Non Destructive Assessment Of Concrete Structures Reliability And Limits Of Single And Combined Techniques State Of The Art Report Of The Rilem 207 Inr Rilem State Of The Art Reports

Written by international experts in the field, this new edition provides the most comprehensive, up-to-date information available on nondestructive testing (NDT) methods used to evaluate concrete structures. Sixteen chapters give you a comprehensive understanding of the tools and techniques used to estimate the inplace strength of concrete and permeation properties that relate to potential durability, and describe methods used to assess the internal condition of concrete and corrosion activity of steel reinforcement.

This book was proposed and organized as a means to present

recent developments in the field of nondestructive testing of materials in civil engineering. For this reason, the articles highlighted in this editorial relate to different aspects of nondestructive testing of different materials in civil engineering—from building materials to building structures. The current trend in the development of nondestructive testing of materials in civil engineering is mainly concerned with the detection of flaws and defects in concrete elements and structures, and acoustic methods predominate in this field. As in medicine, the trend is towards designing test equipment that allows one to obtain a picture of the inside of the tested element and materials. From this point of view, interesting results with significance for building practices have been obtained Acoustic Emission and Related Non-destructive Evaluation Techniques in the Fracture Mechanics of Concrete: Fundamentals and Applications, Second Edition presents innovative Acoustic Emission (AE) and related non-destructive evaluation (NDE) techniques that are used for

damage detection and inspection of aged and deteriorated concrete structures. This new edition includes multi-modal applications such as DIC, thermography, X-ray and in-situ implementations, all of which are helpful in better understanding feasibility and underlying challenges. This new edition is an essential resource for civil engineers, contractors working in construction, and materials scientists working both in industry and academia. Completely updated, with a new chapter on multi-technique damage monitoring Presents new applications and novel technologies on AE and related NDT in the fracture mechanics of concrete Features contributions from recognized world-leaders in the application of acoustic emission (AE) and NDE techniques used for the damage assessment of concrete and concrete structures

Use of Non-destructive Testing for the Assessment of Newly-constructed Concrete Pavements

Handbook on Nondestructive Testing of Concrete

Preliminary Non-destructive Assessment of Moisture Content,

Hydration and Dielectric Properties of Portland Cement Concrete

Non-Destructive Techniques for the Evaluation of Structures and Infrastructure

Fundamentals and Applications

Proceedings of the 7th International Expertcentrum Conference, Košice, Slovakia, October 20th - 22th, 1998

This thesis presents the development and validation of a new wireless Impact Echo (IE) system for condition assessment of reinforced concrete slabs. The new IE prototype was compared with other commercially available non-destructive testing (NDT) devices used for similar purposes, namely Ground-Penetrating Radar (GPR) and Ultrasonic Pulse Echo (UPE). Monitoring and structural inspections are critical to effective management of civil infrastructure and NDTs can enhance the quality of condition assessments by providing objective visualizations of the interior of a structural element. The IE method, first developed in the 1980s, has seen few advancements in the last 20 years. The method has been standardized and used on site, but the underlying technology has become outdated. The data obtained from the transducer is difficult to interpret and requires a computer to post-process it before being usable, thus limiting the direct feedback of the method when conducting tests on-site. Because of those limitations and the test being relatively more time consuming than other alternatives, the method is lacking in usability. A new prototype IE device was designed and built by the project industry partner, FPrimeC Solutions. The

