Anil Neerukonda Institute of Technology and Sciences
(Affiliated to AU, Approved by AICTE & Accredited by NAAC)
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Civil Engineering News

Newsletter published by

Department of Civil Engineering

Vol.4, No.1, September 2018

Vinirmithi'18, Fourth National level student's technical symposium was organized by the Department of Civil Engineering in association with Institute of Engineers (India) ANITS students chapter during February 16-17, 2018. The symposium was inaugurated by the chief guest Dr A.Santha Ram, Director (Retd.) Indian Bereau of Mines. Details inside….

Courses Offered

- **B.Tech.** (**Civil Engineering**) - 4 Years duration
- **M.Tech.** (**Civil Engineering**) with **Soil Mechanics** specialization - 2 Years duration

Anil Neerukonda Institute of Technology and Sciences

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Vol.4 **No. 1** **September 2018**

Patrons	From the Chief Editor's Desk

Dr.N.B.R.Prasad
Chairman

Dr.T.Subramanyam
Principal

Dr.T.V.Hanumantha Rao
Dean, Academic Affairs

I am delighted at the release of the this Issue of Civil Engineering News, News letter published by Department of Civil Engineering, ANITS on the eve of 51st Engineers Day, the 15th September, 2018, commemorating the 157th Birth Anniversary of the Engineering Wizard, Bharath Ratna Sir Mokshagundam Visvesvaraya.

News letter acts as a communication channel in networking among the faculty, students, alumni, Civil Engineering professionals in the Industry and Higher Learning Institutions.

This issue contains 30 technical articles, 2 general articles apart from Department news such as Department Profile, Professional Society Activities, Faculty Publications, Workshops/ Seminars / Symposia organized, R&D and Consultancy Projects in the Department, Faculty Achievements, Seminars/ Workshops/ Conferences attended by Faculty and Student Achievements for the year 2017-18.

I congratulate the faculty members as well as students for contribution of technical articles for this issue on wide range of topics related to Civil Engineering. I also congratulate the Editorial Board on this occasion.

I thank the following Civil Engineers for the contribution of technical articles for this issue

(1) Sri. M T Raju, Chief Engineer (Retd.), Polavaram Irrigation Project, North Coastal districts, Visakhapatnam on "Polavaram Irrigation Project-The complete status report as on August 2018",
(2) Dr.-Ing. B.V.S. Viswanadham, Institute Chair Professor & Professor, Geotechnical Engineering, Department of Civil Engineering, IIT Bombay on "Infrastructure Geotechnics"
(3) Sri P. Bhagat Singh, Chief Engineer, Central Public Works Department (CPWD), Trivendrum, on "Critical Decision Making through Calculated Risk – An Experience at Port Blair"
(4) Sri Madan Kumar Annam, Head of Engineering, Keller India, Chennai on the topic "Significance of Soil Investigation in Civil Engineering Industry"

I am sure that this issue of the News letter fulfilled its intended objective of enhancing the technical knowledge and providing exposure to students to the latest developments in Civil Engineering field.

We are grateful to the Management, Principal and Dean, Academic Affairs for their continuous inspiration, encouragement, and support extended for the release of this "*Civil Engineering News*"

~ Dr.B.N.D.Narasinga Rao

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Department Profile

ANITS

Anil Neerukunda Institute of Technology & Sciences (ANITS) was founded by Anil Neerukundaa Educational Society (ANES), in the fond memory of Anil Neerukonda, son of its chairman Dr. B.R.Prasad, Neerukonda. The Institute's humble journey started in 2001 with four B.Tech. Programmes. Within 14 years of its establishment, the Institute registered phenomenal growth and is accredited by NAAC with A grade and by NBA twice. It is permanently affiliated to Andhra University and achieved Autonomous status by UGC in 2015.

Vision

To emerge as a world class technical institution.

Mission

To impart holistic technical education by providing

- *The state of the art infrastructure*
- *Exceptional technical and teaching expertise*
- *Best of human values.*

Department of Civil Engineering

The Department of Civil Engineering, established in 2011, offers the following programs

- B.Tech. Civil Engineering
- M.Tech. Soil Mechanics

Both programs are approved by AICTE and affiliated to Andhra University.

Vision

To emerge as a leading Civil Engineering Department globally.

Mission

I. *Empower our students with contemporary and industry relevant skills in Civil Engineering using outstanding technical and teaching expertise and best of infrastructure.*

II. *Nurture holistic development of our students inculcating universal human values and life skills for serving the society as leaders of their profession.*

Program Educational Objectives (PEOs)

The Program is expected to enable the students, within 3 to 5 years of their graduation, to:

1. *Successfully practice Civil Engineering in construction industry, public sector and entrepreneurship, ensuring a prosperous professional career.*
2. *Pursue higher education and Research for professional development contributing to the advancement of civil engineering through lifelong learning.*
3. *Demonstrate leadership abilities actively contributing to societal needs with a focus on sustainable development and human values.*

Program Outcomes (POs)

1. ***Engineering knowledge:*** *Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.*
2. ***Problem analysis:*** *Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.*
3. ***Design/development of solutions:*** *Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.*
4. ***Conduct investigations of complex problems:*** *Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.*
5. ***Modern tool usage:*** *Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.*
6. ***The engineer and society:*** *Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.*
7. ***Environment and sustainability:*** *Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.*
8. ***Ethics:*** *Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.*
9. ***Individual and team work:*** *Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.*
10. ***Communication:*** *Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.*
11. ***Project management and finance:*** *Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.*
12. ***Life-long learning:*** *Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.*

Program Specific Outcomes (PSOs)

1. *Plan and develop safe, economical and sustainable buildings and other structures based on applicable professional standards, codes and ethics.*
2. *Analyze and solve stability problems in soils for design of foundations and plan and design highway, railway and other transportation systems based on applicable safety standards and codes*
3. *Plan and develop irrigation and water supply systems and analyze and solve problems due to pollution of air, water and land leading to a nourished, richer and healthy society.*

Department Profile

Infrastructure

All laboratories in the department are well established with latest and modern equipment. The Department has Computer Centre, A/c Seminar hall, Department library etc. The Department also has ArcGIS, STAAD Pro and 25 other civil engineering licensed software.

Faculty

The Department is headed by Dr.B.N.D. Narasinga Rao, having 25 years of Teaching, Research and Consultancy experience. The Department is supported by qualified and experienced faculty, including Prof. A.Ramamohana Rao, former Professors of Andhra University as well as skilled technicians and non-teaching staff. The Department has well equipped laboratories and spacious classrooms.

He is also the Principal Investigator for UGC Minor Research Project on Fly ash utilization. Dr. B.N.D. Narasinga Rao, Professor & Head, Civil authored Text Book on Soil Mechanics and Foundation Engineering, Wiley International Publishers. This book is prescribed by 10 universities and Autonomous colleges across AP, Tamilnadu, Odisha, Rajasthan and UP. Also the book was cited as the Best Book in Soil Mechanics for GATE2017, by the Websites 'Entrances of India' and 'Indiatown.in'.

Consolidation equipment

Triaxial Compression Test equipment

Los Angeles Abrasion testing machine

Total Station

Swell Pressure Equipment

Vane Shear Apparatus

Relative density equipment

Infra-red Moisture meter

Faculty Publications (2017-18)

1. Narasinga Rao, B.N.D., and Anantha Sairam, K. (2017), "Use of Parawada Fly Ash in Concrete as Partial Replacement of Cement", International Journal of Engineering Technology Science and Research IJETSR www.ijetsr.com, ISSN 2394 – 3386 Volume 4, Issue 5, May 2017, pp.405-410, Impact Factor 2.12.
2. Narasinga Rao, B.N.D. and Somasekhar, A.S. (2018) "Geotechnical Properties of Parawada Fly Ash and Thagarapuvalasa soil Mixtures for Use in Highway Embankments", International journal of basic and applied research, Vol. 8, No.6, June 2018, pp.101-115, www.pragatipublication.com, ISSN 2249-3352 (P) 2278-0505 (E), Cosmos Impact Factor (Germany): 5.86
3. Vikranth.J, Reddy PVRK, Rambabu K, (2017) "Application of the Affine Theorem to an Orthotropic Rectangular Reinforced Concrete Slab Having a interior Corner Opening" in International Journal of Engineering Research & Technology(IJERT), Issue 9, Vol 6, pp 84-103.
4. Vikranth.J, Rambabu K, (2018) "Application of the affine theorem to an orthotropic rectangular reinforced concrete slab continuous over one long side and simply supported on other three sides having an interior corner opening", International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 523-542
5. Chaitanya MKSSK,Ratnam M.K.M.V(2018) "Comparative Study of Pre Engineered and Conventional Steel Building" in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 9, pp 358-365
6. Kiran Kumar T, Vikranth.J (2018) "A Study on Effective Use of Plastic Waste in Flexible Pavements" in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 669-684
7. Sravya P.V.R, Rajesh Kumar. M, Sreejani T.P, Srinivasa Rao G.V.R(2017) "Multivariate Statistical Analysis of Godavari River Water Quality for Irrigation Purpose at Rajahmundry & Dhawaleswaram" in International Journal of Civil, Structural, Environmental and Infrastructural Engineering Research and Development, Issue V, Volume 7, pp 13-21.
8. Vineel Ch., Hemalatha devi. G, (2017), "Evaluation of Crusher Dust as Replacement of Filler in Concrete" in IOSR Journal of Engg., Issue IX, Volume 09, pp 1-4.
9. Vineel Ch, Teja T.V.V (2018) "Appraisal of Rock Flour as Frictional Fill Material for use in Reinforced Earth Structures" in SSRG International Journal of Civil Engineering, Issue III, Volume 5, pp 8-12
10. T.V.Viswa Teja(2018), "Planning and Design of Net-Zero Energy Residential Building(NZERB)", in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 576-586
11. P.Vandana Rao, Sudheer Kumar. G, Prasanthi. B, (2018), "A Parametric Study on Black Cotton Soil Stabilized Using Rice Husk Ash" in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 623-632
12. Premchand M, Bhavani S(2018) "Rooftop Rain Water Harvesting Technique for ANITS Campus", Journal of Emerging Technologies and Innovative Research, Issue V, Volume 5, pp 396-399
13. Srinivas Ch., Naveen Kumar, (2018), "Experimental Study on mechanical properties of concrete by partially replacing cement with GGBS and fine aggregate with copper slag" in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 416-425
14. Srinivas Ch.Naveen Kumar V, Vinod E(2018),"Experimental study of Copper slag on mechanical properties of concrete" in International journal of Applied Engineering Research, Volume 13, pp 5328-5331
15. Suryanarayana K, Seshubabu, P(2018) "Study on Glass Fiber Reinforced Fly Ash Concrete" in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 658-668
16. Harsha Vardhana Reddy J, Venkata Anil L, Vinay Kumar D (2018) "A Review on integrated Solid Waste Management in Visakhapatnam City", in International journal of Advanced in Management, Technology & Engineering Sciences, Issue IV, Volume 8, pp 11-16
17. Nagalakshmi M, Satyanarayana Reddy C N V,Usha rani G V (2017), "Effect of shape of Footing on Coefficient of elastic uniform compression of fine sand", in Indian Geotechnical Conference 2017, GeoNEst.

Polavaram Irrigation Project – Complete Status Report

M T Raju, Chief Engineer (Retd.), Polavaram Irrigation Project, North Coastal districts, Visakhapatnam

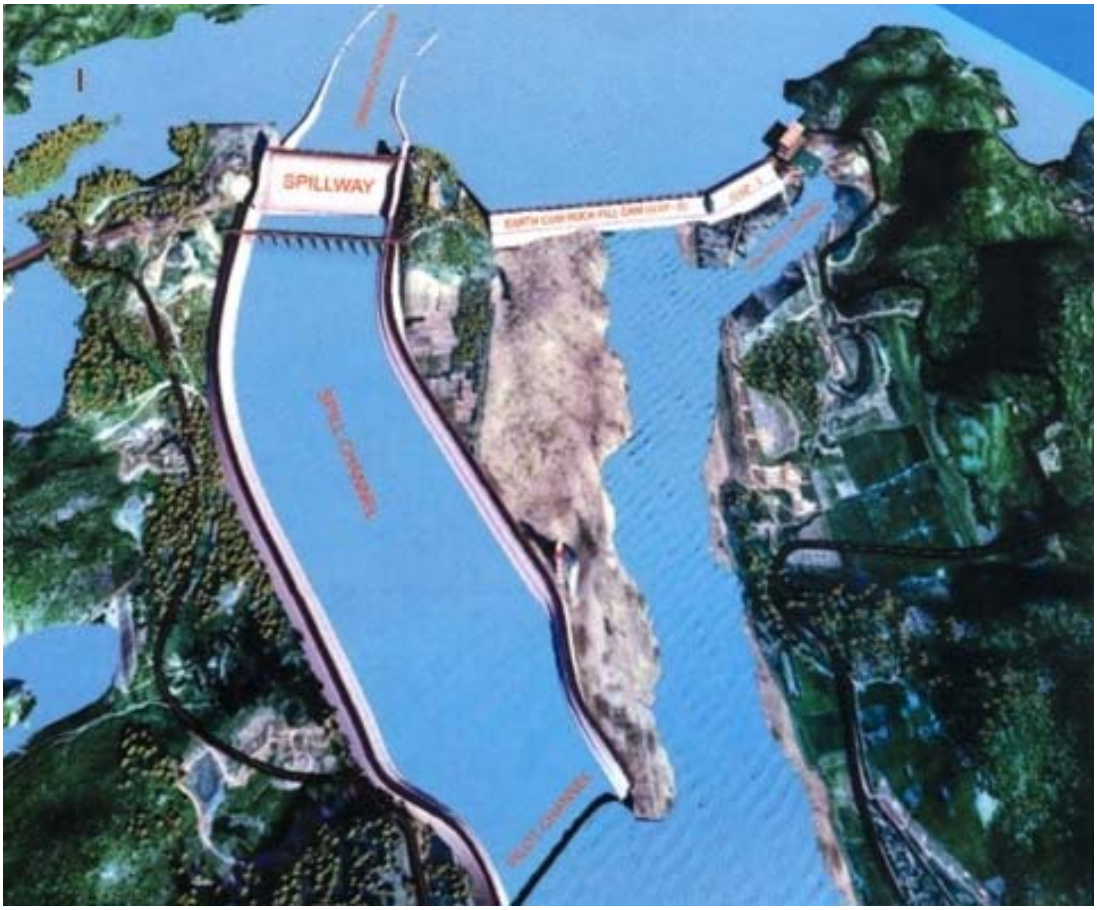


Fig. 1Polavaram Project Site Aerial View

Polavaram Irrigation Project is contemplated on the river Godavari near Ramayyapeta village of Polavaram Mandal in West Godavari District. It is located 42 Km upstream of S.A.C. Barrage @ Dowlaiswaram. The Project is Multipurpose Terminal reservoir on the river Godavari. The Project is under contemplation since 1943 and the Project was taken-up in 2004 as part of JalayagnamProgramme. The Project proposal is strictly in accordance with the provisions of Interstate agreements concluded among co-basin states and GWDT award, 1980.

Government of Andhra Pradesh have accorded Administrative sanction for **Rs. 19319.676 Crores** including LA, R&R and Payments to Forest Department. TAC of CWC accorded Techno Economic clearance for the Revised Estimated cost of Project for **Rs. 16010.45 Crores** on 04.01.2011.

All the clearances are received for the Project. The Government of India declared this Project to be National Project (section-90 of AP-Reorganization Act 2014).

The Agreement value of 22 packages of PIP is Rs.10136.673Crores. The overall progress of PIP works is 63%to end of 08/2018

The total expenditure incurred to end of 08/2018 on Polavaram Irrigation Project including Land Acquisition, R&R Forest and Miscellaneous works is Rs. 13789.279Crores. The total expenditure on the Project including expenditure on Project Establishment is Rs. 14600.067Crores. Central Assistance released by G.O.I., under AIBP during the period from 2008-2010 is Rs. 562.47 Crs. in 2 installments.

After declaration of the project as National Project, the total funds released to the State Government, through Polavaram Project Authority so far during the period from 2015-2018 is Rs. 6727.26Crs.

Objectives:

1. Irrigation to 2.91 Lakh Ha (7.20 Lakh acres) in West Godavari, Krishna, East Godavari and Visakhapatnam Districts.
2. Hydropower with installed capacity of (12 units X 80 MW) 960 MW.

3. Diversion of 80 TMC of water to Krishna river above Prakasam Barrage through Right Main Canal. 80 TMC of water thus saved in Krishna river will be shared in proportion of 45 TMC for Andhra Pradesh 21 TMC for Karnataka and 14 TMC for Maharastra.
4. Out of the storage developed at Polavaram, Orissa and Chhattisgarh could use in their territories, 5 TMC and 1.5 TMC of water respectively by lifting it from the pondage without bearing any cost of construction of the project.
5. Orissa and Chhattisgarh can also enjoy fishing rights in their territories after formation of Polavaram Reservoir.
6. Supply of 23.44 TMC of water for Drinking and Industrial needs of Visakhapatnam city and surrounding areas by left main canal.
7. Drinking water facility to 540 villages (28.50 lakh population) enroute the canals.
8. Stabilization of Godavari Delta Command Area of 10.13 Lakh acres and Krishna Delta with 13.08 Lakh acres by right main canal.
9. Promotion of Pisciculture and Tourism.

Statutory and Other Clearances Obtained:

1. Site clearance from the Ministry of Environment and Forests vide No.J-21011/18/2004-IA.1, dated 19-9-2005.
2. Environment Clearance from the Ministry of Environment and Forests vide No.J-12011/74/2005-IA.1, dated 25-10-2005.
3. Papikonda Wild Life Sanctuary area clearance from the Ministry of Environment and Forests vide F. No.6-3/2003 WL-1 (Pt) dated 6-7-2006.
4. Clearance of Resettlement & Rehabilitation (R&R) plan for Scheduled Tribe Project Affected Families (STPAFs) from the Ministry of Tribal Affairs vide File No.20011/15/2005-CP & R (NGO) dated 17-4-2007.
5. In principle approval for diversion of Forest area (Stage-1 Forest clearance) was accorded by the Ministry of Environment and Forests vide F. No.8-123/2005-FC dated 26/29 December, 2008.
6. Techno Economic approval of Advisory Committee of CWC. Ministry of Water Resources vide No.16/27/2008-PA (N)/275-309, dated 23-1-2009.
7. Investment clearance from the Planning Commission vide Lr.No.File No. 2 (168) 2004-WR dated 25-2-2009 for Rs. 10,151.04 Crs at 2005-06 price level.
8. Final approval on Forest Clearance (Stage-II forest clearance) was accorded by MOEF Govt. of India (FC Division) vide F.NO 8-123/2005 FC dt 28-07-2010 with certain conditions
9. TAC of CWC accorded Techno Economic clearance on 04.01.2011 for Revised Estimated cost of project for Rs. 16,010.45 crores at 2010-11 price level and concurrence was accorded by the State Financial Department.

Clearances to be Obtained:

1. Investment clearance for revised cost of Rs. 16010.45 Crs at 2010-11 price level from Planning Commission.
2. Public hearings for construction of Protective embankments are to be held in Odisha and Chhattisgarh territories as desired by MOEF.

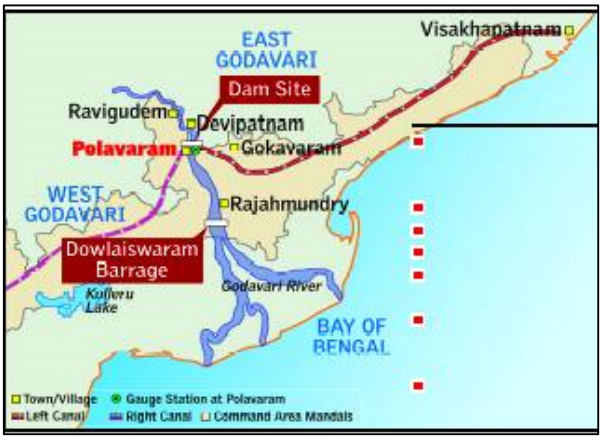


Fig. 1 Polavaram Project Location Map

Declaration as 'National Project':

The Government of India, recognizing the importance of the project, declared this project to be a National project (Section-90 of A.P. Reorganization Act, 2014) and also declared that it is expedient in the public interest that the Union should take under its control the regulation and development of the Polavaram Irrigation Project for the purpose of irrigation. It also specified that the Central Government shall execute the project and obtain all requisite clearances including environmental, forest and resettlement norms.

