



VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

(AUTONOMOUS) (Sponsored by Siddhartha Academy of General & Technical Education)

Approved by AICTE | Affiliated to JNTUK Kakinada | An ISO 9001:2015 Certified Institution



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About the College:

Velagapudi Ramakrishna Siddhartha Engineering College was established in the year 1977, as the first self-financing Engineering College in the composite state of Andhra Pradesh. The college is in Autonomous Status from 2006 onwards granted by UGC, permanently affiliated to JNTUK and approved by AICTE. The institute is accredited by NAAC with A+ grade in 2021. All the UG programs are accredited by NBA under OBE Tier-I format and 5 PG in Engineering programs are also accredited once. The institute was ranked at 178 in NIRF-2021, 156 in NIRF-2020 and 171 in NIRF-2019 by MHRD and also stood at good rankings given in various surveys by national magazines. The institute was ranked in band A' (6-25 Rank) in 'ATAL Ranking of Institutions on Innovation Achievements (ARIA) in 2020 and was ranked 'Excellent' band by MHRD, GOI in 2021. The college received AICTE - CII Indpact award from MHRD for best I-I-I in civil engineering and was rated platinum for four consecutive years 2017-2020. The institute is recognized as 'SIRO' by DSIR, MST, GOI. This is the only private college granted with "Margadarshan Scheme " project by AICTE in the state of AP. The institute was rated PLATINUM by AICTE-CII survey for the last four years. The college has 20+ collaborative labs & COE's supported by Siemens, Dassault, IBM, DST, NI, Oracle, Apple, CISCO etc., The college is offering consultancy services in A.P. and earned more than Rs.12 crores during the last 5 years. The institute received R&D projects worth more than Rs.5.0 crores for the last 6 years funded by UGC, AICTE, DST, DRDO etc. The college has a worthy placement record, competent faculty with more than 135 PhDs. The strong presence of Alumni was felt across the Globe as Entrepreneurs, CEOs, Academic leaders etc. Six departments of the institute were recognized as Research centres by JNTUK, Kakinada. The institute has more than 60 MOUs with industry partners and more than 1000 publications by faculty for the last 3 years in National, International Journals and Conferences. Industry relevant curriculum is offered involving MOOCs Industry based courses, Internship Skill development, and Personality Development & Student practice courses. The college has NSS & NCC units in the campus recognized by State and Central Governments. There are quite a good number of visiting and adjunct faculties from foreign universities and industry. The

Laboratories in the Civil Engineering department are also accredited by NABL which is rare in academic institutions.

About the Department :

The Department of Civil engineering of Velagapudi Ramakrishna Siddhartha Engineering College was established in 1977 at the inception of the college. The under graduation program was started with an intake of 60 later increased to 120 in 2007 and further increased to 180 in 2011. The Department started offering Postgraduate courses Structural Engineering from 1999 and Geotechnical Engineering from 2016 with an annual intake of 18 each. The department has state of the art advanced laboratories to cater the needs of students, research and consultancy. The department has total faculty of over forty-five, with fifteen doctorates and seventeen more pursuing PhD. The department takes pride in its highly experienced faculty specialized in all major specializations of Civil Engineering.

Department Vision :

To impart teaching, research and develop consultancy that serves the society and to strive continuously for excellence in education.

Department Mission :

To provide quality education for successful career and higher studies in Civil Engineering that emphasizes academic and technical competence in profession and research, effective communication, team work and leadership to meet the challenges of the society.

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1. PAPER PUBLICATIONS OF THE FACULTY

i) Effect of Fire on Prefabricated Concrete Beam Column Connections

The objective of this work is to study the performance of the beam column connections in precast structures exposed to fire. Three different connections were considered for the study. The first one is monolithic and the remaining two are precast specimens joined through hybrid and corbel connections. This study is carried out in two phases. The first part of this study is experimental investigation of three beam-column specimens subjected to axial load until failure. The second part is experimental investigation of the beam-column specimens exposed to fire and axial load. The results suggest that irrespective of the fire, among the monolithic, hybrid and corbel connections of beam-column specimens, the specimen with corbel connection has the best performance in terms of toughness of the joint.

ii) An alternative approach to lateral load analysis of framed type elevated water tank stagings

