is available to partially replace river sand (b) demolished concrete waste can be crushed and reused as aggregate to partially replace the crushed coarse aggregate (c) UPVC door/windows can be used to replace conventional teak wood door/windows.

Lot of research has been done on usage of these alternate construction material, but the public in general are not aware of these alternative construction material. The present paper is on the availability and usage of the alternate materials for civil engineering works to protect the environment and maintain ecological balance.

USE OF CRUSHER DUST/ROBO SAND IN PLACE OF RIVER SAND

Crusher dust is an inert material as that of sand. Many of properties match with that of river sand. So, it is an efficient replacement material for sand. Crusher dust replacement for this sand not only reduce the usage of river sand but also reduce the cost of construction, as it is a waste available in abundant. Thus, economy in construction also can be achieved besides environmental protection.

- River sand poses the problem of acute shortage in many areas.
- Removal of river sand causes scouring of riverbeds and loss of natural minerals present in the river.
- On removal of river sand, which acts as filter media, ground water get polluted.

ENGINEERING PROPERTIES OF CRUSHER DUST

Properties like chemical and mineralogical composition, petrographic classification, specific gravity, hardness, strength, physical and chemical stability, pore structure and colour depends on parent rock. Which is crushed to produce concrete aggregates.

PHYSICAL PROPERTIES OF CRUSHER DUST

The physical properties of natural sand and crusher dust used in the present experimental investigations are carefully studied and results are tabulated. All the values for the natural sand and crusher dust have been found by conducting respective test in the laboratory as per IS code provision. It is observed from the tabulated value, that the properties of natural sand and crusher dust give the parallel values.

Properties	Natural Sand	Crusher Dust
Specific gravity	2.66	2.46
Bulk density	1.64	1.69 gm/cc
Void ratio	0.476	0.458
Fineness modulus	2.09	1.60

TESTS ON CONCRETE

Basic M20 grade mixes was chosen for natural sand to achieve M20 concrete. The equivalent mix were obtained by replacing natural sand by crusher dust partially and fully. The test result indicates that crushed stone dust can be used effectively to replace natural sand in concrete. On replacement of sand by crusher dust the compressive strength, split tensile strength, flexural strength and shrinkage reduction increases gradually up to 40% replacement and degreases more than 40% replacement.

Sl. No.	Replacement %	M20 (N/mm^2) 40 % Replacement		
		Compressive Strength	Split Tensile Strength	Flexural Strength
1	0	40.30	3.74	3.60
2	10	42.35	4.00	3.75
3	20	42.50	3.96	4.23
4	30	42.52	4.30	3.76
5	40	45.30	4.45	3.58
6	60	43.25	3.86	4.15

TESTS ON MORTAR

In this study the test was conducted on sand of 10 different fineness moduli and tested for workability and strength. The cement crusher dust mortar strength is higher compare to cement sand mortar when the replacement percentage is 0-40 percentage.

Fig. 1: River Sand

Fig. 2: Crushed Sand

USE OF RECYCLED CONCRETE AGGREGATE IN PLACE OF CRUSHED AGGREGATE

It is now widely accepted that there is a significant potential for reclaiming and recycling of concrete demolished waste and use in value-added applications to have economic and environmental benefits.

Costs to dispose of C&D wastes have risen dramatically in recent years, forcing us to re-evaluate waste disposal methods and choose whether to view C&D waste as a resource.

CONSTRUCTION AND DEMOLITION WASTES

According to (DEFRA, 2008) C&D (Construction and Demolition) waste is one of the major kind of solid waste being sent to landfills, Kartam *et al.* (2004) has determined that the amount of building and construction waste literally being generated is about 500-1000 Kg/capita per annum. The root cause for the generation of the C&D waste is inherently due to the never ending process of constructions, re-construction, Building, Roads, etc.,

some of the ways in which these C&D wastes can be reutilized are as follows: as concrete aggregate for Road construction, Water bound macadam layers, Drainage material and backfill material, Production of cement blocks (using powdered concrete), paved tiles.

USE OF RECYCLED CONCRETE AGGREGATE

Concrete is indisputably the inherent construction material, that is used in different construction works and the facts reflect that around 800 factories are producing about 36 million tonnes of precast concrete products every year. According to Noriega (2011), that the conventional aggregate can be confidently replaced by recycled concrete aggregate as it exhibited similar compressive strength and bearing

Recycled aggregates comprises of original aggregates and adhered mortar. The physical properties of recycled aggregates depend on both adhered mortar quality and the amount of adhered mortar. The adhered mortar is a porous material; its porosity depends upon the w/c ratio of the recycled concrete employed. Crushing concrete to produce coarse aggregate for the production of new concrete is one common means for achieving a more environment-friendly concrete. This reduces the consumption of the natural coarse aggregate obtained by crushing of rocks. The crushing procedure and the dimension of the recycled aggregate have an influence on the amount of adhered mortar. The density and absorption capacity of recycled aggregates are affected by adhered

In India its common practice to pile Construction and Demolition (C&D) projects to pile waste on the roads, resulting in traffic congestion. C&D waste from individual households finds its way into nearby municipal bins making the municipal waste heavy.

Estimated waste generation during construction is 40 kg per m^2 to 60 kg per m^2. Similarly, waste generation during renovation and repair work is estimated to be 40 kg per m^2 to 50 kg per m^2. The highest contribution to waste generation comes from the demolition of buildings. Demolition of pucca (permanent) and semi-pucca buildings, on average generates between 300kg per m^2 and 500 kg per m^2 of waste, respectively.

Fig. 3: Construction & Demolition Waste

Fig. 4: C & D Wastes Converting to Aggregates

ALTERNATE DOORS & WINDOWS IN PLACE OF TEAKWOOD DOORS & WINDOWS

The traditional Teak wood doors and windows being are prepared with teakwood obtained by cutting of trees thus depleting the forests. These teakwood doors, windows can be replaced with cement based particleboards, UPVC, MS/Aluminum/ Glass doors and windows, RCC Door and window frames etc.,

The alternate material doors and windows are in fact economical than the traditional teakwood doors and windows.

Fig. 5: UPVC Windows

Fig. 6: RCC Window Frames

CONCLUSION

In view of that stated above there are numerous alternate materials available for use in civil engineering works in place of the materials directly obtainable from nature, to avoid serious ecological in imbalance.

It is the responsibility of every civil engineer to propagate use of alternate construction material available to save the mother earth for future generation.

Conflict Early Warning System for Uncontrolled Intersections based on the Active Safety Concept

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Understanding gap acceptance behavior of drivers is a key in evaluating performance and safety of unsignalized intersections. Aggressive drivers accept smaller gaps thus, decreasing the delay but thereby reducing the safety. The process is complicated because the gap acceptance behavior is associated with driver characteristics, vehicle types, and the prevalent conditions. Stop and yield signs are used to give priority to various movements at unsignalized intersections in the USA and other developed countries. In India, several unsignalized intersections do not have stop or yield signs. Even if the priorities are indicated with signage, drivers do not follow the indicated priorities because of the non-existent enforcement of priorities at these unsignalized intersections. At a few intersections, where major and minor roads are clearly perceived by drivers, priorities are partially followed mainly because of the concern for safety.

The drivers arriving at the TWSC intersection from the controlled approach are required to come to a full stop and then estimate the gaps on the major road, and enter the intersection when there is a large enough gap between two successive vehicles on the major stream to safely execute the desired maneuver in such a manner that the traffic stream on the mainline remains unaffected. Therefore, the drivers on the minor road need to decide when a gap allows for a safe entry, while also conforming to the right of way hierarchy. This decision making process is commonly known as gap acceptance and depends on three basic factors; (a) Availability of gaps between vehicles on the major road of a particular size and arrival pattern. (b) Usefulness of gaps and the extent to which drivers find gaps of a particular size useful to perform their planned maneuver. (c) Relative priority of movements at the intersection which typically promotes the movement of major stream vehicles.

This study analyzed drivers' gap acceptance behavior at uncontrolled intersections and used gap acceptance analysis results to reduce the traffic conflicts by proposing a new early warning system based on the active safety concept. The designed early intersection conflict warning system collects real time approaching vehicle data using roadside sensors and transmits the data to the driver on other approaches in a timely manner via traffic warning lights. The proposed system enables derivers to perceive possible conflicting vehicle in advance so as to ensure safe driving and avoid sudden braking phenomena. The findings of this study indicate that the gap acceptance principles are important to evaluate the safety systems at partially controlled intersections in India. The demonstrated active safety systems have high potential to reduce the crashes at uncontrolled intersections.

Planning for Road Network, Land Use and Environment for Road Safety and Sustainable Infrastructure

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Abstract—Urban form, built environment, community design, spatial development, and urban geography as a whole Land use development patterns refer to human use of the earth's surface, including the location, type and design of infrastructure such as roads and buildings. This paper examine ways that transportation decisions affect land use patterns, and the resulting economic, social and environmental impacts. These include direct impacts on land used for transportation facilities, and indirect impacts caused by changes to land use development patterns. In particular, certain transportation planning decisions tend to increase dispersed, urban-fringe, automobile-dependent development, while others support *smart growth* like more compact, infill, multi-modal development. These development patterns of road network have various economic, social and environmental impacts. This paper describes specific methods for evaluating these impacts in transport planning.

INTRODUCTION

During the last century, many transportation and land use planning practices toughened a cycle of increased automobile dependency and spread out. This was usually unintentional, reflecting a lack of consideration of the full impacts of these decisions.

Land use patterns can have diverse economic, social and environmental impacts: some require less impervious surface includes buildings and pavement, also called sealed soil per capita and so preserve more open space viz. gardens, farmland and natural habitat, and some are more accessible and so reduce transportation costs to businesses and consumers.

Road networks, transportation planning decisions influence land use directly, by affecting the amount of land used for transport facilities, and indirectly, by affecting the location and design of development. Expanding urban highways increases pavement area, and encourages more dispersed, automobile-oriented development–sprawl, Urban sprawl or suburban sprawl describes the expansion of human populations away from central urban areas into low-density, mono functional and usually car-dependent communities, in a process called suburbanization., while walking, cycling and public transit improvements encourage compact, infill development called sustainable and smart growth. A Road Safety Audit is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

ROAD NETWORK, LAND USE AND ENVIRONMENT FOR ROAD SAFETY

Having complex relationship amongst themselves there are several steps between a **transport planning decision**(development practices, infrastructure investment, zoning, development fees, etc.),

its **impacts on urban form**-Urban Forum Patterns, (density, mix, connectivity, parking supply, etc.) and **travel behaviour** (amount and type of walking, cycling' public transit and automobile travel), **Land Use** (Impervious surface coverage, green space, public service costs) and its **ultimate economic, social and environmental impacts** (consumer costs, public service costs, physical fitness, crashes, pollution emissions, etc.). A particular planning decision can have a variety of impacts and costs can be summarized as following:

Table 1: Transport Planning Land Use Impacts and Costs

Increased Pavement Area	More Dispersed Development
● Reduced open space (gardens, parks, farmlands and wildlife habitat). ● Increased flooding and storm water management costs. ● Reduced groundwater recharge. ● Aesthetic degradation.	● Reduced open space (farmlands and wildlife habitat). ● Longer travel distances, more total vehicle travel. ● Reduced accessibility for non-drivers, which is inequitable (harms disadvantaged people). ● Increased vehicle traffic and resulting external costs (congestion, accident risk, energy consumption, pollution emissions).

CYCLE OF AUTOMOBILE DEPENDENCY AND SPRAWL (SPREAD OUT)

For example, when deciding how much parking to require for a particular type of land use, traffic engineers were probably not thinking about the additional sprawl that would result from a more generous standard, they simply wanted to ensure motorist convenience. Similarly, planning decisions that affect roadway supply, transit service quality or roadway user fees often overlooked various land use impacts.

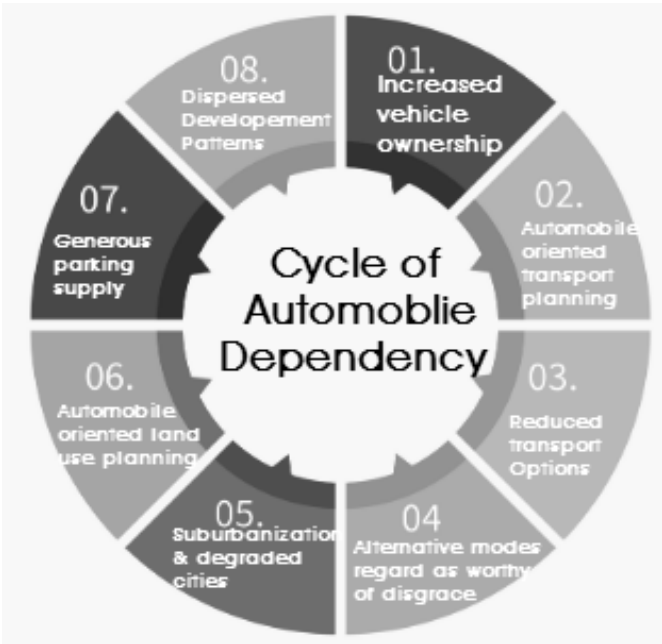


Fig. 1: Illustrates the Self-reinforcing Cycle of Increased Automobile Dependency and Sprawl

EVALUATION FRAMEWORK FOR LAND USE IMPACT

An evaluation framework specifies the basic structure of an analysis, including which impacts are considered and how they are measured and compared. A framework usually identifies:

- Evaluation method, such as cost-effectiveness, benefit-cost, lifecycle cost analysis, etc.
- Evaluation criteria are the factors and impacts considered in a particular analysis.
- Modelling techniques, which predict how a policy change or program will affect travel behaviour and land use patterns, and measure the incremental benefits and costs that result.
- A Base Case (also called do nothing), the conditions that would occur without the proposed policy or program.
- Reference units, such as costs per lane-mile, vehicle-mile, passenger-mile, incremental peak-period trip, etc.
- Base year and discount rate, indicating how costs are adjusted to reflect the time value of money.
- Perspective and scope, such as the geographic range of impacts to consider.
- Dealing with uncertainty, such as sensitivity analysis and statistical tests.
- How results are presented, so that the results of different evaluations are easy to compare.

Following table lists various types of land use impacts that may be affected by transport planning decisions:

Table 2: Land Use Impact Evaluation Criteria

Economic	Social	Environmental
● Value of land devoted to transportation facilities. ● Land use accessibility. ● Transportation costs. ● Property values. ● Crash damages. ● Costs to provide public services. ● Economic development and productivity. ● Storm water management costs.	● Relative accessibility for different groups of people– impacts on equity and opportunity. ● Community cohesion. ● Housing affordability. ● Cultural resources (e.g., heritage buildings). ● Traffic accidents. ● Public health (physical fitness). ● Aesthetic impacts.	● Greenspace and wildlife habitat. ● Hydrologic impacts. ● Heat island effects. ● Energy consumption. ● Pollution emissions.

LAND USE CATEGORIES

The earth's surface, called the landscape, is a unique and valuable resource. The landscape affects and is affected by most economic, social and environmental activities. Major land use categories are listed below.

Table 3: Land Use Categories

Built Environment	Open Space
● Residential (single- and multi-family housing) ● Commercial (stores and offices) ● Institutional (schools, public offices, etc.) ● Industrial ● Brownfields (old, unused and underused facilities) ● Transportation facilities (roads, paths, parking lots, etc.)	● Parkland ● Agricultural ● Forests, chaparral, grasslands ● Wild lands (undeveloped lands) ● Shorelines

Land use patterns can be evaluated based on the following **attributes**:

- ***Density:*** the number of people, jobs or housing units in an area.

- ***Clustering:*** whether related destinations are located close together (e.g., commercial centers, residential clusters, urban villages, etc.).
- ***Mix:*** whether different land use types (commercial, residential, etc.) are located together.
- ***Connectivity:*** the number of connections within the street and path systems.
- ***Impervious surface:*** land covered by buildings and pavement, also called the footprint.
- ***Greenspace:*** the portion of land used for lawns, gardens, parks, farms, woodlands, etc. The *Green Area Factor* or *Green Area Ratio* (GAR) refers to the portion of land that is greenspace.
- ***Accessibility:*** the ability to reach desired activities and destinations.
- ***Nonmotorized accessibility:*** the quality of walking and cycling conditions.

Land use **attributes** can be evaluated at various scales:

- ***Site:*** an individual parcel, building, facility or campus.
- ***Street:*** the buildings and facilities along a particular street or stretch of roadway.
- ***Neighborhood or center:*** a walkable area, typically less than one square mile.
- ***Local:*** a small geographic area, often consisting of several neighborhoods.
- ***Municipal:*** a town or city jurisdiction.
- ***Region:*** a geographic area where residents share services and employment options. A metropolitan region typically consists of one or more cities and various suburbs, smaller commercial centers, and surrounding semi-rural areas.

Geographic areas are often categorized in the following ways:

- ***Village:*** Small urban settlement (generally less than 10,000 residents).
- ***Town:*** Medium size urban settlement (generally less than 50,000 residents).
- ***City:*** is a large settlement (generally more than 50,000 residents).
- ***Metropolitan region or metropolis:*** a large urban region (generally more than 500,000 residents) that usually consists of one or two large cities, and various smaller cities and towns (called suburbs). This development pattern is considered a polycentric.
- ***Urban:*** relatively high density (10+ residents and 5+ housing units per acre), mixed-use development, multi-modal transportation system.
- ***Suburban:*** medium density (2-10 residents, 1-5 housing units per acre), segregated land uses, and an automobile-dependent transportation system.
- ***Central business district (CBD):*** the main commercial center in a town or city.
- ***Exurban:*** low density (less than 2 residents or 1 housing unit per acre), mostly farms and undeveloped lands, located near enough to an urban area that residents often commute, shop and use services there.
- ***Rural:*** low density (less than 2 residents or 1 housing unit per acre), mostly farms and undeveloped lands.