The Ministry of Water Resources (MOWR) Government of India (GOI) has issued a notification vide F. No. 15/4/2014 Dt: 28.05.2014, constituting the Governing Body (GB) to Polavaram Project Authority (PPA) and the same were published in the Gazette of India Dt: 28.05.2014.

It is programmed to complete the Project before 2019.

Location of Head Works	:	42 Km U/S of SAC Barrage on River Godavari near Ramaiahpeta(V) Polavaram (M), West Godavari Dist., AP
Longitude	:	81° 39'46" E
Latitude	:	17° 16'53" N
Full reservoir level	:	+ 45.72 M (+ 150.00 Feet)
Minimum draw down level	:	+ 41.15 M (+ 135.00 Feet)
Crest Level of Spillway	:	+ 25.72 M (+ 84.39 Feet)
Gross storage of reservoir	:	194.60 TMC (5.510 TM cm)
Live storage	:	75.20 TMC (2.129 TM cm)
Utilization of Water Under the Project		
Left Main Canal	:	84.81 TMC 164.90 TMC
Right Main Canal	:	80.09 TMC
Industrial and Drinking water to Visakhapatnam	:	23.44 TMC
Diversion of Godavari water to Krishna River including transmission losses	:	84.70 TMC
Samalkot Canal requirement	:	8.27 TMC
Odisha	:	5.00 TMC
Chhattisgarh	:	1.50 TMC
Evaporation losses	:	34.92 TMC
Total utilization of water	:	**322.73 TMC (9.139 TM cm)**
Flood Discharges		
25 years flood	:	0.636 L.Cumecs / 22.46 L.Cusecs
50 years flood	:	0.723 L.Cumecs / 25.54 L.Cusecs
100 years flood	:	0.814 L.Cumecs / 28.74 L.Cusecs
Observed maximum flood discharge (1986)	:	0.934 L.Cumecs / 33 L.Cusecs
500 years flood	:	1.019 L.Cumecs / 36 L.Cusecs
Probable maximum Flood Discharge	:	1.416 L.Cumecs / 50 L.Cusecs
Ayacut Contemplated		
Left Main Canal Visakhapatnam District	:	1,50,000 Acres
Left Main Canal East Godavari District	:	2,50,000 Acres
Right Main Canal West Godavari District	:	2,58,000 Acres
Right Main Canal Krishna District	:	62,000 Acres
Total	:	**7,20,000 Acres**
Dam and Appurtenant Works		
Earth-Cum-Rock Fill Dam		
Length	:	2454 M
TBL	:	+ 53.32 M
Top width	:	15.00 M
Average bed level	:	+ 15.00 M
Deep Bed Level	:	+ 8.32 M
Height above average bed level	:	38.32 M
Height above Deep bed level	:	45.00 M
Type of cut off	:	Single plastic concrete diaphragm wall of 1.5 m thick
Spillway		
Type	:	Gated Spillway with Ogee profile & Horizontal stilling basin
Length between abutments	:	1128.40 M
Crest Level	:	+ 25.72 M

No. of gates	:	48 Nos. 16 M X 20 M (radial gates with hydraulic hoist)
Road level	:	+ 54.00 m
Deep foundation level	:	- 9.25 m
Maximum height	:	63.25 m
Power House on Left Flank		
Installed capacity	:	960 MW (12 X 80 MW)
Right Main Canal		
Length	:	174 Km
Command area	:	1.29 Lakh Ha (3,20,000 Acres)
FSL at starting	:	+ 40.232 m
Discharge (D)	:	499.299 cumecs
Canal Section	:	85.50 M x 5.00 M
Left Main Canal	:	
Length	:	181.50 Km
Command area	:	1.62 Lakh Ha (4,00,000 Acres)
FSL at starting	:	+ 40.54 m
Discharge (D)	:	497.277 cumecs
Canal Section	:	85.50 M x 5.00 M
B.C. Ratio	:	1.70
R&R		
No. of villages to be Rehabilitated	:	371
No. of villages Rehabilitated so far	:	12
Administrative approval accorded for Project Revised estimated cost of Project (As approved by TAC of CWC and concurrence as accorded by the State Financial Department) D&A works Rs. 9135.79 Crs RMC Rs. 2370.79 Crs LMC & WSC Rs. 1635.47 Crs Power House Rs. 2868.40 Crs **Total Rs. 16010.45 Crs** ***Cost as per 2013-14 Price Level*** LA and R & R Rs. 33225.74 Crs Head works Rs. 11388.37 Crs RMC Rs. 4476.96 Crs LMC Rs. 4644.13 Crs Power House Rs. 4205.66 Crs **Total Rs. 57940.86 Crs** Agreement Value of 22 Packages Value of work done 22 Pkgs. & its % Value of work done under preclosedagreements	.. ..	**Rs. 19319.676 Crores** **Rs.16,010.45 Crores** (At 2010-11 price level) **Rs.57940.86 Crores** (At 2013-14 price level) Rs. 10136.673 Crores Rs. 6396.505 Crs.& (63 %) ESC Rs. 640.434 Crs. Rs. 111.713 Crs. & (7%) ESC Rs. 2.08 Crs
Total expenditure incurred to end of 08/2018	..	Rs. 13786.279 Crores
Total expenditure including Project establishment	..	Rs. 14600.067 Crores

Financial Status of PIP:

So far 62% of works are completed in Polavaram Irrigation Project.

Cumulative expenditure to end of 03/2014
Rs. **5177.2720**Crs
(Prior to taken up by the PPA)

Expenditure during 2014-15	Rs. 374.6296 Crs
Expenditure during 2015-16	Rs. 1780.0443Crs
Expenditure during 2016-17	Rs. 1622.0489 Crs

Cumulative Expenditure to the end of 03/2018
Rs. **12602.7393**Crs

Expenditure during 2018-19 upto 08/2018
Rs.1214.8297Crs

Cumulative expenditure so far Rs.**13786.279Crs**

Total expenditure including expenditure on Project Establishment (Rs813.788Crs)**Rs. 14,600.067Crs.**

Status of Works

Polavaram Irrigation Project Head Works:

a. Government have accorded administrative approval for **Rs. 11298.750 Crores** vide G.O.Ms.No. 96, Dt: 08.09.2016, G.O.Ms.No. 05, Dt: 06.02.2013, G.O.Ms.No. 93, Dt: 24.05.2005 and G.O. Ms. No. 54, Dt: 31.05.2010 for execution of Head works including LA, R&R, Payments to Forest Department. The components of Head works consist of Earth cum Rock Fill Dam,Under gap II, Earth Dams under Gap I & III Spillwayand excavation of Foundations of Power House under one package and Left & Right connectivities under 6 packages (Package Nos. 62 to 67).
b. The previous contracts of Spillway and Earth cum Rock Fill Dam were preclosed in August 2009 due to slow progress.
c. Agreement was concluded in March 2013 with M/s. Transitory JSC EC – UES (JV) for Rs. 4,054.00 Crores for the construction of Spillway, Earth cum Rock fill dam and foundations of Power House. Supplemental Agreement was concluded in 10/2016 for Rs. 1331.91 Crores (Total Rs. 5395.67Crores).
d. All the contracts of 7 packages of Head works with agreement value of Rs.5901.34Crores are in progress. The progress of works of Left & Right connectivity's under 6 Packages (Package No. 62 to 67) is about 59.68%. The progress of Earth cum Rock fill dam, Spillway & Power house (By the new agency) is 54.00%.The overall progress of 7 Packages of Head works is54.28%.
e. The total extent of land required for Head works is 2668.36 Acres. So far an extent of 2664.27 Acres is acquired (99.8%).
f. It is programmed to complete the Head Works by 12/2019.

Bottlenecks with R & R Status:

a. 4.09 Acres of Land is to be acquired in respect of ECRF Dam.
b. Shifting of Sri Satya Sai Drinking Water Pipeline for the packages 66 & 67.
c. Out of 7 villages in East Godavari District under **Phase-I** of R&R programme.
d. 2 villages are to be shifted (Nagallapalli& P-Gonduru)

Polavaram Irrigation Project Right Main Canal:

a. Government have accorded revised administrative approval for **Rs. 4375.776 Crores** vide G.O.Ms.No. 118, Dt: 06.12.2016 for execution of Right Main Canal. The Canal runs for a length of 177.9Kms in West Godavari and Krishna Districts. For execution purpose, the canal is divided into 7 Packages with Agreement value of Rs.2053.6463 Cr. All the works are grounded and the works are in progress. The percentage of work done is 88%.
b. The total extent of land, required for Right Main Canal i.e.,12284.15 Acres was acquired.
c. It is proposed to Irrigate 3,20,000 Acres under this Right Main Canal in West Godavari and Krishna Districts and to divert 80 TMC of water to Krishna river. It is programmed to complete the Right Main Canal works by 06/2019.

Polavaram Irrigation Project Left Main Canal:

a. Government have accorded administrative approval for **Rs. 3645.15 Crores** vide G.O.Ms.No. 117, Dt: 06.12.2016 for execution of Left Main Canal works. The Canal runs for a length of 213.944Kms in East Godavari and Visakhapatnam Districts.
b. For execution purpose, the Canal is divided into 8 Packages with Agreement value of Rs.2181.69 Cr. All the works are grounded and works are in progress. The percentage of work done is 63.51%.
c. It is proposed to Irrigate an ayacut of 4,00,000 Acres in East Godavari and Visakhapatnam Districts and to supply 23.44 TMC of water to Visakhapatnam city for industrial and domestic needs.

d. The total extent of land required is 10626.79 Acres under the Left Main Canal. The extent of land so far acquired is 10448.06Acres (98.3%).
e. Works are in progress in packages 1 to 8.
f. It is programmed to complete the critical works under Left Main Canal by June 2018 for flowing water in LMC.
g. It is programmed to complete the remaining works of Left Main Canal by June 2019.

Bottlenecks:

a. Land to an extent of 195.75 Acres is still to be acquired.
b. One court case is pending in Hon'ble High Court in respect of Package No. 5.
a. Four court cases are pending in Hon'ble Court in respect of New Water Supply Canal under Package No. 8.
c. Permission is to be obtained for 2 Nos. of NH crossings, 2 Nos of Railway crossings and 1 No. HPCL crossing in Package No. 8 and 1 No. HPCL / GAIL crossings in Package No. 1.
d. Shifting of electrical lines in Package No. 7 in the reach from Km 144.750 to Km 145.000 from Km 148.00 to Km 149.00 and from Km 158.000 to Km 159.000.
e. Canal closures to the existing YLM water supply canal which supplies water to Visakhapatnam are to be given twice in a year to complete the works of Package 8 of PIPLMC. The works are hampered due to non closure of YLM WS canal as per schedule period since 2011.\

Status of R & R:

a. Due to the construction of Polavaram Irrigation Project a total of 371 habitations in 2 districts of Andhra Pradesh including 7 Mandals transferred from Khammam District are coming under submergence (East Godavari 44, West Godavari 29 & 7 Mandals transferred from erstwhile Khammam 297). These 371 habitations are programmed to be rehabilitated in a phased manner and the rehabilitation process is to be completed one year before the actual submergence of the habitations take place.

b. Tribal population affected = 94370 Nos.
c. Non Tribal population affected = 92817 Nos.
d. Total population affected = 187187 Nos.

e. In the 1st phase 24 no. of habitations coming under working area are proposed to be rehabilitated. Rehabilitation of 24 habitations is already completed.
f. In the 2nd phase 43 No. of habitations (23 in East Godavari, 18 West Godavari & 2 in transferred 7 Mandals) which fall within +35 m contour are proposed to be rehabilitated before July 2016. Rehabilitation of 1 village is completed under 2nd phase.
g. In the 3rd phase 84 no. of habitations (10 in East Godavari, 4 in West Godavari, 70 in transferred 7 Mandals) are proposed to be rehabilitated by the end of August 2016 which fall below MDDL (+41.15m).
h. In the 4th phase 229 no. of habitations (4 in East Godavari and 225 in transferred 7 Mandals) are proposed to be rehabilitated by February 2017 which fall below FRL.
i. Population rehabilitated so far is 8727 persons (in 2754 families) in the 12 habitations. District wise breakup details appended.

Status of Polavaram Irrigation Project up to end of 08/2018
Physical Status - Polavaram Irrigation Project

S.L. NO	*Name of the Circle*	*Component*	*Earth work (L. Cum)*			*Concrete (L.Cum)*			*Structures (Nos)*			
			Total Qty.	*Executed*	*% Progress*	*Total Qty.,*	*Executed*	*% Progress*	*Total*	*Completed*	*In progress*	*Yet to be started*
1	HEAD WORKS	GAP- I	24.08679	0	0	0.04785	0	0				
2 a)		GAP- II	140.3548	0	0	0.1233	0	0				
b)		D-wall	0	0	0	1.2	0.9599	79.99				
		Total	140.3548	0	0	1.3233	0.9599	72.54				
3		GAP-III	0.71314	0	0	0.0014	0	0.00				
1a		**ECRF**	**165.1547**	**0**	**0**	**1.37255**	**0.9599**	**69.94**				

S.L. NO	Name of the Circle	Component	Earth work (L. Cum)			Concrete (L.Cum)			Structures (Nos)			
			Total Qty.	Executed	% Progress	Total Qty.,	Executed	% Progress	Total	Completed	In progress	Yet to be started
		Spill channel, Pilot channel & approach channel i/c protection to Spill channel	849.74	602.19	70.87	18.212	1.726	9.48				
		SPILL WAY	165.59	209.463	126.50	16.267	10.360	63.69				
		POWER HOUSE	124.08	104.94	84.58	0	0	0.00				
	Main package Total		**1304.56**	**916.59**	**70.26**	**35.85**	**13.05**	**36.39**	**4**	**0**	**4**	**0**
1b	CONNECTIVITIES		113.62	68.23	60.05	5.604	1.584	28.28	20	3	10	7
1	***PIPHW- TOTAL***		**1418.18**	**984.82**	**69.44**	**41.46**	**14.63**	**35.29**	**24**	**3**	**14**	**7**
2	***PIPRMC***		**1184.67**	**1180.82**	**99.68**	**29.93**	**26.35**	**88.05**	**255**	**199**	**39**	**17**
3	***PIPLMC***		**1082.22**	**986.94**	**91.20**	**31.43**	**18.74**	**59.62**	**453**	**147**	**96**	**210**
	Grand Total		**3685.07**	**3152.58**	**85.55**	**102.82**	**59.72**	**58.09**	**732**	**349**	**149**	**234**

Financial Status - Polavaram Irrigation Project upto end of 8/2018

(Amount in Cr.)

S.L.NO	Name of the Circle	Component	Total Amount Involved	Total Value of Workdone till date	% of work done
1	**2**	**3**	**4**	**5**	**6**
1	HEAD WORKS	GAP- I	47.417	0.00	0
2 a)		GAP- II	522.040	77.310	15
b)		D-wall	467.730	456.116	98
		Total ECRF	**1037.187**	**533.426**	51
3		GAP-III	1.297	0.000	0
		ECRF	**1038.484**	**533.426**	51
4		Spill channel, Pilot channel & approach channel i/c protection to Spill channel	2086.211	1036.752	50
5		SPILL WAY	1767.171	1188.834	67
6		POWER HOUSE	250.686	142.510	57
		Transstroy Executed Amount up to 10/2015	253.120		0
	Main Package Total		**5395.67**	**2901.522**	54
7	Connectivities		**505.663**	**301.758**	60
		PIPHW- TOTAL	5901.34	3203.28	54

S.L.NO	Name of the Circle	Component	Total Amount Involved	Total Value of Workdone till date	% of work done
8		*PIPRMC*	2053.6463	1807.6159	91
9		*PIPLMC*	2181.69183	1385.6089	60
10	Grand Total		**10136.673**	**6396.505**	**63**

Particulars of Land Acquisition and R & R as on 18.06.2018.
(As per Commissioner *R&R)*

Land Acquisition in Acres: R & R

	Upto +41.15 m			*Upto +45.72 m*		
	W.G	***E.G***	***Total***	***W.G***	***E.G***	***Total***
Total Villages affected	45	25	70	57	165	222
No. of habitation submerged	53	59	112	137	234	371
No. of habitations Rehabilitated	19	7	26	19	7	26
Total No. of PDFs	16,871	6,187	23,058	27,889	70,929	98,818
No. of PDFs shifted	2,584	1,338	3,922	2,584	1,338	3,922
No. of persons to be Rehabilitated	-	-	-	84349	102838	187187
No. of persons Rehabilitated	-	-	-	7140	1587	8727
Total No. of housing colonies planned	50	24	74	48	162	210
No. of R&R centres completed	19	7	26	19	7	26
No. of housing colonies progress	24	15	39	-	-	-
No.of ST families to be Rehabilitated	5,045	4,137	9,182	8448	17334	25782
No.of ST families Rehabilitated	1181	1338	2519	769	598	1367
No.of ST persons to be Rehabilitated	-	-	-	34835	59635	94370
No.of ST persons Rehabilitated	-	-	-	3076	1105	4181

Budget & Expenditure (Amount in Crores)

	Upto +41.15m			**Upto +45.72m**		
	Total Funds Reqd.	**Expenditure Incurred**	**Balance Reqd.**	**Total Funds Reqd.**	**Expenditure Incurred**	**Balance Reqd.**
Land Acquisition	2694.81	2546.17	148.64	12024.21	5653.29	6370.92
R&R	1925.67	223.16	1702.51	21027.41	219.28	20808.13
Total	4620.48	2769.33	1851.15	33051.62	5872.57	27179.05

Workshops/ Seminars / Symposia organized (2017-18)

1. Vinirmithi'18, Fourth National level student's technical symposium was organized by the Department of Civil Engineering in association with Institute of Engineers (India) ANITS students chapter during February 16-17, 2018. The symposium was inaugurated by the chief guest Dr A.Santha Ram, Director (Retd.) Indian Bereau of Mines. Events like Paper Presentation, Auto CAD, Bridge IT, Technical Quiz, Technical Treasure Hunt, Memory Retention, JAM and Story Framing; are conducted to encourage students to think different and update themselves in the future innovations. A total of 650 students from various colleges have participated in these events.

2. A Two day Student Training Program on "E-Tabs", was organized for students with Resource person from Data Pro, by the Department of Civil Engineering during December 13-14, 2017

3. A Guest Lecture on "Air Pollution Sources and control options" by Ravi Lakshmi Narayana, Environmental Engineer, AP Pollution Control Board, Visakhapatnam, , has been organized by the Department of Civil Engineering on October 24, 2017.

4. A Two day FDP on "ArcGIS", for faculty members of Civil Engineering with Resource persons from ESRI, Hyderabad, has been organized by the Department of Civil Engineering during December 5-6, 2017.

5. A Workshop on "Geotechnical Problems & Practices" by Sri A K Mehra Dr. V Venkateswara Rao, Sri Rishi Jaiswal, Prof. C N V Satyanarayana Reddy, Prof B N D Narasinga Rao have been organized by the Department of Civil Engineering on October 11, 2017.

Workshops/ Seminars / Symposia organized (2017-18)

6. A Guest Lecture on "Geotechnical Investigations at Shivalik Mountain Range" by Dr. A. Santha Ram Director (Senior Mining Geologist, Retd.), Indian Bureau of Mines, was organized by the Department of Civil Engineering on 15-09-2017 on the eve of 50th Engineers Day Celebrations to commemorate the 157th Birth Anniversary of Bharat Ratna Sir Mokshagundam Visvesvaraya.

8. The 4th Board of Studies (Civil Engineering) meeting was held on 28.04.2018 with the agenda of Review and approval of Autonomous syllabus (4th year semester-I & II) & Review of AICTE Model curriculum.

7. A Seminar on smart cities was organized for IV and III B.Tech students with resource persons from Himma International Academy on April 28, 2018

9. Orientation Program for First Year Students for the admitted batch 2017-18 was organized by department of Civil Engineering on 9th September 2017. HOD introduced the faculty and various facilities provided by the college to student in their four years of engineering life. First year introduced themselves and II Year students as well as some students of III Year and IV year shared their educational experience.

