

MULTICHANNEL ANALYSIS OF SURFACE WAVES MASW ACTIVE AND

ADVANCEMENTS IN SURFACE WAVE TESTING ENHANCING USABILITY OF THE MULTI-CHANNEL ANALYSIS OF SURFACE WAVE (MASW) TECHNIQUE FOR SUBSURFACE PHYSICAL PROPERTY MAPPING BY INCORPORATING RANDOM-ARRAY SEISMIC ACQUISITION SURFACE WAVES IN GEOMECHANICS: DIRECT AND INVERSE MODELLING FOR SOILS AND ROCKS EFFICIENT JOINT ANALYSIS OF SURFACE WAVES AND INTRODUCTION TO VIBRATION ANALYSIS: BEYOND THE CLICHÉ S LIMITS AND ABILITY OF THE MULTICHANNEL ANALYSIS OF SURFACE WAVES METHOD TO DETECT AND RESOLVE SUBSURFACE ANOMALIES ADVANCES IN NEAR-SURFACE SEISMOLOGY AND GROUND-PENETRATING RADAR, VOLUME 15 SURFACE WAVE ANALYSIS FOR NEAR SURFACE APPLICATIONS SURFACE WAVE METHODS FOR NEAR-SURFACE SITE CHARACTERIZATION MULTICHANNEL ANALYSIS OF SURFACE WAVES (MASW) FOR OFFSHORE GEOTECHNICAL INVESTIGATIONS GEOTECHNICAL AND GEOPHYSICAL SITE CHARACTERIZATION DYNAMIC SOIL PROPERTIES AND LIQUEFACTION PROCEEDINGS OF 17TH SYMPOSIUM ON EARTHQUAKE ENGINEERING (VOL. 4) CONE PENETRATION TESTING 2022 ENGINEERING GEOPHYSICS GEOTECHNICAL ENGINEERING FOR DISASTER MITIGATION AND REHABILITATION - PROCEEDINGS OF THE INTERNATIONAL CONFERENCE (WITH CD-ROM) ADVANCED RAIL GEOTECHNOLOGY - BALLASTED TRACK LANDSLIDES IN SENSITIVE CLAYS GEOTECHNICS FUNDAMENTALS AND APPLICATIONS IN CONSTRUCTION ANALYSES FOR RETAINING WALLS, SLOPE STABILITY AND LANDSLIDES NEAR-SURFACE APPLIED GEOPHYSICS SIYAVASH MAHVELATI PRASANTA MALATI YELURU CARLO G. LAI GIANCARLO DAL MORO UGUR ARSLAN RICHARD D. MILLER GIANCARLO DAL MORO SEBASTIANO FOTI TOMMASO MCGRATH AN-BIN HUANG ABHISHEK KUMAR MANISH SHRIKHANDE GUIDO GOTTARDI ANNA BONDO MEDHUS JIAN CHU BUDDHIMA INDRARATNA JEAN-SÉBASTIEN L'HEUREUX RASHID MANGUSHEV