methodology followed the traditional approach, but it was designed to work with today's technology. The device is operated wirelessly via a Bluetooth connection, uses smaller-sized electronic components, and connects with a user-friendly interface on a small tablet to set-up the tests and compute the results immediately. The first part of the project focused on product development by testing iterations of the prototype and providing user feedback to improve the device and accompanying software. The second part of the project aimed to validate the new technology using a set of three large reinforced concrete slabs containing artificial defects. The studied points of interest were sound concrete, effect of boundaries and steel reinforcements, vertical cracks, presence of a hollow conduit, artificial voids and delamination. The IE results were also compared with those from commercial GPR and UPE devices. GPR was found to be the quickest method by far, although the results gathered seemed to be limited by the presence of steel reinforcement and also failed to locate certain defects. UPE was a bit slower than GPR, but was generally able to locate more accurately the artificial flaws created in the test specimens. The results showed poor definition of the flaws making it difficult sometimes to properly locate them. The UPE results also seemed to be negatively affected by the presence of reinforcement which were causing frequent abnormal values. Lastly, the IE method was used. This method was greatly improved during the first phase, but it is still a time-consuming method. The value of the data, however, has great potential when compared to the other options. It accurately located most of the flaws generated and was practically unaffected by the presence of steel reinforcing bars. Also, with further analysis of the data, it was possible to determine the depth of some of the flaws accurately. Due to the time-consuming

testing phase and the longer analysis of the data required to obtain the higher quality of results, this study suggests that IE is not likely to be the best choice for a general inspection of a large area (depending on the nature of the information needed). Rather, it is suggested to first conduct a general review of the structure using a quicker method like GPR to locate the problematic areas. After that, refining the grid at key locations to test with IE should provide the best quality of data in a reasonable amount of time.

The non-destructive evaluation of civil engineering structures in reinforced concrete is becoming an increasingly important issue in this field of engineering. This book proposes innovative ways to deal with this problem, through the characterization of concrete durability indicators by the use of non-destructive techniques. It presents the description of the various non-destructive techniques and their combination for the evaluation of indicators. The processing of data issued from the combination of NDE methods is also illustrated through examples of data fusion methods. The identification of conversion models linking observables, obtained from non-destructive measurements, to concrete durability indicators, as well as the consideration of different sources of variability in the assessment process, are also described. An analysis of in situ applications is carried out in order to highlight the practical aspects of the methodology. At the end of the book the authors provide a methodological guide detailing the proposed non-destructive evaluation methodology of concrete indicators. Presents the latest developments performed in the community of NDT on different aspects Provides a methodology developed in laboratory and transferred onsite for the evaluation of concrete properties which are not usually addressed by NDT methods Includes the use of data fusion for merging the measurements

provided by several NDT methods Includes examples of current and potential applications
1.1. SAFETY OF CIVIL STRUCTURES Society expects that the failure of civil structures is extremely rare and relies on the care and expertise of the professionals involved in the design, construction and maintenance of structures. This is in particular true for public technical systems such as transportation or energy supply systems and structures such as bridges. Structural safety may be defined as follows: “Adequate safety with respect to a hazard is ensured provided that the hazard is kept under control by appropriate measures or the risk is limited to an acceptable value. Absolute safety is not achievable.” It is thus not the structure as such that is designated safe but rather the people, goods and the environment in its surroundings. The continued use of existing structures is of great importance because the built environment is a huge economic and political asset, growing larger every year. Nowadays evaluation of the safety of existing structures is a major engineering task, and structural engineers are increasingly called upon to devise ways for extending the life of structures whilst observing tight cost constraints. Also, existing structures are expected to resist against accidental actions although they were not designed for. Engineers may apply specific methods for evaluation in order to preserve structures and to reduce a client’s expenditure. The ultimate goal is to limit construction intervention to a minimum, a goal that is clearly in agreement with the principles of sustainable development.

Proceedings of the 7th International Expertcentrum Conference : Košice, Slovakia, October 20th - 22nd, 1998

Symposium on Non-Destructive Testing of Concrete and Timber

Proceedings of NDE 2019

Nondestructive Testing of Deep Foundations

Non-Destructive Evaluation (NDE) of Polymer Matrix Composites

Non-Destructive Evaluation of Reinforced Concrete Structures

This book gives information on non destructive techniques for assessment of concrete structures. It synthesizes the best of international knowledge about what techniques can be used for assessing material properties (strength) and structural properties (geometry, defects...). It describes how the techniques can be used so as to answer a series of usual questions, highlighting their capabilities and limits, and providing advices for a better use of techniques. It also focuses on possible combinations of techniques so as to improve the assessment. It is based on many illustrative examples and give in each case references to standards and guidelines.