Lateral load is believed to be acted at the centre of mass (CM) of elevated water tank whenever ground motion takes place. Lateral load induces axial force and horizontal shear force in all the columns and vertical shear force in all the braces of the tank staging which are associated with rigid link mechanism between CM and top nodal points of the staging frame. These forces in turn develop column moment and beam moments. Lateral load analysis and staging stiffness of elevated water tanks were found by earlier investigators through analytical methods of those having approximations. The present study aims at proposing a more realistic and simple analytical method to determine stiffness and member force owing to lateral load for any given configuration of elevated tank. The nodal displacements obtained from the proposed method were in line with existing methods. Furthermore, this study attempts to carry detailed analysis of tank staging configuration which consists of columns arranged in two concentric circles. The results of the lateral load analysis show that size of the radial beam has significant influence on the responses of the tank staging.

iii) Study of Fibre-Clay interface behaviour and reinforcing mechanism

The use of fibres in a random orientation within weak/problematic soils is one of the techniques for their improvement. In the recent past, some studies on fibre inclusion in soils at macro-level have been reported. However, the interaction between fibres and soil particles is still not very clear. In the present study, an attempt has been made to explain the response of an individual fibre when the fibre-reinforced specimen is subjected to shear. The comparative analysis between cement-coated and uncoated fibre was done to measure the change in interfacial shear strength of fibre and clay. The effect of different initial orientations of fibre was evaluated by performing the direct shear tests. As the placement of fibre at any specific orientation in compacted clay specimen is practically a very difficult task, the special equipment has been designed to prepare a fibre-clay specimen where a single fibre can be placed at any predefined orientation in compacted clay. The test result shows that the fibre-clay matrix develops high shearing resistance if fibre is oriented near to the horizontal surface. In comparison to the uncoated fibre, due to the development of cementitious bond, the clay specimen reinforced with cement-coated fibre achieves much higher interfacial strength.

iv) Physico-chemical characterization of alkali contaminated tropical kaolinitic clays

This paper presents results of a laboratory investigation aimed at evaluating the influence of alkali on physico-chemical characteristics of kaolinitic clays. A series of experiments, atterberg limits, free swell index, specific gravity, cation exchange capacity, specific surface area, X-ray diffraction, scanning electron microscopy and Oedometer free swell test, were performed on two tropical kaolinitic clays. Based on the results, it was found that the amount of kaolinite mineral in clay significantly influences its behaviour. Once alkali attacked nucleus of clay mineral, the behaviour of clay was governed by the formation of sodium or potassium aluminosilicate complex (zeolite minerals), as evidenced by mineralogical and morphological studies. Swelling results on typical samples clearly illustrated that the plasticity properties could not be a true indication of swelling behaviour of alkali-contaminated clays unlike natural clays. Overall, mineralogical, chemical and physical analysis

showed that the behaviour of alkali-contaminated clays cannot be elucidated without multi-phase characterization techniques.

v) A critical Analysis of Feasibility of Mixing Waste Water in Cement Mortar and Concrete

The aim of this paper is to find the probability of using wastewater obtained from water plants situated in private structures. For the purpose of case study water treatment plants are selected in the region of Kankipadu of Krishna District of Andhra Pradesh. Each plant produces about 3600 to 4100 L/day water is being sold to the consumers of the area. Each plant is producing about 67% of wastewater in this process. Hence 91,500 lts/day is generating as waste water in the municipality region. All plants extract ground water for production and then treat them through Reverse Osmosis Process. The waste water so generated is drained off. Physical and chemical investigation was carried out on 14 water treatment plants. Out of which 10 typical plants were selected namely Chaitanya Junior College (CC), Punadipadu (PC) area, Near Shivalayam (SC) and Bank colony (BC), in view of the convergences of constituent's in wastewater investigated by chemical and physical examinations. Performance of those wastewater plants on the properties for example setting times, flexural strength, and Compressive strength of OPC were performed in lab and contrasted them with test specimens using Distilled Water as blending water. No noteworthy changes were seen in the initial setting time yet considerable change has seen in the final setting time. Concrete properties like Slump & Density had not influenced by mixing water [2]. No major change has observed in compressive strengths (90 days) in four selected plants contrasted with that of test specimens. The XRD was carried out to observe the main compounds in the hydration process.

vi) Study of effect of rise span ratio and study of different hanger configuration in the analysis of bowstring arch bridge