Housing can be categorized in various ways

- ***Small lot:*** less than 7,000 square feet.
- ***Medium lot:*** 7,000 to 12,000 square feet.
- ***Large lot:*** more than 12,000 square feet (0.3 acres)

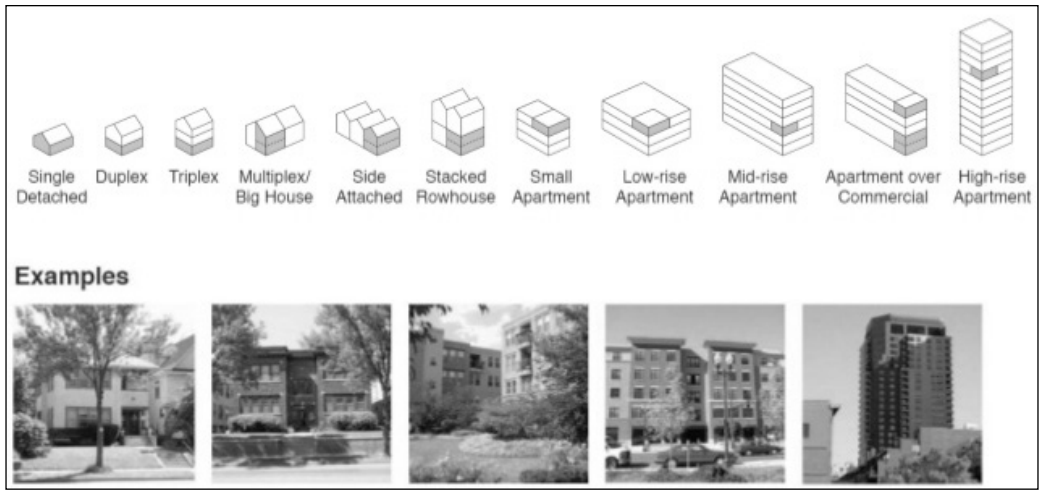


Fig. 2

GENERAL TYPES OF HOUSING

There are often debates about different development patterns, generally termed *sprawl* and *smart growth*. Following Table compares these patterns.

Table 4: Comparing Sprawl and Smart Growth

Attribute	Sprawl	Smart Growth
Density	Lower-density.	Higher-density.
Growth Pattern	Urban periphery (greenfield) development.	Infill (brownfield) development.
Activity Location	Commercial and institutional activities are dispersed.	Commercial and institutional activities are concentrated into centers and downtowns.
Land Use Mix	Homogeneous land uses.	Mixed land use.
Scale	Large scale. Larger buildings, blocks, wide roads. Less detail since people experience the landscape at a distance, as motorists.	Human scale. Smaller buildings, blocks and roads, care to design details for pedestrains.
Transportation	Automobile-oriented transportation, poorly suited for walking, cycling and transit.	Multi-modal transportation that support walking, cycling and public transit use.
Street Design	Streets designed to maximize motor vehicle traffic volume and speed.	Streets designed to accommodate a variety of activities. Traffic claming.
Planning Process	Unplanned, with little co-ordination between jurisdictions and stakeholders.	Planned and co-ordinated between jurisdictions and stakeholders.
Public Space	Emphasis on the private realm (yards, shopping malls, gated communities, private clubs).	Emphasis on the public realm (streetscapes, sidewalks, public parks, public facilities).

Most metropolitan regions are polycentric, with a central business district surrounded by smaller commercial centers, and a central city surrounded by smaller cities and towns. Sprawl refers to dispersed development in low-density, single-use, automobile-dependent areas outside of any city or town; population growth in cities and towns outside existing cities is not necessarily sprawl if the development pattern reflects smart growth principles.

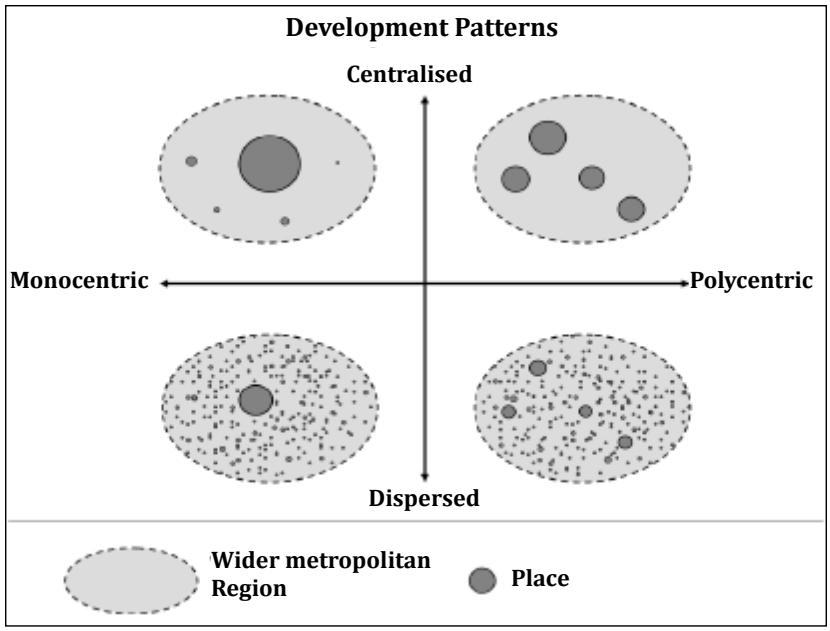


Fig. 3 Most Metropolitan Regions are Polycentric, with Various Business Districts, Cities and Towns. Sprawl consists of Dispersed, Low-density, Automobile-dependent Development Outside any Urban Area

How Transportation Planning Decisions Affect Land Use

Transportation planning decisions affect land use, both directly by determining which land is devoted to transport facilities such as roads, parking lots, and ports, and indirectly by affecting the relative accessibility and development costs in different locations . In general, policies that reduce the generalized cost (financial costs, travel time, discomfort, risk) of automobile travel tend to increase total traffic and sprawl, while those that improve non motorized and transit travel tend to support Smart Growth, are summarized in following Table.

Table 5: Transportation Policy and Program Land Use Impacts

Encourages Sprawl	Encourages Smart Growth
● Increased roadway capacity and speeds ● Generous minimum parking requirements. ● Free or subsidized parking. ● Low vehicle operating costs. ● Inferior public transit service. ● Poor walking and cycling conditions.	● Reduced roadway capacity and speeds. ● Reduced parking supply. ● Parking pricing and management. ● Road pricing and distance-based vehicle fees. ● Transit service improvements and encouragement strategies. ● Pedestrian and cycling improvements. ● Traffic calming and traffic speed reductions. ● Access management and streetscape improvements.

Planning decisions often involve trade-offs between mobility (physical movement of people and goods) and accessibility (the ability to reach desired goods and activities). Incremental increases in road and parking supply create more dispersed land use patterns, increasing the travel distances required to achieve a given level of accessibility. This favors automobile travel and reduces the utility and efficiency of other transport modes. By increasing the amount of land required for a given amount of development, higher road and parking requirements favor urban fringe development, where land prices are lower. As a result, automobile-oriented planning is self-fulfilling: practices to make driving more convenient make alternatives less convenient and increase automobile-oriented sprawl.

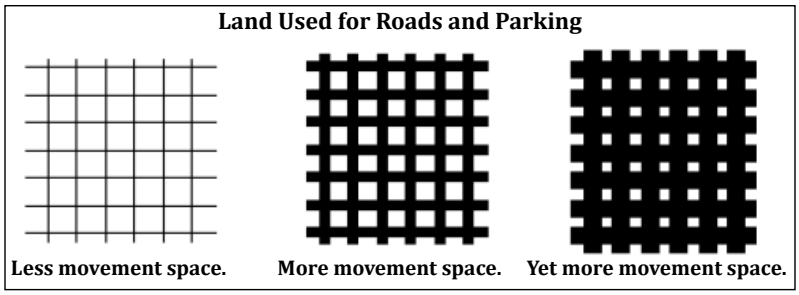


Fig. 4: Automobile Transport Requires Relatively Large Amounts of Land for Roads and Parking, which Reduces the Amount of Land Available for other Activities. This Tends to Disperse Destinations

ROAD NETWORK

Most roads have two to four lanes, each 10-14 feet wide, plus shoulders, sidewalks, drainage ditches and landscaping area, depending on conditions, so typical urban roads with two traffic and two parking lanes have 30-40 foot total widths. Road rights-of-way (land legally devoted to roads) usually range from 24 to 64 feet wide. In high density urban areas road pavement often fills the entire right-of-way, but in other areas there is often an unpaved shoulder that may be planted or left in its natural condition. The amount of land devoted to roads is affected by:

- Projected vehicle traffic demand (which determine the number of traffic lanes).
- Design standards that determine lane and shoulder widths, drainage and landscaping.
- On-street parking practices (whether streets have parking lanes).
- Additional design features, such as shoulders, sidewalks, ditches and landscaping.

A vehicle's road space requirements tend to increase with its size and speed. For example, a vehicle travelling on an urban arterial at 50 km -per-hour (mph) requires about 12 feet of lane width and 60 feet of lane length, or about 720 square feet in total, but at 100 kmph this increases to 15 feet of lane width and 140 feet of length, or about 2,100 square feet in total. A bus requires about three times a much road space (measured as "passenger car equivalents") but typically carries 10-20 times as many passengers under urban-peak conditions.

Automotive transportation allowed and encouraged radical changes in the form of cities and the use of land. Cheap land in the outer parts of cities and beyond became attractive to developers, much of it being converted from agricultural uses. Most of the new housing was in the form of single-family homes on generously sized lots. Automobiles were easily able to serve such residential areas, while walking became more difficult, given the longer distances involved, and mass transportation found decreasing numbers of possible patrons per km of route.

Table 6: Automobile Transportation Land Use Impacts

Land Use Factors	Impact
Impervious surface	Portion of land area that is paved for transportation facilities.
Density	Reduces density. Requires more land for roads and parking facilities.
Dispersion	Allows more dispersed urban-fringe destinations.
Mix	Allows single-use development where common services are unavailable in neighbourhoods.
Scale	Requires large-scale roads and blocks.
Street design	Roads emphasize vehicle traffic flow, de-emphasize pedestrian activities.
Pedestrian travel	Degrades pedestrian environment by increasing air and noise pollution, and risk.

This table identifies how automobile-oriented transport planning supports sprawl.

Road Network/ Structures

The suitability of the three different network structures can be judged by the following indicators:

Road Safety

- travel distances.
- volumes on residential streets (exclusion of through-traffic).
- driving speeds (limited number of straight road sections).
- share of T-intersections.

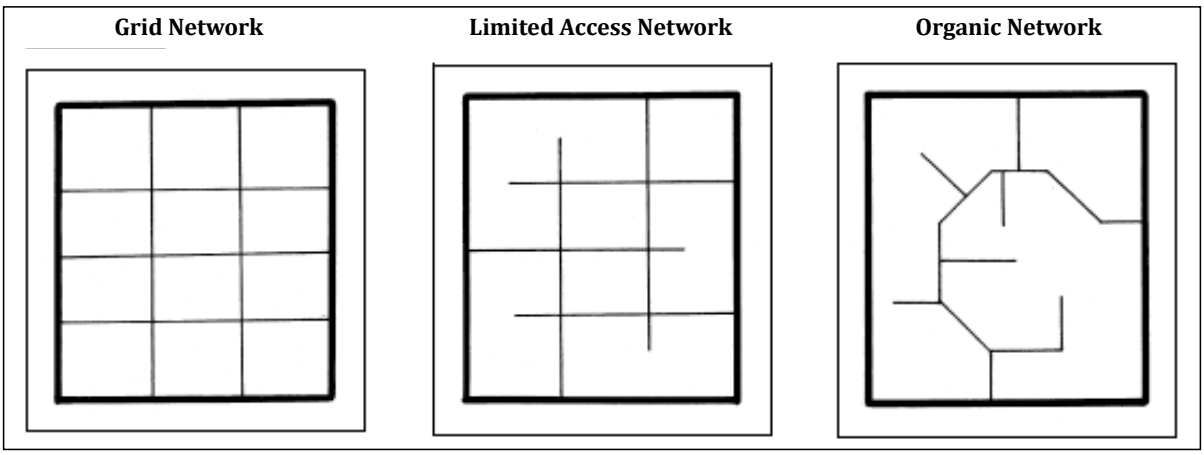
Accessibility

- travel distances.
- detours.
- distribution of volumes on road network.

Costs

- length of traffic network's roads.
- requirement of speed reducing measures.

There are three basic road structures:

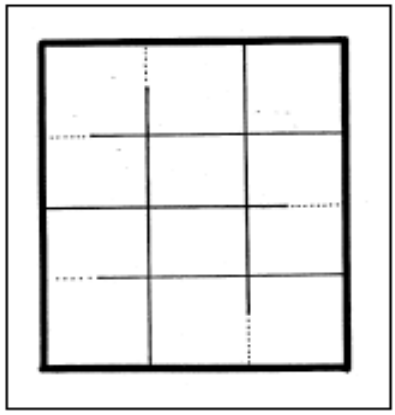


	Grid Network	Limited Access Network	Organic Network
Road Safety	–	+	++
Accessibility	++	+	–
Costs	–	++	+

Table shows the Score of three network structures on three indicators. The score'-' indicates that an aspect has scored badly: high costs, many accidents, poor accessibility.

Provisions for alternative modes: To promote the use of alternative modes (walking, cycling, transit), short and direct routes are very important. A grid network provides short and direct routes, and is therefore the most appropriate network structure for alternative modes. Other network structures could be adapted by creating shortcuts for exclusive use by the alternative modes (cycle track, bus lane).

In this way also limited access or organic networks can provide short and direct routes to promote alternative modes.



COSTS AND BENEFITS OF DIFFERENT LAND USE PATTERNS

ACCESSIBILITY AND TRANSPORTATION COSTS

Study of economic, social and environmental impacts affected by land use patterns, particularly the costs and benefits of sprawl and Smart Growth is essential. People sometimes assume that by increasing development density smart growth increases traffic congestion but this is not necessarily true.

We can have less traffic congestion on roads in more compact urban neighbourhoods than in lower density suburban neighborhoods due to more mixed land use (particularly more retail in residential areas) which reduces trip lengths, more no motorized and public transport use, and a more connected street networks which substantially reduced vehicle travel on major roadways. Smart growth is particularly beneficial to physically, economically and socially disadvantaged people who tend to be constrained in their ability to drive. Smart growth improves non drivers overall accessibility and reduces the portion of lower-income household budgets devoted to transportation.

Household Affordability

Land use patterns affect housing costs . Sprawl reduces unit land costs (dollars per acre) and so reduces costs for larger-lot homes, while Smart Growth reduces land requirements per housing unit, reduces parking requirements, and expands housing types, but may require structured parking and increase other building costs. As a result, overall cost impacts depend on how the question is framed.

Infrastructure and Public Service Costs

Increasing density tends to increase the cost efficiency of providing public infrastructure and services by reducing road and utility line lengths, and travel distances required for services such as garbage collection and emergency response As a result, the per capita costs of providing a given level of services tends to decline with more compact, mixed and connected development.

Safety and Health

Land use patterns affect public safety and health .Although increased density tends to increase crash rates per vehicle-mile, it tends to reduce per capita vehicle travel and traffic speeds, which reduces crash

severity and per capita traffic fatalities. Urban residents will have lower total violent death rates, including traffic injuries and homicide, than suburban residents. Similarly, traffic fatality rates tend to decline with increased per capita transit ridership, probably reflecting the effects of transit-oriented development on travel.

Economic Productivity and Development

Land use patterns affect economic productivity and development. All else being equal, greater accessible and lower transport costs increase economic productivity. More accessible land use that reduces consumers' vehicle and fuel expenditures tends to increase regional employment and business activity. More compact development, including reductions in the amount of land required for transport facilities such as roads and parking, frees up land for other productive uses, including businesses, housing, farmlands, and recreation.

Social Inclusion

Social inclusion, economic opportunity or economic mobility refers to the social and economic opportunities for people who are physically, economically and socially disadvantaged. This is both an efficiency and an equity issue, because people excluded from social and economic opportunities suffer directly, and are less productive, more dependent on social programs, and more likely to be involved in criminal and self-destructive behaviour. Social inclusion therefore provides multiple benefits, including increased social equity, economic development, public cost savings, and reduced crime**.**

Community Cohesion

Community cohesion (also called social capital) refers to the quality of relationships among people in a community, as indicated by the frequency of positive interactions, the number of neighborhood friends and acquaintances, and their sense of community connections, particularly among people of different economic classes and social backgrounds.

The activities in which people engage or desire to engage in may affect their vulnerability to traffic impact. So many of these activities have been suppressed that we sometimes forget they exist, Children wanting to play, and people talking, sitting, strolling, jogging, cycling, gardening, or working at home and on auto maintenance are all vulnerable to interruption, by traffic. One of the most significant and discussed aspects of street life is the amount and quality of neighbouring.

Energy Consumption and Pollution Emissions

Smart Growth tends to reduce per capita energy consumption and pollution emissions by reducing vehicle travel and supporting other energy conservation strategies such as shared building walls and district heating, although it can increase exposure to local emissions such as carbon monoxide, particulates and noise. The following land use factors can affect energy consumption and emissions:

- ***Density*** **(**number of people and businesses in a given area) and clustering (common destinations located close together) affects travel mode and trip distance.
- ***Land use mix*** (the diversity of land uses in an area) affects trip distances and the feasibility of non motorized transportation.

- ***Major activity centers*** (locate employment, retail and public services close together in walkable commercial centers) increases walking, cycling and public transit travel.
- ***Parking management*** (sharing, pricing and regulations to encourage efficient use of parking facilities) affects land use density, and automobile ownership and use.
- ***Street connectivity*** (the degree to which streets connect to each other, rather than having dead ends or large blocks) affects accessibility, including the amount of travel required to reach destinations and the relative speed and convenience of cycling and walking.
- ***Transit Oriented Development*** (locating high-density development around transit stations) makes transit relatively more convenient, and can be a catalyst for other land-use changes.
- ***Pedestrian Accessibility*** and traffic calming affect the relative speed, convenience and safety of non motorized transportation.

AESTHETIC IMPACTS

Roads and traffic also reduce natural environmental beauty and cause urban disfigurement all cite visual aesthetic degradation as major negative impacts of roads. The value of attractive landscapes is indicated by their importance in attracting tourism and increasing adjacent property values.

There are numerous benefits from urban parks and open space which are as follow;

- Increased property values.
- Tourism value.
- Direct use value.
- Public fitness and health value.
- Community cohesion value.
- Reducing urban stormwater management costs.
- Reduced air pollution.

CULTURAL PRESERVATION

Transportation facilities and sprawl sometimes threaten unique cultural resources, such as historic buildings, sacred land areas, neighborhood parks, older neighborhoods and towns, and traditional building styles. By reducing per capita land requirements and providing greater design flexibility, Smart Growth can avoid or reduce these impacts, allowing cultural preservation. Smart Growth also supports urban redevelopment, which helps preserve existing towns and cities, and urban neighborhoods.