The increased use of polymer matrix composites in structural applications has led to the growing need for a very high level of quality control and testing of products

to ensure and monitor performance over time. Non-destructive evaluation (NDE) of polymer matrix composites explores a range of NDE techniques and the use of these techniques in a variety of application areas. Part one provides an overview of a range of NDE and NDT techniques including eddy current testing, shearography, ultrasonics, acoustic emission, and dielectrics. Part two highlights the use of NDE techniques for adhesively bonded applications. Part three focuses on NDE techniques for aerospace applications including the evaluation of aerospace composites for impact damage and flaw characterisation. Finally, the use of traditional and emerging NDE techniques in civil and marine applications is explored in part four. With its distinguished editor and international team of expert contributors, Non-destructive evaluation (NDE) of polymer matrix composites is a technical resource for researchers and engineers using polymer matrix composites, professionals requiring an understanding of non-destructive evaluation techniques, and academics interested in this

field. Explores a range of NDE and NDT techniques and considers future trends Examines in detail NDE techniques for adhesively bonded applications Discusses NDE techniques in aerospace applications including detecting impact damage, ultrasonic techniques and structural health monitoring

Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combined TechniquesState-of-the-Art Report of the RILEM Technical Committee 207-INRSpringer Science & Business Media

Non-Destructive Assessment of Concrete Structures: Reliability and Limits of Single and Combined Techniques

Assessment of the Strength of Concrete by Non-destructive Tests

Non-destructive Evaluation of Concrete and Masonry

Non-Destructive Condition Assessment of Concrete Slabs with Artificial Defects Using Wireless Impact Echo

An Assessment of Two Non-destructive Techniques as a Means of Examining the Quality and Variability of Concrete in

Structures [by] G. MacLeod

ASSESSMENT & EVALUATION OF STRUCTURE USING ADVANCED UNDISTRUCTIVE METHODS

Concrete floors should be diagnosed in order to obtain the proper durability. Non-destructive testing (NDT) methods, which have numerous advantages and are very effective for in situ testing, are recommended for this purpose. Non-Destructive Diagnostics of Concrete Floors: Methods and Case Studies offers useful NDT methods, test methodologies, and case studies. This book contains classifications of NDT methods, examines their areas of usefulness in floor diagnostics, and explains the complementarity and reliability of NDT methods as well as the need to calibrate research equipment. It presents interesting case studies of concrete floors, such as dowelled floors, floors with a top layer made of stone slabs, industrial floors, industrial floors with a top layer of polyurethane-cement, layered floors, post-tensioned floors, and cement screeds. The authors have drawn on many years of experience in both academia and the practical diagnosis of concrete floors using NDT methods.

This book provides an overview and up-to-date synthesis of the most commonly used non-destructive technologies for the reverse engineering of built infrastructure facilities. These technologies tackle both the geometric and radiometric characterization of built structures, and thus, validated technologies such as laser scanning, photogrammetry, and

Durability and service life design of concrete constructions have considerable socio-

economic and environmental consequences, in which the permeability of concrete to aggressive intruders plays a vital role. Concrete Permeability and Durability Performance provides deep insight into the permeability of concrete, moving from theory to practice, and presents over 20 real cases, such as Tokyo's Museum of Western Art, Port of Miami Tunnel and Hong Kong-Zhuhai-Macao sea-link, including field tests in the Antarctic and Atacama Desert. It stresses the importance of site testing for a realistic durability assessment and details the "Torrent Method" for non-destructive measurement of air-permeability. It also delivers answers for some vexing questions: Should the coefficient of permeability be expressed in m2 or m/s? How to get a "mean" pore radius of concrete from gas-permeability tests? Why should permeability preferably be measured on site? How can service life of reinforced concrete structures be predicted by site testing of gas-permeability and cover thickness? Practitioners will find stimulating examples on how to predict the coming service life of new structures and the remaining life of existing structures, based on site testing of air-permeability and cover thickness. Researchers will value theoretical principles, testing methods, as well as how test results reflect the influence of concrete mix composition and processing.