RAJIB SARKAR MARK E. EVERETT ADVANCEMENTS IN SURFACE WAVE TESTING ENHANCING USABILITY OF THE MULTI-CHANNEL ANALYSIS OF SURFACE WAVE (MASW) TECHNIQUE FOR SUBSURFACE PHYSICAL PROPERTY MAPPING BY INCORPORATING RANDOM-ARRAY SEISMIC ACQUISITION SURFACE WAVES IN GEOMECHANICS: DIRECT AND INVERSE MODELLING FOR SOILS AND ROCKS EFFICIENT JOINT ANALYSIS OF SURFACE WAVES AND INTRODUCTION TO VIBRATION ANALYSIS: BEYOND THE CLICHÉ S LIMITS AND ABILITY OF THE MULTICHANNEL ANALYSIS OF SURFACE WAVES METHOD TO DETECT AND RESOLVE SUBSURFACE ANOMALIES ADVANCES IN NEAR-SURFACE SEISMOLOGY AND GROUND-PENETRATING RADAR, VOLUME 15 SURFACE WAVE ANALYSIS FOR NEAR SURFACE APPLICATIONS SURFACE WAVE METHODS FOR NEAR-SURFACE SITE CHARACTERIZATION MULTICHANNEL ANALYSIS OF SURFACE WAVES (MASW) FOR OFFSHORE GEOTECHNICAL INVESTIGATIONS GEOTECHNICAL AND GEOPHYSICAL SITE CHARACTERIZATION DYNAMIC SOIL PROPERTIES AND LIQUEFACTION PROCEEDINGS OF 17TH SYMPOSIUM ON EARTHQUAKE ENGINEERING (VOL. 4) CONE PENETRATION TESTING 2022 ENGINEERING GEOPHYSICS GEOTECHNICAL ENGINEERING FOR DISASTER MITIGATION AND REHABILITATION - PROCEEDINGS OF THE INTERNATIONAL CONFERENCE (WITH CD-ROM) ADVANCED RAIL GEOTECHNOLOGY - BALLASTED TRACK LANDSLIDES IN SENSITIVE CLAYS GEOTECHNICS FUNDAMENTALS AND APPLICATIONS IN CONSTRUCTION ANALYSES FOR RETAINING WALLS, SLOPE STABILITY AND LANDSLIDES NEAR-SURFACE APPLIED GEOPHYSICS SIYAVASH MAHVELATI PRASANTA MALATI YELURU CARLO G. LAI GIANCARLO DAL MORO UGUR ARSLAN RICHARD D. MILLER GIANCARLO DAL MORO SEBASTIANO FOTI TOMMASO MCGRATH AN-BIN HUANG ABHISHEK KUMAR MANISH SHRIKHANDE GUIDO GOTTARDI ANNA BONDO MEDHUS JIAN CHU BUDDHIMA INDRARATNA JEAN-SÉBASTIEN L'HEUREUX RASHID MANGUSHEV RAJIB SARKAR MARK E. EVERETT