Infrastructure Geotechnics

Dr.-Ing. B.V.S. Viswanadham, Professor, Geotechnical Engineering, Dept of Civil Engg,
Institute Chair Professor, IIT Bombay,

Introduction

Innovations in science and technology has fuelled the rapid transition of humanity from the bronze age to the current era of smart buildings and artificial intelligence. Among the various disciplines of engineering that contributed to this transition, civil engineering is, unarguably, the oldest and most prevalent. Indeed, civil engineering deals with various aspects like planning, designing, and maintenance of facilities like buildings, roads, bridges, railway lines, water supply and sewerage facilities, dams, reservoirs, metro tunnels, etc., that form the backbone of modern civilization. Unsurprisingly, the feats of Civil Engineering are both numerous and marvellous - such as BhurjKhalifa, Chenab bridge in Srinagar, Bandra-Worli Sea link in Mumbai and many more. All these structures are supported over ground/soil with its stability depending on the interactions between its foundation and the underlying soil/rock. This is where Geotechnical Engineering has its relevance as, it deals with understanding the behaviour of geo-material – soil, thus ensuring the long term stability of structures founded on them. Karl Terzhagi, one of the pioneers of modern geotechnical engineering, stated that-

"Unfortunately, soils are made by nature and not by man, and the products of nature are always complex". This statement highlights the essence of geotechnical engineering as itinvolves an uncertain material - soil that challenge an engineer to solve practical problems for which there exists no clear cut or ideal solution.

History and Development

In ancient times, the science of studying soil behaviour gained acceptance with increasing cases of foundation related problems like, the Leaning Tower of Pisa. Such incidents prompted engineers to understand the importance of a well investigated and designed substructure for the stability of superstructures built over them. In the early stages, engineers relied on their intuition and past experiences to come up with suitable foundation designs. However, by the eighteenth to nineteenth century, Geotechnical engineering has seen its growth and development with significant contributions from renowned engineers like Joseph Boussinesq, Charles Coulomb, Christian Otto Mohr and many more. These aspects were instrumental in providing a theoretical base for the subject and this was further taken up by Karl Terzhagi who is rightfully remembered as the Father of Modern Geotechnical Engineering. His theories of effective stress and bearing capacities are relevant for most of the practical design problems and form the stepping stone for modern research as well. Subsequently, advanced technologies and better infrastructure have led to more developments in the subject including but not limited to: concepts of critical state and theoretical soil mechanics, constitutive models, physical modelling techniques like centrifuge-based physical modelling, finite element modelling, discrete element modelling, boundary element methods, etc.

Current and Future trends

Over the years Geotechnical engineering (especially infrastructure geotechnics) has attained wider acceptance in the construction world, encompassing a wider range of application. It has in fact, risen above the confinement of foundations of structures and have spread its footing over other areas such as environmental geotechnics, off-shore/marine geotechnics, mining operations etc. With increased urbanization, issues pertaining to waste disposal, landfill maintenance etc. are on a rise and environmental geotechnics is gaining prominence. Land reclamation projects and projects involving construction of structures on difficult soils and terrains inevitably requires the judgement of a geotechnical engineer for its successful execution. The introduction of advanced computing and modelling techniques and use of sophisticated instrumentation have improved the level of quality and accuracy associated with modern geotechnical construction. The construction of structures like Petronas Towers Malaysia, Bhurj Dubai etc. is the outcome of successful collaboration of geotechnical engineering with various other Civil engineering disciplines. In the modern world, Infrastructure Geotechnics is a highly interesting field of engineering which opens up for a variety of possibilities and challenges to the engineers.

Critical Decision Making through Calculated Risk – An Experience at Port Blair

P. Bhagat Singh, Chief Engineer, Central Public Works Department (CPWD), Trivendrum

How critical is any decision, does not depend on the nature of decision alone, but also depends on the outcome of decision? Appropriate sharing &application of scientific and engineering knowhow, added with little bit of calculated risks, make such critical decisions simple.

I would like to narrate a small example I have personally experienced in a Run Way Extension Project, for the Airport at Port Blair, Andaman & Nicobar Islands, where I was the Project manager. It would be hard to imagine that a small issue of breaking down a hard rock formation of a small quantity of around 100 cum, which is generally not perceived to be critical, had become so critical that commissioning of the entire Run Way was held up.

It was in the year 2004, when the Project costing around Rs 125 Cr and constituting primarily the Extension of length &Up gradation of existing Runway from 1.8 km to 3.4 km and related other facilities, was completed against many constraints and adversities of working in the islands. Huge hillocks, falling in the Obstacle Funnel Zone and along the runway, had to be knocked down by breaking hard rock formation of around 10,000 cum. Many Residential and Non-residential habitations were demolished, reconstructed and rehabilitated in a time bound manner.

As per stipulation in the contract, hard rock formations were to be removed without blasting, but using rock excavators, hammers, chisels and other mechanical equipment.

To speed up the project, construction of runway was also taken up along with hard rock excavation adjacent to it. By the time Runway construction was complete, hard rock excavation was nearly complete, except a small rock formation of around 100 cum., which could not be removed without resorting to blasting. Without removal of this rock formation, which is hardly 10m away from the edge of the completed runway, Civil Aviation Authorities would not accord clearance for runway operations.

How then to remove this rock formation? Alternative attempts through other agencies for getting it removed by mechanical means did not succeed. The formation was a hard rock, which could not be removed without resorting to blasting.

Decision would not have been that critical, if blasting was to be allowed by addressing only the contractual and environmental/administrative concerns. But, the wide spread concern was about safety of the already constructed runway, which is very close to this rock formation.

The issue of removal of this rock formation, considering its small quantum in the project, does not appear to be critical, but it was so because of its inter relation with operationalization of the runway.

Highest authorities in the Ministry of Civil Aviation, Airports Authority of India and Andaman& Nicobar Administration, brain stormed the issue but ended up only criticizing the executing agency for not having removed the rock formation prior to completion of runway. No one suggested anything to come out of the impasse but ascertained in the High-Power Committee meetings that the runway could never be made operational.

We Engineers should convert probabilities into scientific possibilities. The probability of damage was got ascertained scientifically, through Central Mining Research Institute, Dhanbad, one of the experts in the subject of mining, as found after extensive but quick enquiry. Pessimistic estimate of crack propagation due to controlled blasting was made by them after site visit, to be around 5m in to the runway. Optimistic estimate was no damage. In the event of pessimistic scenario, cost of reconstruction of damaged runway was assessed to be around Rs 10-15 lakhs. This was insignificant, considering the huge revenue loss running in to crores of rupees, due to non-operation of runway.

We, the Engineers are supposed to find solutions through appropriate application of Science and Engineering and also should take calculated risks. It was this fundamental spirit that has been driving me all along my career, even in Government sector, wherein risk taking is like a taboo.

I decided to take the calculated risk of going for controlled blasting, amidst stiff resistance from the senior colleagues in my department. The risk involved was probable damage to the constructed runway, if the blasting was to be resorted.

Firstly, the damage was only probability causing apprehension, but may not be real. It was like fear of darkness. Secondly, was it worth taking the risk? It was needed to calculate and take the risk.

It was felt unavoidable and also worth taking the calculated risk. Finally, one fine day, controlled blasting was done and much to the delight of every one, cracks

of blasting propagated just up to the edge of runway and there was absolutely no damage to the runway. The fear of damage was shattered, as it would mostly happen with any fear.

In hindsight, it appears a very simple decision, but it was perceived to be impossible by all authorities associated with the project. Operationalization of runway enabled bigger aircrafts flying to Port Blair thereafter, creating an important mile stone.

How pleasant and memorable it was, to simplify the decision with little bit of calculated risk. This is only one example of several such decisions; we all have been taking in such projects.

Every one of us knows that there is no gain if there is no risk. Let us all Engineers follow that in true spirit.

Happy Engineers day.

Fig. 1 Runway at Port Blair

R&D and Consultancy Projects in the Department

1. UGC Minor Research Project on "Wealth from Waste: Fly ash characterization for its bulk utilization in Geotechnical Engineering Applications" with Dr.B.N.D.Narasinga Rao as the Principal Investigator; Amount Sanctioned: Rs.3.1 lacs
2. Successfully completed the Consultancy project, "Geotechnical investigations for Waste to Energy Power plant at Kapuluppada Municipal dump site" worth Rs.9.01 lacs including laboratory testing worth Rs.1.17 lacs at ANITS and drilling of 15 bore holes and in-situ testing by Simhadri bore wells for M/s Jindal Urban Waste Management (Visakhapatnam) Ltd. during October-December 2017
3. Successfully completed the Consultancy project, "Geotechnical investigations for Waste to Energy Power plant at Kapuluppada Municipal dump site" with Dr.B.N.D.Narasinga Rao as the Principal Investigator, worth Rs.1.64 lacs including laboratory testing worth Rs.10,500 at ANITS and drilling of 5 bore holes and in-situ testing by Simhadri bore wells for M/s Jindal Urban Waste Management (Visakhapatnam) Ltd. during August-October 2016.
4. The Department undertakes consultancy services in the following areas
   a) *Material Testing: Soil, aggregate, cement, concrete, steel, brick, bitumen, water etc.*
   b) *Soil investigations and foundation selection, including Safe Bearing capacity, depth and type of foundation and its design*
   c) *Planning and Design of all Structures*
   d) *Surveying for all purposes using Total Station*
   e) *Transportation and Traffic surveys etc*

Significance of Soil Investigation in Civil Engineering Industry

Madan Kumar Annam, madankumar@kellerindia.com, Head of Engineering, Keller India, Chennai, India

Introduction

In general, subsoil conditions vary drastically across the construction sites. Unfortunately, many people underestimate the importance of proper geotechnical investigations during the conceptual phase of a project. One of the greatest causes of foundation failure is insufficient knowledge over the ground conditions. Insufficient data or over confidence on soil conditions may result in geotechnical failures such as bearing capacity, settlements, overall stability of structures in turn causing structural failure. Apart from this, conservative approach of soil design parameters may lead to high construction costs. For any civil engineering project, however big or small, it is of primary importance that a proper field survey and a very precise soil investigation is ensured. This article highlights the importance of soil investigation using traditional borehole investigation and advanced soil investigation method namely Electric Cone Penetration Testing, ECPT, as well.

Importance of Soil Investigations

Soil investigation is an integral part of the construction to understand physical and engineering characteristics of soil/rock conditions before finalization of the foundation design. Therefore, adequate and accurate soil investigation is significant in design and execution of Civil Engineering projects. The importance of soil investigation is not recognised by most of the practicing engineers and sometimes by the developer of the project too. As per the experience, it is very clear that the total foundation cost decreases with an increase in scope of soil investigation. The soil investigation scheme with limited testing will also result in expensive foundations. Usually, about 1% of the project cost is to be budgeted for the soil investigation for any project. This is a very low investment compared to the cost savings from the design optimization, when compared to the losses due to structural failures and its remediation costs.

Soil testing shall be conducted in the early stages of the project i.e., conceptual stage or design phase as it helps in the estimation of project cost. The structural and geotechnical engineers will arrive a consensus on how the results affect the design of the structure, based on the soil investigation data.

Soil Investigation Process

A planned soil investigation program is necessary to evaluate the general suitability of the site for the proposed project and it helps determining the soil characteristics, topography, stratigraphy, bearing capacity of soil, possible maximum or differential surface settlement, ground water level variation and so on. The depth and extent of detail in which soil investigation is to be conducted depends on the local experience, design objectives, level of geotechnical risk and potential cost savings. Provisions stipulated in the local standards or project technical specifications provide guidance in deciding the type and number of tests to be conducted for a project. Time and cost constraints as well as the judgement and experience of the consulting geotechnical engineer do govern the scope of soil investigation.

The results of soil investigation can affect the economics of the entire project. The practicing engineer will decide the bearing capacity of soil and rate of soil settlements based on its properties and accordingly adjust the depth and type of the foundation. Accordingly, construction stages and necessary precautions will be decided. The soil investigation data provides a certain level of predictability and confidence over the ground conditions. A design engineer usually idealizes subsoil profile by interpolating the available soil data or assume appropriate soil design parameters based on local experience. Figure 1 illustrates the process of various stages in soil investigation.

Project design team	Geotechnical designers	Geotechnical contractor
Definition of project	Geotechnical advice on likely design issues	
Site selection	Preliminary desk study to advise on relative geotechnical merits of different sites	
Conceptual design	Geotechnical advice on optimizing structural forms and construction methods, in order to reduce sensitivity of proposed construction to ground conditions Detailed desk study and walk-over survey to produce a report giving: • expected ground conditions • recommended types of foundations • geotechnical design problems needing analysis	
	Ground investigation plan	
		Ground investigation: • profiling • classification • determination of parameters
Detailed structural / architectural design	Detailed geotechnical design	
Construction	Comparison of actual and anticipated ground conditions-assessment of new risks	Additional ground investigation
Performance	Geotechnical monitoring	Instrumentation

Figure 1: Order of Events in Soil Investigations

Types of Soil Investigations

Various types of soil investigations are available in practice such as Boreholes (BH), Electric Cone Penetration Tests (ECPT), flat Dilatometer Tests (DMT), other penetration tests and Electric Resistivity Tests. Standard Penetration Tests (SPT), Vane Shear Tests (VST) and Pressure Meter Tests (PMT) are usually conducted in boreholes. Disturbed and undisturbed soil samples will be collected for laboratory testing to assess physical and engineering properties of soil/rock. Figure 2 illustrates various types of soil investigations. SPT N value provides an indication of soil consistency for cohesive and cohesionless soils (Ref. Figure 3). Typical soil drilling rigs is shown in Figure 4.

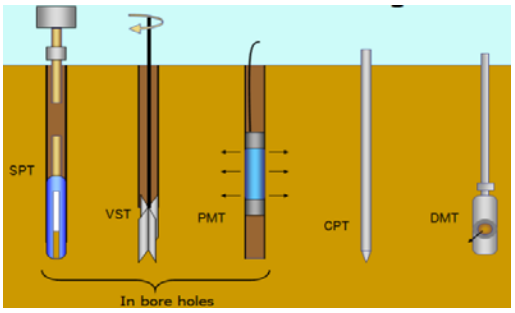


Figure 2: Various types of soil investigations

Sand		Clay	
N	Density	N	Consistency
< 4	Very loose	< 2	Very soft
4-10	Loose	2-4	Soft
10-30	Normal	4-8	Normal
30-50	Dense	8-15	Stiff
> 50	Very dense	15-30	Very stiff
		> 30	Hard

Figure 3: Soil types based on SPT N values

Figure 4: Soil investigation using borehole drill rigs

Advanced soil investigation using ECPT

Electric Cone Penetration Test (ECPT) is the advance soil investigation method used to determine the continuous soil profile for identification of soil behaviour type and to evaluate the engineering parameters of the soil. ECPT consists of a cone setup equipped with electric tip and computer system which can continuously monitor the data during the penetration. The electric tip is equipped with pore pressure transducers to measure the pore pressure variation in the profile in addition to tip resistance (q_c) and sleeve friction (f_s) and accordingly friction ratio will be estimated. Pore pressure response during cone penetration can used as an additional parameter in identification of subsoil type. It also helps in identifying the ground water level. ECPT is advantageous over traditional methods as it is fast. Also, soil investigation using traditional methods using boreholes require more man power, equipment and safety precautions compared to CPT tests (refer, Figure 5). Typical ECPT data is presented in Figure 6.

Summary

Soil investigation helps in a safe design in terms of geotechnical concerns such as bearing capacity criteria, settlement criteria, liquefaction etc. It also assists in project cost saving through design optimization and elimination of probable costs due to repair and retrofitting in the later stages. Practicing engineers are responsible in highlighting the importance of soil investigation to the Client and explaining how it plays a critical role in optimizing the construction process.

Figure 5: Electric Cone Penetration Testing Equipment

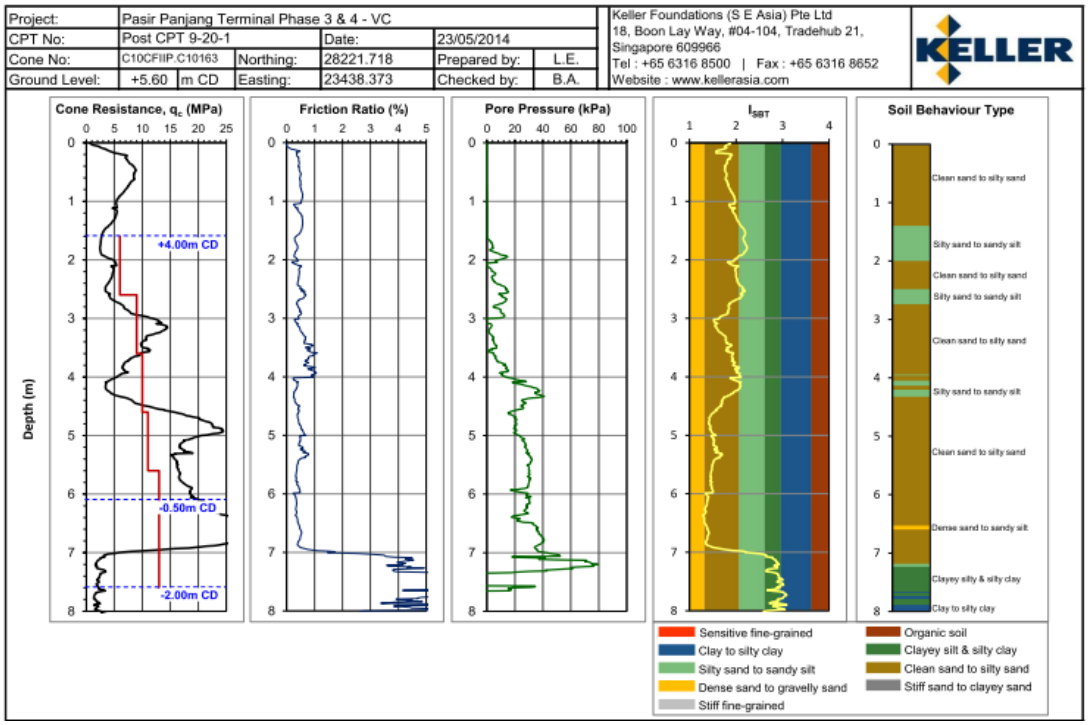


Figure 6: Electric Cone Penetration Test (ECPT) data

Smart Cities: STAR Community Rating System

Dr, B.N.D.Narasinga Rao, Professor & Head, Civil Engineering, ANITS

Why Smart city?

Smart city has become the buzz word of the world today. Cities are the future of the mankind. In the 18th century, less than 5% of the global population lived in cities. The share of urban population in the world, has increased tremendously to 51% in 2011 and is expected to increase to 70% by 2050.

During this rapid urbanization, the urban infrastructure has grown piecemeal and rising urban populations are putting pressure on housing and transport, land, water, energy and finance, causing depleting vegetation and water resources, excessive pollution and waste generation leading to ecological imbalance and climate change at large as well as loss of quality life. Urban transport is now a potential source of air pollution by the release of greenhouse gases.

The alarming rate of global warming from economic development has raised the eyebrows of all nations. The Sustainable Development Goals adopted at the UN Conference on Sustainable Development in 2012 and the CoP21 Paris agreement in 2015 call for balancing the aspirations for holistic economic development with ecosystem preservation.

Sustainable development is the challenge of meeting growing human needs for natural resources, energy, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future life and development.

As cities contribute to 80% of world's GDP, Smart cities with focus on sustainable development ensure economic development without endangering the environment and quality of life.

In this article, an introduction to smart cities and the STAR Rating system for evaluation of smart cities is covered. In subsequent articles, ISO 37120 Guidelines for Smart cities, GIFT as model Smart city, India's Smart city mission and Visakhapatnam as Smart city will be dealt with.

What is Smart City?

What is a 'smart city'? There is no universally accepted definition of a Smart City. It means different things to different people. There is substantial literature on the definition of smart cities, which could be categorized into three major sources:

1. From the Research and academic view: This view, overall, puts sustainability (mainly environmental sustainability) as the primary agenda for a smart city and quality of life and economy emerge as second-level priority factors.
2. Corporate sector's (mainly technology companies) view: This emphasizes ICT as a panacea, assuming that the required outcomes such as city efficiency, management, infrastructure, environment, and quality of life follow automatically. Notably, there is nominal emphasis on the overall functionality, resilience, city form and urban design of the smart city.
3. Governments view: This sector reflects a larger understanding of the use of ICT in delivering governance, recognizes the critical relevance of human resources, and puts emphasis on quality of life as well as environment.

The conceptualization of Smart City, therefore, varies from city to city and country to country, depending on the aspirations of the stakeholders, level of development, willingness to change and reform and available resources.

Smart city Characteristics: STAR Framework

The evolution of diverse concepts of smart city has led to the development of STAR (Sustainability Tools for Assessing & Rating Communities) Rating System during 2008-2012, consisting of a standard framework of goals, objectives, and evaluation measures for smart cities. In STAR terminology, cities are called communities. The STAR framework, integrates economic, environmental, and social aspects of sustainability, provides cities (communities) with a menu-based system to customize their approach based on local conditions and priorities. Cities can pursue the most important or relevant objectives, addressing regional variability and differing priorities along the way.