ENVIRONMENTAL AND ECOLOGICAL IMPACTS

Road and sprawl environmental impacts are widely recognized by land use planners and ecologists. Ecologically active lands such as wetlands, forests, farms, and parks, collectively called greenspace or openspace, provide external benefits, including wildlife habitat, air and water quality, and beauty. Urban areas often contain high value habitat and species. These external benefits of ecologically-active lands exist in addition to direct benefits to landowners and are not reflected in land's market value. Some of these benefits result from the contribution that an ecological system makes toward market goods, such as fishery production or water quality. Other values are reflected in the tendency of greenspace to increase nearby property values and tourism, and in existence, option, and bequest values.

Following are the benefits of open space preservation:

- Protecting groundwater.
- Protecting wildlife habitat.
- Preserving natural places.
- Providing local food.
- Keeping farming as a way of life.
- Preserving rural character.
- Preserving scenic quality.
- Slowing development.
- Providing public access.

Table 7: Environmental Benefits by Land Use Category

	Air Quality	Water Quality	Eco-logic[a]	Flood Control	Recreation[b]	Aesthetic	Cultural[c]	Eco-nomic[d]
Wetlands	High	High	High	High	High	High	High	High
Pristine Wildlands	High	High	High	Varies	High	High	High	Varies[e]
Urban Greenspace	High	High	Medium	Medium	High	High	High	Varies[e]
2nd Growth Forest	High	High	Medium	High	High	Varies	Medium	Medium
Farmland	Medium	Medium	Low	Medium	Low	Varies	Medium	Varies
Pasture/ Range	Low	Medium	Low	Low	Low	Varies	Medium	Low
Mixed Urban	Low	Low	Low	Low	Varies	Varies	Varies	High
Highway Buffer	Low	High	Low	Low	Low	Low	Low	Low
Pavement	None	None	None	None	None	None	None	Varies

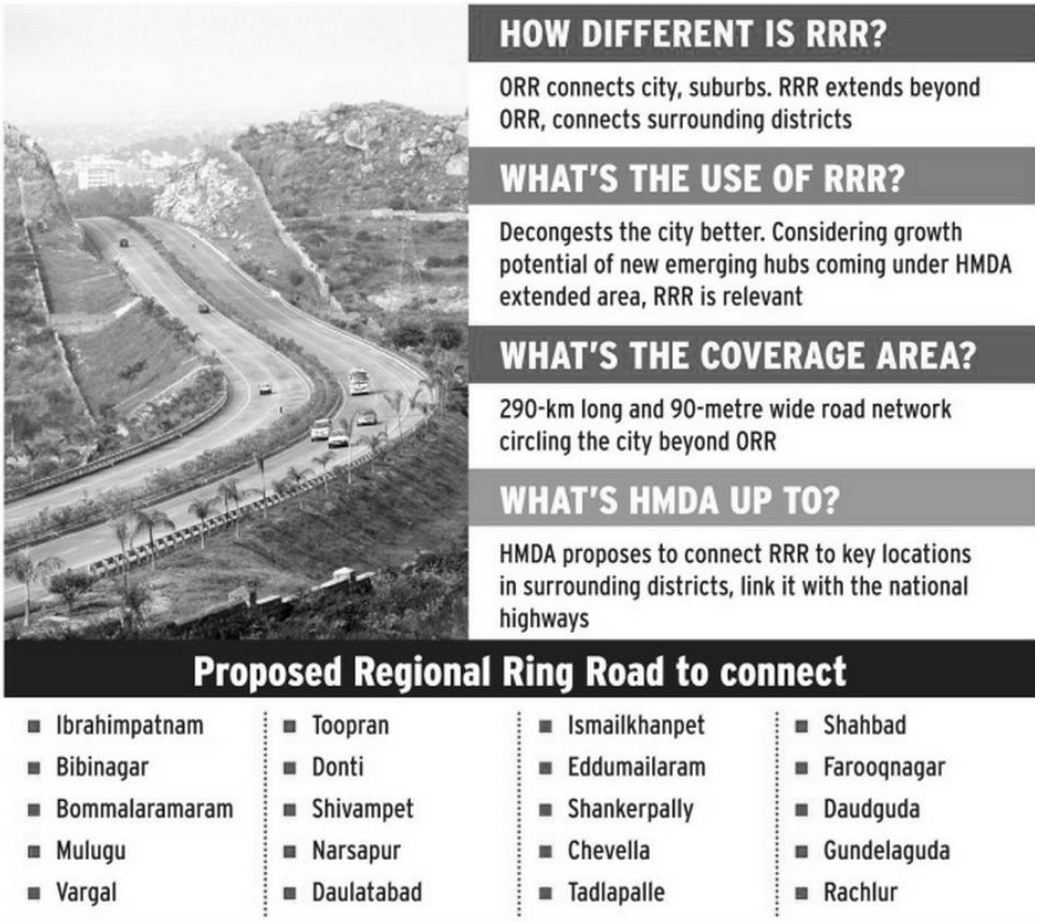
A comprehensive development of land use requires several steps Between a decision And Its Ultimate Effects to achieve smart sustainable growth by proper Planning for Road Network, Land Use and Environment for Road Safety.

CASE STUDY

Regional Ring Road to pass through 125 villages, link three major Telangana highways India Central Govt. gave green signal to the Hyderabad Regional Ring Road (RRR) by sanctioning Rs 5,500 cr, the RRR is expected to take off soon.

RRR plan has a 290-km long road network circling the city beyond the ORR With the Outer Ring Road (ORR) starting to finally fall in place, the Hyderabad Metropolitan Development Authority (HMDA) is now looking forward to laying the Regional Ring Road (RRR).

Proposed in the Master Plan, which has been submitted to the government for approval, the ambitious RRR plan has a 290-km long road network circling the city beyond the ORR. After the HMDA jurisdiction was expanded with inclusion of parts of surrounding districts of Medak, Nalgonda, Mahabubnagar and Ranga Reddy, the HMDA proposed the RRR to connect key locations in these districts and also link it with the national highways



According to officials, the RRR proposal, after suggestions and objections in the draft Master Plan, has been fixed at 290-km long and 90-metre wide. Once the government's approval for the Master Plan is received, work on alignments for the road and other related works will be taken upl. The RRR would be given a shape by strengthening the existing roads and adding new stretches wherever linkages were found missing.

CONCLUSIONS

Planning and decisions for Road Network, Land Use and Environment for Road Safety can have many direct and indirect land use impacts. These impacts are often significant and should be considered when evaluating a particular policy or project. Conventional transport planning often overlooks some of these impacts, particularly when evaluating a single policy or project.

The relationships between transportation and land use are complex. Comprehensive analysis of transportation land use impacts includes consideration of:

- Impacts of lands used for transportation facilities.
- Impacts on the location, type and cost of development.
- Impacts on accessibility and travel options.
- Impacts on travel behavior.

Table 8: Road Network, Land Use and Environment for Road Safety Impacts

Economic	Social	Environmental
● Value of land devoted to transportation facilities. ● Land use accessibility. ● Transportation costs. ● Property values. ● Crash damages. ● Costs to provide public services. ● Economic development and productivity. ● Storm water management costs.	● Relative accessibility for different groups of people – impacts on equity and opportunity. ● Community cohesion. ● Housing affordability. ● Cultural resources (e.g., heritage buildings). ● Traffic accidents. ● Public health (physical fitness). ● Aesthetic impacts.	● Greenspace and wildlife habitat. ● Hydrologic impacts. ● Heat island effects. ● Energy consumption. ● Pollution emissions.

More comprehensive analysis of these impacts can help integrate Road Network, Land Use and Environment for Road Safety, resulting in transport decisions that better support land use objectives, and land use decisions that support transport objectives. It can help planners determine which congestion reduction strategies support strategic community development objectives, and therefore help reduce infrastructure costs, improve accessibility for non-drivers and preserve open space.

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3D Printing in Construction

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3D printing technology will dominate the world in the forth coming years. As you could see 3D printing is being effectively used in the field of automotive, aerospace and medical industry. Soon they will find the applicability of 3D printing in civil engineering too. In fact there were lot of research, majority of them at the initial stages, are going on based on the usage of 3D printed entities for construction. The major advantage of 3D printing is that it reduces the amount invested on tools for manufacturing and the associated labour. Though the investment cost is high, it's one time and has the added advantage of wastage reduction at source. For now, it has direct application in contour crafting, a construction process for making 3D printed homes. It is more of an gantry girder running over the entire building period lot to 3D print and fabricate. It has been found to be fast, less energy use and less or zero wastage. It also works in accordance with BIM building information modeling, CAD/CAM technology to avoid rework. However everything in construction are of large scale., and several factors comes in to play like., quality of the mortar, (material used), workmanship, design for seismic activity. The equipment is also costly and requires skilled labour to operate and maintain. The usage of 3D printing technology is at the primitive stage, in civil engineering field, and there is a lot to be explored.

Three Dimensional Printing (3DP) is a manufacturing process that builds layers to create a three-dimensional solid object from a digital model. It allows for mass customization and complex shapes that cannot be produced in other ways, eliminates the need for tool production and its associated labor, and reduces waste stream. Because of these advantages, 3DP has been increasingly used in different areas, including medical, automotive, aerospace, etc. This automated and accelerated process is also promising for civil structures, including building and bridges, which require extensive labor. If successful, it is expected that 3D structural printing can significantly reduce the construction time and cost. However, unlike applications in other areas, civil structures are typically in large scale, with length or height spanning hundreds of feet. They are subjected to complex loadings, including gravity, live, wind, seismic, etc. Therefore, it is challenging to develop suitable printing tools and materials. As a result, although there are limited 3D printed buildings, 3DP of civil structures is still at a primitive stage. This papers aims to explore the applicability of 3DP for civil structures. The first part is devoted to a review of 3DP in different areas, including 3D printed buildings. Based on the state of art, the weakness and opportunities of 3DP are identified. Finally, future directions for 3DP in civil structures are discussed

HISTORY

According to 3DPI (2014), 3DP started in the late 1980's. It was known as Rapid Prototyping (RP) technology developed by Kodama in Japan. Six years later, Charles Hull invented Stereo Lithography Apparatus (SLA). In 1987, SLA-1 was introduced as the first commercial RP system. In 1989, a patent for Selective Laser Sintering (SLS) was issued for Carl Deckard at University of Texas. Through the 1990's until early 2000's, SLS has been developed to focus on industrial applications such as casting. New terminology, Casting and Rapid Manufacturing (RM), was introduced for such applications. In 2005, the terminology evolved to include all processes under Additive Manufacturing (AM). The term *Additive Manufacturing* (AM) is defined by ASTM as "a process of joining materials to make objects from 3D model

data, usually layer upon layer" (ASTM Standard 2012). Unlike *Subtractive* term which means machining away the material from a block to form the required object. Casting or shaping the material in a mold is often called *Formative* process.

3DP is based on AM process. It is a process where a 3D model is created using Computer Aided Drafting (CAD) software. The model is then transferred to the 3D printer as a standard data known as stereolithography language (STL), where the model is converted into layers that can be applied consecutively. Each layer is formed where the printer head deposits an activating agent, and premixes it with a power material. The layers are bonded together consecutively to form the 3D object. In 2009, the first commercial 3D printer was offered for sale. In 2012, an alternative 3D printer was introduced at entry level of the market with affordable price.

APPLICATIONS OF 3D PRINTING

3DP has been increasing used in different areas. Architectural modelling is one of the major areas that uses 3DP for developing prototypes that facilitate the communication between the architect and customer. Architect can print now complex structures and color it as well for better representation (Gibson *et al.* 2002). In medical area, 3DP is used to create high quality bone transplant, modelling of damaged bones for better fracture analysis (James *et al.* 1998; Murray *et al.* 2008). 3PD can also be used to print complex shapes, such as human tissue or artificial blood vessels that are used in coronary bypass surgery (Wong and Hernandez 2012). Dentists are using 3DP to create a plaster model of the mouth or to replace patient's teeth (van Noort 2012). In aerospace industry, 3DP is used to print airfoils (Thomas *et al.* 1996). In automotive field, Song *et al.* (2002) used RP technology to manufacture the die of an automobile deck part.

3DP FOR CIVIL STRUCTURES

Warszawski and Navon (1998) pointed out the following problems concerning construction industry: low labor efficiency compared with automated machines, high accident rate, low quality work due to insufficient skilled workforce, and difficulty of applying control of construction site. Applying automation or 3DP can overcome these problems.

Automation in construction industry started in terms of robotics [Gambao *et al.* (2000); Kuntze *et al.* (1995); Lorenc *et al.* (2000); Williams *et al.* (2004)]. Buswell *et al.* (2007), (2008) conducted a review over RM technologies for construction, based on which they developed a Freeform Construction method. The term of Freeform Construction was defined for methods that deliver large-scale components for construction without the need of formworks using AM. They concluded that Freeform Construction could reduce the construction cost and provide freedom of selecting desired geometry with better performance than traditional method. Lim *et al.* (2009) stated that Freeform Construction methods are currently limited to CC (US); Concrete Printing (UK); and D-shape (Italy).

Khoshnevis (1998) introduced the Contour Crafting (CC) which later become an effective method of printing 3D houses. Khoshnevis (2004) defined CC as "*an additive fabrication technology that uses computer control to exploit the superior surface-forming capability of troweling to create smooth and accurate planar and free-form surface*". The idea of CC was to use two trowels to form a solid planar surface for external edges. Filler material such as concrete can then be poured to fill the extruded area. They demonstrated that CC can be used in building structures as shown in Figure 1, where a nozzle is supported by a gantry system which moves in two parallel lanes. The nozzle is capable of full 6-axis positioning and can extrude both sides and filler material. CC nozzle can also be used for forming paint-ready surface, placing reinforcement before pouring concrete, plastering and tiling, plumbing and installing electrical modules and communication line wiring.

Zhang and Khoshnevis (2013) developed an optimized method for CC machine to efficiently construct complicated large-scale structures. Extensive research was done to avoid collision between multiple nozzles. Three approaches were compared, namely: path cycling, buffer zone path cycling and auxiliary buffer zone. The results indicated that the path cycling and buffer zone cycling provided the maximum optimization. They concluded that using CC method is significantly faster than traditional methods and implementation to multi-story building is possible by climbing as shown in Figure 3.

According to Roodman and Lenssen (1995), the construction industry consume more than 40% of all raw materials globally. CC can reduce the material waste from 7 tons to almost none for a single-family home. And the speed of the construction can be increased to one day per house. Although the ability of using this method in luxury structures or complex structures is still limited, implementation of CC can help with fast construction of low income housing and emergency shelter.

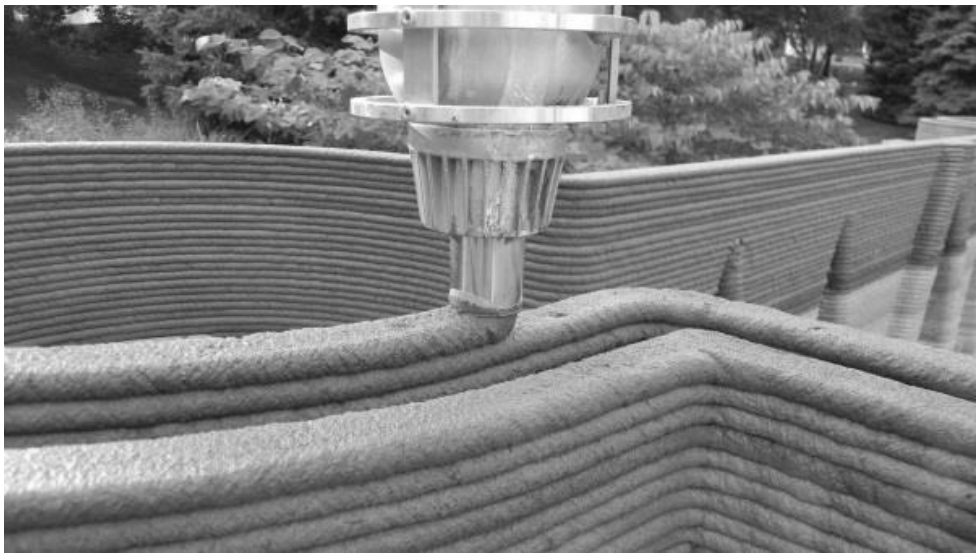

Fig. 1

Source: www.designingbuildings.co.uk/wiki/3D_printing_in_construction

Fig. 2

Source: www.3dnatives.com

Fig. 3

Source: www.3dnatives.com

Fig. 4: Russian Company Apis Cor Built this House in just 24 Hours using their Concrete 3D Printer

Fig. 5

This two-story building was recently completed in Dubai. This was printed by a special kind of robotic arm printer and took 11 months to print. The whole building took more than 1.5 years to complete and was done by EEC for the Dubai Municipality. This is not the first construction-scale 3D print for the region. 3D printed construction has been underway in the United Arab Emirates since Sheikh Mohammed bin Rashid, Vice President and Ruler of Dubai, opened a futuristic office for 3D printing technology outside Emirates Towers three years ago. (Image courtesy of Dubai Municipality.)

Fig. 6

Denmark-based firm COBOD International manufactures construction-scale 3D printers. Pictured here is the company's first-generation printer, the BOD, a gantry extrusion 3D printing system with an open-source mixture for layer-by-layer deposition. COBOD International signed a distribution agreement with organizations in Austria, Switzerland and Germany. (Image courtesy of COBOD.)

Fig. 7

This home in Austin, Texas was 3D printed by the Vulcan, a signature extrusion printer from construction technologies company ICON. After getting the building permit from the city of Austin, the one-ton Vulcan is manned by a crew of five on average and has a massive footprint: 9 ft tall by 28 ft. wide. The material for this extrusion printer is a proprietary concrete mixture the company calls Lavacrete. The company recently announced the next edition of their 3D printer: the Vulcan II 3D printer. (Image courtesy of ICON.)

Fig. 8: In Spain, the First Pedestrian Bridge Printed in 3D in the World (3D BRIDGE) was Inaugurated 14th of December of 2016 in the Urban Park of Castilla-La Mancha in Alcobendas, Madrid

Fig. 9

MudBots uses a mixture of lime, sand and cement to create large-scale prints. The prints include structural elements like pillars as well as the major construction of small homes using extrusion gantry system 3D printing. (Image courtesy of MudBots.)

Fig. 10

The visualization you see here is called TECLA. The idea was conceived in a similar spirit to New Story by an organization called WASP, or World's Advanced Saving Project. WASP was founded in 2012 by a group of architects who were inspired by the eco-friendly habitat building prowess of potter wasps. It's currently being constructed in Bologna, Italy and is geometrically distinct from most other extrusion 3D printed shapes. It is built from recyclable and reusable materials (clay in this case) from the terrain immediately surrounding it, in an attempt to move the construction industry towards a more fundamentally sound ecological methodology. TECLA is the first 3D printed home to utilize a group of 3D printers. The material is a combination of locally sourced clays, which means it has virtually no waste when compared to traditional construction techniques. The project is so far incomplete. (Image courtesy of WASP.)