THE MULTICHANNEL ANALYSIS OF SURFACE WAVES MASW METHOD HAS BEEN WIDELY USED TO EVALUATE THE SUBSURFACE IN ENGINEERING APPLICATIONS SINCE LATE 1990 S IN MASW SURFACE WAVES ARE INTRODUCED INTO THE SUBSURFACE AND RECORDED BY SENSORS ALONG THE GROUND SURFACE THE CHARACTERISTICS OF THE PROPAGATING SURFACE WAVE ARE INFLUENCED BY THE SUBSURFACE STRATIFICATION THE MANNER IN WHICH THE SURFACE WAVES ARE INPUT INTO THE GROUND AND THE SURVEY PARAMETERS TO ACQUIRE DATA RAYLEIGH WAVES ARE TYPICALLY GENERATED BY VERTICAL STRIKES ON A METALLIC PLATE WHICH SERVES AS A COUPLER BETWEEN THE ACTIVE INPUT SOURCE E G A SLEDGEHAMMER AND THE GROUND SURFACE IT HAS BEEN SUGGESTED THAT PLASTIC TYPE BASE PLATES CAN IMPROVE THE LOW

FREQUENCY ENERGY OF RAYLEIGH WAVES AND THEREFORE CAN INCREASE THE DEPTH OF INVESTIGATION AMONG OTHER POTENTIAL IMPROVEMENTS HOWEVER VERY LITTLE STUDIES EXIST IN THE LITERATURE THAT EVALUATE THE ROLE OF BASE PLATE MATERIAL ESPECIALLY PLASTIC MATERIALS IN ADDITION TO RAYLEIGH SURFACE WAVES SEISMIC SURFACE WAVES CAN ALSO BE GENERATED WITH HORIZONTAL IMPACTS I E LOVE WAVES USING SPECIALIZED BASE PLATES IN THIS REGARD MUCH LESS IS AVAILABLE IN THE LITERATURE REGARDING LOVE WAVES AS SOURCES IN MASW TESTING WHICH MEANS THAT OPTIMUM FIELD SURVEY PARAMETERS THE EFFECTS OF NEAR FIELD AND THE ROLE OF SEISMIC SOURCE HAVE NOT BEEN THOROUGHLY INVESTIGATED YET FOR LOVE WAVES GIVEN THE AFOREMENTIONED GAPS IN THE LITERATURE TWO ASPECTS OF MASW HAVE BEEN INVESTIGATED FIRST THE ROLE OF BASE PLATE MATERIAL SPECIFICALLY PLASTIC TYPE PLATES HAS BEEN STUDIED FIELD DATA COLLECTED FROM SIX SITES ALONG WITH THE DATA FROM LABORATORY EXPERIMENTS AND NUMERICAL SIMULATIONS OF HAMMER PLATE IMPACT WERE STUDIED THE RESULTS SHOWED THAT SOFTER BASE PLATES IMPROVE THE ENERGY TRANSFER BY AS MUCH 20 AND LEAD TO MINOR IMPROVEMENTS TYPICALLY ONE DIGIT NUMBERS IN RELATIVE CHANGES IN OTHER SIGNAL CHARACTERISTICS SUCH AS SIGNAL BANDWIDTH AND SIGNAL TO NOISE RATIO THESE RESULTS WERE CORROBORATED WITH LABORATORY TESTING AND NUMERICAL MODELS OF WAVE PROPAGATION WITH DIFFERENT BASE PLATE MATERIALS THE SECOND GOAL WAS TO IMPROVE UNDERSTANDING OF LOVE WAVE PROPAGATION PARTICULARLY AS RELATED TO RESOLUTION CAPABILITIES FROM SURVEY PARAMETERS RAYLEIGH AND LOVE WAVEFORMS WERE COLLECTED WITH MULTIPLE ACTIVE SEISMIC SOURCES AT THREE SITES AND A SYSTEMATIC COMPARISON WAS MADE BETWEEN THE TWO TYPES OF WAVES ALSO SEISMIC WAVE PROPAGATION WAS SIMULATED USING THE RESEARCH COMMUNITY CODE SPECFEM2D TO FURTHER INVESTIGATE THEIR DIFFERENCES THE RESULTS REVEALED CRITICAL NEW INFORMATION ABOUT THE DEPTH OF INVESTIGATION THE EFFECTS OF BEDROCK LOCATION ON NEAR FIELD EFFECTS AND THE ROLE OF THE DIFFERENT SURVEY PARAMETERS ON RAYLEIGH AND LOVE WAVE DATA THE DEPTH OF INVESTIGATION OF LOVE WAVE MASW WAS DEEPER BY ABOUT 2.9 m THAN THAT OF RAYLEIGH MASW AS A RESULT OF IMPROVED MINIMUM FREQUENCY THE MINIMUM SOURCE OFFSET TO AVOID NEAR FIELD EFFECTS WAS COMPARABLE FOR BOTH RAYLEIGH AND LOVE WAVES 0.3-0.4 OF MAXIMUM WAVELENGTH AT CLOSER SOURCE OFFSET LOCATIONS RAYLEIGH WAVES WERE MORE AFFECTED BY NEAR FIELD EFFECTS AND SHOWED AN ADDITIONAL 10 UNDERESTIMATION OF PLANAR PHASE VELOCITIES OVERALL THE RESULTS FROM BOTH PARTS OF THIS STUDY PROVIDES NEW PRACTICAL INSIGHTS ABOUT SOME OF THE UNEXPLORED ASPECTS OF SURFACE WAVE TESTING USING MASW