Bowstring arch bridges have significant advantages in economical and aesthetic appearance which provide suitable option for bridges of longer spans. Though bowstring arch

bridges have different design parameters which effect the performance of bridges. Parameters such as rise-span ratio, various hanger arrangements affect the economy of the bridge. The purpose of this paper is to investigate the influence of different parameters and determining the most suitable solution for a railway bridge. The hangers are significantly prone to premature failure or harm because of fatigue as they endure continual loading with giant variations and ample load cycles. The rise-span ratio has comparatively large effect on stability of structure. Excessively large or small rise-span ratio is drawback for structural stability. The work focuses on comparing the results of different rise-span ratio with each other and the response of the tensile stresses when different hanger arrangements are used. The work focuses on decreasing fatigue stress without increasing bending moments in arch and tie.

vii) Durability Assessment of Concrete with Class-F Fly Ash by Chloride Ion Permeability

This paper discusses on Rapid Chloride Permeability Test investigations on penetration of chloride ions included with replacement of cement by flyash material. By weight of cement, the fly ash content is replaced from 0% to 60%. Concrete mixes with different binder content varies from 350, 400 and 450 kg/m³ were proportioned with different water binder(w/b) ratios = 0.4, 0.45 and 0.50. Specimens were casted and tested for 28 days. For all the combinations, RCPT was carried out and the charge passed through the specimens was noted. Rapid Chloride Permeability Test value of concrete without fly ash was found to be more than the concrete with fly ash. The Rapid Chloride Permeability Test values are found to be decreased if the percentage of flyash increases. The reason could be the pozzolanic reaction products (CSH) fill the pores between the cement pastes and cause a denser concrete matrix, resulting in better durability. Hence, it can be suggested that the fly ash concrete up to 50% replacement can be used for variety of applications.

viii) Behaviour of Cold Formed Light Gauge Steel Angle Columns Subjected To Eccentric Loading

Coldformed steel is an exceptional engineering material for residential and commercial applications because of its inherent structural efficiency obtained by hot and cold bending and its wide range of prefabricated geometries. A lot of research has been done to study the structural behaviour of light gauge axially loaded steel angle columns. The study of cold formed light gauge steel angle columns subjected to eccentric load is to be required to know its performance in the place of hot rolled steel columns. The load is varying from shear centre to centre of gravity of angle section. The study of such columns can be done experimentally with varying thickness and b/t ratios by taking fixed-hinged end condition and the same can be validated in the finite element model by using ABAQUS / CAE 6.14 finite element software to find the buckling behaviour of different columns.

ix) Design Concept of Pre-Stressed Balanced Cantilever Segmental Bridge

Bridges are constructed by cantilever method to cross geological critical areas such as valleys, rivers, and in heavy traffic areas for the easy flow of vehicles where shoring may become costly or even may not be able to be adopted. The construction is carried out segment by segment on either side of the pier above the ground level and so it can also be called as segmental balanced cantilever bridges. Spans of 80 to 150m are favored for bridges with prestressed concrete box girder decks built by the cantilever method. However, this method can be used for spans up to 200m in common widths without major problems. This paper is going to explain a design procedure for segmental prestressing along with an example which was solved using IRC6-2014 and IRC112-2011. The concept of simplified frame analysis is adopted for transverse analysis, and a line beam modeling is adopted for longitudinal analysis. For the calculation of prestressing forces, Magnels graphical method is used.

x) CFD Analysis of Auditorium using Ansys Fluent

The primary aspect of any building design and management is heating, ventilation and air conditioning (HVAC). Such systems play very important role in building construction and then the comfort of the occupants of buildings. Hence proper design of such HVAC system is necessary and is essential for efficient and green buildings the HVAC equipment perform the duty of heating and/ or cooling for residential and commercial buildings. Such HVAC system also provide fresh outdoor air to dilute the air contaminants such as odor from occupants of buildings, volatile organic compounds , chemicals etc. Air conditioning equipment is one of the major components in HVAC system. In the project work, an effort has been made to analyses the HVAC system used in seminar halls of which have sitting capacity of 100 people. It is very much essential to have comfortless for people participating in events like seminar, conferences, commercial presentations in seminar hall. Good cooling of seminar hall is essential especially in summer season and moderate warmness is necessary in winter season. In sitting arrangements, the 10 chairs are arranged in 10 rows. The Computational Fluid Dynamic analysis of HVAC system available in seminar hall is carried out by using ANSYS FLUENT software both summer and winter seasons. Parameter studies have been carried out by varying inlet velocity of air in the range 0.1 to 0.5 m/s. the results have been presented in the form of velocity, pressure and temperature contours. As it is observed that as inlet air velocity increases from 0.1 to 0.5 m/s. the outlet temperature decreases from 307 to 302 K.