Despite the many advantages of CC, Lim *et al.* (2009) listed some limitations of CC as follows. The mold is not disposed and becomes a part of the wall. CC method requires excessive steps including molding, installing reinforcement, and placing concrete to build layers up to 20 mm high. These limitations encouraged them to develop another Freeform Construction method called Concrete Printing. Similar to 3DP idea, the concrete printing machine has a frame of 5.4m x 4.4 m (footprint) x 5.4 m (height) and a printing head moving on a mobile beam. A 9 mm nozzle is supported with the printing head to provide the material extrusion. Later, Le *et al.* (2012) conducted experimental program to figure out the optimum mix design of a high- performance fiber-reinforced fine-aggregate concrete for printing concrete.

The 3D printed houses can provide a cheap and efficient homes of low-income families. The printed houses consist of different printed parts assembled together to form the house. It can take less than 24 hour to build one house. However, no details are provided about 3DP of wiring, plumbing and HVAC, etc.

The latest development of 3DP was from WinSun, a Chinese company. They printed five-story apartment block using 3DP as shown in Figure 4 (Charron 2015). They stated that the houses were in full compliance

with relevant national standards, which overcomes one of the main issues that face 3D printed houses. WinSun also printed a decorated house as shown in Figure 5.

3DP can also be used for non-conventional structures. DUS, a Dutch architecture company used 3DP to design facades integrated with solar panels, where the angle of the solar panel could be optimized automatically for any location. This can eliminate the need of manufacturing a mold for every different location (Jordan *et al.* 2015).

Other automation effort was done by the industry sector. For example, Shimizu Corporation in Japan developed an automated system that included erection and welding of steel-frames, laying concrete floor planks, installation of exterior and interior wall panels, and installation of various other units (Yamazaki and Maeda 1998).

Lim *et al.* (2012) compared CC, D-shape, and Concrete Printing. They concluded that Concrete Printing could optimize strength prior to manufacturing, which resulted in less material. It could also create complex concrete shapes without the need of labor-intensive molding as shown in Figure 2.

FIRST 3D PRINTER FOR CONSTRUCTION IN INDIA MADE BY IIT MADRAS

The civil engineering department of Indian Institute of Technology Madras (IIT-M) along with Tvasta Manufacturing Solutions, an additive manufacturing startup, claims to have developed the country's first 3D Printing Construction Technology. In partnership with a private manufacturing company, the Civil Engineering Department of IIT Madras has set up the IIT Madras Printability Lab to develop the technology for mass production. Usually, a concrete layer takes minimum 28 days to 30 days for curing. But, through their innovative technology, the concrete sets in 3 to 5 hours. After constructing the house on the computer using 3D modelling, if we feed it to the printer, then, the delivery system will bring out the component through the printer. The component either could be a house or a part of the house. By using the technology, a conventional house can be built within a month at a comparable cost. They have now developed a 10x10 metre prototype 3D printer, to study the feasibility of developing a full-fledged printer that can build a house. Even the material used can be saved by a huge margin. The reason being printing technologies can build complicated shapes that aren't possible through existing methods.

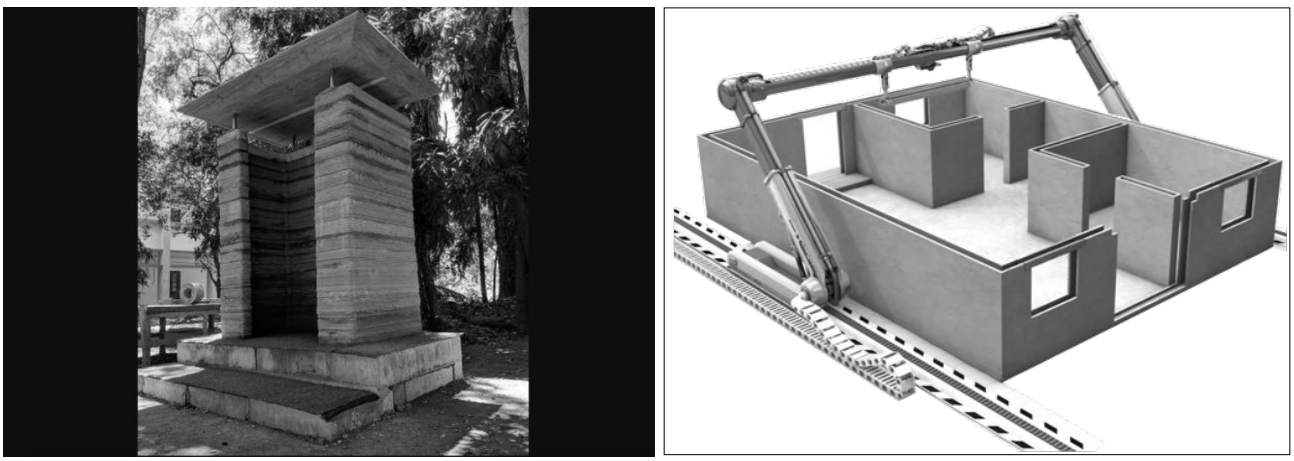

Fig. 12: A 3D-printed Building Made using the Newly Developed Technology

Image courtesy: IIT Madras

CHALLENGES OF 3DP FOR CIVIL STRUCTURES

As described above, 3DP allows for mass production, uses less labor, increases the construction speed and produces less waste compared to traditional construction methods. 3D printed structure is a layered structure, which is not new in civil engineering. Concrete Masonry Unit (CMU) structure is a typical layered structure, where the CMU units are installed by pieces and bonded together with mortar. The author of this paper has designed CMU buildings up to 13 stories and 125 feet high. The integrity of 3D printed structure is better than CMU structure. Therefore, 3D printed structure should be able to exceed the height of CMU structure. However, the tallest building that has been printed so far was the 5-story apartment building. Khoshnevis (2004) and Buswell *et al.* (2007) stated multiple issues that slowed down the growth of automation industry in construction. It can be summarized as follows:

1. automated fabrication is often not suitable for large scale products and conventional design approaches;
2. smaller ratio of automated products in comparison with other industries;
3. only limited material can be used by automated machines;
4. expensive automated machines tend to be unfeasible economically; and
5. managerial issues and the increasing pressure towards environmental issues of construction materials in developing countries (Guthrie *et al.* 1999).

CONCLUSIONS AND FUTURE DIRECTIONS OF 3DP FOR CIVIL STRUCTURES

It can be shown from this paper that the application of 3D printing in civil engineering is promising. It can not only help to improve communication among designers by creating prototypes of the desired projects, but also be used in high-stress performance testing and end- user applications. Considering the limitations described above, in the authors' opinion, the following directions of 3DP for civil structures deserve further attention.

Construction components of significant size are heavy, typically being up to 5 tons. Suitable equipment needs to be developed in order to lift and move heavy component. However, before suitable equipment can be developed for large scale structure, in-situ deposit approach, i.e., printing lighter parts on site followed by assembly would be an alternative option.

3DP can be especially useful for structures with complex shapes. For example, rubber can be used to print shock absorbers in a large scale which can help in reducing the seismic effects on buildings.

3DP can also open up a frontier to use new materials. These new materials need to satisfy specific requirements from 3DP. For example, they need to have proper curing time since the lower layer needs to support the upper layer. The bonding between different layers should be strong. These materials also require extensive testing to determine their mechanical properties, including the properties of the materials, inter- and intra-layers.

Jordan *et al.* (2015) stated that automated industry will take over the constructions process. This requires revising building codes to ensure that additive machines are operating within limits and meet performance criteria. For example, the 3D printed structure should be able to take complex loads, including gravity, live, wind, seismic, etc., and satisfy the performance requirements, such as fire, smoke and toxicity. In addition to that, current safety factors are high due to the consideration of human mistakes. Such factors can be lowered in case of using automated machines instead of human workforce.

Development of a complete process from the parametric design until printing the building is needed to control the whole process and eliminate any wasted time during printing. Khoshnevis (2004) proposed a planning system that shows each component of future automated system. Figure 7 shows a brief explanation for the proposed plan.

Further research is also needed in connections for 3D printed structures, where few studies are available. These include, but not limited to, beam-column, column-footing, wall connections, etc.

ACKNOWLEDGEMENTS

The information in this article is compiled from (1) Yossef, Mostafa and Chen, An, "Applicability and Limitations of 3D Printing for Civil Structures" (2015). *Civil, Construction and Environmental Engineering Conference Presentations and Proceedings*. 35. http://lib.dr.iastate.edu/ccee_conf/35 (2) Andrew Wheeler post at engineering.com.

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Effect of Elevated Temperatures on the Behaviour of Geopolymer Concrete Made with Manufactured Sand as Fine Aggregate

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Abstract—Concrete is the most widely used construction material in the world. The production of one ton of Portland cement emits approximately one ton of carbon dioxide into the atmosphere that leads to about 7% of global warming. Geopolymer is a promising alternative binder to Portland cement, it is an innovative eco-friendly, construction material, it is produced from by-product materials such as fly ash and blast furnace slag; hence recognized as a low-emission alternative binder for concrete. On the other hand river sand is becoming scare day by day and costlier. So the manufactured sand turns out to be alternative material for river sand. The present study is to assess engineering properties of low calcium fly ash and slag based geopolymer concrete of G30 and G50 with manufactured sand as fine aggregate when it is exposed to elevated temperatures i.e. 100 °C, 200 °C, 400 °C and 600 °C for different duration of 1, 2, 4 and 6 hours. It is observed that conventional concrete started developing cracks at 400 °C, whereas geopolymer concrete did not show any visible crack up to 600 °C i.e. geopolymer concrete shows better resistance against surface cracking when exposed to elevated temperatures.

Keywords: Elevated Temperature, Fly Ash, Geopolymer Concrete, GGBS and Manufactured Sand

INTRODUCTION

Concrete is the only construction material which is used world and its consumption is second only to water. Production of cement is not only energy intensive, but also responsible for emission of carbon dioxide (CO_2) in large quantity. Geopolymer is a promising alternative binder to Portland cement. It is produced mostly from by-product materials such as fly ash and blast furnace slag. The global warming is caused by the emission of greenhouse gases, such as CO_2, to the atmosphere by human activities. Among the greenhouse gases, CO_2 contributes about 65% of global warming. The cement industry is responsible for the emission of carbon dioxide, for one ton of Portland cement emits approximately one ton of CO_2 into the atmosphere. There are many efforts are being made to reduce the use of Portland cement in concrete by finding alternative binders to Portland cement this include the utilisation of supplementary cementing materials fly ash, granulated blast furnace slag, rice-husk ash and metakaolin. In 1972, Joseph Davidovits coined the name ''geopolymers'' to describe the zeolite like polymers. Geopolymers are the alumina-silicate polymers which consist of amorphous and three dimensional structures formed from the geopolymerisation of alumina-silicate monomers in alkaline solution. Investigations have been carried out on calcined clays (e.g., metakaolin) or industrial wastes (e.g., fly ash or metallurgical slag). A reaction pathway involving the polycondensation of orthosialiate ions (hypothetical monomer) is proposed by Davidovits.

The objective of this paper is to study the behavior of low calcium fly ash and slag based geopolymer concrete of G30 and G50 when it is exposed to elevated temperatures i.e. 100 °C, 200 °C, 400 °C and 600 °C for different duration of 1, 2, 4 and 6 hours. The loss in compressive strength and weights are evaluated and compared both controlled and geopolymer concrete of respective grade.

MATERIALS

Ordinary Portland Cement

In the experimental investigations, 53-grade of ordinary Portland cement is used. The cement thus procured was tested for physical properties in accordance with the IS: 4031-1968 and found to be conforming various specifications of IS 12629-1987.

Fine Aggregate

Manufactured sand nothing but crushing of hard stone aggregates to the size of natural sand. The M-sand used is collected from local suppliers. The manufactured sand used was without any organic impurities and conforming to IS: 383-1970 [Methods of physical tests for hydraulic cement]. The M-sand was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386-1963 [Methods of test for aggregate for concrete].

Coarse Aggregate

The crushed angular aggregate of 20mm maximum size obtained from the local crushing plants is used as coarse aggregate in the present study. The physical properties of coarse aggregate such as specific gravity, bulk density, flakiness and elongation index are tested in accordance with IS: 2386-1963.

Fly Ash

In the present study of work, the Class F-fly ash is used, which is obtained from Vijayawada thermal power station in Andhra Pradesh.

Ground Granulated Blast Furnace Slag

Ground Granulated Blast Furnace Slag (GGBS) is a by product of the steel industry. Blast furnace slag is defined as “the non-metallic product consisting essentially of calcium silicates and other bases that is developed in a molten condition simultaneously with iron in a blast furnace”. About 15% by mass of binders was replaced with GGBS.

Water

Water free from chemicals, oils and other forms of impurities is used for mixing of concrete as per IS: 456:2000.

Sodium Hydroxide

Sodium Hydroxide is one of the major ingredients of geopolymer concrete. The following are the specifications of Sodium hydroxide pellets and this material is procured from the local laboratory chemical vendors in Hyderabad. Specifications are tabulated in table 1 as given by the suppliers.

Table 1: Shows Physical Properties of NaOH

Molar mass	40 gm/mol
Appearance	White solid
Density	2.1 gr/cc
Melting point	318 °C
Boiling point	1390 °C
Amount of heat liberated when dissolved in water	266 cal/gr

Sodium Silicate Solution

Sodium silicate solution is a type of alkaline liquid plays an important role in the polymerisation process. This material is procured from the local laboratory chemical vendors in Hyderabad. Specifications are tabulated in table 2 as given by the suppliers.

Table 2: Properties of Na_2SiO_3 Solution

Specific gravity	1.57
Molar mass	122.06 gm/mol
Na_2O (by mass)	14.35%
SiO_2 (by mass)	30.00%
Water (by mass)	55.00%
Weight ratio (SiO_2 to Na_2O)	2.09
Molarity ratio	0.97

Super Plasticizer

Super plasticizer GLENIUM B233 of Fosroc chemical India Ltd. was used as water reducing admixture, it increases workability.

EXPERIMENTAL INVESTIGATION

General

The objective of this paper is to study the behavior of low calcium fly ash and slag based geopolymer concrete of G30 and G50 when it is exposed to elevated temperatures i.e. 100 °C, 200 °C, 400 °C and 600 °C for different duration of 1, 2, 4 and 6 hours. The cubes of size 100mm × 100mm × 100mm were cast and after one day rest period, half of the specimens were cured in an oven at 60 °C for 24 hours and the remaining period cured in sun light until the specimens kept in muffle furnace. After 28 days, an initial weights are taken then the specimens are kept in Muffle furnace to heat at an elevated temperatures 100 °C, 200 °C, 400 °C and 600 °C for 1hr, 2hr, 4hr and 6hr. The specimens were taken out from MufflleFurnace then final weights and residual compressive strengths were calculated.

Mixing and Casting of Geopolymer Concrete

Geopolymer concrete is prepared by using the same procedure whatever is used in the conventional concrete. In the laboratory, the fly ash and the aggregates were mixed together in dry by using a pan mixer for about two minutes, then the alkaline liquid was mixed with the super plasticizer and extra water if any. The liquid component of the mixture was then added to the dry material and the mixing continued usually for another two minutes. The fresh concrete was cast and compacted by the usual methods used in the case of conventional concrete. The workability of the fresh concrete was measured by means of the conventional slump test.

TEST RESULTS

Weight Loss and Residual Compressive Strength

The weights, percentage loss of weights, compressive strengths and percentage loss of compressive strengths of controlled and geopolymer concrete specimens exposed to elevated temperatures. From the tables and graphs it is observed that as the temperature increases the percentage loss of compressive strength and weights are increased.