SUBSURFACE IMAGING IS VERY CRITICAL TO EXPLOIT SUBSURFACE RESOURCES MONITOR THE FLUID MOVEMENT IN THE RESERVOIR MAPPING TUNNELS ETC AS SCIENCE ADVANCES SCIENTISTS AND OTHER RESEARCHERS ARE CONSTANTLY TRYING TO DEVELOP NEW TECHNIQUES AND METHODS FOR SUBSURFACE IMAGING THAT ARE MORE EFFECTIVE EFFICIENT AND ARE MORE ROBUST UNDER VARYING FIELD CONDITIONS THE MAIN FOCUS OF THIS RESEARCH IS ONE SUCH EFFORT TO IMPROVE AND INCREASE THE USABILITY OF THE MULTI CHANNEL ANALYSIS OF SURFACE WAVE METHOD MASW METHOD IN DETERMINING REGOLITH AND ROCK PROPERTIES BY INTRODUCING A NEW TYPE OF RECEIVER ARRANGEMENT TO EXTEND ITS USAGE IN PLACES THAT ARE INACCESSIBLE FOR EXAMPLE NEAR EMBANKMENTS MILITARY PLACES CLANDESTINE BURIALS ETC ADVANCES IN NEAR SURFACE GEOPHYSICAL TECHNIQUES SUCH AS MULTI CHANNEL ANALYSIS OF SURFACE WAVES MASW HAVE GREATLY INCREASED OUR ABILITY TO MAP SUBSURFACE VARIATIONS IN PHYSICAL PROPERTIES HERE ON EARTH THE MASW METHOD INVOLVES DEPLOYMENT OF MULTIPLE SEISMOMETERS TO ACQUIRE 1D OR 2D SHEAR WAVE VELOCITY PROFILES THAT CAN BE DIRECTLY RELATED TO VARIOUS ENGINEERING PROPERTIES THE PURPOSE OF THE RESEARCH PRESENTED HERE IS TO DEMONSTRATE THE USEFULNESS AND CAPABILITIES OF MASW TECHNIQUE USING A RANDOM RECEIVER ARRAY 1 THROUGH CONTROLLED SITE EXPERIMENTS 2 THROUGH MODELING EXPERIMENTS AND 3 AND FINALLY APPLY THE TECHNIQUE AT TERRESTRIAL SITE THE BLACK POINT LAVA FLOW WITH A DIFFERENT GEOLOGIC SETTING THE RESULTS FOCUS ON NEAR SURFACE MASW STUDIES AND INTERPRETATION OF THE SUBSURFACE GEOLOGY USING A RANDOM GEOPHONE ARRAY THE FIELD TECHNIQUES AND METHODOLOGIES DISCUSSED IN THIS DISSERTATION ALTHOUGH APPLICABLE ON EARTH ARE ALSO INTENDED FOR SURFACES AND REGOLITH IN THE FUTURE EXPLORATION OF PLANETARY BODIES FOR POSSIBLE HUMAN HABITATION THIS WOULD INCLUDE MARS ITS MOON PHOBUS DEIMOS NEAR EARTH ASTEROIDS NEAR EARTH S MOON WITH EACH SITUATION THE NATURE OF THE REGOLITH AND ITS FORMATIONAL PROCESSES WILL PLACE CERTAIN RESTRICTIONS AND LIMITATIONS UPON THE APPLICATIONS THIS IS EXPECTED WITH ANY CHANGE OF TERRAINS EVEN ON THE EARTH LET ALONE BETWEEN PLANETARY BODIES

THEORIES OF SURFACE WAVES DEVELOP SINCE THE END OF XIX CENTURY AND MANY FUNDAMENTAL PROBLEMS LIKE EXISTENCE PHASE AND GROUP VELOCITIES ATTENUATION QUALITY FACTOR MODE CONVERSION ETC HAVE BEEN IN PART SUCCESSFULLY SOLVED WITHIN THE FRAMEWORK OF SUCH SIMPLE MODELS AS IDEAL FLUIDS OR LINEAR ELASTICITY HOWEVER A SUFFICIENTLY COMPLETE PRESENTATION OF THIS SUBJECT PARTICULARLY FOR SOLIDS IS STILL MISSING IN THE LITERATURE THE SOLE EXCEPTION IS THE BOOK OF I A VIKTOROV WHICH CONTAINS AN EXTENSIVE DISCUSSION OF FUNDAMENTAL PROPERTIES OF SURFACE

WAVES IN HOMOGENEOUS AND STRATIFIED LINEAR ELASTIC SOLIDS WITH PARTICULAR EMPHASIS ON CONTRIBUTIONS OF RUSSIAN SCIENTISTS UNFORTUNATELY THE BOOK HAS NEVER BEEN TRANSLATED TO ENGLISH AND ITS RUSSIAN VERSION IS ALSO HARDLY AVAILABLE PRACTICAL APPLICATIONS OF SURFACE WAVES DEVELOP INTENSIVELY SINCE A MUCH SHORTER PERIOD OF TIME THAN THEORIES EVEN THOUGH THE MOTIVATION OF DISCOVERERS OF SURFACE WAVES SUCH AS LORD RAYLEIGH STEMS FROM THEIR APPEARANCE IN GEOPHYSICS AND SEISMOLOGY NOWADAYS THE GROWING INTEREST IN PRACTICAL APPLICATIONS OF SURFACE WAVES STEM FROM THE FOLLOWING TWO MAIN FACTORS SURFACE WAVES ARE IDEAL FOR DEVELOPING RELATIVELY CHEAP AND CONVENIENT METHODS OF NONDESTRUCTIVE TESTING OF VARIOUS SYSTEMS SPANNING FROM NANOMATERIALS E G