xi) Performance assessment of Soil biotechnology treatment process – A case study

Soil Biotechnology (SBT) is one of the emerging decentralized wastewater treatment technologies for small communities with several advantages. The establishment of treatment process involves experimental evaluation of its components, with locally available material for required degree of treatment. In this connection, an attempt has been made to study the required depth of contact media for different rates of application of domestic sewage for a chosen local material for Soil biotechnology treatment process. For which a

column experimental study was conducted for sewage flow rates of 0.50, 1.00, 1.50, 2.00, 2.50 l/hr using dosing pump, after clarification in settling tank. The fabricated column setup consists of 100 mm diameter pvc pipe filled with locally available over burnt brickbats as contact media, culture catalyst and appropriate Inlet and outlets. The investigation was carried out at designated depths of 1.50 m, 2.00 m, 2.50 m and 3.0 m. The percentage removal of Biochemical Oxygen Demand (BOD) & Chemical Oxygen Demand (COD) was observed at each depth for a selected rate of sewage flow. It is found that 81.2 – 94.2% of BOD and 78.4 - 90.7% of COD removal were observed at 3.0 m depth for all discharges considered in the present study. While 69.1 – 82.5% of BOD and 67.9 - 79% of COD were removed at 2.5 m depth for all discharges. The rate of removal of BOD and COD are increasing with increase in depth of contact media because of more contact time between sewage and contact media. Further, the rate of removal of BOD & COD is decreasing with increase in rate of application of sewage, since the rate of flow is inversely proportional to the contact time.

xii) Remediation of Urban Polluted Lake Water and Sediments

Entry of contaminated soils and sediments in to the water sources from the urban runoff decreases lake water quality and increases the cost of water purification. Water pollution is inevitable issue when the surrounding activities of nearby people are not maintained proper water handling techniques with respect to preserving lake water quality along with the quantity. Sedimentation is a complex process where the eroded soil particle enters in to the water bodies through flowing water or through any of the transporting media and settles as layers on the bottom of the water bodies. Maintenance of good water quality in the lakes is always most important criteria for promoting good irrigation standards and drinking facilities to the nearby people along with other benefits like recreation, fisheries etc. but all these benefits are questionable in the current scenario as the water in the lakes are being contaminated by industrial and municipal waste disposal practices along with agricultural runoff at certain rural connected areas. Urban areas especially in India are facing severe problems with water as the availability of water reducing year by year at an alarm rate which in turn leads to increased pressure on sustainable consumption of lake water to meet

the daily water demand of the city. There should be some suitable management strategies for Protecting water bodies to promote ecological balance at study area, the present study has taken up at koritapadu lake falls under the limits of guntur municipal corporation, Andhra Pradesh, earlier this lake served as major source for drinking and also for other requirements of water to the nearby people but now it became un useful as the water contamination is high and unable to consume as part of daily activities. Total eight samples were collected for both water and sediments by considering all possible corners of contamination, all he samples were analyzed by adopting standard water quality analysis procedures [7]. By keeping the above considerations this study was initiated to promote water quality for future consumption.

xiii) Urban Water Quality Scenario by using Geospatial Engineering

In the world scenario the contamination of water due to the various reasons is one of the major problems in the urban and semi-urban areas which have both positive and negative impact on the existed environment and also on the quality of human life. The developing activities taking place in and around the urban areas covers soil with concrete which leads to reduced soil recharge capacity at one side and the other side releasing of untreated urban sewage in to nearby open water bodies without any concern became most practicing method in most of the urban areas. The new capital region of Andhra Pradesh is selected as study area which is rapidly developing with commercial and residential built-up area. Due to which the pressure on groundwater is increased rapidly with respect to its quality and the quantity to meet the requirement of the living as well as migrating people from all the corners to the newly developing capital region. If the similar situation continues there will be a severe and irreparable damage to the availability of groundwater for the future generation and also there will be a notable reduction in the living standards of urban people. The present study examines groundwater and surface water quality and compared with water quality standards to determine the status of water quality at study area. A total three samples were collected for three times in three consecutive months of study period and analyzed by using standard analytical procedures. Geo spatial technology was adopted to represent the statistical

data of water quality in the form of GIS maps for more accuracy to identify the periodical changes in water quality at study area.

xiv) Compressive Strength Assessment using GGBS and Randomly Distributed Fibers in Concrete