Table 3: Weight Loss in Percentage of Controlled (M30 & M50) & Geopolymer Concrete (G30 & G50) when Exposed to Elevated Temperatures

Temperature in °C	Exposure Time in Hours	M30	% Loss	G30	% Loss	M50	% Loss	G50	% Loss
100	0	2.450	0.00	2.240	0.00	2.510	0.00	2.290	0.00
	1	2.448	0.08	2.239	0.04	2.506	0.16	2.289	0.04
	2	2.442	0.33	2.239	0.04	2.499	0.44	2.289	0.04
	4	2.426	0.98	2.238	0.09	2.482	1.12	2.288	0.09
	6	2.420	1.22	2.237	0.13	2.474	1.43	2.286	0.17
200	0	2.450	0.00	2.240	0.00	2.510	0.00	2.290	0.00
	1	2.428	0.89	2.238	0.09	2.486	0.96	2.286	0.17
	2	2.411	1.59	2.226	0.63	2.465	1.79	2.269	0.92
	4	2.401	2.00	2.218	0.98	2.455	2.19	2.254	1.57
	6	2.371	3.22	2.208	1.43	2.425	3.39	2.245	1.97
400	0	2.450	0.00	2.240	0.00	2.510	0.00	2.290	0.00
	1	2.348	4.16	2.214	1.16	2.391	4.74	2.259	1.35
	2	2.282	6.86	2.197	1.92	2.325	7.37	2.236	2.36
	4	2.263	7.63	2.177	2.81	2.305	8.17	2.217	3.19
	6	2.253	8.04	2.160	3.57	2.295	8.57	2.201	3.89
600	0	2.450	0.00	2.240	0.00	2.51	0.00	2.290	0.00
	1	2.281	6.89	2.178	2.77	2.334	7.01	2.223	2.93
	2	2.263	7.63	2.162	3.48	2.314	7.81	2.201	3.89
	4	2.233	8.86	2.143	4.33	2.285	8.96	2.176	4.98
	6	2.154	12.08	2.098	6.34	2.199	12.39	2.137	6.68

Table 4: Compressive Strength Loss in Percentage of Controlled (M30 & M50) & Geopolymer Concrete (G30 & G50) when Exposed to Elevated Temperatures

Temperature in °C	Exposure Time in Hours	M30	% Loss	G30	% Loss	M50	% Loss	G50	% Loss
100	0	41.32	0.00	42.37	0.00	61.56	0.00	62.43	0.00
	1	39.41	4.62	42.43	-0.14	58.06	5.68	62.84	-0.65
	2	38.72	6.29	42.56	-0.44	57.54	6.53	64.24	-2.89
	4	38.16	7.64	43.02	-1.53	57.22	7.05	64.76	-3.73
	6	38.11	7.76	43.36	-2.33	57.12	7.21	65.36	-4.69
200	0	41.32	0.00	42.37	0.00	61.56	0.00	62.43	0.00
	1	40.02	3.14	42.12	0.59	59.34	3.60	62.17	0.41
	2	39.37	4.71	41.77	1.41	58.27	5.34	61.48	1.52
	4	38.22	7.50	40.21	5.09	57.64	6.36	60.13	3.68
	6	38.03	7.96	40.06	5.45	56.76	7.79	59.82	4.18
400	0	41.32	0.00	42.37	0.00	61.53	0.00	62.43	0.00
	1	38.81	6.07	41.02	3.18	57.16	7.14	60.13	3.68
	2	37.74	8.66	40.49	4.43	55.47	9.89	59.61	4.51
	4	36.21	12.36	39.07	7.78	54.93	10.95	58.15	6.85
	6	35.92	13.06	38.54	9.03	53.32	13.38	54.12	13.31
600	0	41.32	0.00	42.37	0.00	61.56	0.00	62.43	0.00
	1	26.60	35.62	36.32	14.27	38.14	38.04	51.65	17.26
	2	25.15	39.13	35.09	17.18	35.12	42.94	49.60	20.55
	4	24.89	39.76	33.63	20.62	33.77	45.14	47.25	24.31
	6	24.03	41.84	32.29	23.79	30.54	50.38	45.19	27.61

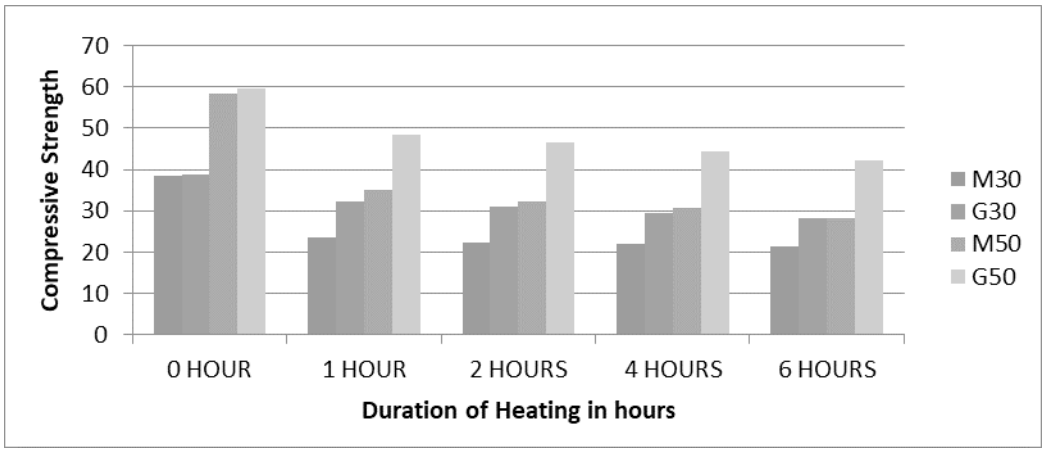

Fig. 1: Shows Compressive Strength Against Duration in Hours at 600 °C

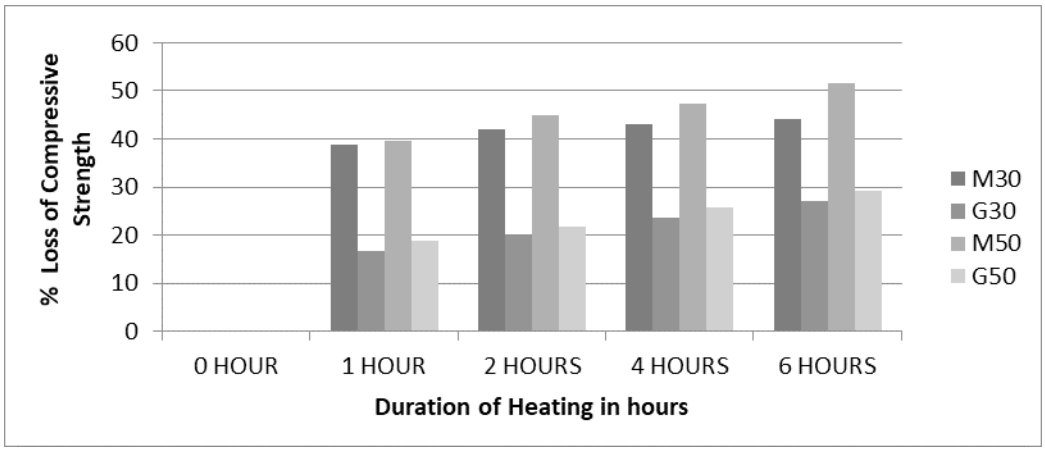

Fig. 2: Shows % Loss of Compressive Strength Against Duration in Hours at 600 °C

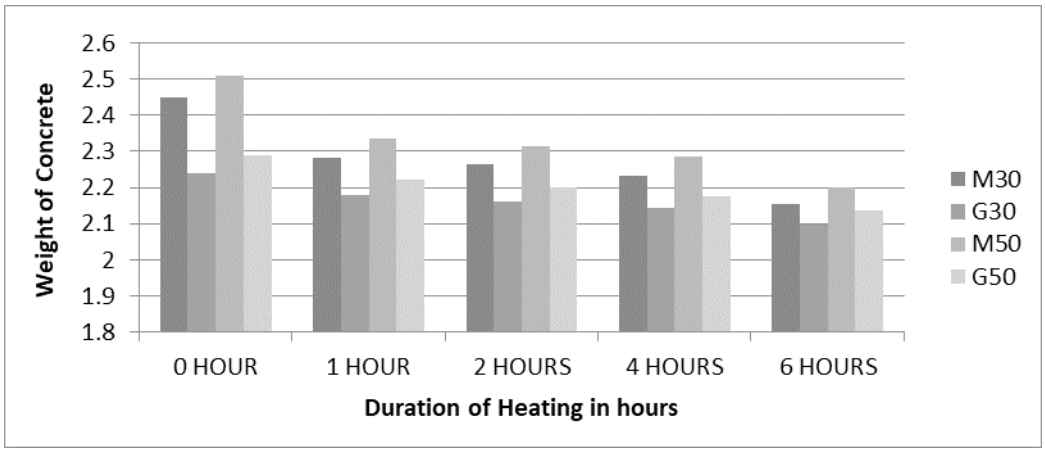

Fig. 3: Shows % Loss of Weight Against Duration in Hours at 600 °C

CONCLUSIONS

The following specific conclusions can be drawn from the present experimental investigation:

1. It has been observed that there is a steady loss in compressive strength with an increase in temperature in geopolymer concrete whereas in controlled concrete the loss of strengths relatively more when exposed to elevated temperatures of 200 °C, 400 °C and 600 °C temperature for 1hr, 2 hrs, 4hrs and 6 hrs duration.
2. The loss of compressive strength up to 400 °C is about 9.03% in geopolymer concrete and 13.38% in controlled concrete. It can be concluded that both the concretes can sustain up to this temperature.
3. It is reported that at 600 °C, there is significant loss in compressive strength and it is about 41.84% and 50.38% in M30 and M50 respectively, whereas in geopolymer concrete of G30 and G50 grades, it is about 23.79% and 27.61% respectively.
4. The loss of compressive strength in M50 and G50 grades is high beyond 400 °C when compared with M30 and G30 grades. The reason may be due to high brittleness and dense micro structure of higher grade concrete.
5. It is reported that at 600 °C, there is a loss in weights also and it is about 12.08% and 12.39% in M30 and M50, whereas it is about 6.33% and 6.68% in G30 and G50 respectively.

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Effect of Strip Load Location and Width on Horizontal Stress of Non-yielding Wall

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Abstract—In this paper, an analysis is discussed to bring out the the effect of strip load location and its width on the non yielding wall. In the analysis, the location of strip load from the non yielding wall is considered at 1m, 2m, 3m 4m and 5m and the usual range 1m, 1.5m, 2m, 2.5m and 3m width of strip load is considered. The Boussinsq's expression for horizontal stress due to strip load is used for the analysis. The horizontal stresses are analysed up to a depth of 10m at 1m intervals. The analysis revealed that as the location of strip load increases from the wall, the horizontal stress is decreaing up to about 1m depth and thereafter there is marginal increase in the horizontal stress. The maximum horizontal stress is noticed at about 1.0m depth from the ground surface irrespective of strip width and its position.

INTRODUCTION

Retaining walls near the coal handling plants usually experience surcharge loads due to coal carrying heavy vehicles. Surcharge loads acting on retaining wall are additional vertical loads that used to the backfill soil above the top of the wall. Live load surcharge is considered when vehicular actions act on the surface of backfill soil at a distance which equal or less than the wall height from the wall back face. A surcharge load is any load such as spoil embankments, streets or highways, construction machinery and coal carrying vehicles, which is imposed upon the surface of the soil close enough or distance to the excavation/or wall. This load causes a lateral pressure to act on the system in addition to the basic earth pressure. One of the most famous methods is Boussinesq strip method. After many considerations on adjacent surcharge, it was found that the distribution of lateral surcharge had not accuracy, and the shape and also the magnitude of the lateral pressure were not correct [1]. In the compacted backfill soil, the lateral earth pressure measured near the top of the wall is almost identical to the passive earth pressure estimated by the Rankin theory [2]. Stress history of backfill soil influences the coefficient of at rest earth pressure. Mayne and Kulhawy [3] provide an excellent summary of the effects of stress history on K_o. With regard to the K_o values obtained through statistical analysis, the Jaky's formula agrees very well with the test data for normally consolidated soils. Studies of many researchers have shown that the compaction of soil increases the lateral earth pressure exerted on non-yielding structures. It was proved that compaction has a larger impact on near surface residual lateral earth pressure and as the depth is increased, this effect is diminished [4].

BOUSSINESQ'S HORIZONTAL STRESS EXPRESSION FOR STRIP LOAD

The Boussinsq's expression for horizontal stress due to strip load is considered. The nomenclature and parameters are shown in the Fig.1. The expression for horizontal stress due to strip load is shown in Equation.1. A surcharge load q = 100 kPa is considered in the analysis. The width of strip load 'B' is varied from 1m to 3m. The horizontal distance of center of strip load 'x' is varied from 1m to 5m.

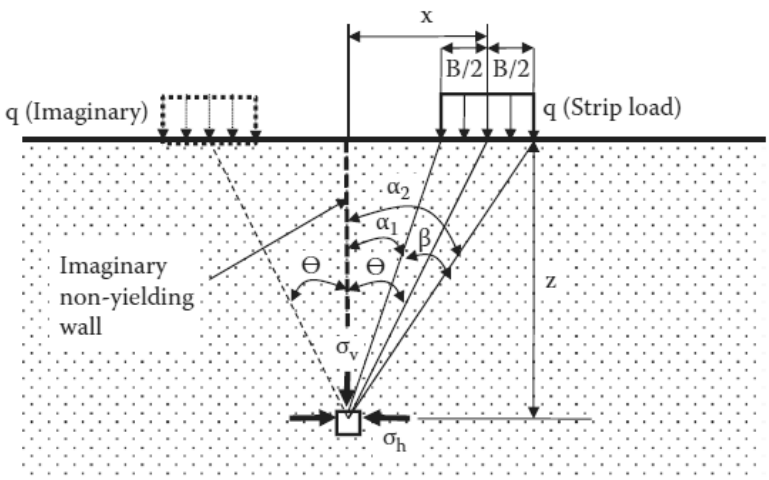

Fig. 1: Strip Load and Physical Parameters for Horizontal Stress

$$\sigma_z = \frac{2q}{\pi}[\beta - sin\beta \cos(2\theta)] \quad \text{...Eqn. 1}$$

From the geometry in Fig.1, the expressions for associated physical parameters are as follows:

$\theta = \tan^{-1}(x/z)$, $\alpha_1 = \tan^{-1}[(x - B/2)/z]$, $\alpha_2 = \tan^{-1}[(x + B/2)/z]$ and $\beta = \alpha_2 - \alpha_1$.

VARIATION OF HORIZONTAL STRESS DUE TO STRIP LOAD POSITION

The variation of horizontal stress with depth due to strip load is presented in Figs.2 to 7.

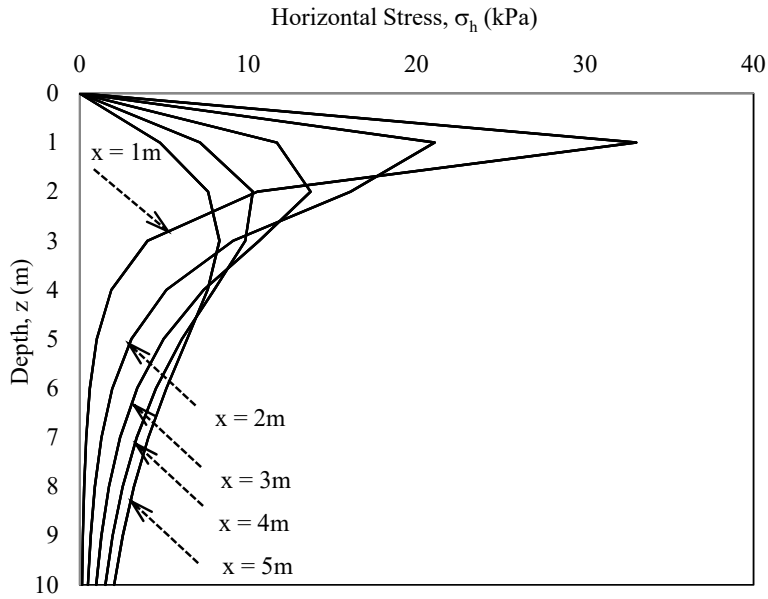

Fig. 2: Horizontal Stress Variation with Depth for Strip Load Width, B = 1m

Figs. 2 to 6 presents the variation of horizontal stress with depth due to varied strip load widths of 1m, 1.5m, 2.0m, 2.5m and 3.0m respectively. And also in these figures, the effect of strip load position, i.e., x = 1m, 2m, 3m, 4m and 5m from the non yielding wall on horizontal stress is shown further. The maximum horizontal stress is varying from 33 kPa to 105 kPa as width of strip load increases from 1m to 3m for

surcharge load 100 kPa and for strip position from wall x = 1m. Irrespective of strip width and strip position, the maximum horizontal stress is occurring at 1m depth from the ground surface where strip load is placed.

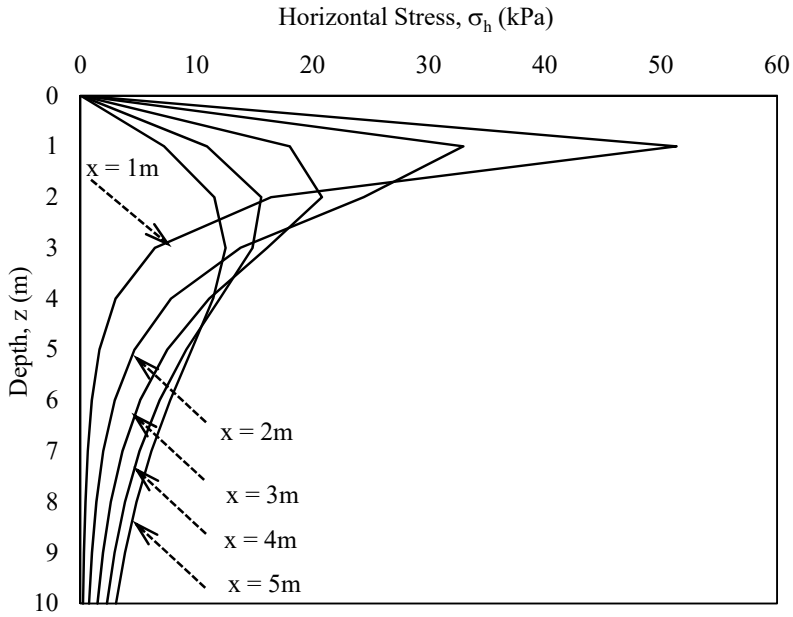

Fig. 3: Horizontal Stress Variation with Depth for Strip Load Width, B = 1.5m

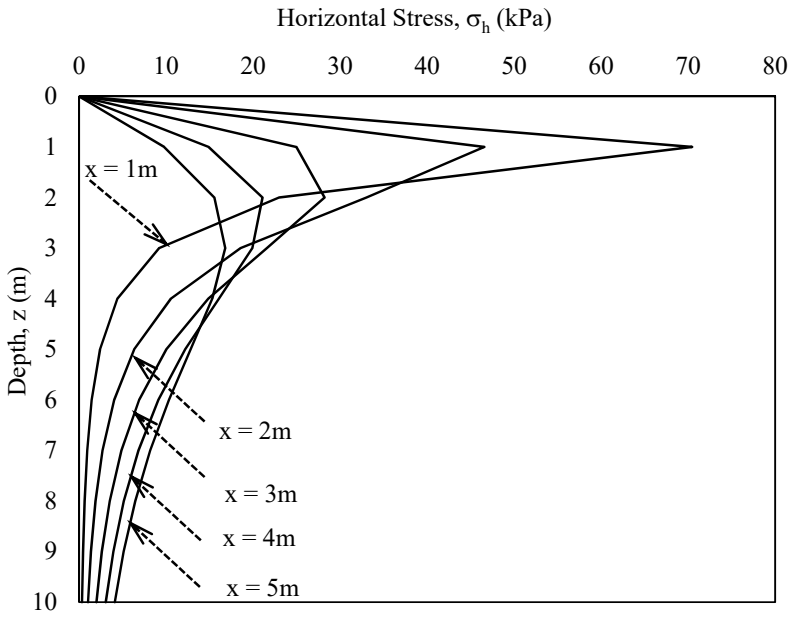

Fig. 4: Horizontal Stress Variation with Depth for Strip Load Width, B = 2.0m

Further it is noticed that as the location of strip increases from the non yielding wall, the horizontal stress is decreasing in the shallow depth and it is increasing marginally at deeper depth. From the figures further it is noticed that the increase in horizontal stress when location of strip changes from x = 5m to 1m towards non yielding wall, and for various widths of strip 1m, 1.5m, 2m, 2.5m and 3m and at z =1m are 6.96, 7.125, 7.21, 7.13 and 6.85 times respectively.