Non-destructive Evaluation of Damage in Concrete with Applications in Shallow Foundations

Non-Destructive In Situ Strength Assessment of Concrete

Non-Destructive Passive Magnetic and Ultrasonic Inspection Methods for Condition Assessment of Reinforced Concrete

From Theory to Field Applications

Assessment of Concrete Structure Using Non-destructive Method (NDT)

The Assessment of Concrete by Non-destructive Means

This Study deals with Non Destructive Testing (NDT) for both Normal and High Performance Concrete (HPC). An experimental study was carried out, involving both destructive and non destructive methods applied to different concrete mixes, with compressive strength of 30, 40, 50, 60 and 70 MPa. The cubes use were 100mm x 100mm x 100mm. Model were choose from the literature and the strength Prediction Model for the HPC using UPV, Normal Concrete using UPV , generalized strength Prediction Model for Normal and HPC using Sclerometer and lastly combined generalized model were validated by the data obtained from the present study. Data were plotted in order to estimate the percentage of error that was given by the model. The results show Strength prediction model using Sclerometer test is a generalized model. Strength prediction model using UPV method could not be generalized and therefore, two different models were used for normal and

high performance concrete. The combined NDT model that is combined of Sclerometer and UPV method gave a power model and implied generalized.

Many concrete structures and elements of concrete infrastructure have exceeded their original design lives and are deteriorating to an extent where they are becoming dangerous. The deterioration can be internal or not obvious and therefore only shows up with detailed testing. Non-destructive evaluation of reinforced concrete structures, Volume 1: Deterioration processes and standard test methods reviews the processes of deterioration and classical and standard test methods. Part one discusses deterioration of reinforced concrete and testing problems with chapters on topics such as key issues in the non-destructive testing of concrete structures, when to use non-destructive testing of reinforced concrete structures, deterioration processes in reinforced concrete, modelling ageing and corrosion processes in reinforced concrete structures, components in concrete and their impact on quality, and predicting the

service life of reinforced concrete structures. Part two reviews classical and standard testing methods including microscopic examination of deteriorated concrete, the analysis of solid components and their ratios in reinforced concrete structures, the determination of chlorides in concrete structures, and investigating the original water content of reinforced concrete structures. With its distinguished editors and international team of contributors, Non-destructive evaluation of reinforced concrete structures, Volume 1: Deterioration processes and standard test methods will be a standard reference for civil and structural engineers as well as those concerned with making decisions regarding the safety of reinforced concrete structures. Provides a comprehensive discussion from examination of the components in concrete and their affect on quality through to the role of and tools required for lifetime management Experts in the field identify the testing problems associated with infrastructure considering design, build and maintenance stages Presents a guide for

when to use non-destructive testing of reinforced concrete structures including the role of time in testing

The most widely used material for civil infrastructure is reinforced concrete. The concrete deteriorates over time because of several reasons, and therefore, inspection of concrete is necessary to ensure its compliance with the design requirements. Decision makers often have insufficient data to implement the appropriate corrective measures in the face of infrastructure failure. Better assessment methods are essential to obtain comprehensive and reliable information about the concrete elements. Although, different methods exist to inspect concrete members, there is no comprehensive technique available for condition assessment of concrete of shallow foundations. To ensure the integrity of shallow foundations during construction and during its service life, it is necessary to monitor their conditions periodically. To achieve this goal a new NDT methodology is developed to reliably evaluate the conditions of new shallow foundations without changing their future performances.