In 2015, the rating system's governance and technical committees recommended an update to STAR in order to integrate data and best practices from the first 50 STAR Certifications and address on-going issues like alignment with external standards (e.g. ISO 37120 and the United Nations Sustainable Development Goals)

and development of new content to address gaps (e.g. biodiversity, good governance, aging, local government resource footprint).

STAR (Version 2.0) Framework

An analysis of points received by Certified STAR Communities revealed deficiencies in the Equity & Empowerment and Climate & Energy goal areas; it was suggested that restructuring and improvements to methodologies could resolve some of the issues communities were having with these gap areas.

Working groups of formal committee members and on call advisors were assembled and met weekly between August 2015 and January 2016 to review new research, data sets, and methodologies and recommend revisions to the framework. In May 2016, their work was compiled into a working draft of Version 2.0 of the STAR Community Rating System. The working draft was presented during the STAR 2.0 Stakeholder Convening in Washington, DC; this in-person meeting convened 50 committee members and partners to address remaining issues, concerns or omissions. Stakeholders approved the working draft at the meeting and put STAR Version 2.0 out for public comment on June 15, 2016. The latest STAR Community Rating System Version 2.0 was released in October 2016.

Hundreds of public comments were received and analyzed by staff before presenting a final draft to committees in August 2016. The Technical Advisory Group and Steering Committee approved the final draft of the Rating System on August 23rd and August 25th, 2016 respectively.

STAR's Goal Areas and Objectives

1) Built Environment: Achieve livability, choice, and access for all where people live, work, and play
2) Climate & Energy: Reduce climate impacts through adaptation and mitigation efforts and increase resource efficiency
3) Economy & Jobs: Create equitably shared prosperity and access to quality jobs
4) Education, Arts & Community: Empower vibrant, educated, connected, and diverse communities
5) Equity & Empowerment: Ensure equity, inclusion, and access to opportunity for all community members
6) Health & Safety: Strengthen communities to be healthy, resilient, and safe places for residents and businesses
7) Natural Systems: Protect and restore the natural resource base upon which life depends

Table-1 STAR's Goal Areas and Objectives

Built Environment	Climate & Energy	Economy & Jobs	Education, Arts & Community	Equity & Empowerment	Health & Safety	Natural Systems	Innovation & Process
Ambient Noise & Light	Climate Adaptation	Business Retention & Development	Arts & Culture	Civic Engagement	Active Living	Green Infrastructure	Best Practices & Processes
Community Water Systems	Greenhouse Gas Mitigation	Green Market Development	Community Cohesion	Civil & Human Rights	Community Health	Biodiversity & Invasive Species	Exemplary Performance
Compact & Complete Communities	Greening the Energy Supply	Local Economy	Educational Opportunity & Attainment	Environmental Justice	Emergency Management & Response	Natural Resource Protection	Local Innovation
Housing Affordability	Energy Efficiency	Quality Jobs & Living Wages	Historic Preservation	Equitable Services & Access	Food Access & Nutrition	Outdoor Air Quality	Good Governance
Infill & Redevelopment	Water Efficiency	Targeted Industry Development	Social & Cultural Diversity	Human Services	Health Systems	Water in the Environment	
Public Parkland	Local Government GHG & Resource Footprint	Workforce Readiness	Aging in the Community	Poverty Prevention & Alleviation	Hazard Mitigation	Working Lands	
Transportation Choices	Waste Minimization				Safe Communities		

An eighth category, Innovation & Process, supports the evolution of sustainability practice by recognizing best practices and processes, exemplary performance, local innovation, and good governance. Each of the rating system's goal areas is supported by a series of objectives aimed at achieving community-level aspirations, as shown in Table-1. Objectives are the clear and desired achievement intended to move the community toward the broader sustainability goal. Objectives are measured in two ways: through attainment of community level outcomes and/or completion of local actions that are essential to reaching the outcomes. These evaluation measures provide the avenue for communities to achieve credits in the rating system.

Evaluation Measures

As noted, STAR objectives are achieved through attainment of two types of evaluation measures: community level outcomes and local actions. Outcomes are measurable condition-level indicators that depict a community's progress toward a preferred state or condition within the STAR objective which it supports. Outcomes are represented as trend lines, targets, or thresholds in the rating system.

Local actions describe the range of decisions and investments that a local government or community can make, or the activities that they can engage in, that are essential to achieving desired outcomes. Local actions in the rating system focus on the key interventions that move the needle towards STAR's identified outcomes.

Since many public, private, and nonprofit organizations within the community contribute towards advancing sustainability goals, the rating system recognizes these efforts also, along with those of the local government. The rating system awards credits for local actions performed by community actors other than the applicant local government, provided that the applicant demonstrates that the activities have had a significant, positive impact on progress towards achieving the desired outcome(s) for the community as a whole.

Weighting of Goal Areas

STAR's seven goal areas serve as the foundation of the system's interconnected, triple bottom line approach to sustainability. There are currently no universally accepted standards for rating one sustainability goal as of greater importance or value than any other. Therefore, STAR's goal areas are equally weighted at 100 points each, as shown in Table-2.

Achieving Points within STAR Objectives

Within each goal area, there are 6 or 7 objectives and each objective has a total point value between 10 and 20 points. For example, the goal area, Built Environment (BE) has 7 objectives with points for each objective as shown in Table-3. Objectives for remaining Goal Areas can be referred in STAR V2.0 Rating system cited in Reference. Objectives are assigned a total point value based on their impact on achieving community sustainability as well as impact towards meeting the STAR goal area that it is situated beneath.

Applicants accumulate points in the rating system through achievement of objectives. Within each objective, there are three paths to achieving the total points available: communities can complete community level outcomes, local actions or a combination of the two types of evaluation measures.

Table-2 Goal Areas for Smart cities in STAR framework

S. No.	Goal Area	Points Available
1	Built Environment	100
2	Climate & Energy	100
3	Economy & Jobs	100
4	Education, Arts & Community	100
5	Equity & Empowerment	100
6	Health & Safety	100
7	Natural Systems	100
8	Innovation & Process	50
	Total	750

Certification and Recognition

STAR certification provides a clear, data-driven approach to assessing communities' sustainability efforts. Certification allows communities to credibly and transparently track progress toward overall sustainability objectives. Communities receive a rating based on the total cumulative score of points achieved across the menu-based rating system. Communities choose the measures that they would like to report on and are not required to submit on all measures. The flexibility of a menu-based system allows local governments to select the objectives they feel are most important and relevant to their communities.

The STAR Community Rating System supports three leadership certifications: 3-STAR Community, 4-STAR Community and 5-STAR Community. Since STAR is menu-based and communities decide which measures to report on, the final scores do not provide a true head-to-head comparison. STAR is a rating, not a ranking, system. A certified STAR Community Rating lasts for four years after the award date, at which point a community is expected to measure and report progress through recertification. A community that has not had their application verified, but is working toward certification, is a Reporting STAR Community.

Table-3 Evaluation of the Goal Area, Built Environment

Objective Number	Objective Title and Purpose	Available Points
BE-1	Ambient Noise & Light: Minimize and manage ambient noise and light levels to protect public health and the integrity of ecological systems	10
BE-2	Community Water Systems: Provide a clean and secure water supply for all local users through the management of potable water, wastewater, storm water, and other piped infrastructure	15
BE-3	Compact & Complete Communities: Concentrate development in compact, human-scaled, walkable centers and neighborhoods that connect to public transit, offer diverse uses and services, and provide housing options for families of all income levels	20
BE-4	Housing Affordability: Construct, preserve, and maintain an adequate and diverse supply of location-efficient and affordable housing options for all residents	15
BE-5	Infill & Redevelopment: Focus growth and redevelopment in infill areas to reduce sprawl and ensure existing infrastructure that supports the community is in satisfactory working condition	10
BE-6	Public Parkland: Create a system of well-used and enjoyable public parkland that feature equitable, convenient access for residents throughout the community	15
BE-7	Transportation Choices: Promote diverse transportation modes, including walking, biking, and public transit, that are safe, low-cost, and reduce vehicle miles traveled	15

General descriptions and point ranges required for certification are shown in Table-4.

Table-4 STAR Certification Ratings

Certification Levels	Point Range
Certified 3-STAR Community Recognized for sustainability leadership	250 – 449
Certified 4-STAR Community Recognized for national excellence	450 – 649
Certified 5-STAR Community Recognized as top tier achiever in national sustainability	650+

Certification Process

The certification process enables communities to baseline their sustainability performance against the national standards and benchmarks in the STAR Community Rating System. U.S. cities and counties of all sizes and resource levels have achieved STAR certification. There is no minimum or maximum population size for pursuing certification, however the city or county government must be the primary applicant. Communities as small as Charles City, IA (pop.7,600) and as large as Houston, TX (pop. 2.2 million) have successfully achieved STAR certification. On average, the certification process takes a community a year from start to finish. Communities begin by aligning their existing programs, policies, and plans with the STAR Community Rating System using project management tools and resources provided by STAR Communities. Then they gather data on the evaluation measures of their choice from the rating system and enter the data into STAR's online data entry and reporting platform. Because the rating system measures community-wide sustainability, data and information on programs will need to be provided by a variety of different governmental departments and agencies, as well as from community stakeholders and civic partners.

The most common project management set-up has been to have 1 or 2 key staff people supported by interns, a community sustainability group, a green team, and/or a university partner. In general, the project team spends 1-2 months on getting organized and 4-6 months on data collection if they are working on a part-time basis. Once the community has completed as many of the evaluation measures as possible, they submit their online application for verification. STAR Communities' Technical Team then performs a robust verification process that includes an opportunity for the community to make amendments or edits to the application. The Technical Team assigns the final STAR Community Rating®, which lasts for 4 years, at which point the community is expected to report on progress and recertify.

To meet the needs of diverse communities, STAR Communities offers multiple paths to certification through a subscription service model. Communities can work at their own pace or join the annual Leadership STAR Community Program for full service and support. There are no prerequisites for certification.

Verification

STAR Communities prides itself on a detailed and thorough approach to verification. The intent of the verification process is to preserve the rigorous nature and integrity of the STAR Community Rating System and provide solid credibility to all communities that achieve a certified STAR Community Rating.

STAR's verification process includes a two-phase review of every evaluation measure submitted by a community and provides applicants with an opportunity for amendments and improvements. As a result, governments, businesses, non-profits, residents, and other stakeholders can be confident in their and other communities' certified STAR Community Ratings.

Reference

1. STAR Community Rating Systems Version 2.0 downloaded from www

Faculty Achievements (2017-18)

1. Dr. B.N.D. Narasinga Rao, Professor & Head, Civil has delivered invited lecture on "Professional Ethics", Seminar on "Civil Engineering-Theory to Practice", organized by Andhra University(A) on 24th March 2018.
2. Dr. B.N.D. Narasinga Rao, Professor & Head, Civil, delivered Guest lecture on "Fly ash utilization in Structural and Geotechnical Applications", organized by Chalapathi Institute of Technology, Guntur, on 24th February 2018.
3. Dr. B.N.D. Narasinga Rao, Professor & Head, Civil Served as Resource person & Delivered a lecture on "Fly Ash and Solid Waste Management" at the Workshop on "Geotechnical Problems and Practices", organized by Department of Civil Engineering, ANITS on 11th October 2017.
4. Dr.B.N.D. Narasinga Rao, Professor & Head, Civil, Conferred the 25th Business School Affaire and Dewang Mehta National Education Award (Regional Round) for Best Professor in Civil Engineering on 27th December 2017

Body - The Greatest Gadget: Sadguru

(Excerpts from the discourses by Sadguru Jaggi Vasudev)

Dr, B.N.D.Narasinga Rao, Professor & Head, Civil Engineering, ANITS

Charles Darvin, in his theory of evolution, says that man has evolved from the ape. Once you have become human, the unconscious evolution is finished for you. You can only evolve consciously. The "Human" is not an established state, rather it is a state of flux. This moment you can be godlike, the next moment you can be a brute. You may have seen this yourself – you are wonderful this moment, nasty the next moment, beautiful the next moment, ugly the next. A human is not a being, he is a becoming. He is an on-going process – a possibility. For this possibility, there is a whole system of understanding the mechanics of how this life functions and what we can do with it, which we refer to as Yoga.

Unfortunately, yoga is misunderstood as sitting in some impossible posture. Yoga is not just twisting your body, standing on your head or holding your breath – a circus artist can do all these things better than most yogis. Yoga means, in your experience, everything has become one.

The word yoga means union. What is the union? What can unite with what? Right now, your idea of who you are – your sense and experience of who you are – is very strong. You perceive yourself as an individual. But what the trees exhale, you inhale, and what you exhale, they inhale. One half of your lung is hanging up there. Without it your lungs within would be dysfunctional. Yet, in your experience, you think this individual "myself" is everything.

This is not everything. Not only in terms of breath – according to modern physics, every subatomic particle in your body is in constant transaction with everything else in the existence. If this transaction stops, you will cease to exist. Scientists have proved that the whole existence is just one energy. Whether a scientist says "everything is one energy" or a religious person says "God is everywhere", it is still the same reality. It is just that a scientist has not experienced it, rather he has arrived at it through mathematical deductions. A religious person has not experienced it either, he believes it because it is written in some scripture or declared by someone. But if you are a hard case, who is not willing to settle for deductions or beliefs, you want to know it for yourself, then you must turn inward. If you turn inward through yoga for just one moment, everything that is worth knowing in the existence can be known.

In the history of evolution, physiological transformation is not the only evolution that is happening. Purely physiological evolution is only the first phase. After physical evolution, the process shifts from physical to other dimensions. From animal to human being, evolution has happened in different dimensions. Above all, the fundamental consciousness has evolved. The whole significance of yoga and other related practices is to bring more of you into a conscious process. Fundamentally, the significance of yoga is that even an involuntary part of your system can be made into a conscious process, where you decide the pace at which your heart should go. It is not an involuntary process any more.

A survey by some cell phone companies in India found that ninety-seven percent of people are using only seven percent of the capabilities of the ordinary phone (not even the smart phone). If they remove ninety percent of the electronics, most people will not know the difference. So what about your system – what percent of this human system do you think you are employing? It is well below one percent, because for your survival process, to conduct your day to day life in the world, you do not even need one percent of your system's potential. One fundamental aspect of yoga is learning to use your body as an instrument to its full potential. The ultimate goal of yoga is to bring the whole existence, into your consciousness, in its true and complete dimension. And in that state of consciousness, your activities will become a blessing not just to you, but to the whole world.

(*To be continued*…)

Non-Destructive Testing of Concrete

J Vikranth, Associate Professor, Civil Engineering Department, ANITS

Non-destructive testing of concrete is a method to obtain the compressive strength and other properties of concrete from the existing structures. This test provides immediate results and actual strength and properties of concrete structure. The standard method of evaluating the quality of concrete in buildings or structures is to test specimens cast simultaneously for compressive, flexural and tensile strengths. The main disadvantages are that results are not obtained immediately; that concrete in specimens may differ from that in the actual structure as a result of different curing and compaction conditions; and that strength properties of a concrete specimen depend on its size and shape. Although there can be no direct measurement of the strength properties of structural concrete for the simple reason that strength determination involves destructive stresses, several non-destructive methods of assessment have been developed. These depend on the fact that certain physical properties of concrete can be related to strength and can be measured by non-destructive methods. Such properties include hardness, resistance to penetration by projectiles, rebound capacity and ability to transmit ultrasonic pulses and X and γ-rays.

Following are different methods of NDT on concrete:

1. Penetration method
2. Rebound hammer method
3. Pull out test method
4. Ultrasonic pulse velocity method
5. Radioactive methods

Penetration tests on concrete :

The Windsor probe is generally considered to be the best means of testing penetration. Equipment consists of a powder-actuated gun or driver, hardened alloy probes, loaded cartridges, a depth gauge for measuring penetration of probes and other related equipment.

A probe, diameter 0.25 in. (6.5 mm) and length 3.125 in. (8.0 cm), is driven into the concrete by means of a precision powder charge. Depth of penetration provides an indication of the compressive strength of the concrete. Although calibration charts are provided by the manufacturer, the instrument should be calibrated for type of concrete and type and size of aggregate used.

Rebound hammer method:

The rebound hammer is a surface hardness tester for which an empirical correlation has been established between strength and rebound number. The only known instrument to make use of the rebound principle for concrete testing is the Schmidt hammer, which weighs about 4 lb (1.8 kg) and is suitable for both laboratory and field work. It consists of a spring-controlled hammer mass that slides on a plunger within a tubular housing. The hammer is forced against the surface of the concrete by the spring and the distance of rebound is measured on a scale. The test surface can be horizontal, vertical or at any angle but the instrument must be calibrated in this position. Calibration can be done with cylinders (6 by 12 in., 15 by 30 cm) of the same cement and aggregate as will be used on the job. The cylinders are capped and firmly held in a compression machine. Several readings are taken, well distributed and reproducible, the average representing the rebound number for the cylinder. This procedure is repeated with several cylinders, after which compressive strengths are obtained.

Average rebound number	Quality of concrete
>40	Very good hard layer
30 to 40	Good layer
20 to 30	Fair
<20	Poor concrete
0	delaminated

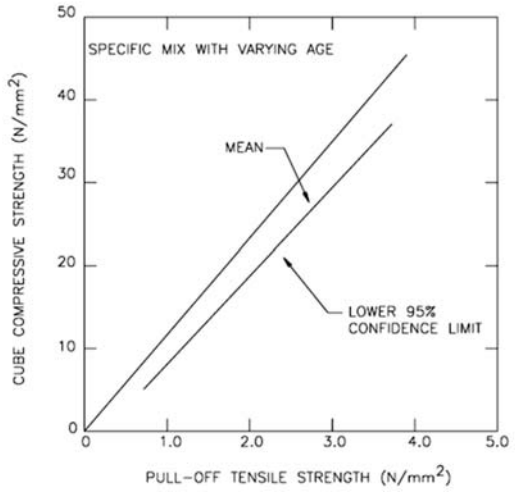
Pull-out tests on concrete:

A pull-out test measures, with a special ram, the force required to pull from the concrete a specially shaped steel rod whose enlarged end has been cast into the concrete to a depth of 3 in. (7.6 cm).The concrete is simultaneously in tension and in shear, but the force required to pull the concrete out can be related to its compressive strength. The pull-out technique can thus measure quantitatively the in-situ strength of concrete when proper correlations have been made. It has been found, over a wide range of strengths, that pull-out strengths have a coefficient of variation comparable to that of compressive strength.

Dynamic non destructive tests on concrete:

At present the ultrasonic pulse velocity method is the only one of this type that shows potential for testing concrete strength in situ. It measures the time of travel of an ultrasonic pulse passing through the concrete. The fundamental design features of all commercially

available units are very similar, consisting of a pulse generator and a pulse receiver.



Pulses are generated by shock-exciting piezo-electric crystals, with similar crystals used in the receiver. The time taken for the pulse to pass through the concrete is measured by electronic measuring circuits.

Table: Quality of concrete and pulse velocity

General Conditions	Pulse Velocity ft/sec
Excellent	Above 15,000
Good	12,000-15,000
Questionable	10,000-12,000
Poor	7,000-10,000
Very Poor	below 7,000

Radioactive methods of NDT on concrete

Radioactive methods of testing concrete can be used to detect the location of reinforcement, measure density and perhaps establish whether honeycombing has occurred in structural concrete units. Gamma radiography is increasingly accepted in England and Europe. The equipment is quite simple and running costs are small, although the initial price can be high. Concrete up to 18 in. (45 cm) thick can be examined without difficulty.