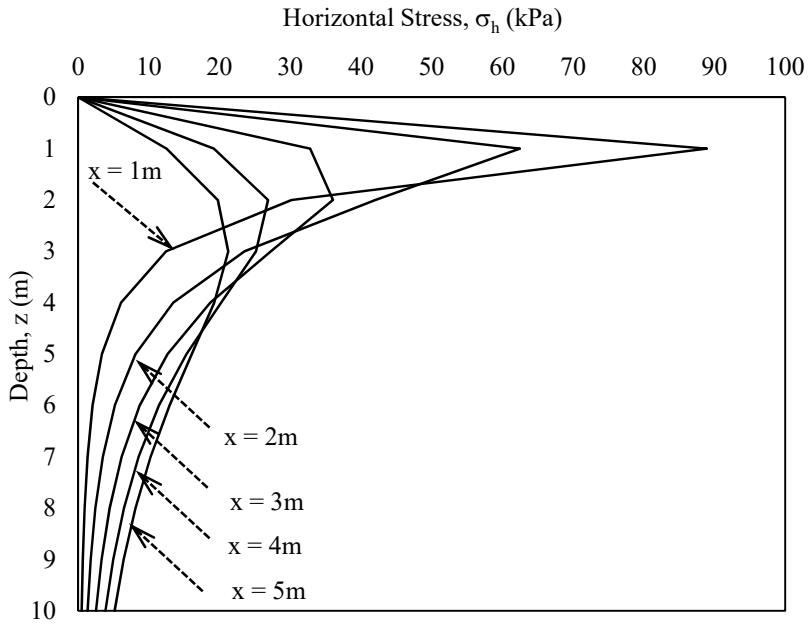

Fig. 5: Horizontal Stress Variation with Depth for Strip Load Width, B = 2.5m

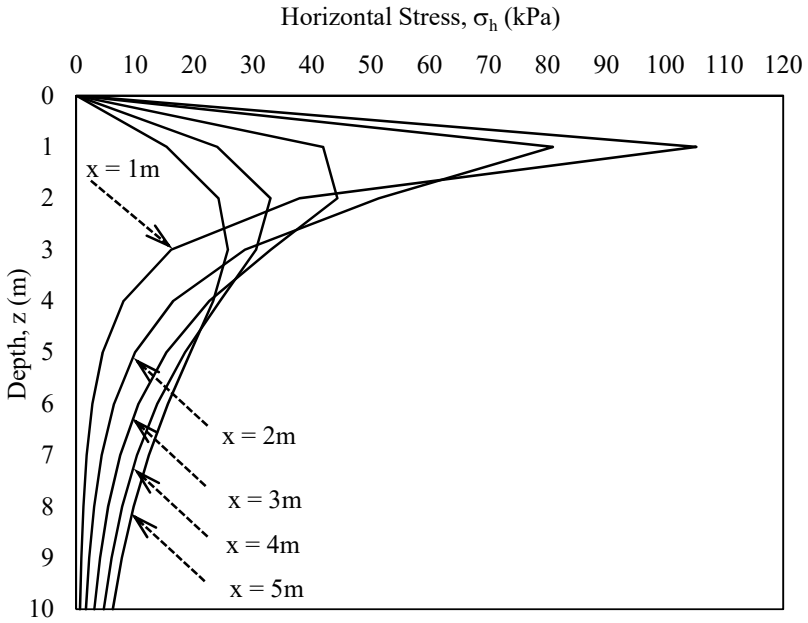

Fig. 6: Horizontal Stress Variation with Depth for Strip Load Width, B = 3m

Also at z = 5m, the analysis showed that the horizontal stress is increasing marginally as location of strip moves from wall to away i.e., from x = 1m to 5m. This increase at z = 5m depth for the above conditions is 7.6, 5.87, 5.36, 4.82 and 6.85 times. Comparatively, the horizontal stresses at depth z=5m are very low than z=1m. These stresses at z=1m when strip is at x = 1m are 33, 31.5, 29.5, 26.7, 23.54 times than the stresses at z =5m for strip widths 1m, 1.5m, 2.0m, 2.5m and 3.0m respectively. Similarly when strip is at x =5m, the stresses at z =5m are 1.60, 1.33, 1.31, 1.29 and 1.26 respectively than at z = 1m.

Fig.7 presents the variation of horizontal stress with depth when strip is at x = 1m and for various strip widths such as B = 1m, 1.5m, 2.0m, 2.5m and 3.0m. From this figure, it can be noticed that as the depth

increases, the horizontal stress is increasing up to a depth z = 1m for all the strip widths. Thereafter there is decrease in horizontal stress with depth. As width of load strip increases from B = 1m to 3m, the increase in horizontal stress at z = 1m and for x = 1m is 3.186 times, whereas at depth z = 5m, this increase in horizontal stress when strip width increase from B = 1m to 3m is 4.47 times. But the magnitude of horizontal stresses are high at depth z = 1m than at z = 5m.

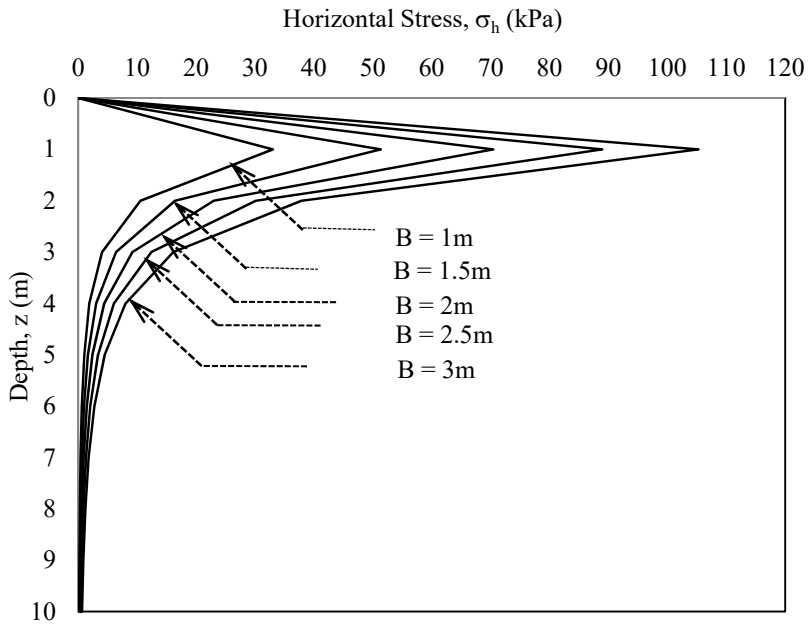

Fig. 7: Horizontal Stress Variation with Depth for Strip Load Position, x = 1m

CONCLUSIONS

From the above analysis and discussion, it is observed that the horizontal stresses due to strip load surcharges are important while designing the non yielding retaining walls towards achieving the stability requirements. Strip width and strip location both will influence the additional horizontal stresses apart from the soil stresses on the wall. The stresses will increase if width of strip load increases and also the stresses are high when strip load is near to the wall. The stresses developed due to strip load are marginal at deeper depths beyond z = 1m. Hence soil which is there at shallow depth will be stressed more and in turn cause more horizontal stress on the wall.

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CONFERENCE PAPERS ABSTRACTS

Investigational Assessment using CBR Approach on Designing of Thickness for Flexible Pavement Subgrade Soils

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Abstract—Pavement is the actual travel surface particularly made durable and serviceable to resist the traffic load shuttling upon it. The friction for the vehicles thus provides comfort to the driver and it transfers the traffic load from the upper surface to the natural soil to the pavement. A highway pavement is a structure consists of superimposed layers of processed materials above the natural soil sub-grade, where its primary function is to disperse the applied vehicle loads to the subgrade. The pavement structure provides a surface of appropriate riding quality, sufficient skid resistance, positive light reflecting characteristics, and minimal noise pollution. The aim is to ensure that the transmitted stresses due to wheel load are adequately reduced, so that they will not exceed bearing capacity of the sub- grade. This present study deals with the design thickness of flexible pavements, where majority of the Indian roads are flexible pavements having bituminous layer. Earlier, due to the scarcity of cement and India went for flexible pavements with bituminous toppings. This flexible pavement is preferred over cement concrete roads as they have a great advantage that these can be strengthened and improved in stages with the growth of traffic. With a major advantage of this roads and their surfaces milled and recycled for rehabilitation. The flexible pavements are less expensive also about initial investment and maintenance. In this present study, the flexible pavement thickness is designed for both sub grade soils as per IRC:37-2001 code and its pavement thickness is calculated by California Bearing Ratio (CBR)method.

Keywords: Flexible Pavements, California Bearing Ratio, Thickness of Pavement

Feasibility Study of Recycled Plastic Waste as Fine Aggregate in Concrete

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Abstract—Now a days, Environment concerns towards plastic waste rises because of its low degradability and creating problems like chunking sewer lines, drainages, water ways, filling landfills and health problems also. The best approach is recycling and reuses the plastic waste. Increase in production of plastic day by day but, very little recycled. On the other hand, huge demand of concrete in construction industry. Utilization of recycled plastic waste in production of sustainable concrete by partial replacement of fine aggregate. This study has been investigated the utilization of two types of recycled plastic waste Polyethylene (PET) and Polypropylene (PP) as fine aggregate in concrete. M30 grade of concrete has been used by partial replacement of fine aggregate (River Sand) with recycled plastic waste in the percentage of 5, 10, 15, 20, 25 and 30. The workability and compressive strength results are checked to find the acceptable percentage of incorporation of PET and PP in concrete. From the results, it is observed that the workability is decreased as the percentage of recycled plastic waste is increased.

Keywords: Recycled Plastic Waste, Polyethylene, Polypropylene, Feasibility and Conventional Concrete

A Sustainable Study on Permeable Concrete using Bagasse Ash and Rice Husk Ash as a Partial Replacement of Cement

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Abstract—Pervious concrete is a special concrete which consists of cement, coarse aggregate and water. Due to rapid growth of globalization and urbanization, the construction of concrete roads increasing day by day which leads to decrease in percolation of storm water, surface runoff occurring to the decrease in ground water table.

In previous concrete, single sized aggregate is used to maintain the void ratio in the concrete. The cement paste is bonded with aggregate with a void ratio of 20%. In this investigation M20 grade of concrete with water cement ratio 0.38 is used. In order to increase the properties of concrete, Rice husk ash and Bagasse ash are used in different percentages (10%, 20%, 30%) by weight of cement and with the combination of rice husk ash and bagasse ash 10% (5%RA + 5%BA), 20%(10%RA+10%BA), 30%(15%RA+15%BA) are used. The compressive strength for cubes, split tensile for cylinders are casted and tested at 7 days and 28 days. After testing, the optimum percentages of replacement of admixtures are found in the pervious concrete. Therefore the strength and durability properties of pervious concrete with the addition of bagasse ash and rice husk ash with partial replacement of cement are compared with conventional concrete.

Keywords: Pervious Concrete, Strength, Durability, Rice Husk Ash, Bagasse Ash

Enhancement of Load Carrying Capacity of Existing Telecom Tower through Redesign of Bracing Pattern

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[2]Professor, Department of Civil Engineering, JNTUH, Hyderabad Telangana, India

Abstract—In this paper, effectiveness of strength enhancement technique through redesign of existing bracing pattern has been investigated for triangular hybrid tower configuration – legs are made up of circular hollow section and bracings are of angular profiles. Although Different bracing pattern are extensively used in lattice towers, current paper deals with single lacing pattern due to its effectiveness for smaller loads, easiness of implementation using existing gusset plates and elimination of secondary members. While redesign of existing bracing pattern, circular hollow section is used to replace existing angular bracing with a fact that circular profiles are having larger stiffness for smaller steel area, lesser wind load and higher radius of gyration compared to angular profiles. In addition, bolted connection is followed for replacement of existing angular bracing with hollow section by flattening at both ends. From the detailed analysis, it is concluded that Re-Design of existing bracing pattern along with replacement of angular bracings with tubular member is reliable and efficient solution not only for reduction of wind forces but also ensure effective utilization of existing reserved capacity of in each section and as well more effective where foundation strengthening is requiring reducing existing base reactions. Therefore, this solution is more effective compared to other traditional strengthening solutions.

Mapping of Urban Land Use and Land Cover Changes using Remote Sensing and GIS Technologies

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[3]Professor of Environmental Science & Technology

Abstract—Urbanization with its extend growth in built up affords favourable to human in technological expansion, substitute it leads to ecological hazards. Mapping of urban area land use land cover(LULC) changes is vital for sustainable development. Remote sensing with its emerging technology designed as earth observatory and providing information to do research. The remotely collected data from 3rd quarter of 20th century is accessible to do analysis in GIS and output the result to various purposes. Supervised classification performed for LANDSAT Imagery of study area and the collected data for five years i.e 1977, 1995,2004, 2011 and 2019 are free from atmospheric conditions. LULC with five classes namely Builtup, Barrenland, Vegetation ,Waterbody and Wetland are classified for Study area Hyderabad city with co-ordinates 17.3850° N, 78.4867° E . Overall accuracy assessment for each classified image is executed at 80%. The result shows the change detection of study area and its urban development indicates LULC transformations posed a serious threat to the natural resources.

Keyword: Land Use Land Cover (LULC), Mapping, Supervised Classification, Urbanization

Optimal Cropping Patten using Linear Programming to Improve the Water Utilization Efficiency: A Case Study in Sriramsagar Project

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Abstract—According to Irrigation and Drainage paper no. 33 (Yield Response to Water) of Food and Agriculture Organization of the United Nations, Water Utilization Efficiency (Kg/m3) is the amount of harvested yield produced by the crop per unit of water evapotranspired. Project Efficiency is the ratio between the amount of water stored in the root zone and the amount of water released at project headworks. There is an urgent need to improve the Water Utilization Efficiency and Project Efficiency of all irrigation projects in the world to meet the ever increasing food production requirements. In this paper, an attempt is made to maximize the net benefits of crop production to meet the United Nations' sustainable development Goal 1 (End Poverty in all its forms everywhere), Goal 2 (End hunger, achieve food security and improved nutrition and promote sustainable agriculture) and Goal 6 (Ensure availability and sustainable management of water and sanitation for all).

A study area in Sriramsagar Project is selected to optimize the cropping pattern. A linear programming model is fitted with available constraints. The model is run with TORA software. The cropwater requirements are computed using CROPWAT 8.0 of Food and Agriculture Organization. Sensitivity analysis of the optimum result is carried out.

Keywords: Water Utilization Efficiency, Project Efficiency, United Nations Sustainable Development Goals, Linear Programming, CROPWAT, Sensitivity Analysis, TORA

Effect of Manufactured Sand on Flexural Behavior of Geopolymer RCC Beams

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Abstract—In recent days, the continuous depletion of the ozone layer and global warming issue have increased the awareness of the construction industries in using more eco-friendly construction materials. Against this background, geopolymer concrete has begun to increase huge consideration from the research scholars and construction practitioners, because of its beneficial in utilizing result waste to replace cement and diminishing ozone depleting substance emission during its generation It also possesses better mechanical properties and durability compared to conventional concrete. On the other hand river sand is becoming scare day by day and costlier. So the manufactured sand turns out to be alternative material for river sand. Despite its advantageous, the use of geopolymer concrete in practical is considerably limited, this is mainly due to the lacking in the studies in terms of structural elements, design and application studies. This paper objective is to investigate the material and structural performances of geopolymer concrete to identify the research gaps in this area for future research development. Analysis on flexural behavior of beams shown that geopolymer concrete can replace conventional concrete as they presented relatively better mechanical property in terms of flexural strength.

Keywords: Manufactured Sand, Geopolymer Concrete, Conventional Concrete, Flexural Behavior and Alkaline Solution

Studies on Structural Behavior of RCC Beams Made with Geopolymer Concrete when Coarse Aggregate Replaced by Recycled Aggregate

Dr. T. Srinivas[1], G. Abhignya[2] and Dr. N.V. Ramana Rao[3]
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[3]Professor, Department of Civil Engineering, JNTUH, Hyderabad–500085

Abstract—In present day scenario, concrete construction is rapidly increasing for different uses and aspects irrespective of the economy and its usage. Due to this imbalanced usage of economy, scarcity of raw materials increasing day by day and environment is getting affected due to manufacturing of cement. This study has been done to reduce environmental pollution by using different kind of waste materials in replacement to OPC. The cement is replaced with fly ash and GGBS and aggregates are partially replaced with recycled aggregates which come from demolished structures. Experimental investigations have been carried out to find the optimum content of aggregates to be replaced in this study. The flexure behavior of the beams is evaluated and the load at the first crack has been recorded. From the experimental study, the optimum compressive strength is achieved at 30% replacement of recycled aggregate and ductility natures of both Geopolymer and conventional concrete beams are compared.

Keywords: Recycled Aggregate, Geopolymer Concrete, Conventional Concrete, Flexural Behavior and Alkaline Solution

A Review on Generation and Development of Foam Concrete

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[2]Professor of Civil Engineering Gokaraju Rangaraju Institute of Engineering & Technology, Hyderabad (Telangana)

Abstract—This paper presents review on generation and developments of foam concrete. Majorly focussed on reliable advantages and properties of foam concrete. Also pointed out the key points in strength development of foam concrete using with different filler materials such as, river sand, sea sand and quarry dust (stone dust), fly ash, GGBS etc., with cement. Discuss the effects on foam concrete when several foaming agents are used. A sample calculation of foam concrete mix design also present.

Keywords: FC-Foam Concrete

Performance of Moment Resisting RC Building Equipped with X-plate Damper under Seismic and Blast Loading

N. Omprakash Reddy[1] and Atul Kumar Manchalwar[2]
[1]M.Tech Scholar, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad
[2]Associate Professor, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

Abstract—This study is an attempt to evaluate the effects of blast induced vibrations and seismic ground vibrations on reinforced concrete structure equipped with X-plate dampers and also to study the response of structure against blast and seismic vibration which can be reduced by employing protective systems such as dampers. Moment-resisting RC frame buildings were analysed to evaluate the structural responses under dynamic excitations. Non-linear Time-history analysis has been conducted on reinforced concrete structures. The ground accelerations were analytically determined and model was created in SAP2000.

Keywords: X-plate Damper, Ground Induced Vibrations, Energy Dissipation Device, Time-History Analysis

Seismic Isolation System using U-shaped Steel Damper

G. Jyothi Sri Sravya[1] and Atul Kumar Manchalwar[2]
[1]M.Tech Scholar, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad
[2]Associate Professor, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

Abstract—In the present paper base isolation system is analyzed and its seismic behavior is investigated using U-shaped steel dampers as an isolator by placing it at the bottom of the structure. It is the most popular way of protecting the structure using control techniques for earthquake ground motion. The dampers significantly reduced damage factors such as displacement and drift. To reduce structural response to external forces, which can be accomplished through the use of special protective systems. So to prevent these damages, seismic isolation technique can be used for newly constructed structures. The time history analysis of the time domain on this structure is conducted by using SAP2000 software.