THIS BOOK BRIDGES THE GAP BETWEEN THEORY AND PRACTICE SHOWING HOW A DETAILED DEFINITION OF THE SHEAR WAVE VELOCITY VS PROFILE CAN BE EFFICIENTLY OBTAINED USING LIMITED FIELD EQUIPMENT AND FOLLOWING SIMPLE ACQUISITION PROCEDURES IT DEMONSTRATES HOW SURFACE WAVES USED TO DEFINE THE VS PROFILE AND VIBRATION DATA USED TO DESCRIBE THE DYNAMIC BEHAVIOUR OF A BUILDING CAN BE RECORDED USING THE SAME EQUIPMENT AND ALSO HIGHLIGHTS COMMON PROBLEMS AMBIGUITIES AND PITFALLS THAT CAN OCCUR WHEN ADOPTING POPULAR METHODOLOGIES WHICH ARE OFTEN BASED ON A SERIES OF SIMPLISTIC ASSUMPTIONS TODAY MOST NATIONAL AND INTERNATIONAL BUILDING CODES TAKE INTO ACCOUNT A SERIES OF PARAMETERS AIMED AT DEFINING THE LOCAL SEISMIC HAZARD SITES ARE CHARACTERISED BASED ON THE LOCAL VS PROFILE AND THE DYNAMIC BEHAVIOUR OF EXISTING BUILDINGS IS DEFINED THROUGH THE ANALYSIS OF THEIR EIGENMODES THE BOOK INCLUDES A SERIES OF CASE STUDIES TO HELP READERS GAIN A DEEPER UNDERSTANDING OF SEISMIC AND VIBRATION DATA AND THE MEANING PROS AND CONS OF A SERIES OF TECHNIQUES OFTEN REFERRED TO AS MASW ESAC SPAC REMI HVSR MAAM AND HS IT ALSO PROVIDES ACCESS TO SOME OF THE DATASETS SO THAT READERS CAN GAIN A DEEPER AND MORE CONCRETE UNDERSTANDING OF BOTH THE THEORETICAL AND PRACTICAL ASPECTS