Seminars/ Workshops/ Conferences Attended by Faculty (2017-18)

1. Mr. B.Ramana Raja, Assistant Professor, CIVIL has attended a two Day national Seminar on "Structural Reliability" organized by MVGR College of Engineering(A) on 8th December 2017.
2. Mrs. P.V.R. Sravya, Assistant Professor, CIVIL has attended a one Day Workshop on "The Emergence of Green Building Practice and Its Impact on Environmental Concerns" organized by Andhra University (A)on 11th August 2017.
3. Mrs. P.V.R. Sravya, Assistant Professor, CIVIL has attended an International Conference on "Environmental Biotechnology (EBIO-2017)" organized by Andhra University (A) on 23rd November 2017.
4. Mr. T.V.Viswa Teja, Assistant Professor, CIVIL has attended a Short Term Course on "Geosynthetics as Modern Civil Engineering Construction Materials(Organised by IGS)" organized by IIT-Madras on 05th February 2018 to 10th February 2018.
5. Mr. T.V.Viswa Teja, Assistant Professor, CIVIL has attended National seminar on " Educate The Educator's Program(Organised by IGS)" organized by IIT-Madras during 05th February 2018 to 10th February 2018.
6. Mr. T.V.Viswa Teja, Assistant Professor, CIVIL has attended a 12 days fellow development program on "Pedagogical Training on Outcome Based Education" organized by GVP College of Engineering (A) from 18th December 2017 to 30th December 2017.
7. Mr. T.V.Viswa Teja, Assistant Professor, CIVIL has attended a One Day Workshop on "The Emergence of Green Building Practice and Its Impact on Environmental Concerns", organized by Andhra University (A) on 11thOctober 2017.
8. Mrs.P.Vandana Rao, Assistant Professor, CIVIL has attended a One Day National Workshop on "The Emergence of Green Building Practice and Its Impact on Environmental Concerns" organized by Andhra University (A) on 11th October 2017.
9. Mrs.P.Vandana Rao, Assistant Professor, CIVIL has attended a Two Day National Workshop on "GIS and Its Application in Civil Engineering" organized by Vignan Institute of Information Technology(A) on 16th march 2018.
10. Mr.Ch Srinivaas, Assistant Professor, CIVIL has attended a Two Day National Workshop on "GIS and Its Application in Civil Engineering " organized by Vignan Institute of Information Technology(A) on 16th march 2018.
11. Mr M. Premchand has attended a GIAN course on "Urban Water and Wastewater Management for India" organized by IIT- Kharagpur from 30th April to 4th May 2018.
12. Mr. J Harsha Vardhana Reddy has attended a Two day international seminar on "Latest Trends in Structural Engineering & Geo environmental Engineering", organized by GVP College of Engineering on 2nd & 3rd March 2018
13. Ms. M Naga Lakshmi has attended Indian Geotechnical Conference on Geotechnics for Natural and Engineered Sustainable Technologies at IIT Guwahati on 14th & 15th December 2017.

Pre-Engineered Building

M K S S K Chaitanya, Assistant Professor, Civil Engineering Department, ANITS

The Pre-Engineered Building (PEB) technology is expected to speed up infrastructure projects in the country. The PEB industry is expected to be around Rs 5,000 crore in India and is growing at a rapid pace. PEB technology speeds up construction, brings in high durability, low maintenance costs, versatile use and it also brings in ease of expansion of the building. PEB solutions are gaining huge traction in India and are preferred mostly in western and developed nations as an alternative to conventional construction that involves constructing at the site of the project. Through PEB technology, the building units are completed at the factory premises of the manufacturer and the projects can be finished faster, say at one-third of time than a conventional construction.

An example of Pre-Engineered Building

Noida-based building solutions company, Everest Industries, has been instrumental in popularising this concept of PEB and the company has been involved in the construction of projects like Ro-Ro Ferry Terminal in Gujarat and the Goa Shipyard, which is one of the tallest PEB building in the country recently. Interestingly, the Goa Shipyard has 50 lakh screws and each hole for that screw is made as per the correct alignment. "The Pre-Engineered Building (PEB) technology can help solve the problem of prolonged delays of some projects. In India, the Goa Shipyard took 11 months to complete and we had to design the place in such a way that a ship could comfortably enter inside, Tata Power facility in just 9 months time frame. Currently, PEB technology is being used to build a facility for the Indian Army, near Leh, where the temperatures can go as low as -35 degree Celsius. The conventional method of construction would not be able to withstand such a kind of low temperature.

Currently, the Everest Steel Building Solutions have completed more than 2000 PEB projects covering more than 5 crore sq.ft of construction across 275 cities in 29 states in India. "In the US and Europe, PEB projects are the preferred ones due to the faster turnaround time and the fast pace of completion and above all better control over the project," added Sanghi.

Construction and Sustainability Aspects

The preoccupations of the sustainable development are of particular concern for the construction sector, which is responsible for 25% of greenhouse gas emissions and for 40% of the primary energy consumption. They constitute a major stake for all the involved professionals. Steel is an excellent solution for conserving raw materials, thanks to its recyclability. It can be infinitely recycled without losing its properties and strength. Today, the production of steel consists of 50% recycled metal, reducing the need for ore; for certain products intended for construction, this rate can reach up to 98%. This re-use of the material is in particular made possible by its magnetic properties facilitating the sorting the control of energy and the reduction of carbon dioxide emissions during

production have led to vast improvements in developing new steel materials and taking into account life cycle of materials and products.

Steel is the mainspring in our quest to improve the quality of our buildings and their impact on our living environment. General principles are established according to three main considerations: ecological, economical and socio-cultural, although the methods for determining their impact have not yet been agreed on an international scale. The sustainability of buildings concerns a range of issues related to choice of materials, construction process, occupation and end of life. These issues may be expressed in terms of specific criteria, such as energy materials use, waste minimization, reduction of primary energy use (and CO2 emissions), pollution and other global impacts.

Innovations in Transportation Engineering

T. Kiran Kumar, Assistant Professor, Civil Engineering Department, ANITS(A)

It is undeniable that the road construction industry every day is looking for a greater effectiveness and efficiency in its techniques and methods. In other words, with rising globalization, roads have become a very vital infrastructure in enabling the transfer of freight as well as people, making the better and sustainable development of roads very important. Discussed below are some the best innovations across the world in regard to transportation technology.

Anti-Icing Roads:

Many people have heard the term deicing, which is the melting of ice and snow. But anti-icing is less understood, even though it has become increasingly important in recent years, as evidenced by the sight, reassuring to motorists, of trucks spraying salt brine before a snowstorm. Anti-icing prevents frozen precipitation from bonding to a road's surface. In some circumstances, anti-icing can significantly cut the cost of maintaining a safe road surface when compared to conventional deicing. The main anti-icing material used is a saturated solution of road salt in water, called brine.

Salt is used more efficiently because carefully controlled brine spray doesn't bounce or blow off the road surface. This saves money and minimizes potential losses to the environment.

Advantages of Anti-Icing:

- The roadway surface never becomes impassable.
- Anti-icing returns road surfaces to normal faster, resulting in fewer accidents and delays.
- Crews can cover more territory by beginning treatment in advance of a storm.

Wind powered light for roads:

TAK's wind-powered light uses the moving air from cars zipping by on the highway to generate energy that can be used to power roadside lighting. It's a controversial idea could wind from passing cars actually provide enough power for lighting? but one that has the potential to save lots of cash in already wind-heavy regions.

Alternatively, cities might consider using solar-powered lights instead. The idea has been proven to work many times over, including at the recent COP15 climate change conference.

Porous Pavement:

Porous pavement, or pervious pavement, is the newest development in green technology for road construction. It contains more rock and less oil than traditional asphalt. This combination provides a higher amount of air voids in the paved surface, causing it to be much more permeable than regular asphalt. Instead of rainwater stopping when it hits traditional asphalt and becoming runoff, porous pavement allows the rainwater to flow through its voids into a rock bed underneath. Once the rainwater passes through this filtering rock bed it is returned to the groundwater system.

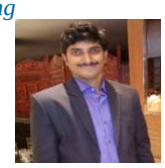
Plastic Roads:

These roads are made from recycled plastics, and the first step in constructing them is to collect and manage the plastic material. The plastic involved in building these roads consists mainly of common post-consumer products such as product packaging. Some of the most common plastics used in packaging are polyethylene terephthalate (PET or PETE), polyvinylchloride (PVC), polypropylene (PP), and high- and low-density polyethylene (HDPE and LDPE). These materials are first sorted from plastic waste. After sorting, the material is cleaned, dried, and shredded. The shredded plastic is mixed and melted at around 170°C. Hot bitumen is then added and mixed with the melted plastic. After mixing the mixture is laid as one would with regular asphalt concrete.

- On the proposed model by Volker Wessel's, plastic roads can have hollow space built in to allow ease of wiring, connecting pipes etc.
- Heating and power generation can be incorporated into plastic roads. Heating can prevent roads from freezing; it can also help evaporate water from the surface.
- Since plastics come with various chemical and physical properties, roads can be engineered to meet specific requirements (e.g. weather and wear resistance).

Ground Improvement Techniques For Curbing Liquefaction Related Problems

Ch. Vineel, Assistant Professor, Civil Engineering Department, ANITS (A)



What is Liquefaction?

"A Phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid" - Hazen,1918

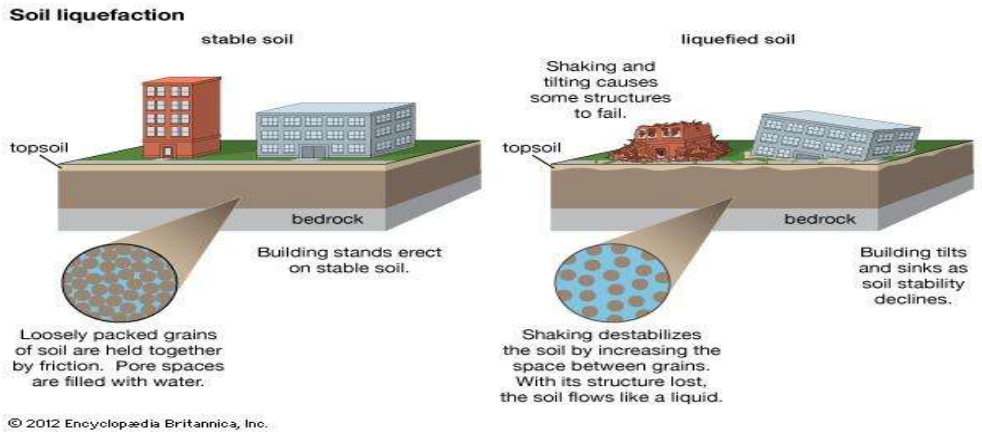


Image Source: Encyclopedia Britannica, Inc.

Introduction

When someone travels to a cold region or a hill station they generally take certain precautions so that the odd conditions won't affect their health the same way when someone wants to go for a construction at a site which is vulnerable to earthquakes they should take care of certain problems that may arise during the occurrence of earth quakes. One of the most dangerous problems that a soil will experience during an earthquake is liquefaction. Saturated soils are more vulnerable to Liquefaction, that is, soils in which the space between individual particles is completely filled with water. This water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Prior to an earthquake, the water pressure is relatively low. However, earthquake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other. Liquefaction will reduce the strength and stiffness of soil which will cause the soil to liquefy temporarily and leads to flow of soil along the slopes.

Effect of Liquefaction:

The consequences of liquefaction for shallow foundations include the loss of bearing capacity, excessive settlement, lateral spreading, and flow failures whereas in deep foundations, liquefaction can cause reduction in lateral capacity, additional down drag forces, additional lateral spreading or flow failures.

Ground Improvement Techniques:

By adopting proper ground improvement techniques we can avoid the damages caused by liquefaction. Some of the techniques adopted for controlling the liquefaction problems are like,

1. Earth quake drains.
2. Vibro replacement.
3. Vibro compaction.
4. Dynamic compaction.

Earth quake drains:

A heavy gauge steel pipe of 3 inch diameter (mandrel) is used for inserting the geotextile fabric into the soil. Earthquake drains are installed by vibrating the insertion mandrel during penetration and removal. The vibrations result in some densification of the granular soils, assisting in the liquefaction mitigation. The drain core is tightly wrapped with geotextile filter fabric, allowing free access of pore water into the drain, while preventing the piping of fines from adjacent soils.

Vibro replacement:

This process densifies granular soils and reinforces all soils. Vibro replacement stone columns are constructed with either the wet top-feed process, or the dry bottom-feed process. In the wet top-feed process, the vibrator penetrates to the design depth using the vibrator's weight and vibrations, as well as water jets located at the tip. The stone (crushed stone or recycled concrete) is then added at the ground surface to the annular space around the vibrator created by the jetting water.The dry bottom-feed process is similar, except that no water jets

are used and the stone is fed to the vibrator tip through an attached feed pipe.

Vibro compaction:

The vibrator is typically hung from a crane and lowered vertically into the soil under its own weight and vibrations. Penetration is usually helped by water jets integrated into the vibrator assembly. After reaching the bottom of the treatment zone, the soils are densified as the vibrator is raised in lifts. During vibro compaction, clean sand backfill is typically added at the ground surface to compensate for the decrease in soil volume from the densification process.

Dynamic compaction:

Dynamic compaction is a ground improvement technique that densifies soils and fills materials by using a drop weight. The drop weight, typically steel, is lifted by a crane and repeatedly dropped onto the ground surface. Vibrations transmitted below the surface improve soils at depth. The drop locations are typically located on a grid pattern, the spacing of which is determined by the subsurface conditions and foundation loading and geometry. Treated granular soils and fills have increased density, friction angle, and stiffness.

By using proper techniques we can definitely curb the losses created due to the natural calamities. Liquefaction is one of the most dangerous problems encountered by a structure during the earth quakes.

"Ground Improvement technique is the most imaginative part in Geotechnical Engineering, where the soil is forced to adopt to the project requirements"

Gabion – Properties, Types, Applications & Advantages

Mr. T V ViswaTeja, Asst. Professor, Dept. of Civil Engg. ANITS (A)

Gabion is a welded wire cage or box filled with Materials such as stone, concrete, sand, or soil. So, gabion is a partially flexible block construction used for slope stability and erosion protection in construction. Various types of gabions are constructed and used in different engineering constructions.

Sometimes, live rooting branches may be placed between the rock-filled baskets which improves durability and stability of the gabion. This article presents gabion definition, types, ap plications, and advantages.

Table-1: Gabion wire mesh properties

Raw material	**Gabion wire mesh properties**		
Technical properties	**Unit**	**Descriptions**	**Tolerances**
Mesh	mm	50×70, 60×80, 80×100, and 100×120	—
Maximum wire thickness	mm	2-5	0.05
Amount of covering	gr/m^2	30-300	5
Tensile strength	MPa	350-2000	2
Elongation (25cm long)	—	10%	—
Zinic coating strength	Turns	5	Shall not break or crack

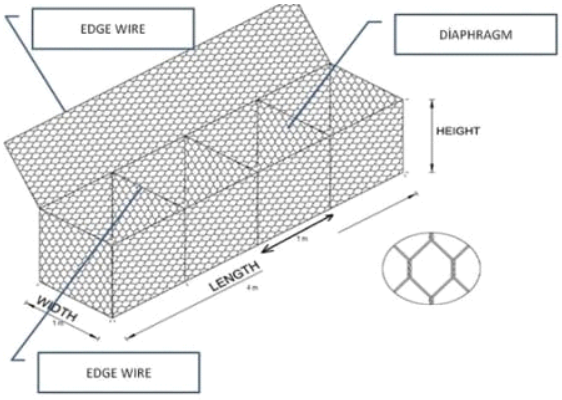


Fig. 1: Wire mesh boxes for gabions

Gabion wire mesh properties

Wire mesh used to manufacture the cage of gabion shall poses certain properties otherwise it might not serve its purpose properly. Table 1 provides the desired properties of gabion wire mesh.

Types of Gabions

There are number of gabion configurations that can be selected based on their cost and function. Common types of Gabion are as follows:

1. Gabion baskets

- It is a net wire mesh that produced in box-shaped and in different sizes.
- Used in highway and railway works.
- It would be economical unless filling materials are not available from quarries near the project site.

Fig.2: Basket gabion

2. Gabion mattresses

- Gabion mattresses, also known as reno mattresses.
- Gabion mattresses height is shorter than the other types of measurements as it might be observed from the Fig. 3.
- It is employed in the channel coating for preventing erosion. So, it tackles wave and erosion induced velocity.
- Common size, 6 m long by 2 m wide by 0,3 m high.

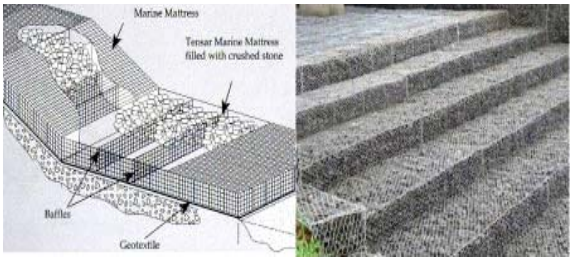


Fig. 3: Gabion mattress

3. Gabion sacks

- This type of gabions is formed quickly.
- It has a porous and flexible structure.
- Gabion sacks are usually used in hydraulic works in emergency conditions.

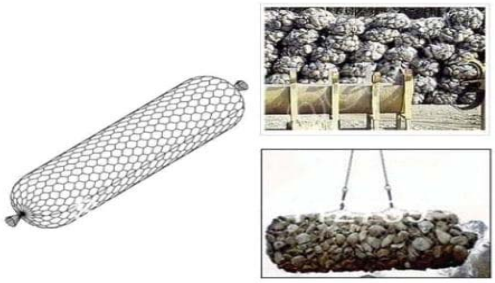


Fig. 4: Gabion sacks

4. Gabion wire mesh

- It is utilized to keep the possible rock and stone fall on the highway and railway surfaces.
- Gabion wire mesh maintains stability of the slope close to highway and railways.
- It is applied for anti-erosion to slope.
- It enhances embankment soil strength in combination with geogrid reinforcement.


Fig. 5: Gabion wire mesh used to prevent rock fall from highway slopes

5. Decorative Gabion Elements

- It is used indoor and outdoor decoration, garden design and landscaping.
- Gabion elements offer suitable environment for the growth of plant roots


Fig. 6: Decorative gabion elements

Applications of gabions

Gabions are used in several engineering projects and serve various purposes. common applications of gabions are as follows:

- Retaining structures such as retaining walls (Fig. 7), revetment and toe walls to embankments and cuttings.
- Corrosion prevention structures for instance sea walls, river bank defences, canal banks (Fig. 8), dams, weirs, groynes and for the protection of reservoirs and lakesides.
- cylindrical metal gabion is used for dams or in foundation construction.
- It is employed as a noise barrier.
- Gabions are also used as a temporary flood walls.
- It is utilized to change the direction of the force of flood water around weak structure
- Stepped gabions improve energy dissipation in channels.
- Finally, it is used for aesthetic purposes

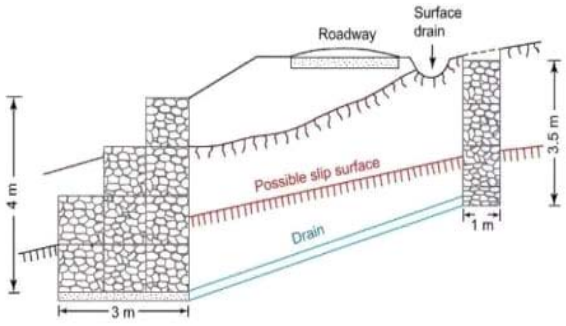


Fig. 7: Gabion retaining wall for road embankment

Fig. 8: Gabions used for aesthetic purpose

Advantages of gabions

1. Durability

Gabion has a very high resistance to atmospheric corrosion because of the well bonded zinc coating on the wire and their ability to support vegetation growth.

2. Flexibility

This feature permits the gabion to settle and deform without failure and loss of efficiency. Specifically, when unstable ground and moving water are encountered.

3. Permeability

It provides automatic and easy drainage which eliminates the need for the installation of drainage pipes.

4. Strength

Gabions are satisfactory strong that is it is capable of resisting flood force, torrential force, and ice and earth pressure.

5. Economical

It is more economical in terms of both material and labor in comparison with other gabion alternatives.

6. Environmentally friendly

Recycled materials can be placed into the gabion cage. The gaps in the soil between filling materials allow the plantation to grow over time. Gabion elements are not affected by natural phenomena.

Building Integrated Photovoltaics (BIPV)

Mrs P Vandana Rao, Asst. Professor, Dept. of Civil Engg. ANITS (A)

BIPV (Building Integrated Photovoltaics) is the integration of photovoltaics (PV) into the building envelope. The primary function of BIPV system is to generate the energy from the solar radiation. BIPV functions are solar protection, thermal insulation, weather protection, sound protection and insulation. These products should be light in weight, flexible and possess large solar cell resistance. PV panels have cells encapsulated with glass, allowing light to be captured from both sides of the cell. Variety of module options for windows, roofs, and facades are available. These modules transmit daylight. Spraying of silicon nano particles on to the window, serves as solar cells.

Photovoltaic/thermal (PV/T) panels have coils on the back of the PVs, which allow water to pass across. This reduces the cell temperature and thus increases the solar electrical efficiency. The water from the PVs can also be used to supply heating of the building, which picks up some more energy from the solar irradiation striking their surface. This approach improves the total performance of the PVs.