Keywords: Isolation, U-shaped Damper, Time History Analysis, SAP2000, MDOF

Performance of RC Structure with Viscous Damper under Seismic Loading

A.V. Sai Veda[1], G. Nirmala[2], G. Jyothi Sri Sravya[3], N. Omprakash Reddy[4] and Atul Kumar Manchalwar[5]

[1,2,3,4]M.Tech Scholar, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

[5]Associate Professor, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

Abstract—Failure of structure is mainly due to its inelastic non-linear behaviour. Passive control techniques are being introduced for enhancement of structure and prevent against failure. The present research is to evaluate the efficiency of passive control technique (fluid viscous damper) for two moment resisting RC buildings which is subjected to non-linear static (push over analysis) and non-linear dynamic analysis (time history).Two moment resisting RC structures (Regular and Irregular buildings) equipped with FVD are analysed for both non-linear static and non-linear dynamic analysis to evaluate the performance of damper in mitigating external loads. Irregularity of the structure is assumed as per IS1893 2016. Non-linear analysis is performed in SAP2000. Usage of FVD's enhanced the structural performance.

Keywords: RC Structure, Fluid Viscous Damper, Time History Analysis, Pushover Analysis, SAP2000

Vibration Control of Water Tank Staging Equipped X-plate Damper

G. Nirmala[1] and Atul Kumar Manchalwar[2]

[1]M.Tech Scholar, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

[2]Associate Professor, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

Abstract—During post-earthquake requirement the staging of elevated water tanks are considered as essential structures. Failure of staging leads to collapse of water tank so required to control the vibration of water tank Staging. In This paper elevated circular tank supported with frame was modeled to control the vibration of staging. Non-linear dynamic analysis (time-history analysis) was performed on model by using SAP-2000 software to study the seismic behaviour. The additional dissipation of energy occurs by using damper constitute an effective technique for the earthquake reduction of staging members and In this study an attempt has been made to use the X-plate metallic steel damper for reducing the seismic response.

Keywords: X-plate Damper, Time History Analysis, SAP 2000, Water Tank, Energy Dissipation Device

Investigation on Workability of M20 Grade Concrete with Partial Replacement of Crumb Rubber and M Sand for Fine Aggregates and Flyash for Cement

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[1]Assistant Professor, Gokaraju Rangaraju Institute of Engineering & Technology, Hyderabad
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[3]M.Tech Student Gokaraju Rangaraju Institute of Engineering & Technology, Hyderabad

Abstract—Concrete plays a vital role in every construction. This paper focus on workability of the concrete with partial replacement of crumb rubber and M sand for fine aggregate and fly ash for cement. In this investigation the crumb rubber is utilised in place of fine aggregate. The scrap tyre treatment is currently a serious issue against environmental pollution. India represents the fourth largest market for tyres in the world after china, Europe and the US. Fly ash and M sand is an industrial waste which is included in the concrete. In this investigation workability of concrete is conducted on M20 grade concrete by replacing river sand with the manufactured sand and crumb rubber at percentage of replacements 0 to 20% at an regular interval of 5% and Compare the results obtained by the modified concrete with the normal concrete.

Keywords: Workability, Crumb Rubber, Manufactured Sand (M Sand), Flyash

Behaviour of Copper Slag on as a Partial Replacement of Fine Aggregate in Concrete Mix

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[3]Professor and HOD, Department of Civil Engineering, CMRTC, Hyderabad

Abstract—This paper reports an experimental program to investigate the impact of utilizing copper slag as a replacement of fine aggregate on the strength properties. Copper slag is a by-product or a waste material of matte smelting and refining of copper such that each ton of copper generates approximately 2.5 tons of copper slag. Copper slag is one of the materials that is considered as a waste which could have a promising future in construction Industry as partial or full substitute of aggregates. For this research work, M25 grade concrete was used and tests were conducted for various proportions of copper slag replacement with sand of 0 to 100% in concrete. The obtained results were compared with those of control concrete made with ordinary Portland cement and sand.

Keywords: Copper Slag, Fine Aggregate, Compressive Strength, Flexural Strength, Partial Replacement

Strength Properties of Double Blend and Triple Blend Self Compacting Concrete Subjected to Different Curing Methods

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[2]Professor in Civil Engineering Department, JNTU, Hyderabad, Telangana, India
[3]Advisor, ACE Engineering College, Hyderabad, Telangana, India

Abstract—The behaviour of Self Compacting Concrete is complex with the addition of both chemical and mineral admixtures. The use of supplementary cementing materials such as Metakaolin, FlyAsh, GGBS and Silica fume is required to improve the flow properties of fresh concrete, to decrease the cement contents, to increase the strength as well as durability of cement and to reduce cement consumption for environmental and economical concern. The method of curing plays a vital role on hydration mechanism, strength and setting characteristics of SCC. Hence, this paper presents the results of an investigation dealing with the effects of curing methods on the compressive strength of SCC incorporating Metakaolin as main supplementary cementing material to 53grade OPC. FlyAsh, GGBS and Silica fume are used individually for triple blend binders with OPC and Metakaolin. The Grade of concretes made were Standard concretes of M50. The compressive strengths of the concretes were determined at 7 and 28days. The Curing methods adopted were the conventional method of water pond as reference and the Wax based Liquid membrane and Polymer based liquid membrane curing compounds for research. The superplasticiser based on a polycarboxylic ether polymer with long lateral chains, is used to reduce water cement ratio and to improve the flow ability and filling ability of SCC. The performance of the Polymer based membrane curing compound is better than Wax based membrane curing compound. In addition to this, the polymer based membrane allows plastering and painting over the concrete surface. The early gain in strength is observed in all the membrane cured cubes at 7 days, but the rate of gaining strength is reduced after 7 days when compared with the Water pond cured cubes.

An Experimental Study on Self-compacting Concrete by Packing Density Method

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Department of Civil Engineering, CMRTC, Hyderabad

Abstract—In the 21st century concrete had reached a big mile stone, i. e self compacting concrete, compaction of concrete was done by its own weight. More research was focused on this self-compacting concrete by make use of different materials and design methods. However, still no mix design was become standardized mix design. For self-compacting concrete due to lack of mix design, no of trails are required more to obtain self-compacting concrete. In this light, aggregate packing density method is new kind of mix design. The main advantage of these methods is to provide optimize the paste content. In the present study, focused on design the mix proportions based on packing density of aggregate with varying w/c ratio (viz. 0.38, 0.40, and 0.42). In the initial stage, bulk density of aggregate with varying 4.75mm aggregate, river sand, robo sand was conducted. Further, packing density was determined and taken optimum proportions. For these mixes, optimum dosage of admixture and compressive strength to be determined and UPV test was performed to analyze quality of concrete.

Vibration Control of Water Tank Staging Equipped X-plate Damper

G. Nirmala, Atul Kumar Manchalwar and Sakshi Manchalwar
Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad

Abstract—During post-earthquake requirement the staging of elevated water tanks are considered as essential structures failure of staging leads to collapse water tank so required to control the vibration of water tank. In this paper elevated circular tank supported with frame was modeled to control the vibration of staging. Non-linear dynamic analysis (time-history analysis) was performed on model by using SAP-2000 software to study the seismic behaviour. The additional dissipation of energy occurs by using damper constitute an effective technique for the earthquake reduction of staging members and In this study an attempt has been made to use the X-plate metallic steel damper for reducing the seismic response.

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Keywords: Isolation, U-shaped Damper, Time History Analysis, SAP2000, MDOF

Experimental Study on Concrete by Partial Replacement of Fine Aggregate & Coarse Aggregate with Copper Slag & Recycled Coarse Aggregate

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Abstract—Concrete is the man made material widely used for construction purposes. The usual ingredients in concrete are cement, fine aggregate, coarse aggregate and water. It was recognized long time ago that the suitable mineral admixtures are mixed in optimum proportions with cement improves the many qualities in concrete. With increasing scarcity of river sand and natural coarse aggregates across the country, researches began cheaply available materials as alternatives for natural sand and natural coarse aggregate (NCA).

In India, there is great demand of aggregates mainly from civil engineering industry for road and concrete constructions. But, now days it is very difficult problem for availability of fine aggregates. So researchers developed waste management strategies to apply for replacement of fine aggregates for specific need. Natural resources are depleting worldwide while at the same time the generated wastes from the industry are increasing substantially. The sustainable development for construction involves the use of nonconventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways conserving the environment.

In developing countries, construction and demolition waste (CDW) is disposed to landfill, causing social, environmental, and economic crises. In these nations, CDW exponentially increase due to their rapid economic growth, industrialization, and urbanization. We aim to examine the possibility of recycling concrete waste for production of new concrete. Utilization of industrial waste or secondary material has increased in construction field for the concrete production because it contributes to reducing the consumption of natural resources. The Crushing of concrete waste to produce Recycled Coarse Aggregate (RCA) and reusing it with natural coarse aggregates to create concrete elements has been recognized as one of the most practical and sustainable methods for handling of construction and demolition waste (CDW).

In this study, we aim to examine the possibility of recycling concrete waste for production of new concrete. We are going to replace the fine aggregate with copper slag and natural coarse aggregate with recycled coarse aggregate in different proportions ranging from 0%, 10%, 20%, 30%, 40% and 50% and different tests on resulting concrete like compressive strength, split tensile strength and flexural strength tests for 7days and 28days will be carried out and also tests for workability conditions, adding 1% od superplasticizer admixture will also be done.

Keywords: Copper Slag, Super Plasticizer, Compressive Strength, Split Tensile Strength, Flexural Strength, Construction and Demolition Waste (CDW), Recycled Coarse Aggregate (RCA), Natural Coarse Aggregate (NCA)

Glass Fibre High Performance Concrete in Exterior Beam-column Joint Subjected to Monotonic Loading using Ansys Analysis

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Abstract—Strength and ductility of structures depend mainly on proper detailing of the reinforcement in beam-column joints Beam-column joints have a crucial role in the structural integrity of the buildings provided with adequate stiffness and strength

to sustain the loads transmitted from beam and column. In RC buildings, portions of columns that are common to beams at their intersections are called Beam column joints. When forces larger than these are applied during earthquakes, joints are severely damaged. As far as earth quake is concerned, study on beam-column joint is necessary. In High Performance Concrete, materials and admixtures are carefully selected and proportioned to form high early strengths, high ultimate strengths and high durability beyond conventional concrete.

The admixtures like fly ash, silica fume, ground granulated blast furnace slag (GGBS), are added both for strength and durability and enhance its marketability as an environmentally friendly product. The main objective of the present investigation is to study the behavior of high performance reinforced beam-column joints (replacement of cement with Ground granulated blast-furnace slag). Ground granulated blast furnace slag is used as a partial replacement of cement with glass fibre and super plasticizer is used to achieve require workability. In this investigation, a comparison of control specimen and specimen with 7.5% GGBS and 0.3% glass fibre replacement designed as per IS 456:2000. Also to determine the behaviour of beam-column joints subjected to monotonic loading for high performance concrete using Ground Granulated Blast Furnace Slag (GGBS) and glass fibre.

Keywords: Beam-column Joints, Ground Granulated Blast Furnace Slag (GGBS), Glass Fibre, Monotonic Loading

Development of Strength for High Volume Fly Ash Self Compacting Concrete with Lime and Silica Fume as Additives

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Abstract—Since the time Self-compacting concrete (SCC) has been developed in Japan, it has been a challenge to concrete technologists to develop sustainable high strength SCC which has low carbon footprint. SCC shows lot many advantages which are incomparable to any other type of concrete, as it flows itself into compact reinforcement avoiding noisy vibration and compaction on site. The major challenge in producing SCC lies in mix design, which involves calculation of suitable quantities of materials, and such composition should be achieving maximum possible strength and show consistent durability properties. SCC is expensive when compared with normal conventional concrete. Hence, it is desired to produce low cost SCC by replacing cement with higher percentages of fly ash, which is a no cost material and available in abundance. At the same time to achieve higher grade HVFASCC, micro silica which is otherwise condensed silica fume can also be used along with fly ash to enhance the strength properties of HVFASCC. Micro silica increases the compactness and denseness of the mix by filling gaps between cement particles to a maximum extent. By replacing fly ash in high volumes in the mix, high amount of pozzolanic material becomes available, majorly reactive silica, for which more calcium hydroxide is necessary for further pozzolanic reaction. As we are reducing cement quantity, the amount of calcium hydroxide available is reduced thus demanding external addition of hydrated lime which can be supplied as additive to cater to the need of calcium hydroxide required for reactive silica in fly ash.

The present investigation aims to achieve strength for high volume fly ash self-compacting concrete. The replacement of cement with fly ash is made in 45%, 50%, 55%, 60%, 65% and 70% with 20% hydrated lime and 10% silica fume in one trial. In another trial, 30% hydrated lime and 10% silica fume is added with replacement of fly ash to cement varying in same percentages. The design mix is tested for workability and flowability and cubes are casted for compression strength test and tested at 28 days, 56 days and 90 days.

Keywords: Self-compacting Concrete, HVFA, Nan Su, Fly Ash, High Performance Concrete

Optimal Cropping Patten using Linear Programming to Improve the Water Utilization Efficiency: A Case Study in Sriramsagar Project

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Abstract—According to Irrigation and Drainage paper no.33(Yield Response to Water)of Food and Agriculture Organization of the United Nations , Water Utilization Efficiency(Kg/m^3) is the amount of harvested yield produced by the crop per unit of water evapotranspired. Project Efficiency is the ratio between the amount of water stored in the root zone and the amount of water released at project head works. There is an urgent need to improve the Water Utilization Efficiency and Project Efficiency of all irrigation projects in the world to meet the ever increasing food production requirements. In this paper , an attempt is made to maximize the net benefits of crop production to meet the United Nations' sustainable development Goal 1 (End Poverty in all its forms everywhere),Goal 2 (End hunger , achieve food security and improved nutrition and promote sustainable agriculture) and Goal 6(Ensure availability and sustainable management of water and sanitation for all).

A study area in Sriramsagar Project is selected to optimize the cropping pattern. A linear programming model is fitted with available constraints. The model is run with TORA software. The crop water requirements are computed using CROPWAT 8.0 of Food and Agriculture Organization. Sensitivity analysis of the optimum result is carried out.

Keywords: Water Utilization Efficiency, Project Efficiency, United Nations Sustainable Development Goals, Linear Programming, CROPWAT, Sensitivity Analysis, TORA

Smart Concrete Curing System

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Abstract—As we know that in the present era, water scarcity is the biggest problem. In Construction potable water is required for mixing concrete and for curing concrete. The curing process is required for 28days. So water requirement in construction field for curing purpose is very large. Due to various reasons potable water availability is decreasing day by day. So it is required to spend considerable amount on the procurement of water. In order to control the wastage of water for curing it is necessary to use water in controlled manner by adopting advanced technology. It is known as smart concrete curing system. Smart concrete curing system is developed to create an automatic curing mechanism to supply water for curing depending on the availability of moisture in the concrete and surrounding temperature. Moisture content of structure is detected by using a moisture sensor without human intervention. Whenever moisture content decreases in the structure the sensors will automatically turns the pumping motor ON. When moisture content reaches the required level the motor will OFF automatically. This smart curing system project requires Sensors, Arduino micro-controller, 0.25hp motor, Node MCU, PCB etc. Arduino micro-controller is programmed to collect the input signal according to moisture content of concrete structure. The system will be connected to the internet using Wi-Fi. The current moisture content level of concrete structure and the pump status will be pushed to the cloud. A mobile app will access this data from the cloud. So that the curing process monitoring can be done remotely. Based on observation to maintain the optimum moisture content, threshold value is set at 400. If the sensor value becomes more than 400 pump will be turned ON, if the value is low automatically pump will be turned OFF.

Keywords: Moisture Sensor, Arduino Microcontroller and Node MCU

Performance of Concrete Blended with Inhibitors and Slag Exposed to Chloride Environment

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Abstract—Reinforced concrete is widely used as a construction material and plays an important role in worldwide due to its excellent properties. Corrosion of reinforcement is one of the drawbacks in reinforced concrete structures, to overcome corrosion problem an attempt will be made in the present investigation by use of corrosion inhibitors to concrete. This research is proposed to conduct the experiment on four types of cements, they are Ordinary Portland cement(OPC), portland pozzolona cement(PPC), Portland slag cement(PSC) and Corrosion Resistance cement(CRC) with the water cement ratio of 0.35. The corrosion resistance inhibitors proposed to be used in this research are Calcium Nitrate and Sodium Nitrate. These inhibitors form protective hydrophobic film on the surface of reinforcement with high alkalinity present in concrete. The reinforced concrete specimens will be immersed in the hydrochloric acid (HCl), sodium chloride (NaCl) and magnesium sulphate (MgSO4) solution to induce corrosion. The corrosion resistance of the concrete to be evaluated with the help of Rapid chloride penetration test (RCPT), by measuring concrete resistivity and potentials and also accelerated corrosion test will be conducted to assess the corrosion resistance efficiency of the different concretes .

In this research also the performance of high volume fly ash concrete and Ordinary Portland Cement concrete with the addition of Organic and inorganic inhibitors with the water cemnt ratio of 0.35 will be studided. The organic inhibitors are extracted from Azadirachta indica (Neem) and dehydrated Aloe-vera powder and the inorganic inhibitors to be used are Calcium Nitrate, Sodium Nitrate and Ethylene diamine tetra acetic disodium dihydrate . Then the compressive strength test will be conducted for different curing ages such as 3, 7, and 28 days. Rapid chloride penetration test (RCPT) will be conducted to explore the resistance to chloride penetration, by measuring concrete resistivity and potentials and also accelerated corrosion test will be conducted to assess the corrosion resistance of above proposed concretes. Then the test results of the High volume fly ash concrete with inhibitors and the Ordinary Portland cement concrete with inhibitors will be compared and the corrosion resistance efficiency of the concretes to be estimated.

Development of Quaternery Blending of Self Curing Concrete using Polyethylene Glycol as Internal Curing Agent

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Abstract—Today Water is the most required substance in the era. In common, Curing of concrete is maintaining moisture in the concrete during early ages specifically within 28 days of placing concrete, to develop desired properties. Proper curing of concrete is essential to obtain maximum durability, especially if the concrete is exposed to serve conditions where the surface will be subjected to excessive wear, aggressive solutions and severe environmental conditions. Poor curing practices adversely affect the desirable properties of concrete which makes a major impact on the permeability of a given concrete. Unexpected shrinkage and temperature cracks can reduce the strength, durability and serviceability of the concrete. The surface zone will be seriously weakened by increased permeability due to poor curing. The development of concrete strength is proportional to the rate of moisture loss in concrete.