THE MULTICHANNEL ANALYSIS OF SURFACE WAVES MASW METHOD IS A NON INVASIVE SURFACE WAVE METHOD USED TO CHARACTERIZE THE LAYERING AND STIFFNESS OF THE SUBSURFACE THIS STUDY ASSESSES THE PRACTICAL LIMITATIONS OF USING THE MASW METHOD FOR DETECTING AND RESOLVING SUBSURFACE ANOMALIES THE SENSITIVITY OF MASW DISPERSION DATA TO THE PRESENCE OF SUBSURFACE ANOMALIES IS EXAMINED THROUGH VARIOUS TWO DIMENSIONAL PLANE STRAIN FINITE DIFFERENCE ELASTIC WAVE PROPAGATION SIMULATIONS THESE SIMULATIONS WERE PERFORMED ON MODELS CONTAINING ANOMALIES OF VARYING SIZE STIFFNESS AND DEPTH THE MISFIT BETWEEN THE DISPERSION DATA FROM A MODEL WITH AN ANOMALY TREATMENT MODEL AND THE SAME MODEL WITHOUT AN ANOMALY CONTROL MODEL WERE COMPARED AS A QUANTITATIVE MEANS OF DISCERNING IF THE ANOMALY WAS RELIABLY DETECTABLE I E OUTSIDE THE BOUNDS OF COMMON DISPERSION DATA UNCERTAINTY THOSE MODELS CATEGORIZED AS CONTAINING A DETECTABLE ANOMALY BASED ON THEIR EXPERIMENTAL DISPERSION DATA WERE FURTHER STUDIED TO DETERMINE IF THE DISPERSION DATA COULD BE INVERTED TO ACCURATELY RESOLVE THE ANOMALY S SIZE STIFFNESS AND DEPTH TO RIGOROUSLY PERFORM THE INVERSIONS THE PROCEDURES RECOMMENDED BY THE SURFACE WAVE INVERSION WORKFLOW SWINVERT WERE ADOPTED THESE INVERSION PROCEDURES INVOLVE USING MULTIPLE LARGE SCALE GLOBAL SEARCH INVERSIONS TO ADDRESS THE PROBLEM S NON LINEARITY AND MULTIPLE LAYERING PARAMETERIZATIONS TO ADDRESS THE PROBLEM S NON UNIQUENESS FOLLOWING THE INVERSION PROCESS THE SHEAR WAVE VELOCITY VS PROFILES FROM THE SINGLE BEST TRIAL MODEL ASSOCIATED WITH EACH LAYERING PARAMETERIZATION WERE COMPARED TO THE 1D VS PROFILES FROM THE CENTERLINE OF THE TRUE CONTROL MODEL USING AN ERROR FUNCTION TO QUANTITATIVELY ASSESS THE ABILITY OF THE MASW METHOD TO ACCURATELY RESOLVE SUBSURFACE ANOMALIES IN THIS STUDY ANOMALIES WITH LATERAL EXTENTS LESS THAN APPROXIMATELY $\frac{1}{2}$ THE MASW ARRAY LENGTH LOCATED AT DEPTHS GREATER THAN 5 M COULD NOT BE RESOLVED ACCURATELY BY USING MASW EVEN WHEN THE ANOMALIES WERE RELATIVELY THICK 2 M AND THE IMPEDANCE CONTRASTS WERE NOTABLY HIGH $\frac{1}{2}$ THE ABILITY OF MASW TO DETECT AN ANOMALY OF A GIVEN SIZE STIFFNESS AND DEPTH IS SUMMARIZED IN NORMALIZED FIGURES WHICH ARE INTENDED AS A FEASIBILITY TOOL FOR THOSE SEEKING TO USE MASW FOR ANOMALY DETECTION

ADVANCES IN NEAR SURFACE SEISMOLOGY AND GROUND PENETRATING RADAR SEG GEOPHYSICAL DEVELOPMENTS SERIES NO 15 IS A COLLECTION OF ORIGINAL PAPERS BY RENOWNED AND RESPECTED AUTHORS FROM AROUND THE WORLD TECHNOLOGIES USED IN THE APPLICATION OF NEAR SURFACE SEISMOLOGY AND GROUND PENETRATING RADAR HAVE SEEN SIGNIFICANT ADVANCES IN THE LAST SEVERAL YEARS BOTH METHODS HAVE BENEFITED FROM NEW PROCESSING TOOLS INCREASED COMPUTER SPEEDS AND AN EXPANDED VARIETY OF APPLICATIONS THIS BOOK DIVIDED INTO FOUR SECTIONS REVIEWS METHODOLOGY INTEGRATIVE APPROACHES AND CASE STUDIES CAPTURES THE MOST SIGNIFICANT CUTTING EDGE ISSUES IN ACTIVE AREAS OF RESEARCH UNVEILING TRULY PERTINENT STUDIES THAT ADDRESS FUNDAMENTAL APPLIED PROBLEMS

THIS COLLECTION OF MANUSCRIPTS GREW FROM A CORE GROUP OF PAPERS PRESENTED AT A POST CONVENTION WORKSHOP ADVANCES IN NEAR SURFACE SEISMOLOGY AND GROUND PENETRATING RADAR HELD DURING THE 2009 SEG ANNUAL MEETING IN HOUSTON TEXAS THIS IS THE FIRST COOPERATIVE PUBLICATION EFFORT BETWEEN THE NEAR SURFACE COMMUNITIES OF SEG AGU AND EEGS IT WILL APPEAL TO A LARGE AND DIVERSE AUDIENCE THAT INCLUDES RESEARCHERS AND PRACTITIONERS INSIDE AND OUTSIDE THE NEAR SURFACE GEOPHYSICS COMMUNITY PUBLISHER DESCRIPTION