PV modules can be made of different types of materials, of which crystalline silicon is the most significant one. Most commonly used types of PV modules are Monocrystalline silicon, Polycrystalline Silicon and Amorphous Silicon.

Mc-Si module has an average electrical efficiency of 10–17%, which are higher than that of other types of silicon. But it is slightly more expensive than others due to more time and energy required for the manufacturing process.

Polycrystalline Silicon (Pc-Si) module is made from cells cut from an ingot of melted and recrystallized silicon using a casting process. It is cheaper than Mc-Si one due to the simpler manufacturing process. However, it tends to be slightly less efficient, with an average electrical efficiency of 11–15%.

Amorphous Silicon (A-Si) is non-crystalline silicon. A-Si module is composed of silicon atoms in a thin homogenous layer rather than a crystal structure. It absorbs solar radiation more effectively than crystalline ones, so the module can be thinner. A-Si can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and ‘fold-away' modules. A-Si module is, however, less efficient than Mc-Si and Pc-Si with a typical efficiency of 4–7%, but it is easier and therefore cheaper to produce, and the output is less affected by high temperatures.

A hybrid module is made from two different types of PV technologies. The advantage of the module is that it performs well at high temperature and maintains higher efficiency than conventional silicon PV modules. However, a hybrid module always comes at a cost premium. At present, Mc-Si and Pc-Si modules are the most common-used types for PV application.

No harmful green house gas emissions occur from solar PV and thus it is environmentally friendly. BIPV system is architecturally clean. Its usage in offices or commercial buildings reduces energy bills and makes the buildings more energy efficient. It has no mechanically moving parts. PV panels are totally silent, producing no noise at all.

Figure BIPV System as Roofs

Acoustic Doppler Velocimeter

M.Premchand, Assistant Professor, Department of Civil Engineering, ANITS

Now a days Remote sensing has become an integral part of day to day life. When we question ourselves that what is remote sensing? Many options strike out, but the actual meaning of remote sensing is without any physical contact with a body or surface information of that body or surface we can access the information through remote sensing. Remote sensing can be done using different media like sound waves, temperature difference etc. In open channel flow, through remote sensing velocity of flow can be measured in all the three directions i.e along x, y, z directions respectively. Instrument which uses the principle of remote sensing to measure velocity of flow in open channels is "Acoustic Doppler Velocimeter".Acoustic Doppler Velocimeter (ADV) works on the principle of Doppler shift. This principle can be illustrated by a simple example: if you are standing at a railroad crossing and a train blares its horn as it passes by, you hear the horn at a higher pitch as the train approaches, and then a lower pitch as it leaves. As the train moves toward you, sound waves from the horn are compressed (meaning higher frequency) and you perceive the sound at a higher pitch. As the train leaves you, sound waves are no longer compressed and you hear a lower-pitched, lower frequency noise. This shift in frequency can be calculated using the equation:

$$\mathbf{F_{doppler} = -F_{source}\frac{V}{C}} \qquad (1)$$

$F_{doppler}$ = change in received frequency (Doppler Shift);
F_{source} = Frequency of transmitted sound;
V= Velocity of sound relative to the receiver; C = Speed of sound.

For there to be a Doppler shift, there must be relative motion between the sound and the observer; if you were on the train and moving with it, you would hear the train's horn at one pitch for the entire trip. This is evidenced in the equation – if relative velocity between the sound and observer is zero (V=0), there is zero shift of frequency. The ADV uses this Doppler shift principle to measure the velocity of water in three dimensions.ADV device sends out a beam of acoustic waves at a fixed frequency from a transmitter probe. These waves bounce off of moving particulate matter in the water and three receiving probes "listen" for the change in frequency of the returned waves. The ADV then calculates the velocity of the water in the x, y, and z directions. A general schematic of the ADV is shown in Figure 1.

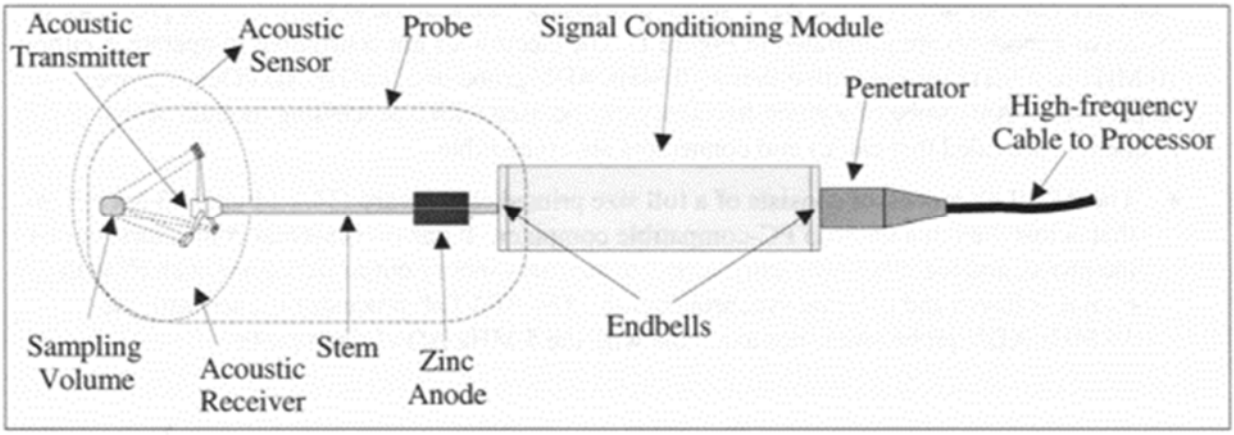


Figure 1: Schematic of Sontek ADV probe(Courtesy: Sontek)

The ADV system has three main modules: measurement probe, signal conditioning module and signal processing module. The probe is submerged in the flow and the acoustic receivers are slanted at 30º from the axis of acoustic transmitter and focus on a common sampling volume. The volume is either is located at 5 or 10 cm from the probe to reduce flow interference. High frequency cable is connected to the processor which in turn is connected to the computer. Electrical power to the signal conditioning module and for driving the transducers is derived from the AT power bus so that no external power supply is required.

Fig-2 shows the basic measurement technique employed by ADV. The system operates by transmitting short acoustic pulses along the transmit beam. As the pulses propagate through the water some amount of acoustic energy gets scattered by suspended particulate matter in the water like suspended

sediments, small organisms etc. The three receivers detect the "echoes" originating at the sampling volume, which are doppler shifted due to relative motion between the water and the probe.

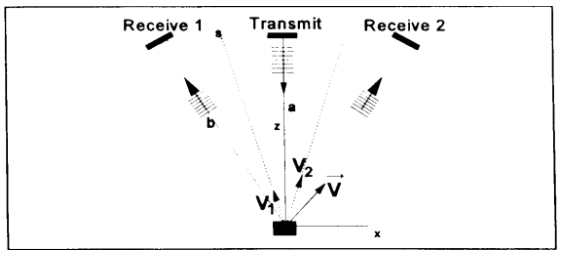


Figure-2 Doppler measurement technique (Courtesy: ASCE)

Figure -3 Real time application of ADV

The Doppler shift measured at each receiver is proportional to the component of the flow velocity (V_1 and V_2) along the bisector of the receiver and transmit beams. Doppler shift measured at the three receivers thus provides the estimates of flow velocity along three different directions, which are then combined geometrically to obtain the three orthogonal components of the water velocity vector $\bar{V}$.

Figure-4 ADV with transducer and probes (Courtesy:Google)

Green Buildings

Ch.Srinivas, Assistant Professor, Civil Engineering department, ANITS

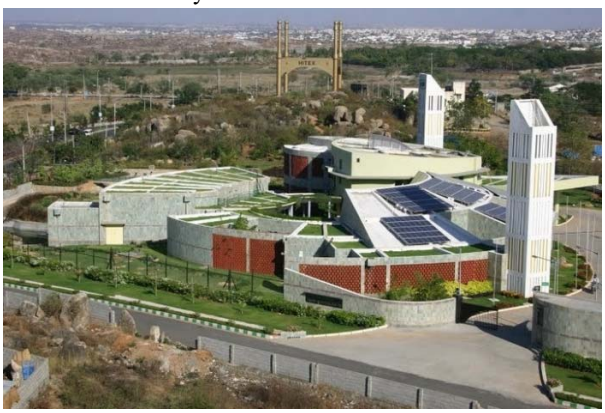
Green buildings are those which are environment friendly and provide a healthier life to occupants. They are environmentally responsible and resource efficient throughout their life cycle. They use less water, less electricity and generates less waste. Plants are grown in possible conditions within and outside of green building. Green vegetation is even provided on exterior walls and top of the roof to improve the air quality. Materials used for construction of green buildings are recyclable or already recycled.

A Green building at Mumbai, INDIA

Water efficient systems like low flow rate taps, low flush water fixtures, small size rain water & grey water treatment equipments are provided in a green building. Energy efficient systems running with solar, wind or hydro powers are provided. Natural chilling systems are specially designed and installed in living rooms of green building. Skylight openings are provided in large number to effectively utilize the natural light.

World Green Building Council (WGBC) is the independent and non-profitable statutory organization which organizes conferences and programmes to spread awareness on green buildings globally. Indian Green building Council (IGBC) is the governing council for green buildings in India. IGBC follows various measures to promote the green buildings in every corner of the country. IGBC provides two types of ratings to green buildings in India. They are LEED (Leadership in Energy and Environmental Design) and GRIHA (Green Rating for Integrated Habitat Assessment). LEED give rating as silver, gold and platinum based on points obtained. GRIHA give rating as 1 star to 5 stars based on points obtained.

The first green building in India is ‘Sohrabji Godrej’ located in Hyderabad. It was the first building to be rated as Platinum by LEED in India.



‘Soharbji Godrej’ Green building at Hyderabad

Although initial cost of green building construction is high, long run maintenance cost will be very less when compared to conventional buildings. There is more scope of green building constructions in the coming years with a view of protecting environment. But, there should be a financial support from Governmental organizations and banks.

Air - Heavy to Breath

J. Harsha vardhanareddy, Assistant professor, Civil Engineering department, ANITS

Industrial stock emissions

Nature has been deteriorated markedly over the last few decades due to severe decline in natural resources and rapid increase in environmental pollution. Depletion of forests, population growth, vehicular emissions, use of hazardous chemicals and various other undesirable human activities are mainly responsible for this degraded scenario of environmental wealth in India. It is, in fact, considerable economic loss to the country which warrants serious attention of policy makers, administrators, scientists and public in general to save environment. India is at the bottom of the charts when it comes to clean, safe air. The worst forms of air pollution are often found in Indian cities. Particulate matter (PM), one of the most widely monitored pollutants in India, is the main cause of the increasing air pollution in this South Asian subcontinent. The particulate matter build up reached as high as five times above the safety limits for some cities in India. This creates a major health concern for the people living and breathing in the polluted air every day. The National Air Quality Monitoring Program claims that nearly half of the Indian cities monitored have reached critical levels of particulate matter.

The recent Report on Environmental Performance Index (EPI) 2018 finds that air quality is the leading environmental threat to public health. The biennial report is produced by researchers at Yale and Columbia Universities in collaboration with the World Economic Forum. The report ranks 180 countries on 24 performance indicators across 10 issue categories covering environmental health and ecosystem vitality. Switzerland leads the world in sustainability, followed by France, Denmark, Malta, and Sweden. Switzerland's top ranking reflects strong performance across most issues, especially air quality and climate protection. India is among the bottom five countries on the Environmental Performance Index 2018, plummeting 36 points from 141 in 2016.India ranks 178 out of 180 as far as air quality is concerned. Its overall low ranking 177 among 180 countries was linked to poor performance in the environment health policy and deaths due to air pollution categories. Low scores on the EPI are indicative of the need for national sustainability efforts on a number of fronts, especially cleaning up air quality, protecting biodiversity, and reducing Green house gas (GHG) emissions, said the researchers. It said deaths attributed to ultra-fine PM2.5 pollutants have risen over the past decade and are estimated at 16, 40,113 annually in India.

Highlighting major links between environment and health, a study revealed lifestyle diseases like obesity, mental health, cancer and heart diseases to count a few, as the major killers in India. Revealing the links of air pollution with mental diseases, a report by Centre for Science and Environment (CSE) stated that air pollution is responsible for 30 per cent of premature deaths in India while every third child in Delhi has impaired lungs.

India, experts say, could be wending on an anfractuous path to be both the world's most populated and at the same time, most polluted country in the next ten years. Despite government action, pollution from solid fuels, coal and crop residue burning, and emissions from motor vehicles continue to severely degrade the air quality for millions of Indians. In recent times the national capital city of India; New Delhi has faced severe threat due to alarming air pollution levels. The situation went worse which made to shutdown educational institutions and all industrial activities.

There is a hidden and dangerous pollution of the air we breathe daily. Our continuous existence depends on it,

and yet, air is full of extremely toxic particles. Humans have been polluting the Earth like never before. There is rarely a place today that has not been subjected to pollutants in one form or another. Some pollution comes in a visible form, like pieces of plastic washed up on our beaches, or illegal dumpsites in groves nearby large cities.

India's white marvel, the Taj Mahal, is slowly turning brownish-yellow because of air pollution, says an Indo-US study which also identifies the pollutants responsible for the effect. It says Taj is changing colour due to deposition of dust and carbon-containing particles emitted in the burning of fossil fuels, biomass and garbage. The study confirms what has been suspected for long — that Agra's poor air quality is impacting India's most celebrated monument.

Eco-Friendly Non-Plastic Disposables

M. Nagalakshmi, Assistant Professor, Civil Engineering Department, ANITS (A)

Plastic pollution has become a serious problem all over the world. Million tons of plastic are being released into the water bodies every year. Aquatic life and birds die from eating it or getting tangled in it. The plastic broken down in the ocean and become small enough to enter the food chain. Only 14% of plastic packaging is collected for recycling, while most plastic packaging is used only once. The following three strategies should be adopted to control global plastic pollution.

Following strategy one, Ellen MacArthur Foundation has initiated New Plastic Economy to make the innovators and manufacturers to rethink and redesign the future of plastics starting with packaging. Following new inventions are the winners of new plastic economy.

- An Indonesian company AvaniEco, has created "I AM NOT PLASTIC BAGS". I AM NOT PLASTIC BAG looks and feels like plastic but is completely bio-degradable and compostable. It is made from cassava, the vegetable root which is mostly in Africa, Latin America and Asia. It also dissolves in water and is so safe that humans could even swallow it.
- More than 100 billion disposable coffee cups are being used globally every year. Hardly one percent are recycled. US-based start-up Trio-Cup has designed a disposable paper cup with an origami-like technique that removes the need for a plastic lid. It's made from a 100% compostable material.
- VTT Technical Research Centre of Finland, has invented a new substance made from wood for packaging nuts and cheese. This substance is a compostable multi-layer material sourced from agricultural and forestry by-products.
- Evoware, Jakarta based company, has made food wrappings and sachets out of a seaweed-based material that can be dissolved in water or eaten. It is 100% biodegradable and contains vitamins and minerals, making it a natural fertilizer for plants.

Nonlinear Dynamic Analysis - The Only Option For Irregular Structures

P V R K REDDY, Assistant Professor, Civil Engineering Department, ANITS(A)

Introduction

The response of buildings to earthquakes is a complex, three dimensional, nonlinear and dynamic problem. Limitations in technology and the depth of our understanding of this problem have lead to developing a number of simplified methods, most of which disregard one or more of its fundamental aspects:

1) The Linear Dynamic Procedure (LDP) or Response Spectrum Analysis, ignores nonlinearity.
2) The Nonlinear Static Procedure (NSP) or Pushover Analysis, ignores dynamic effects.
3) The Linear Static Procedure (LSP) or Equivalent Static Analysis, ignores both.

In contrast, the Nonlinear Dynamic Procedure (NDP) attempts to fully represent the seismic response of buildings without any of these major simplifying assumptions.

Despite the compromises inherent in the simplified analysis techniques, the NDP is used infrequently in the Civil Engineering design practice. The LDP is perhaps the most common analysis procedure used in the design offices for multistory building design. Although not necessarily appropriate, design codes such as the New Zealand Loadings Code, NZS4203:1992 tend to favour this analysis method for all structural types, including irregular structures.

Why isn't Everyone Using NDP?

Commonly cited reasons for using conventional analysis techniques rather than NDP include:

- Relative computational expense of the procedure.
- Need for more detailed input including appropriate hysteresis rules and appropriately scaled acceleration records.
- Lack of readily available computer software.

Analysis

The applicability of simplified methods will always be challenged when an attempt is made to use them with structural configurations other than those considered in the development of the method. The idealized structures that are used for developing these types of procedures inevitably cover only a very narrow range of real structures. Because of this, the NDP is the only completely reliable analysis method.

Simplified methods are still of great value because they can provide insight as to why a certain type of buildings perform in a certain way, highlighting patterns in the complex problem that is seismic response. In the age of performance based design, however, the use of these methods should be restricted to developing the preliminary design solution. NDP is the only universally appropriate method for verifying the performance of the solution.

There are many other situations where the NDP can provide a superior assessment over conventional methods. This is because NDP directly addresses effects such as dynamic magnification, building ductility and P-delta among others, rather than relying on semi-empirical relationships which have been developed by considering a relatively narrow range of structural configurations.

Irregular Structures

Despite the obstacles to the use of NDP mentioned above, there are several types of structure that cannot be effectively modelled using lower level analysis techniques. 'Irregular Structure' is used to describe any structure that cannot be satisfactorily represented by the simplifying assumptions of analysis procedures other than the NDP. Some examples of structural types that fall into this definition are:

1) Rocking structures
2) Base-isolated structures
3) Structures with supplemental damping
4) Pounding buildings
5) Structures with uneven founding levels
6) Vertical irregularity due to large stiffness changes.
7) Buildings with flexible diaphragms
8) Existing buildings without well defined seismic systems.

Conclusions

It is concluded that there are certain types of structure that require the use of the NDP to obtain a reasonable representation of their seismic response. Other analysis methods would either provide dangerously inaccurate assessments of these structures, because they ignore the implications of one or more of the structural characteristics that define structural response, or they would be overly conservative, perhaps limiting the ability to make use of innovative design solutions and therefore uneconomical. The impediments in the use of the NDP are no longer sufficient to justify the lack of adoption of this procedure in the industry. The

profession needs to change their mind set and start embracing what technology now enables us to do.

SWOT/SWOC Analysis for Students

Mr. T V ViswaTeja, Asst. Professor, Dept. of Civil Engg. ANITS (A)

What is SWOT/SWOC Analysis?

SWOT/SWOC is an acronym for Strengths, Weaknesses, Opportunities, and Threats/Challenges and is a structured planning method that evaluates those four elements of an individual, an organization, project or business venture. It involves specifying the objectives and identifying the internal and external factors that are favourable and unfavourable to achieve those objective(s).

Why is SWOT/SWOC Analysis important for Students?

Self-analysis is perhaps one of the most complicated things to conduct. But, it plays a very significant role in personal progress. The personal skills SWOT/SWOC analysis will help you to learn more about you. Carrying out a personal SWOT/SWOC analysis is an important step for any individual towards **finding life and career direction**.

How one can conduct a Self SWOT/SWOC Analysis?

Before you begin this process, make sure that you are ready to provide honest answers to yourself because we easily scrutinize colleagues, companies, jobs, employers, etc., scrutinizing ourselves is the first step here. Dig deep and identify what your own contributions really are. The analysis entails finding out what you are good at and what you are terrible at. **SWOT is a tool for you**. After you learn all the necessary details about yourself, you can make an effort to make positive changes which will lead to new opportunities. In general, SWOT analysis provides a better picture of all pros and cons that one possesses.

How to Analyse Personal SWOT/SWOC Analysis?

The outcome of your personal SWOT analysis will depend on how you react to the findings. You can either understand how they can be threating to not only your career but also your personal life, or you can work to overcome the weakness. **It is always wise to think positively**. Act proactively to turn the weakness into strength. Also, try to eliminate all threats. Give importance to your strengths and take advantage of the opportunities.

What are the various elements of a Personal SWOT/SWOC analysis?

A personal SWOT analysis focuses on the 4 elements included in its acronym. Knowing about these positive and negative factors can help you make changes more effectively. Typically, a SWOT analysis is done by creating a matrix, divided into 2 columns and 2 rows as shown in Table 1.

A list of some example questions is given below; one may vary his/her questions to their suitability.

Strengths

- What special traits do you have which others do not have? This could include skills, education, or connections.
- What are you better at than anyone else?
- What personal resources do you have access to?