Recently, there is a trend to overcome coupling issues between the transducers and the object under investigation, by installing sensor networks in concrete to assess its integrity. Although many NDT approaches are designed to evaluate the integrity of concrete structural elements, shallow foundations, which are concrete elements embedded in soil, have received less attention. The challenging aspect of characterizing shallow foundations is limited accessibility for in-service foundation inspections because of structural restrictions. Even when accessibility is possible, the NDT methods (ultrasonic pulse velocity, UPV) used may produce measurements with high uncertainties because of inconsistent coupling between the transducer and the surface of the material being tested. In the current research project, a new NDT procedure is developed based on design of new transducers embedded at the base of lab-scale concrete foundation models, and these transducers are waterproof and used as receivers. The transducers consist of radial-mode piezoceramics that can detect waves from

different orientations. The developed methodology relies mainly on two methods to emit the transmission pulse; either using a direct contact method by gluing the transducer to the concrete surface or using a plastic tube partially embedded in concrete and filled with water. The first procedure is used when the accessibility to the top surface of the foundations is possible; otherwise, the second option is employed to reach the concrete surface of foundations. The new methodology can be used in different stages: during construction of foundations to monitor the uniformity and quality of the concrete, and during in-service life to periodically assess the condition of the foundations, specifically after an event that may cause severe damage in concrete such as earthquake and overloading. To verify the applicability of the methodology, unreinforced and reinforced shallow foundation lab-scale concretemodels were tested in the laboratory under uniaxial compression loads. In this work, all ultrasonic measurements are averaged 16 times to ensure the consistency of the results and to

eliminate high frequency noise. The average coefficient of variance obtained is less than 3.5%; which is considered acceptable in this type of measurements (typical measurement error ~5%). Also, different tests were repeated more than three times by removing and putting back all the ultrasonic transducers to enhance the statistical significance of the results. The main contributions of the research presented in this thesis are: ? Characterization of low and high frequency transducers using laser vibrometer to characterize their responses for better ultrasonic measurements. ? Characterization of a single fracture growth in a homogenous material based on wave velocity and wave attenuation. ? Characterization of cement-based materials using ultrasonic pulse velocity and laser vibrometer methods. ? Evaluation of freeze/thaw damage and monitoring progressive damage in concrete specimens subjected to uniaxial compression load using ultrasonic pulse velocity and laser vibrometer methods. ? Fabrication of thirty-six new radial ultrasonic transducers to embed in concrete models for quality control

purposes and to monitor progressive damage using new transmission pulse methodology.

Non-Destructive Testing of Concrete

Methods and Case Studies

Advances in Non-destructive Evaluation

Non-Destructive Testing of Structures

Concrete Permeability and Durability Performance

Practical Application of the RILEM TC 249-ISC Recommendations

A comprehensive text to the non-destructive evaluation of degradation of materials due to environment that takes an interdisciplinary approach Non-Destructive Evaluation of Corrosion and Corrosion-assisted Cracking is an important resource that covers the critical interdisciplinary topic of non-destructive evaluation of degradation of materials due to environment. The authors—noted experts in the field—offer an overview of the wide-variety of approaches to non-destructive evaluation and various types of corrosion. The text is filled with instructive case studies from a range of industries including aerospace, energy, defense, and processing. The authors review the most common non-destructive evaluation techniques that are applied in both research and industry in order to evaluate the properties and more importantly degradation of

materials components or systems without causing damage. Ultrasonic, radiographic, thermographic, electromagnetic, and optical are some of the methods explored in the book. This important text: Offers a groundbreaking interdisciplinary approach to of non-destructive evaluation of corrosion and corrosion-assisted cracking Discusses techniques for non-destructive evaluation and various types of corrosion Includes information on the application of a variety of techniques as well as specific case studies Contains information targeting industries such as aerospace, energy, processing Presents information from leading researchers and technologists in both non-destructive evaluation and corrosion Written for life assessment and maintenance personnel involved in quality control, failure analysis, and R&D, Non-Destructive Evaluation of Corrosion and Corrosion-assisted Cracking is an essential interdisciplinary guide to the topic.