SEISMIC WAVE ANALYSIS FOR NEAR SURFACE APPLICATIONS PRESENTS THE FOUNDATIONAL TOOLS NECESSARY TO PROPERLY ANALYZE SURFACE WAVES ACQUIRED ACCORDING TO BOTH ACTIVE AND PASSIVE TECHNIQUES APPLICATIONS RANGE FROM SEISMIC HAZARD STUDIES GEOTECHNICAL SURVEYS AND THE EXPLORATION OF EXTRA TERRESTRIAL BODIES SURFACE WAVES HAVE BECOME CRITICAL TO NEAR SURFACE GEOPHYSICS BOTH FOR GEOTECHNICAL GOALS AND SEISMIC HAZARD STUDIES INCLUDED IN THIS BOOK ARE THE RELATED THEORIES APPROACHES AND APPLICATIONS WHICH THE LEAD EDITOR HAS ASSEMBLED FROM A RANGE OF AUTHORED CONTRIBUTIONS CAREFULLY SELECTED FROM THE LATEST DEVELOPMENTS IN RESEARCH A UNIQUE BLEND OF THEORY AND PRACTICE THE BOOK S CONCEPTS ARE BASED ON EXHAUSTIVE FIELD RESEARCH CONDUCTED OVER THE PAST DECADE FROM THE WORLD S LEADING SEISMOLOGISTS AND GEOPHYSICISTS EDITED BY A GEOPHYSICIST WITH NEARLY 20 YEARS OF EXPERIENCE IN RESEARCH CONSULTING AND GEOSCIENCE SOFTWARE DEVELOPMENT NEARLY 100 FIGURES PHOTOGRAPHS AND EXAMPLES AID IN THE UNDERSTANDING OF FUNDAMENTAL CONCEPTS AND TECHNIQUES PRESENTS THE LATEST RESEARCH IN SEISMIC WAVE CHARACTERISTICS AND ANALYSIS THE FUNDAMENTALS OF SIGNAL PROCESSING WAVE DATA ACQUISITION AND INVERSION AND THE LATEST DEVELOPMENTS IN HORIZONTAL TO VERTICAL SPECTRAL RATIO HVSR EACH CHAPTER FEATURES A REAL WORLD CASE STUDY 13 IN ALL TO BRING THE BOOK S KEY PRINCIPLES TO LIFE

DEVELOP A GREATER UNDERSTANDING OF HOW AND WHY SURFACE WAVE TESTING WORKS USING EXAMPLES AND CASE STUDIES DIRECTLY DRAWN FROM THE AUTHORS EXPERIENCE SURFACE WAVE METHODS FOR NEAR SURFACE SITE CHARACTERIZATION ADDRESSES BOTH THE EXPERIMENTAL AND THEORETICAL ASPECTS OF SURFACE WAVE PROPAGATION IN BOTH FORWARD AND INVERSE MODELING THIS BOOK ACCENTS

GEOTECHNICAL AND GEOPHYSICAL SITE CHARACTERIZATION COLLECTS THE PAPERS PRESENTED AT THE THIRD INTERNATIONAL CONFERENCE ON SITE CHARACTERIZATION ISC 3 THAT TOOK PLACE IN TAIPEI FROM APRIL 14 2008 THE SUBJECTS COVERED INCLUDE NEW DEVELOPMENTS IN MECHANICAL IN SITU TESTING AND INTERPRETATION TECHNIQUES STATISTICAL ANALYSIS OF TEST DATA GEO