Weaknesses

- What type of tasks do you usually avoid because of lack of confidence?
- What do people think your weaknesses are?
- Are you happy with your education and skills training?

Opportunities

- What new technology can assist you?
- Can you take advantage of the world scenario in its present state?
- Do you have a network of strategic contacts to offer good advice or help you?
- Could you create an opportunity by offering solutions to problems?

Threats

- What hindrances do you currently face?
- Can technological changes threaten your worth?
- Could any of your weaknesses lead to threats?

One can create their own Personal SWOT Matrix answering the self-questionnaire and filling the relevant cell in the matrix.

Knowing the focus elements as in the acronyms of SWOT one can make the necessary strategy combination and orient themselves in that direction. Reading the various strategies are simple and as follow:

- A **S/O Strategy (or) Maxi-Maxi Strategy** helps in maximizing one's career and finding right place for their efforts.
- A **W/O Strategy (or) Mini-Maxi Strategy** helps in identifying one's weaknesses also overcoming which will enable them to grab the opportunities available.

- **AS/T Strategy (or) Maxi-Mini Strategy**
- possible threats that could likely stop you from reaching your objectives. So, one can work upon the possible threats so as to achieve their objectives utilizing their strengths to the fullest.

A **W/T Strategy (or) Mini -Mini Strategy** helps in knowing one's weaknesses and possible threats. One needs to focus the cell in the SWOT Matrix so as to always make themselves appealing to the world scenario.

Important Suggestions:

1. SWOT/SWOC Analysis is **NOT** and **NEVER** a comparison between anyone, it is purely a helps in knowing personal strengths and self-analyzing technique, which leads for the overall development of an individual.
2. Whatever might be the strategical cell one is in, **positive thinking** and **learning from deficiencies/failures** will always drive the individual towards a better developed being.
3. With a Hope that this helps students in understanding themselves much better such that they could reach all their positive goals.

Table 1 SWOC Matrix

		Internal	
		Strengths	Weaknesses
External	Opportunities	**S/O Strategy (or) Maxi-Maxi Strategy**	**W/O Strategy (or) Mini-Maxi Strategy**
	Threats	**S/T Strategy (or) Maxi-Mini Strategy**	**W/T Strategy (or) Mini -Mini Strategy**

Student Achievements (2017-18)

1. B Vineeth (315126508002), R. L N Harish (315126508044), T Sai Kumar (315126508049), S Jagadeesh (315126508065) of III/IV B.Tech has won a Consolation Prize in Paper Presentation at IIT Madras
2. T Sai Kumar (315126508049), III/IV B.Tech CIVIL has won 1st prize in Paper Presentation event at Two days national Technical Fest *ASPIRE2K18* Organized by Department of CIVIL, Aditya College of Engineering
3. T Sai Kumar (315126508049), III/IV B.Tech CIVIL has won 2nd prize in Paper Presentation event at Two days national Technical Fest "*CHAKRAVYUH2K18"* Organized by Department of CIVIL, Raghu College of Engineering
4. B Gnana Sagar (315126508003), Ch Raghuram (315126508012), J Vamsi Krishna (315126508022), III/IV B CIVIL has won 1st prize in Quiz event at Two days national Technical Fest "*SOUDHA2K18*" Organized by Department of CIVIL, JNTU Kakinada
5. A Vaghna (315126508001), D Mani Kumari (315126508017), K Bindhu Bargavi (315126508057), III/IV B CIVIL has won 2nd prize in Paper Presentation event at Two days national Technical Fest "*SATHAKARYAN*" Organized by Department of CIVIL, GVP College of Engineering
6. T Sai Kumar (315126508049), J Vamsi Krishna (315126508022), III/IV B CIVIL has won 3rd prize in Paper Presentation event at Two days national Technical Fest *"VINIRMITHI'18"* Organized by Department of CIVIL, ANITS
7. B Gnana Sagar (315126508003), Ch Raghuram (315126508012), K Ravi Teja(315126508026), III/IV B CIVIL has won 2nd prize in Bridge Contest event at A Two days national Technical Fest *"VINIRMITHI'18"* Organized by Department of CIVIL, ANITS
8. B Vineeth (315126508002), D Mani Kumari (315126508026), III/IV B CIVIL has won 2nd prize in Quiz event at A Two days national Technical Fest *"VINIRMITHI'18"* Organized by Department of CIVIL, ANITS
9. J Swetha (315126508021),), III/IV B CIVIL has won 1st prize in Quiz event at A Two days national Technical Fest *"VINIRMITHI'18"* Organized by Department of CIVIL, ANITS
10. B Gnana Sagar (315126508003), Ch Raghuram (315126508012), K Ravi Teja(315126508026), III/IV B CIVIL has won 3rd prize in Bridge Contest event at Two days national Technical Fest "VINIRMITHI'18" Organized by Department of CIVIL, ANITS
11. Ch Raghuram (315126508012), R Jnanee (315126508042) , III/IV B CIVIL has won 1st prize in Paper Presentation event at A Two days national Technical Fest "VINIRMITHI'18" Organized by Department of CIVIL, ANITS
12. Mk Rameez Raja(315126508033), III/IV B CIVIL has won 1st prize in Story Framing event at A Two days national Technical Fest "VINIRMITHI'18" Organized by Department of CIVIL, ANITS
13. S Shanmuka Rao (315126508045), III/IV B CIVIL has won 1st prize in Memory Retention event at A Two days national Technical Fest "VINIRMITHI'18" Organized by Department of CIVIL, ANITS
14. R. L N Harish (315126508044), III/IV B CIVIL has won 3rd prize in Paper Presentation event at A Two days national Technical Fest "VINIRMITHI'18" Organized by Department of CIVIL, ANITS
15. A Total of 23 Students got selected in Various Reputed Companies like Infosys Technologies ltd, Krikamit Engineering Pvt Ltd, KEC International Limited, Sobha Limited, etc. and got GATE ranks
16. N. Mounika (315126508036), J.Swetha (315126508021), V.N.Viswanath (315126508053), D.Manikumari (315126508017), III/IV B. Tech Civil attended a Workshop on "The emergence of Green Buildings Practice and its Impact on Environmental Concerns" organized by Andhra University on 11th August 2017.
17. G.Sai Lakshmi (314126508019), IV/IV B.Tech Civil, Achieved 1st Place in Andhra University "Intercollegiate Table Tennis (Women) Championship" held at Andhra University, Visakhapatnam during 12th to 13th September, 2017.

Application of Internet of Things (IOT) in Civil Engineering Construction

K. Swaroop, III Year B.Tech. Civil, ANITS

Introduction:

Internet of Things (IOT) is a unified division of imminent internet consisting combination of prevailing and rapid development of network.

IoT is the branch of Information Technology which generates a connectivity link between "Internet" and actual physical 'Things". IoT intensions to amalgamate everything under common infrastructure and provide not only the control over everything but also defines provides the actual status of things. This article addresses the basic notion of Internet of Things, reviews and application of IoT in the civil engineering construction projects. The renown of the review is on two important civil engineering application areas of Internet of Things. The core intent of the study is to present an indication about various applications of Internet of Things for the development of Smart City Infrastructure & Smart dwelling construction projects.

The connection link between the Internet and physical things make available to admittance the control over physical things from well-defined or possible distance under common infrastructure and to accesses the sensor data. 'Smart things/objects' plays vital role in the Internet of Things Network will develop by Internet of Things with number of wireless perceptible "things".

The architecture of IoT is constructed in such a way that it can be used by anyone, on any device, at any place, at any time. It can be satisfied by Radio Frequency Identification (RFID).

Applications of IoT in Design of Smart homes:

A smart dwelling system establish on B/S width i.e. (Browse/Server) for the execution of IoT in the design of smart homes. Service-oriented architecture (SOA) and integrant technology in smart home design. An IoT based smart home systems to achieve home luxury, relaxation and most important safety.

A Smart phone app made on Android platform is used for access and supervising gadget there is no requirement of any dedicated server PC and it also offers innovative announcement etiquette to scrutinize and supervise home surroundings. Different types of sensors like temperature sensor and current sensor, light switches and power plug are integrated in the design of home control system

Applications of IoT in Development of Smart City:

The design of a universal infrastructure for the development of Smart City with interaction between new generation services like intelligent mobile gadgets, sensors, family gadgets, gadgets comprising of RFID along with surrounding environment. It will also create novel moments for scrutinizing and geographical awareness. The framework of IoT has been formed on concepts of Web Sensor Empowerment specifications.

IoT Parameters	**Smart Homes**	**Smart Cities**
Size of network	Under Sized	Intermediate
No. of Users	Limited, restricted to family members	Several, General Public
Energy make up	Revivable Battery	Revivable Battery, Energy Reaping
Source of Internet	Wi-Fi, 3G, 4G LTE	Wi-Fi, 3G, 4G LTE
Data management	Confined Device	Mutual Device
Gadget	RFID, WSN	RFID, WSN
Bit-rate requirements	Undersized	Undersized

The European cities to become a Smart Cities by using system groundwork and gadgets based on internet. They created applications working on internet in every sector of the market & society as well as mutual novel kinds of partnership amid domestic governments, research institutes, as well as firms. These developed opportunities in addition to the consequential "innovation ecosystems" works in the growth of economy and created more opportunities to cities. They investigated these strategies in four different cities and analysis is carried out about the strategies and forecasted the prospects of the Future Internet benefits on the socio-economic development of urban areas.

Construction Materials from Waste

M. UshaRani, IV Year B.Tech. Civil, ANITS

With drastic increase in population the need for power and utilization of construction materials also increased in leaps and bounds. With modernization the production rates were also increased but on the other hand the world is facing serious problems in dumping the waste generated from the processes. Production of waste materials (e.g.: coir pith, pond ash, brick powder, fly ash etc.) are rapidly increasing day by day which is imposing serious problems on health and socio economical issues. .In order to reduce the impact on environment, these materials can be used as replacement material in constructions.

Coir Pith:

India is the largest coir producing country in the world with 31,64,250 metric tonnes of coir pith is generated annually. Coir pith is a by-product generated in the process of fibre extraction from coconut husk in coir manufacturing industry. For every ton of fibre extracted, about two tons of coir waste is produced. Disposal of this waste in the environment causes unhygienic conditions. Coir pith possesses better strength and it also reduces the swelling and shrinkage of black cotton soil. Hence these days it is used in the stabilization of soil. Coir pith has remarkable capacity to absorb moisture.

Fig.1 Coir pith

Pond Ash:

Pond ash is a product obtained from thermal power plants. India is a country which is heavily reliant on thermal power plants for electricity. So availability of pond ash is more which is the deposit is obtained from the thermal power plants. In India 70 million tonnes of pond ash is generated annually. This product can be used in cement manufacturing and brick manufacturing, part replacements of cement in mortar and concrete, in embankment stabilization, filling in low lying areas, dyke constructions. Use of pond ash not only reduces pollution in environment but also increases the aesthetic appearance of building.

Fig.2 Pond Ash

Brick Powder:

Brick powder, a waste material available in abundance at brick kilns, is rich in silica and is available free of cost. Brick powder is being successfully used in mortar and concrete making from the past few decades. Partial replacement of cement with brick powder in mortar has showed that with use of brick powder the recycled-aggregate mortar seemed to be superior in terms of mortar-brick bond strength mainly because of its rheological properties. Studies on use of brick powder as stabilizer for black cotton soil showed that when about 50% brick powder is mixed with black cotton soil there has been significant increase in strength aspects of the soil.

Fly Ash:

Fly ash is a coal combusted material of the particulates (fine particles of burned fuel) that are driven out of coal-fired boilers together with the fuel gases**.** The generation of fly ash in India has increased from 68.88 million tonnes to 163.56 million tonnes in the span of 16 years from 1996-97 to 2012-13. This can used as a replacement for Portland cement in concrete and stabilization of soil. As fly ash greatly improves the strength and durability of concrete, and reduces swelling and shrinkage. It can be used as a option for the stabilizing material for soil.

Fig. 4 Fly Ash

Solar Trapping Tree

A Vaghna, IV Year B.Tech. Civil, ANITS

Energy sources are becoming limited throughout the world. The price of fuels is rising day by day. The technology of renewable resources is an alternate solution of energy sources. Solar energy is available in abundance and considered as easiest and cleanest means of tapping the renewable energy. The sun is constantly sending energy to the earth and all we need to do is to catch it and then use it.

A solar tree is a structure incorporating solar energy technology on a single pillar, like a tree trunk. In the name 'Solar tree', tree stands for **T**rees generating **R**enewable **E**nergy and **E**lectricity. It may be called as a solar artwork or a functional power generator.

Solar Tree is made of metal structure, resembling a tree but the canopy is modified. Ithas solar panels at the top instead of branches of real tree. The components included in a solar tree are Solar panels, long tower, LED's, Batteries and Stems for connecting panel. A technique called Spiraling Phyllotaxy is used in designing of solar tree. It is a unique technique used which provides a way to help the lower panels from the shadow of upper ones so that every cell gets equal amount of energy and it can track maximum power from sun. Solar energy is collected by Solar panel.

To generate 2 MW power from a photovoltaic module we require 10–12 acres of land for housing of only panels but for the same amount of energy we require only 0.10-0.12 acres of land in case of solar tree. It is eco-friendly, reduces electricity bill and requires less maintenance.

Fig: Solar tree near Wellington road in London

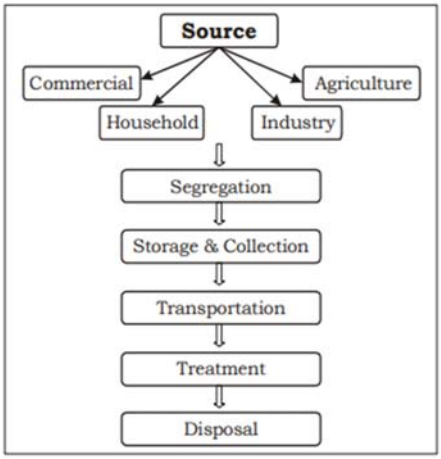
To fulfill the increasing energy demand of the world and saving of land, solar tree is very successful and should be implemented in populated countries like India to provide electricity without the problem of power cut and the extra energy can be provided to the grid. Solar tree is an add-on solution for our future energy needs.

Urban Municipal Waste Management

Ch. Rahul Reddy, S. Shanmukha Rao, IV Year B.Tech. Civil, ANITS

Life Cycle assessment of Municipal Solid waste:

The life cycle of waste is often referred to as a journey from when an item is put on the curb or placed in a dumpster to when value is restored by creating usable material or energy, or the waste is transformed into emissions to water or air or into inert material placed in a landfill. Waste minimization can be achieved in an efficient way by focusing primarily on the 5Rs, "reduce," followed by "reuse", "recycle" and then "recover" and finally "remove". The concept of minimizing waste impacts in terms of quantity or ill-effects, by reducing quantity of wastes, reusing the waste products with simple treatments and recycling the wastes by using it as resources to produce same or modified products and recovery of energy/useful product is usually referred to as 5R.



Benefits of 5R in the life Cycle of Solid Waste Management:

Life cycle assessment (LCA) methodology was used to determine the optimum municipal solid waste (MSW) management strategy. The inclusion of 5R technique in the life cycle assessment of SWM result into following advantages

1. Demand for natural resources is reduced.
2. Emissions to environment are decreased (less energy is used for reprocessing secondary materials than for extraction of virgin materials).
3. The amount of the solid waste is reduced and smaller amounts of waste remain for disposal.
4. Decrease the burden on collection services as well as on treatment and final disposal facilities.

Disposal of Solid Waste:

Sanitary Landfills have also been widely unsuccessful in countries like India because the landfill sites have a very limited time frame of usage. The population of the developing countries is another factor that detrimentally impacts the function of landfill sites. As the population keeps increasing, the garbage quantity also increases, which, in turn, exhausts the landfill sites. Landfills are also becoming increasingly expensive because of the rising costs of construction and operation. Incineration can greatly reduce the amount of incoming municipal solid waste. However, incinerator ash may contain hazardous materials including heavy metals and organic compounds such as dioxins. Recycling and Recovery (treatment/processing) plays a large role in solid waste management. Recycling can be the first choice in solid waste disposal. Recycling is the recovery and reuse of materials from wastes. Solid waste recycling refers to the reuse of manufactured goods from which resources such as steel, copper, or plastics can be recovered and reused. Recycling can also play a key role in the GHG reductions that occur when recycled materials are used instead of virgin materials, saving energy.

Greenhouse gases (GHG) are those that absorb and emit infrared radiation in the wavelength range emitted by Earth. In order, the most abundant greenhouse gases in Earth's atmosphere are:

1) Water vapour (H_2O)
2) Carbon dioxide (CO_2)
3) Methane (CH_4)
4) Nitrous oxide (N_2O)
5) Ozone (O_3)
6) Chlorofluorocarbons (CFCs)
7) Hydro fluorocarbons (incl. HCFCs and HFCs)

The major non-gas contributors to Earth's greenhouse effect are clouds because it absorb and emit infrared radiation and thus have an effect on greenhouse gas radioative properties. Clouds are water droplets or ice crystals suspended in the atmosphere. The global warming potential (GWP) depends on both the efficiency of the molecule as a greenhouse gas and its atmospheric lifetime. GWP is measured relative to the same mass of CO_2 and evaluated for a specific timescale. Thus, if a gas has a high (positive) radiative forcing but also a short lifetime, it will have a large GWP on a 20-year scale but a small one on a 100-year scale. Conversely, if a molecule has a longer atmospheric lifetime than CO_2 its GWP will increase when the timescale is considered. Carbon dioxide is defined to have a GWP of 1 over all time periods.

Reuse of recovered material generally requires less energy than the use of virgin material. For example for every ton of recycled paperboard packaging produced,

there is an overall net reduction of 3.6 metric tons of carbon dioxide emission. In addition the amount of energy that is wasted by not recycling paper, printed material, glass, plastic and aluminum and steel cans is equivalent to the output of 15 medium sized power plants. Recycling also diverts waste from landfills and offsets landfill methane emission in that manner. Pearce and Brisson (1993) show that various economic instruments can be used to balance the marginal costs and benefits of recycling to arrive at an optimum level of recycling.

The Jeddah Tower

G Raj Kumar, IV Year B.Tech. Civil, ANITS

The tallest building in the world is Burj Khalifa. But in 2020, this might be the wrong answer. Yeah, what you read is correct. Burj Khalifa is going to be the second tallest building, by giving its title to "Jeddah Tower" in 2020. The Jeddah Tower is located in the Jeddah city of Saudi Arabia.

Jeddah tower is also known as the Kingdom tower. The name for this structure is initially planned to be as Mile high tower since initially it was planned to build this structure to a total height of 1 mile. But the geological considerations of the site limited its height to 1000m. According to the recent update, the construction work of the Jeddah Tower has been delayed due to the financial issues and is going to be completed by the year 2020. The construction has already reached the 66th floor and the superstructure concrete shell and the cladding is going to be completed by the next year.

The main features of the Jeddah Tower comparing with the Burj Khalifa are given in the Table-1:

Table-1 Main features of Jeddah Tower

Point of Comparison	**Burj Khalifa**	**Jeddah Tower** (If executed as per planned)
Architectural tip	828m	1008m
Cost	1.6 Bn $(US)	1.23 Bn $(US)
Observatory deck	555.7m (148th Floor)	644m (157th Floor)
No. of floors	154 (163 with inhabitable floors)	170 (252 with inhabitable floors)
No. of lifts	59	57
Construction period	06-01-2004 To 02-12-2010	01-04-2013 To 2020
Total floor area	309473 m^2	243886 m^2

The Jeddah tower is designed by Adrian smith (also the designer for Burj Khalifa) and Gordon Gill architecture. The total quantity of concrete required for the construction is approximately 5,00,000 m^3 whose quantity is equal to the concrete used for 6 Hoover dams. The total steel used is 80,000 tonnes whose quantity is equal to the steel used for 8 Eiffel towers.
The structure is used for different purposes such as offices, hotels, residential apartments, tourism etc. Jeddah tower has the largest observation deck in the world which is the main advantage for the tourism.

The competition for the tallest is never going to end. Sky is the limit is the foremost learning of the tall structures.

Fig 1 Under construction - Jeddah tower

Fig 2 Proposed construction - Jeddah tower

Eco-BLAC Brick

(Pollution Free Bricks)

G Gowri Prasad, IV Year B.Tech. Civil, ANITS

By 2050 the population in India is expected to reach 1.5 billion people. It is anticipated that this increase in population will place a substantial demand on the housing stock and need for building materials. For centuries, the clay fired brick has been the most popular building material in India due to its local availability and low cost.