Engineers have a range of sophisticated techniques at their disposal to evaluate the condition of reinforced concrete structures and non-destructive evaluation plays a key part in assessing and prioritising where money should be spent on repair or replacement of structurally deficient reinforced concrete structures. Non-destructive evaluation of reinforced concrete structures, Volume 2: Non-destructive testing methods reviews the latest non-destructive testing techniques for reinforced concrete structures and how they are used. Part one discusses planning and implementing non-destructive testing of reinforced concrete structures with chapters on non-destructive

testing methods for building diagnosis, development of automated NDE systems, structural health monitoring systems and data fusion. Part two reviews individual non-destructive testing techniques including wireless monitoring, electromagnetic and acoustic-elastic waves, laser-induced breakdown spectroscopy, acoustic emission evaluation, magnetic flux leakage, electrical resistivity, capacimetry, measuring the corrosion rate (polarization resistance) and the corrosion potential of reinforced concrete structures, ground penetrating radar, radar tomography, active thermography, nuclear magnetic resonance imaging, stress wave propagation, impact-echo, surface and guided wave techniques and ultrasonics. Part three covers case studies including inspection of concrete retaining walls using ground penetrating radar, acoustic emission and impact echo techniques and using ground penetrating radar to assess an eight-span post-tensioned viaduct. With its distinguished editor and international team of contributors, Non-destructive evaluation of reinforced concrete structures, Volume 2: Non-destructive testing methods is a standard reference for civil and structural engineers as well as those concerned with making decisions regarding the safety of reinforced concrete structures. Reviews the latest non-destructive testing (NDT) techniques and how they are used in practice Explores the process of planning a non-destructive program features strategies for the application of NDT testing A specific section outlines significant advances in individual NDT techniques and features wireless monitoring and electromagnetic and acoustic-elastic wave technology

This book comprises the proceedings of the Conference and Exhibition on Non Destructive Evaluation, (NDE 2019). The contents of the book encompass a vast spectrum from Conventional to Advanced NDE including novel methods, instrumentation, sensors, procedures and data analytics as applied to all industry segments for quality control, periodic maintenance, life estimation, structural integrity and related areas. This book will be a useful reference for students, researchers and practitioners.

ICE Manual of Construction Materials: Fundamentals and theory; Concrete; Asphalts in road construction; Masonry

Non-destructive Testing and Experimental Stress Analysis of Concrete Structures

Non-destructive Testing and Evaluation of Civil Engineering Structures

State-of-the-Art Report of the RILEM Technical Committee 207-INR

Non-destructive Testing of Wisconsin Highway Bridges

An Assessment of Two Non-destructive Techniques as a Means of Examining the Quality and Variability of Concrete in Structures

Moisture availability is a focal point in the structural development of young concrete. Under low humidity and hot weather conditions, concrete loses moisture rapidly as it hardens, and it is very difficult, if not impossible, to minimize this loss even though proper curing procedures are used. Early losses in moisture content jumpstart premature surface self-dissecation, increase surface paste porosity, prevent concrete from achieving the mechanical properties for which it was

originally designed, and facilitate the development of surface distresses such as spalling. Curing effectiveness and structural assessment of young concrete is generally done through conventional destructive or invasive testing. However, there is no fully established non-destructive testing protocol to assess moisture content and its effects on concrete properties quantitatively in an on-site, fast, and non-invasive way. The possibility and feasibility of establishing a testing protocol with such attributes is explored. Previous research on pavement bases has used dielectric measurements to relate moisture content to their structural performance. Due to the high dielectric value of water as compared to any other material used in construction, it is possible to relate high volumetric water content to high dielectric readings. In this study, compressive strength tests combined with dielectric and mass measurements are used to investigate how dielectric properties change with hydration. The results of this study suggest that it may be possible to approximate the volumetric moisture content in concrete by measuring the dielectric value of concrete as it hardens.