India is producing enormous amounts of industrial by-products out of which 150 million tonnes of GGBS itself. Apart from disposal of this solid waste, engineers strive for its value addition through its use as a construction material for achieving better economy, eco-friendliness without compromising on technical aspects. In this study, varieties of concrete are mixed with GGBS as a replacement material for cement to understand its compressive strength and long term behaviour. It is seen from literature that the fibers enhance the performance of concrete. Accordingly, six trials were made with GGBS replacement along with variation of cement content, water cement ratio and steel fibers with aspect ratio 60 and variation in reinforcing indices. The workability of concrete increased with increasing the GGBS content and also observed there is a reduction in workability in fiber reinforced concrete. The results indicated that the concrete made with GGBS indicates the strength comparable to the concrete made with OPC for all replacement levels. There is a substantial decrease in strength at 80% replacement. While there is a substantial increase in long-term strength. The compressive strength of GGBS concrete was increased up to 19% than that of OPC concrete and also observed 5 to 12% strength increased in fiber reinforced concrete than GGBS concrete. For this purpose studied the compressive strength of concrete at the ages of 3, 7, 28, 56, 90 and 180 days.

xv) An evaluation of manufactured sand and metakaolin impacts on concrete properties

This paper deals with M25 Concrete mix in which replacing Natural Sand by the Manufacturing Sand of 35% and 65% at Cement by Metakaolin of 0, 5, 10, 15 and 20 percentages is compared with concrete had cement with Metakaolin at different percentages without replacement of natural sand .Workability is determined for Concrete and Cylindrical

specimens of 150mm*300mm of size are casted to test Concrete properties such as Split Tensile strength(STS) and Compressive Strength(CS) of Concrete. These specimens are placed under curing of 7days, 28days and 60days; after that time placed under testing and compared the results with Normal Concrete.

xvi) Modelling Vehicular Behaviour using Trajectory Data Under Non-Lane Based Heterogeneous Traffic Conditions

The present study aims to understand the interaction between different vehicle classes using various vehicle attributes and thereby obtain useful parameters for modelling traffic flow under non-lane based heterogeneous traffic conditions. To achieve this, a separate coordinate system has been developed to extract relevant data from vehicle trajectories. Statistical analysis results show that bi-modal and multi-modal distributions are accurate in representing vehicle lateral placement behaviour. These distributions help in improving the accuracy of microscopic simulation models in predicting vehicle lateral placement on carriageway. Vehicles off-centeredness behaviour with their leaders have significant impact on safe longitudinal headways which results in increasing vehicular density and capacity of roadway. Another interesting finding is that frictional clearance distance between vehicles influence their passing speed. Analysis revealed that the passing speeds of the fast moving vehicles such as cars are greatly affected by the presence of slow moving vehicles. However, slow moving vehicles does not reduce their speeds in the presence of fast moving vehicles. It is also found that gap sizes accepted by different vehicle classes are distributed according to Weibull, lognormal and 3 parameter log logistic distributions. Based on empirical observations, the study proposed a modified lateral separation distance factor and frictional resistance factor to model the non-lane heterogeneous traffic flow at macro level. It is anticipated that the outcomes of this study would help in developing a new methodology for modelling non-lane based heterogeneous traffic.

2. CONFERENCES ATTENDED BY FACULTY

i) Study on Optimum location of Outrigger in outrigger system in high rise buildings

Due to rapid population growth and constraint on land availability, construction sector spread its wings in vertical dimension. As high-rise buildings are stretching toward sky, challenges with structural behavior govern the choice and design of structural system. Lateral load resisting systems popularly in use are moment resisting frames, load bearing structural walls, dual systems, tube system, and moment-resisting frames with outrigger. The intent of the work in this paper is to investigate the performance of outrigger, location optimization, and their efficiency when used in multiple numbers placed at various heights (2/3rd, 1/2th, 1/3rd times the height of building). Models of 30 storey buildings with outrigger and belt truss systems are analyzed for earthquake and wind loads and the lateral drift responses are compared to find the optimum location of outrigger and belt truss systems. The results are interpreted and found that outrigger system can effectively reduce the lateral drift of the building and optimum location of outriggers is found to be at mid-height of building considered along with cap truss.