India's brick industry, spread out over 1,00,000 kilns and producing up to 2 billion bricks a year. However, negative environmental and social impacts surrounding its production have raised and a number of industrial wastes are being generated which are often disposed in harmful ways to the population and the environment.

Fig.1 Eco- BLAC Brick

Generally these clay bricks are fired to 1,000 degrees Celsius.They consume a tremendous amount of energy from coal and there's also the issue that these bricks are made completely of topsoil, so they are depleting the amount of farmable land. Therefore here is the solution for pollution free – "Eco BLAC Brick"

The Eco BLAC brick manufactured from industrial wastes and requires no firing at all and makes use of waste boiler ash that otherwise clog up landfills. The Eco-BLAC brick performed better in all categories, 24% better in human health, 15% better in climate change and 33% better in resources.

The Eco BLAC brick consists of:

- 70 % - Boiler ash
- 20% -Clay
- 10 % -Lime

It is cured at ambient temperature, relying on "alkali-activation technology" to give strength.

Fig.2 Boiler Ash

Advantages:

- Early strength development (over 50% of 28 day strength after 1 day curing).
- Low cost.
- Maximum use of boiler ash in order to reduce the landfills.

If the Eco BLAC bricks prove successful, that would be good for India's air quality as well as its food security. Eco-BLAC Bricks was named one of the top innovations of MIT$ 100K Entrepreneurship Competition, 2015.

Why Can't We Reuse?

Silaparasetti Jagadeesh Prasad, IV Year B.Tech. Civil, ANITS

Nowadays, construction activities are increasing day by day. As a part of development and improvement, number of old structures are being renovated. In this process of improvement and renovation, huge amount of building waste is being generated. Based on the present situation in India, 90% of total building waste is being used as landfill material only, as it is a very good process of reusing of broken building material. But there are other new techniques that these waste materials can be used in different ways.

Reusing means to use the same material in different place without changing its size and properties of the material. Recycling is a process of converting waste materials into new useful material,

Recycling is processed after the demolition of structure, every material which can be recycled is collected and transported to recycling plants, after recycling new material is transported to work site.

The materials that can be recycled are steel (reinforcement), concrete, plastics.

- Concrete can be recycled by first crushing the concrete into pieces and the crushed concrete is separated according to the grain sizes. This crushed stone like concrete pieces can be effectively used in concrete in some percentage of aggregates so that cost of concreting gets reduced.

- Steel is recycled by the best process which is to melt the old steel materials at 1370ºC to 1520ºC and after melting this, it can be converted into required shape and structure with required dimensions.

- Plastic is also recycled by making old plastic material into small pieces based on the quality of plastic, and they are converted into another new product.

The greatest disadvantage for recycling is it increases transportation costs and recycled material is not as efficient as original.

On the other hand, reusable materials are to be pre identified before the demolition of structure. The best way to use these materials in other construction is to share our available list of materials with dimensions, quality of the item, and description of the item in online source, where users can directly contact and get benefited. In this way, reusing of old materials leads to reduction in cost of construction, and it is also an indirect way of helping the environment. The materials that can be reused are aluminum (frames of windows), timbers (doors, window doors, and cupboards), and glass. These are some of the materials that can be directly used from the old construction.

Advantages of reusing:

- Reduces transportation cost
- It reduces the overall cost of construction.
- Originality of the material is retained
- Both buyer and seller are benefited.

Recycling and reusing both are good processes for effective utilization of old material but reusing is better as it has more advantages then the recycling process. It is not just about one building it is an effective way of managing of waste and building up our own new generation of building in an efficient an effective manner.

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Brooklyn Bridge

Omkar Ganti IV Year B.Tech. Civil, ANITS

Out of all the Engineering Advances in the 1800s, The Brooklyn Bridge Stands Out as Perhaps the Most Famous and Most Remarkable. The bridge was conceived by German immigrant John Augustus Roebling in 1852.

Pioneering Efforts of Brooklyn Bridge

Perhaps the Greatest Innovation Dictated by John Roebling Was the Use of Steel in The Construction of The Bridge. Earlier Suspension Bridges Had Been Built of Iron. This Is the First Bridge to Use Explosives in Dangerous Underwater Foundation Called "Caissons". To Dig the Foundations for the Bridge's Enormous Stone Towers, Caissons, Enormous Wooden Boxes with No Bottoms, Were Sunk in The River. Compressed Air Was Pumped into Them, And Men Inside Would Dig Away at The Sand and Rock on The River Bottom. The Stone Towers Were Built atop The Caissons, Which Sank Deeper into The River Bottom. Caisson Work Was Extremely Difficult, And the Men Doing It, called "Sand Hogs," Took Great Risks. After the caissons had been sunk to the river bottom, they were filled with concrete, and the construction of the stone towers continued above. When the towers reached their ultimate height, 278 feet above high water, work began on the four enormous cables that would support the roadway. Spinning the cables between the towers began in the summer of 1877 and was finished a year and four months later. But it would take nearly another five years to suspend the roadway from the cables and have the bridge ready for traffic. By the time it was finished in 1883, the bridge had cost about $15 million, more than twice what John Roebling had originally estimated. And while no official figures were kept on how many men died building the bridge, it has been reasonably estimated that about 20 to 30 men perished in various accidents.

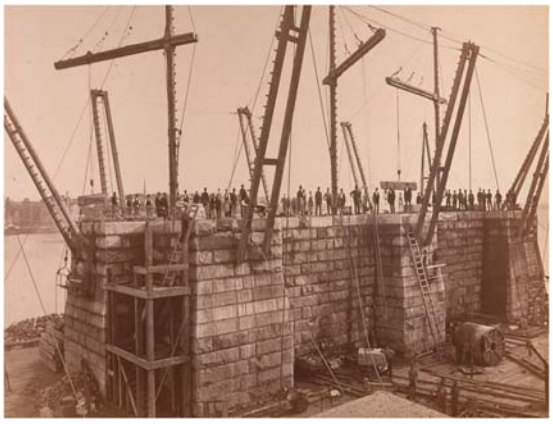

Fig :1- Brooklyn Bridge at the time of counstruction

Fig :2 - Brooklyn Bridge now

Precast Concrete Panels for Road Repairs

B. Gnanasagar, Ch.Ganesh, N. Mounika, T. Gayatri, P. Madhukumar, IV Year B.Tech. Civil, ANITS

Precast Concrete Panels (PCP) used for rapid repair of existing concrete pavements and for rehabilitation of existing concrete and asphalt pavements. PCP's may also be used for reconstruction or as an overlay application. PCP's applications include isolated repairs, intersection and ramp rehabilitation, urban street rehabilitation, and rehabilitation of longer mainline pavement sections.

This article describes how precast concrete slabs can be an effective way to conduct roadway repairs where time is of the essence. Precast concrete is also advantageous because it is durable, high-quality concrete that has a high cement content cured under controlled conditions. In addition, precast concrete has extra steel that provides the strength necessary for transporting and suspending the panels. Three different systems for installing precast concrete highway slabs are being currently used by state Departments of Transportation (DOT) and toll-way authorities of U.S.A.

The first system, which is the patented Super-Slab system, uses standard dowel bars for load transfer onto engineered grades. The applications of this system include Super-Slab in New York and New Jersey (see Fig.1 & Fig.2).

The second system, which involves precast slabs under sealed with polyurethane foam, and its use in highway rehabilitation projects. The foam is used to anchor and level the precast panels during placement (see Fig 3).

Fig.1 Super slab system in NewYork

The third method is a post-tensioned system that consists of three different panel types: joint, central stressing, and base panels. The panels are positioned and then post-tensioned in a longitudinal direction. The edges have shear keys that align during installation and interlock the panels, thus preventing vertical movement between joints. This system was adopted in a Caltrans project in which 31 panels were placed in two nights on one of the most heavily-trafficked areas in the U.S.

Fig.2 Super slab system in NewJersy

Fig.3 precast slabs under sealed with polyurethane foam

Fig.4 Post-tensioned system

These PCP systems can be fabricated and installed successfully in developing countries also like India. A wide range of projects have been constructed using different pre-casters and different contractors. Overall, there does not appear to be any concern about the long term performance of the PCP system that are designed well and installed well. By following these kinds of systems in the road works the maintenance cost is reduced and possess long life

Durability of Concrete with Partial Replacement of Cement by GGBS

N.SaiTeja, T.Sankeerthana, P.Durga Rao, P.Gnana Prakash, T.Satyavathi, IV Year B.Tech. Civil, ANITS

Concrete is probably the most extensively used construction material in the world. Now-a-days the cost of building materials is increasing, availability of material is decreasing and due to the production of cement, CO_2 emission is also increasing. To overcome all these problems, cement is partially replaced with supplementary materials like Ground Granulated Blast Furnace slag (GGBS), Fly ash, Silica fume, Metakaolin etc.

Fig.1 Ground Granulated Blast Furnace Slag

The blast furnace slag is a by-product of the iron industry which has Iron ore and coke resulting to a molten slag. Molten slag floats above molten iron at a temperature of about 1500º C to 1600º C. It has a composition of about 30% to 40% SiO_2 and about 40% CaO, which is close to the chemical composition of Portland cement. After the molten iron is collected for manufacture of various metals, remaining molten slag of mainly siliceous and aluminous residue is then water-cooled rapidly resulting in the formation of a glassy granulate. This glassy granulate is dried and ground to the required size, which is known as ground granulated blast furnace slag (GGBS).

The replacement of Portland cement with GGBS will lead to significant reduction of carbon dioxide gas emission. GGBS is therefore an environment friendly material. Past researches concluded that 50% of the Portland cement used in concrete can be replaced with GGBS. GGBS concrete has better water impermeability characteristics as well as improved resistance to corrosion, sulphate and chloride attacks in concrete. Thus, GGBS effectively can replace the Sulphate Resisting Portland Cement (SRPC) in the market because of its superior performance and less cost when compared to SRPC. GGBS also reduces thermal gradient in concrete, which prevents the occurrence of micro-cracking in concrete.

Thus, Ground Granulated Blast Furnace Slag is an effective supplementary material due to its specific advantages for partially replacing cement in concrete

The Future of Transportation Engineering

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This article will focus on the revolutionary changes in transportation that are occurring right now and will be continuing over the next decades. These changes include (1) automation and connectivity, (2) alternative fuels and fuel economy standards and (3) the availability and use of so-called big data. First, vehicles are becoming more automated and starting to communicate. Basic automation and communication technologies have been around for several decades. Now there are driverless vehicles for off-road driving, for agriculture, for space exploration, and for on-road driving in traffic. Google (now named Waymo Division within Google parent Alphabet) reports that its autonomous vehicles have traveled more than three million miles in automated mode. Although there are numerous technical and policy barriers to overcome before we routinely see self-driving vehicles on the roads, we can expect to see increasing automation and increasing communication between vehicles and infrastructure. Most motor vehicle manufacturers are already offering packages of automated driving aids and improved sensors. A good example is a back-up camera and warning to prevent slow-speed, backing-up collisions. Benefits from all of this automation should include fewer crashes, less congestion, better traveler information, and more fuel-efficient driving. Transportation engineers will have to change their assumptions about traffic flow and driver behavior. As noted earlier, vehicle automation and connectivity will likely affect the amount of travel overall as individuals with impairments or those having other tasks to perform take advantage of driverless vehicles. At the same time, telecommuting and better communications may reduce overall transportation demand. Two other significant in-vehicle changes are increased use of alternative fuels and increasingly stringent fuel economy standards. Most U.S. light-duty vehicles already operate with 10% ethanol biofuels. In the future, we will likely have a variety of fuels in regular use, including natural gas, biofuels, and grid electricity. Different kinds of transportation infrastructure will be required, such as residential charging stations. For vehicles still relying entirely on petroleum for fuel, sophisticated technology and downsizing will be required to meet fuel economy standards.

We are in the new era of big data and powerful computing. Video cameras are cheaper and becoming much more widespread. They can provide real-time vehicle counts, vehicle speeds, incident detection, and pavement condition. Smart phones provide a means of tracking individual travelers in addition to communicating with vehicles, infrastructure, and the Internet. Transportation agencies should be able to rely on private providers of volumes and travel times. Unmanned aerial vehicles—drones—provide a new way to gather information. Transportation engineers must identify the best way to use this new flood of information to better manage the transportation system. This discussion focused on roadway transportation, but these technologies will also revolutionize other modes. In railroads, the newest step in automation is called positive train control. In aviation, considerable automation has already been introduced in cockpits, and what is called next- generation air traffic control is under development. In both aviation and railroads, alternative fuels and big data are affecting how each mode is managed and performs. In sum, we can expect great change but also great opportunities. I think it is a very exciting time to be civil engineer.

Source: Some Thoughts on the future of Transportation Engineering by Chris Hendrickson

Soil Nailing

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Soil nailing is a technique used to reinforce and strengthen existing ground. It consists of installing closely spaced bars into a slope or excavation as construction proceeds from top down. It is an effective and economical method of constructing retaining wall for excavation support, support of hill cuts, bridge abutments and high ways. This process is effective in cohesive soil, broken rock, shale or fixed face conditions.

Fig.1.Soil Nailing

Types of Nails

Driven Nails: Generally small-diameter nails (15-46 mm) with a relatively limited length (about 20 m) made of mild steel that are closely spaced in the wall.

Grouted Nails: Steel bars, with diameters ranging from 15 to 46 mm, stronger than driven nails. These are inserted into boreholes of 10-15 cm and then cement-grouted.

Jet-grouted Nails: A composite of grouted soil and a central steel rod, up to 40 cm thick.

Launched Nails: Nails between 25 and 38 mm in diameter and up to 6 m or longer are fired directly into the soil with a compressed-air launcher.

Machinery Used For Soil Nailing

1. Drilling Equipment.
2. Grout Mixing Equipment.
3. Shotcreting/Guniting Equipment.
4. Compressor

Materials Used for Soil Nailing are:

Steel Reinforcements: For corrosion protection, all steel component shall be galvanized. If machine threading after galvanization is unavoidable, then proper zinc based coating shall be applied onto the thread.

Grout Mix: For conventional soil nail, the water cement ratio of the grout mix ranges from 0.4 to 0.5. As most cementitious grout will experience some grout shrinkage, non-shrink additive can be used to reduce breeding and grout shrinkage.

Shotcrete / Gunite: Shotcrete or gunite can be continuous flow of mortar or concrete mixes projected at high speed perpendicularly onto the exposed ground surface by means of pneumatic air blowing for dry mix or spraying for wet mix.

Soil Nailing Applications:

1. Stabilization of railroad and highway cuts lopes.
2. Excavation retaining structures.
3. Tunnel portals in steep and unstable strained slopes.
4. Construction and retrofitting of bridge abutments with complex boundaries involving wall support under piled foundations.
5. The stabilizing of existing over steep embankments.

Soil nailing is an accepted technology, the theoretical aspects of which are well understood and well reported in technical literature. However, research indicates that there are few practical guidelines available that offer a comprehensive, experience-based insight into the construction considerations that should be addressed before a soil nail system design is finalized and implemented.

Prefabricated Vertical Drains

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Prefabricated vertical drain or wick drains are composed of plastic encased by geotextiles for the purpose of expediting the consolidation of slow draining soils. The two main components of PVD are Core which serves as a longitudinal flow path along the drain and the Filter jacket which allows water to pass into the core obstructing the entry of soil particles.

Prefabricated vertical drains (PVD) are commonly used to decrease the drainage path within soft soils to accelerate the time of primary consolidation. Prefabricated vertical drains cause less soil displacement with less disturbance to the soil mass. It is very important to stabilize soft soil before commencing any major construction work to prevent the settlement. Many soft clay strata contain thin bands of silt or sands which result in the instability of embankments due to the horizontal spread of excess pore pressure vertical drains relives the excess pore pressure and thus avoids the occurrence of instability. The advantages of square pattern are that it is more convenient to install and manage on site. However, triangular pattern is the most popular because it provides a more uniform consolidation between drains than square pattern.

Fig.1 Prefabricated vertical drain

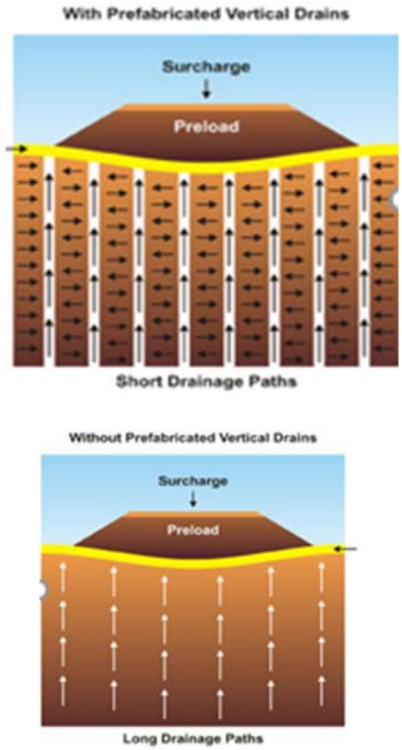

Fig.2 Cross-Section Without and With Vertical Drains

Fig.2 shows the soil stabilization with PVD's combined with a surcharge and a surcharge alone. In the soil stabilized with PVD's, the pore water is flowing laterally to the nearest drain thereby shortening the pore water travel distance, reducing the preloading time. Whereas the soil without PVD's the drainage path is long and thus increases the consolidation time, preloading time.

100 Percent Fly ash Concrete

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More than 20 billion tons of concrete is produced around the world every year in a manufacturing process that contributes 5 to 10 percent of carbon dioxide to global emissions, surpassed only by transportation and energy as the largest producers of the greenhouse gas. Fly ash binder does not require the high-temperature processing of Portland cement, yet tests showed it has the same compressive strength after seven days of curing. It requires only a small fraction of the sodium-based activation chemicals used to harden Portland cement. Manufacturers often use a small amount of silicon- and aluminum-rich fly ash as a supplement to Portland cement in concrete. The industry typically mixes 5 to 20 percent fly ash into cement to make it green, but a significant portion of the mix is still cement. Previous attempts to entirely replace Portland cement with a fly ash compound required large amounts of expensive sodium-based activators that negate the environmental benefits and, in the end, it was more expensive than cement.

According to Taguchi analysis, a statistical method developed to narrow the large phase space all the possible states of a chemical composition, followed by computational optimization to identify the best mixing strategies. This greatly improved the structural and mechanical qualities of the synthesized composites and led to an optimal balance of calcium-rich fly ash, Nano silica and calcium oxide with less than 5 percent of a sodium-based activator.

Most of past works focused on type F fly ash, which is derived from burning anthracite or bituminous coals in power plants and has low calcium content. But globally, there are significant sources of lower grade coal such as lignite or sub-bituminous coals. Burning them results in high-calcium, or type C, fly ash, which has been more difficult to activate. The work provides a viable path for efficient and cost-effective activation of this type of high-calcium fly ash, paving the path for the environmentally responsible manufacture of concrete. Future work will assess such properties as long-term behaviour, shrinkage and durability. It is suggested that the same strategy could be used to turn other industrial waste, such as blast furnace slag and rice hulls, into environmentally friendly cementitious materials without the use of cement.

The durable new concrete eliminates the use of cement, which is known to be harmful to the environment. Instead of cement, the fly ash is used as a binder in the concrete. Traditionally, concrete is processed by mixing cement with sand and gravel, which contributes anywhere from 5 to 8 percent of greenhouse gas emissions worldwide. Cement is the key ingredient in concrete and to produce it requires extremely high temperatures and a massive amount of energy. This new development comes at a time when researchers around the world are beginning to look at engineering on a nano-sized scale, like researching concrete at the molecular level.

To sustainably advance the construction industry, we need to utilize the 'bottom-up' capability of nanomaterials. To activate the fly and turn it into a cement-like material capable of binding the concrete, the team used graphene oxide, a recently discovered nanomaterial, and combined it with the fly ash and water. The combination creates a chemical reaction which rearranges the atoms in the solution, creating strongly bonded atoms in a durable, cement-like binder. Design of the fly ash concrete is pervious, meaning that water can pass through it. This has the benefit of replenishing groundwater as well as lower potential for flooding. Several tests were done on the concrete and can withstand various kinds of weight loads and temperatures. Other tests, like monitoring sensors buried under the concrete, are still underway.

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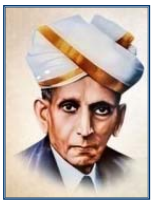
Anil Neerukonda Institute of Technology and Sciences

Civil Engineering News

Newsletter published by Department of Civil Engineering



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