The book presents the work of the RILEM Technical Committee 249-ISC. Addressing the effective application of new recommendations for non-destructive in situ strength assessment of concrete, it provides information about the different steps of the investigation and processing of test results, until the delivery of strength estimates, and includes tables giving the minimum required number of cores in a variety of situations as well as several examples of how the recommendations can be used in practice. The book explores a topic which is of major importance, i.e. the assessment of concrete compressive strength in existing structures. This

property (both mean and standard deviation) is a key input in many cases, such as the reinforcement of structures, the safety checking, the extension of service life. As the new RILEM recommendations imply a deep revision (and improvement) of field practice, the book is intended for managers of structures, structural engineers and specialists of NDT that have to answer these issues. More widely, it will benefit engineers and students who are interested in NDT and in the safety analysis of structures.

Providing a comprehensive overview of the techniques involved in testing concrete in structures, Testing of Concrete in Structures discusses both established techniques and new methods, showing potential for future development, and documenting them with illustrative examples. Topics have been expanded where significant advances have taken place in the field, for example integrity assessment, sub-surface radar, corrosion assessment and localized dynamic response tests. This fourth edition also covers the new trends in equipment and procedures, such as the continuation of general moves to automate test methods and developments in digital technology and the growing importance of performance monitoring, and includes new and updated references to standards. The non-specialist civil engineer involved in assessment, repair or maintenance of concrete structures will find this a thorough update.

Deterioration Processes and Standard Test Methods

Proceedings of the 7th International Expertcentrum Conference Held by the RILEM Slovak National Committee, the IABSE Slovak National Committee with RILEM and IMEKO

Scientific Sponsorship in Cooperation with Expertcentrum Bratislava

Fourth Edition

Acoustic Emission and Related Non-destructive Evaluation Techniques in the Fracture Mechanics of Concrete

Non-Destructive Evaluation of Corrosion and Corrosion-assisted Cracking

Nondestructive Testing involves the use of methods such as wave propagation, electromagnetism, electrical conductivity, and thermal conductivity to test structural integrity and thereby allow nondestructive assessment of structures and the possibility of structural failures before they occur. Nondestructive Testing of Deep Foundations covers different techniques designed to provide information about the integrity and quality of the material that makes up a deep foundation. Nondestructive Testing methods are used at all stages of a structure's life - from new construction quality control to residual lifetime prediction, and even during the monitoring of demolition. In addition, Nondestructive Testing is being increasingly specified in deep foundation projects, though often without a good understanding of its limitations and with the result that methods are often misused. In order to be able to specify an appropriate method, or to recognize an inappropriate specification, it is necessary for the engineer, specifier and/or contractor to understand the capabilities and limitations of each of the methods currently in use. Nondestructive Testing of Deep Foundations: Describes the most commonly used deep foundation construction techniques, including typical use of material Provides a brief history of the development of commercially available nondestructive methods Summarises each method's capabilities and limitations Acts as a one stop reference drawing

together resources only previously available in conference proceedings and journal papers
This manual will prove to be a welcome addition to the bookshelf of all practitioners in civil/structural and geotechnical engineering and architecture. It will also provide a valuable insight into this highly technical field for university researchers, lecturers and postgraduate students in civil/structural and geotechnical engineering.
The Special Issue “Non-Destructive Testing of Structures” has been proposed to present the recent developments in the field of the diagnostics of structural materials and components in civil and mechanical engineering. The papers highlighted in this editorial concern various aspects of non-invasive diagnostics, including such topics as the condition assessments of civil and mechanical structures and the connections of structural elements, the inspection of cultural heritage monuments, the testing of structural materials, structural health monitoring systems, the integration of non-destructive testing methods, advanced signal processing for the non-destructive testing of structures (NDT), damage detection and damage imaging, as well as modeling and numerical analyses for supporting structural health monitoring (SHM) systems.
Reinforced and pre-stressed concrete are widely used for the construction of infrastructures such as bridges, industrial structures, buildings, etc. Most of the time, the quality of the concrete mix is assumed to be guaranteed but due to the congestion of reinforcement and the quality control exercised during placing and vibrating, honeycombs and voids are likely to be present in the hardened concrete. The presence of voids leads to the early deterioration of concrete and corrosion also sets in. The corrosion of reinforcement causes damage to the cover concrete and also section loss in the area of steel. In the case of pre-stressed concrete