ii) Stabilization of Pavement Subgrade by Using Fly Ash Activated by Cement

The performance of pavement is very responsive to the characteristics of the soil subgrade. For that reason, weak subgrade is enhanced by adopting the most efficient stabilization technique. Based on the literature review, stabilization with fly ash activated with cement was found to be an effective option for improvement of soil properties. In this regard an experimental program was undertaken to study the effect caused by the combined action of fly ash and cement stabilization on the geotechnical characteristics of expansive subgrade soils. Expansive soil treated with varying percentages of fly ash, 0, 5, 10, 15, and 20 percent combined with 5% cement content were studied. Consistency limits, compaction, California Bearing Ratio, swell potential and swell pressure tests were conducted on treated

and untreated soils. The experimental results show that addition of cement-fly ash admixture to the soil has great influence on its properties. It was found that the optimum dosage of fly ash is 15% mixed with 5% cement revealed in significant improvement in strength and durability and reduction in swelling and plasticity properties of the soil. Based on the results, it is recommended that cement-fly ash admixture be considered a viable option for the stabilization of expansive subgrades.

iii) Characterization of Tropical Red Earth Contaminated with Alkali Solutions

This paper presents results of a laboratory investigation aimed at evaluating the influence of alkali on physico-chemical characteristics of kaolinitic clays. A series of experiments, atterberg limits, free swell index, specific gravity, cation exchange capacity, specific surface area, X-ray diffraction, scanning electron microscopy and Oedometer free swell test, were performed on two tropical kaolinitic clays. Based on the results, it was found that the amount of kaolinite mineral in clay significantly influences its behaviour. Once alkali attacked nucleus of clay mineral, the behaviour of clay was governed by the formation of sodium or potassium aluminosilicate complex (zeolite minerals), as evidenced by mineralogical and morphological studies. Swelling results on typical samples clearly illustrated that the plasticity properties could not be a true indication of swelling behaviour of alkali-contaminated clays unlike natural clays. Overall, mineralogical, chemical and physical analysis showed that the behaviour of alkali-contaminated clays cannot be elucidated without multi-phase characterization techniques.

iv) Review of the Fuzzy Logic Based Approach in Traffic Signal Control Prospects

In the present time the number of private vehicles is increasing rapidly. As result the traffic congestion is growing and becoming a huge problem in big cities. Due to traffic congestion many huge problems are occurring like pollution, wastage of time, money, accidents etc. Traffic congestion occurred very frequently in the present time which affect the daily life and introduce so many problems and challenges. To solve all these problems traffic

signal control is a best solution. Fuzzy set theory have been widely applied to many applications and it can easily deal with uncertainty, complexity and imprecision in many systems. The problems in traffic engineering are mainly characterized by the imprecise, ambiguous and uncertain parameters. Due to such type of parameters fuzzy logic method is best suitable approach for traffic signal control. The performance of fuzzy logic based controller is better for two one way street based on extension of green light time. Later fuzzy logic controller was developed for two way intersection without turns, single intersection with all movements, multiple intersection etc. Better performance of fuzzy logic based traffic signal control in comparison of traditional traffic signal control increase the research in this field. Fuzzy logic approach will definitely help in transportation management system in future.

3. BOOK CHAPTERS BY FACULTY

i) Experimental investigations on expansive soils grouted with additives

Various stabilization techniques have been in practice to counteract the swell-shrink problems posed by expansive soils. Apart from the techniques such as belled piers and under-reamed piles, chemical stabilization of expansive soils has met with considerable success. Various additives used in chemical stabilization. This experimental investigation presents the efficacy of an innovative and comparative study of stabilization technique in the form of columns Fly Ash, lime and GGBS embedded in expansive clay beds. In order to assess the intensity of expansion, swell pressure test is performed on expansive clay beds into which additives are injected which serve as compacted columns. It is observed that swelling decreased significantly in expansive soil used with grouted columns.

ii) Tri-axial behaviour of steel-fiber reinforced sand

Many soil improvement/stabilization methods are available for modifying the soil mass in order to increase the overall engineering performance of soil. In the conventional method of reinforced soil construction, the inclusions are normally oriented in a preferred direction and sequentially in alternating layers. Another soil strengthening technique is mixing of randomly distributed discrete fibers into the soil, similar to admixture stabilization in its preparation. The discrete fibers are simply added and mixed randomly with the soil. In the present study, the laboratory triaxial compression tests were carried out on soil specimens uniformly mixed with steel fibers at different confining pressures. Steel fiber contents having two different sizes (1 mm×2 mm and 1 mm×5 mm) were mixed with the cohesionless soil, and the effects of reinforcement content and size on failure strain, peak deviator stress, ultimate strength ratio, and initial tangent modulus/secant modulus were studied. The failure occurred between 5–9% of vertical strain and the optimum reinforcement content was around 4%.