When concrete is properly cured, water retained in concrete would help continuous hydration and development of enough tensile strength to resist shrinkage stresses. The continuous development of strength reduces shrinkage and initial cracks or micro-cracks. Curing operations should ensure that adequate amount of water is available for cement hydration to occur. Internal water curing can be used to mitigate self-desiccation and self-desiccation shrinkage.

The investigation is mainly contributed on improvising the strength parameters of Self-Curing Concrete which doesn't need any necessity of water in which Polyethylene Glycol PEG 400 is used as the curing agent with a percentage of curing agent is 0.3 with mineral admixtures such as Flyash, Microsilica, Ground Granulated Blast Slag and Metakaolin from the cementitious material. Variation were made in the blended concrete materials with a partial replacement and it is compared with the conventional concrete mix in the M30 Grade of concrete designed as per IS 10262:2009. As a part of research initiative, this investigation of Fibrous Self Curing Concrete, proportion and addition of blended materials which will be resulted in the strength development and formation of micro cracks in order to reduce the autogenous shrinkage and improvement of durability.

Keywords: Polyethylene Glycol PEG 400, Flyash, Microsilica, Ground Granulated Blast Slag, Metakaolin, Compressive, Tensile and Flexural Strength

Effect of Industrial Effluent on Surface Water Quality Annalysis of Medchal Lake, Medchal District, Telangana

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Abstract—Water is a natural resource (lakes and rivers) which is decisive for the survival of living organisms. Due to rapidly increasing population, exponential industrialization and urbanization, etc. various water bodies,all over India are exposed to various forms of environmental degradations. This leads to aggregations of phytoplankton, macro algae and occasionally colourless heterotrophic protists can discolour the water giving rise to foam. Due to this, there is reduction in DO (Dissolved Oxygen) level which ultimately disturbs the ecological balance of the lake and finally leads to eutrophication in water bodies. In the present work, the Medchal Lake situated in Medchal District, Telangana, India has been selected for sampling collection. This study reveals the current status of the Medchal Lake in terms of water quality. Higher values recorded containing salts, land fill leachates and animal. Over the due course of time various parameters regarding the water quality were analyzed & the Indian Standards: 10500 (Drinking water specifications) was referred to in order to check the acceptability of water. The physico-chemical parameters which were analyzed are as follows Temperature, Determination of pH, Electrical Conductivity, Determination of Acidity, Determination of Alkalinity, Determination of Chlorine, Determination of Dissolved Oxygen Most of the parameters were not found to be in the desirable range for drinking water & hence, appropriate measures were suggested to improve the quality of water.

Keywords: Lake Water, Water Quality, Physico-chemical Analysis

Study of Rolling Barrier System

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Abstract—The tremendous increase in road mishaps has become a cause of concern for the government. The transportation sector in India has expanded rapidly especially after the onset of the new century. The government of India is investing huge amount of revenue in the infrastructure and transportation sector in order to link various cities and towns. The government has been trying to come up with the latest technology available to overcome the situation of road accidents every year lakhs of people become part of accidents and many of them lost their lives. Road accidents are the outcomes of various factors such as length of road networks, vehicle population, etc. The number suggests at least 413 people died every day in 1,317 road accidents. So to overcome this situation a small manufacturing company of Korea came with an innovative concept of roller barrier. Our study aims is to find the effectiveness of RB and understand the characteristics. It works on the principle of conversion of shock energy to rotational energy. These barriers can be placed in hilly areas, highways, deep curves. Some can also be placed in the place of divider place.

Keywords: Shock Energy, Rotation Energy, Innovative, Tremendous, Mishaps

Experimental Study on Properties of Concrete using STP Treatement Water

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Abstract—Concrete is the most widely used construction material in the world. In addition to this concrete is one of the largest water consuming industries. This study deals with the effect of treated waste water on properties of concrete such as compressive strength, tensile strength and flexural strength. The STP water used for the project has to be collected from the STP plant present in the GRIET campus, Kukatpally. With the prior knowledge, the water collected from the STP plant is tested for its properties. The grade of concrete to be used is M25 which is prepared, casted and further tested for its compressive strength at 7 days, 14 days, 28 days and 60 days. Compressive strength, durability properties and microscopic study both concrete prepared with treated waste water and portable water is studied.

Improved Capacity of Geotextile Encased Stone Columns: An Experimental Study

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Abstract—The benefits of using stone columns has proved to be an efficient ground improvement technique for construction on soft soils and has been successfully applied for the foundation structure like oil storage tanks, earth embankments, raft foundation, near shore structures etc. When the stone columns are installed in extremely soft soils, the stone column capacity depends on circumferential lateral confinement offered by the surrounding native soil may not be adequate to form the stone column. In such soil, encasing the stone column with a geotextile can induce required lateral confinement. This paper presents an experimental study of single and pile encasement in improving the bearing capacity and reducing the settlements.

In the present work, laboratory experiments have been carried out with granular piles of size, 5 cm and 11 cm. In laboratory setup, hydraulic pressure was used to apply the load to the soil granular pile system and the dial gauges was used to measure the settlements. To obtain the stiffness of the pile, a test were carried on pile encasement, by loading only the pile material neglecting the confining effect of the surrounding soil as the soil is soft in nature. Study of the bearing capacity ratio which is defined as ratio of the bearing capacity of treated soil with granular pile to the bearing capacity of untreated soil for a given settlement for the foundation was made. Granular piles made of stone and sand, and encasement of piles with leno netted material. To cast the piles, casing pipes of the required diameter were used.

Experimental Investigation on Flexural Behavior of RCC Beams Made with Low-calcium Fly Ash and Slag Based Geopolymer Concrete

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Abstract—In the process of production of concrete, the emission of carbon dioxide has become a life-threatening issue and a major drawback towards sustainabledevelopment, as there is need to reduce and control this carbon dioxide. It is required to find an alternative greener material to the existing cement-concrete.Due to its considerably lower carbon footprint and making use of industrial by-products including fly ash and ground granulated blast-furnace slag in geopolymer concrete is considered as a sustainable alternative.

Low calcium Fly ash is a by-product from the coal industry, which is widely available throughout the world. Fly ash is rich in silicate and alumina, hence it reacts with alkaline solution to produce alumina silicate gel that binds the aggregate to produce a good concrete. The compressive strength increased due to reduction of porosity, as the fineness of fly ash increases. The flexural behavior of geopolymer concrete (GPC) beams have been studied and compared with the reference concrete beams of the respective grade. It has been observed that the development of flexural cracks are relatively less in geopolymer RCC beams compared to conventional RCC beams.

Keywords: Geopolymer Concrete, Flexural Behavior, RCC Beams, Alkaline Solutions, Conventional Concrete

Mechanical Properties and Mix-design of Geo-polymer Concrete: A Review

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Abstract—Geo-Polymer concrete (GPC) is a most viable solution to cement as the raw materials depleting down the years and many countries have started imposing carbon taxes. After a review for the literature reveals that there is no proper mix design procedure developed yet. GPC has better mechanical properties when compared to normal concrete. Curing conditions, setting times, workability, alkaline solution to binder ratios, molarity of alkaline solution, Na2SiO3/NaOH and SiO2/Al2O3 ratios play an important role to develop GPC . This paper presents an overview of Geopolymarization process, mechanical properties and mix design of GPC. Geopolymer mixtures with desired properties can be designed for ambient temperature curing condition with minerals additives which may further promote them as an environmentally friendly construction material.

Keywords: GPC, Geo-polymer, Alkaline Solution, Mix Design

Response Reduction Factor for Different Heights of RC Structure

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Abstract—Seismic analysis is considered as an important parameter for any structural design. The strength and ductility of frame members in seismic design depends on the response reduction factor. In this paper four symmetrically framed structures are considered of different heights under the critical zone condition. The primary emphases of this work is regarding calculation of response reduction factor values attained from designing RC framed structures. The results are computed by applying non-linear static pushover analysis. SAP-2000 software is used for analyzing the non-linear behaviour of the structure.

Keywords: Seismic Analysis, Pushover Analysis, Response Reduction Factor, SAP-2000

Mechanical Properties of Concrete with a Partial Replacement of Cement with Bagasse Ash

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Abstract—The development of a country is depends on its infrastructure which is in turn depends on urbanisation and industrialisation. This leads to the shortage of construction space, raw materials and increased productivity of waste materials. The continuous construction activities require continuous supply of raw materials which may get depleted completely in future. The solution for this problem is to replace the raw materials in proportions. One of the basic and most important raw materials is cement.

In these work, mechanical properties of cement partial replacement with bagasse ash is investigated. An appropriate mix design used and specimens were cast. Workability, compressive strength, split tensile strength tests are investigated and results were compared with control mix.

Keywords: Cement, Bagasse Ash, Compressive Strength, Split Tensile Strength, Workability, Cube Mould

Durability Properties of Geo-polymer Concrete: A Review

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Abstract—Geopolymer concrete is prepared from the reactions between silica, alumina rich minerals and caustic activator. More often, industrial wastes such as GGBS, Fly-Ash, BRHA and Alccofine, are used as binders which reduce almost 80% of CO2 emission which leads to a sustainable environment. Past studies suggested that replacement of cement with chemical and mineral admixtures enhanced the properties of concrete. Researchers found the need of alternate cementitious material as their necessity is increasing due to insistent constituents. The current study presents a review on durability properties of geo-polymer concrete. The Micro-morphology, shrinkage and durability of GPC are reviewed. XRD studies shown enhanced polymerisation reaction which is responsible for development of strength. Elevated temperatures and Surface deterioration are controlled in GPC than OPC. Geopolymer concrete provides better resistance for specimens to chemical attack and also water absorption, sorptivity and porosity have good influence to the durability properties in ambient curing conditions.

Keywords: Geo-polymer Concrete, Durability, Curing Regime

Effect of Elevated Temperature on Geo-polymer Concrete: A Review

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Abstract—The study on the effect of elevated temperature (ET) on Geo-polymer concrete (GPC) got its significance because conventional concrete start to deteriorate around 4000C. GPC gains attention as it is eco-friendly and economical, by utilising industrial by-products. GPC also an alternate solution as the raw materials to produce cement are depleting day by day. GPC gains strength by geo-polymerisation with the reactions between mineral admixtures and alkaline solutions. This paper presents the studies on general properties and advantages of GPC over conventional concrete which depend on properties of binder, type of curing etc. Current study mainly concentrates on effect of elevated temperatures and post fire properties of GPC depending upon rate of heating, duration of fire and maximum high temperature. Strength and durability recovery of fire damaged concrete is discussed.

Keywords: Geo-polymer Concrete, Eleveated Temperature, Curing Regime

Review on Decision Making Systems by Comparing Quality and Quantity of Water Management

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Abstract—Decisions on effective water management is playing very important issues in the society to prevent the health of human and national prosperity. Water management play vital role especially in arid and semi arid regions. Descion support journals on water resources management is studying and review the various methods and comparing and analysing the theme. The DSS journal are segregated based on the work and methodology involved in decision making. In this paper reviewed the mathematical model based and frame work based, GIS based spatial decision for the water shed management Evaluations. Water quality model decisions conception frame work Approach and reservoir management conflict decisions. Large reviers web based decisions and Smart watering magament systems. Mathematical model to make descinons in effective water management-aided system of water management in the river basins (S. Kaden, A. Becker and A. Gnauck etal). Complexity of these tasks for water management and for the national economy growth make the real methods as efficient to get the models-as decision-support systems. For effective water management and solutions all these dss modules are taken into account for Description Making apparatuses that are regular to investigate a multipurpose single supply framework are given in the model-base administration framework. Water management intended to deal with relation between two gatherings who have on-request water prerequisites for water system, drinking water, hydropower age, or limiting flood harm. (Veerakcuddy Rajasekaram, Nandalal k.D. *et al.*).

Performance of Concrete using Hypo Sludge as Partial Replacement of Cement

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Abstract—Increase in the paper waste from paper industries become most serious disposal problem by occupying large space and environmental pollution which is increasing day by day. To reduce the paper waste and environmental pollution, it is proposed to use the paper waste as Hypo sludge in concrete mix which contains cementitious properties like silica and magnesium. The main ingredient of concrete is cement. During the manufacturing of cement, large amount of carbon dioxide is released into the environment which causes global warming. To control environmental pollution from cement industries, Hypo sludge is used as a partial replacement of cement so that it can reduce cement content and support as an eco-friendly building material. In this research cement is replaced with GGBS and Hypo sludge. By adding 3%, 5% and 10% of hypo sludge, compressive and split tensile strength of concrete and also performance of Hypo sludge concrete are studied. From the experiment, compressive strength and split tensile strength of Hypo sludge concrete increases up to optimum dosage.

Keywords: Hypo Sludge, GGBS, Strength and Performance of Concrete

Effect of Recycled Aggregates on Durability and Workability of Concrete

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Abstract—This research is conducted with the use of recycled course aggregate and recycled fine aggregate as replacement. In terms of the use of recycled course aggregate and recycled fine aggregate, the percentage of recycled course aggregate and recycled fine aggregate should be determined because the strength of concrete would not be obtained by the high percentage of recycled course aggregate. The scope of study is about comparison between recycle coarse aggregate and recycled fine aggregate with natural coarse aggregate and fine aggregate in terms of specific gravity, absorption, particle size distribution. Moreover, this research will also focus on the comparison between recycled aggregate and recycled fine aggregate for 0%, 10%, 15%, 20%, 25%, 30% replacement. Indian standard recommends target mean compressive strength of the conventional concrete in terms of water cement ratio. The present work is an experimental study on the behaviour of recycled aggregate concrete (coarse& fine aggregates) to the compressive strength and performance (durability and workability).

Keywords: Recycled Coarse Aggregate, Recycled Fine Aggregate, Durability, Workability

A Study on Effect of Temperature Curing on Light Weight Expanded Clay Aggregate Concrete

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Abstract—Lightweight Aggregate Concrete is usually produced by using lightweight aggregate together with mineral and chemical admixtures. This paper is focused on use of lightweight expanded clay aggregate (LECA) for the development of structural lightweight concrete. The present investigation was carried out by replacing LECA with 30% of normal weight aggregate (NWA) with different w/b ratios to produce a lightweight expanded clay aggregate concrete i.e. LECAC30 (30 % LECA + 70 % NWA). LECAC30 was cured with potable water at boiling temperature for different durations like 3hr, 6hr, 9hr and 12 hr and the effect of temperature curing on early development of compressive strength and flexural strength of Lightweight expanded clay aggregate concrete was studied. The study also includes the improvement of compressive strength and flexural strength of Lightweight expanded clay aggregate concrete under temperature curing with the addition of mineral admixture.

Keywords: Normal Weight Aggregate (NWA), Normal Weight Aggregate Concrete (NWAC), Light Weight Expanded Clay Aggregate (LECA), Light Weight Expanded Clay Aggregate Concrete

Durability Study on HDPE Fibre Reinforced High Performance Concrete

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Abstract—High performance concrete (HPC) is a special concrete designed to provide high strength and excellent durability. The use of HPC with locally available and indigenous cementitious materials has been increasing the world over. Hence flyash byproduct of coal industries is blended with cement and high density polyethylene (HDPE) fibers obtained from cement jute plastic bags mixed in HPC. However, like all concretes HPC also has the disadvantages of a low tensile strength and a large brittleness. To improve the tensile strength the ductility and the toughness fly ash and non-bio degrabable HDPE fibres are selected. The fly ash 30% and fibre volume fraction is 0% and 2% in mass basis in both M40 and M60 concretes. A study is done on the performance and durability of non-biodegradable HDPE fiber reinforced concrete. The durability of HDPE fibre reinforced HPC is examined with the help of sulphates and chlorides. Short and discrete small fibres can improve the engineering properties of concrete notably flexural strength. It is observed that there is an overall improvement of all the properties of HPC with a blend of fly ash and HDPE fibers. The positive interactions between HDPE fibres and flyash lead to the lowest drying shrinkage of fibreous concrete with flyash. The results of acid tests indicated HPC containing flyash and HDPE fibres showed improved durability performance.

Keywords: High Performance Concrete (HPC), High Density Polyethylene (HDPE), Fibre Reinforced Concrete, Flyash , Durability, Non-biodegradable

Traffic Volume Studies and Estimation of Traffic Congestion

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Abstract—The aim of this project is to determine traffic volume at peak hours, traffic congestion, determine level of service and provide suitable solution to reduce congestion and improve level of service. Hyderabad is a rapidly urbanizing metropolitan city with a population of 68.1lakhs. The increasing population has led to a tremendous increase in vehicular ownership resulting in high motorization rates. Vehicular population in Hyderabad is about 50lakhs. This increase in vehicular population, congestion and hazardous traffic conditions have resulted in traffic congestions, traffic delays, accidents, environ, noise pollution, air pollution and many more. Traffic volume studies are conducted for the determination of the number of vehicles, movement and classification of vehicles at the selected location. Data obtained from these are useful for the identification of traffic flow, the influence of pedestrians on vehicular traffic flow, etc. IRC 106-1990 is referred. The data collected from surveys will be used for determination and analyzing the traffic volume, passenger car unit (PCU), congestion, Level of service, Average daily traffic, flow fluctuations, and Directional distribution, volume capacity ratio.

A report is to be made on the road of 7km, Miyapur X road to Nizampet and is studied for traffic volume, road conditions, traffic conditions, peak hour volume, pedestrian count where congestion usually happens, manually using tally sheets and recommend some measures for increasing Level of service of the road.

Prefabricated Construction

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Abstract—As India is a developing country, the scope for innovative and new construction methods is high. Due to large population and fast rate of growth, the newer techniques in construction field plays a major role in accomplishing the targets in an instantaneous and faster way. Prefabrication constructions are such a method used to fasten the process of construction, so that a building can be constructed with in months. At present precast concrete buildings are the advanced construction techniques used worldwide. Being its wide applicability, the total precast concrete building systems are becoming a popular choice for many constructions. Precast concrete available in many shapes, sizes, including structural elements and unreinforced pieces. The prefab industry is the back bone for the development of the new ideas of construction business in any country.Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing site, and transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located. A modular structure however, is not a mobile structure; it is simply a structure that is built off-site opposed to on-site. These structures are often called factory-built structures, system built or pre-fabricated structures. These structures often helps to manage time and are more economic. They are eco-friendly and includes the green materials in the process of construction.

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