members, the corrosion leads to a catastrophic failure without any warning. Hence, it becomes necessary to evaluate the condition of concrete using Non Destructive Techniques (NDT) and Partially Destructive Techniques (PDT). The Ultrasonic Pulse Velocity (UPV) method which is widely adopted till now gives the relative quality and integrity of concrete and is based on the transit time. The rebound hammer gives the quality of concrete in the cover zone based on the rebound number. In this study, the efficiency of the advanced non destructive techniques namely Ground Penetrating Radar (GPR), Ultrasonic Pulse Echo (UPE) and Impact Echo (IE) methods have been studied on different concrete specimens. The major advantage is that all are one sided techniques and can be used from one side only and it can be carried out in a rapid manner also. With the development in the signal processing, the details/features such as thickness, reinforcements, voids, etc., can be seen in the form of images. The cross sectional images namely B-scan and C-scan are obtained by processing the reflected signals. In the present work, a unique two storey large scale reinforced concrete specimen has been constructed with various features such as thickness variations in the slabs, different reinforcement percentages, inclusion of voids, PVC pipes, steel plates/box in the structure. The efficiency of the advanced NDT techniques namely GPR, UPE and IE have been studied extensively on this unique large scale reinforced concrete structure constructed with various features. The UPV testing (IS:13311-Part-1 and ASTM-C597) is a point based measurement and gives the quality of concrete based on the velocity. The limitation of the ultrasonic pulse velocity method in identifying the honeycombs, voids created by the presence of PVC pipes and steel box, etc., has been demonstrated. For the determination of minimum size of void that can be detected using GPR and UPE and also the effect of reinforcement on the determination

of void, experimental studies were carried out with different sizes of voids kept at different locations i.e., at different depths under the reinforcement. The 25 mm, 50 mm and 75 mm cubical voids were introduced. The voids were created with Expanded Polystyrene (EPS) blocks and the dielectric constant of EPS is 1.05 which is closer to air and the advantage of this is taken in the simulation of voids. The effect of reinforcement on the determination of vi void in radar is to be explored because the signals from the radar is of electromagnetic in nature, and reflected because of the metallic nature of the reinforcement. The limitation of the UPV method in determining the honeycombs and voids have been explained and demonstrated in this research work. To study the evaluation of the presence of duct, influence of first layer of reinforcement and the efficiency of grouting, two concrete specimens were cast, one with duct under the reinforcement and the other specimen with the duct between the reinforcement. One duct was fully grouted to half the length and the other half was partially grouted. All the three methods namely radar, UPE and IE have been used for the evaluation of different parameters. The size of the duct has been determined using GPR and UPE and compared with the actual. Comprehensive literature study has been carried out on the radar technique as a non destructive tool for the evaluation of concrete structures. Not much information is available on the minimum spacing of reinforcement that can be measured using radar and also the determination of the second layer of reinforcement and also the determination and influence of duct. Casting of large number of concrete specimen requires more time and the profile inside the specimen cannot be shifted. So, in order to collect more data with various profiles, a simulated specimen was constructed. Using this specimen, various configurations of reinforcement meshes, with and without ducts, different size of defects, have

been studied in detail. The need for a holistic approach in the evaluation of concrete structures has been demonstrated in this study. In addition for the radar technique, the influencing parameters with respect to the reinforcement and duct have been studied in detail and guidelines are arrived.

Impact-echo

Non-Destructive Testing Methods

Testing of Concrete in Structures

Non-destructive Analysis of Concrete Through Dynamic Testing

Non-destructive Testing of Materials in Civil Engineering

Assessment of Concrete Strength by Combined Nondestructive Methods for Normal and High Performance Concrete