THIS BOOK WILL PRESENT THE SELECT PROCEEDINGS OF THE 8TH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS 8ICRAGEE HELD AT THE INDIAN INSTITUTE OF TECHNOLOGY IIT GUWAHATI BETWEEN DECEMBER 11 AND 14 2024 IT CONTAINS THE LATEST RESEARCH PAPERS COVERING THE CONTRIBUTIONS AND ACCOMPLISHMENTS IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS IN THE LAST FOUR YEARS THE FIVE VOLUMES OF THE BOOK COVER A WIDE RANGE OF TOPICS INCLUDING BUT NOT LIMITED TO SEISMIC HAZARD ANALYSIS WAVE PROPAGATION AND SITE CHARACTERIZATION DYNAMIC PROPERTIES AND LIQUEFACTION OF SOILS PILE FOUNDATIONS OFFSHORE FOUNDATIONS SEISMIC DESIGN OF RETAINING STRUCTURES AND DAMS SEISMIC SLOPE STABILITY AND LANDSLIDES DYNAMIC SOIL STRUCTURE INTERACTION SEISMIC DESIGN OF STRUCTURES FURTHER RECENT DEVELOPMENTS ON THESE TOPICS ARE COVERED IN DIFFERENT CHAPTERS THIS BOOK WILL BE VALUABLE NOT ONLY FOR RESEARCHERS AND PROFESSIONALS BUT ALSO FOR DRAWING AN AGENDA FOR FUTURE COURSES OF ACTION FROM THE PERSPECTIVE OF GEOTECHNICAL EARTHQUAKE ENGINEERING KEEPING THE NATIONAL NEED AT THE FOREFRONT THIS BOOK WILL PRESENT THE SELECT PROCEEDINGS OF THE 8TH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS 8ICRAGEE HELD AT THE INDIAN INSTITUTE OF TECHNOLOGY IIT GUWAHATI BETWEEN DECEMBER 11 AND 14 2024 IT CONTAINS THE LATEST RESEARCH PAPERS COVERING THE CONTRIBUTIONS AND ACCOMPLISHMENTS IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS IN THE LAST FOUR YEARS THE FIVE VOLUMES OF THE BOOK COVER A WIDE RANGE OF TOPICS INCLUDING BUT NOT LIMITED TO SEISMIC HAZARD ANALYSIS WAVE PROPAGATION AND SITE CHARACTERIZATION DYNAMIC PROPERTIES AND LIQUEFACTION OF SOILS PILE FOUNDATIONS OFFSHORE FOUNDATIONS SEISMIC DESIGN OF RETAINING STRUCTURES AND DAMS SEISMIC SLOPE STABILITY AND LANDSLIDES DYNAMIC SOIL STRUCTURE INTERACTION SEISMIC DESIGN OF STRUCTURES FURTHER RECENT DEVELOPMENTS ON THESE TOPICS ARE COVERED IN DIFFERENT CHAPTERS THIS BOOK WILL BE VALUABLE NOT ONLY FOR RESEARCHERS AND PROFESSIONALS BUT ALSO FOR DRAWING AN AGENDA FOR FUTURE COURSES OF ACTION FROM THE PERSPECTIVE OF GEOTECHNICAL EARTHQUAKE ENGINEERING KEEPING THE NATIONAL NEED AT THE FOREFRONT

THIS BOOK PRESENTS SELECT PROCEEDINGS OF THE 17TH SYMPOSIUM ON EARTHQUAKE ENGINEERING ORGANIZED BY THE DEPARTMENT OF EARTHQUAKE ENGINEERING INDIAN INSTITUTE OF TECHNOLOGY ROORKEE THE TOPICS COVERED IN THE PROCEEDINGS INCLUDE ENGINEERING SEISMOLOGY AND SEISMOTECTONICS EARTHQUAKE HAZARD ASSESSMENT SEISMIC MICROZONATION AND URBAN PLANNING DYNAMIC PROPERTIES OF SOILS AND GROUND RESPONSE GROUND IMPROVEMENT TECHNIQUES FOR SEISMIC HAZARDS COMPUTATIONAL SOIL DYNAMICS DYNAMIC SOIL STRUCTURE INTERACTION CODAL PROVISIONS ON EARTHQUAKE RESISTANT DESIGN SEISMIC EVALUATION AND RETROFITTING OF STRUCTURES EARTHQUAKE DISASTER MITIGATION AND MANAGEMENT AND MANY MORE THIS BOOK ALSO DISCUSSES RELEVANT ISSUES RELATED TO EARTHQUAKES SUCH AS HUMAN RESPONSE AND SOCIOECONOMIC MATTERS POST EARTHQUAKE REHABILITATION EARTHQUAKE ENGINEERING EDUCATION PUBLIC AWARENESS PARTICIPATION AND ENFORCEMENT OF BUILDING SAFETY LAWS AND EARTHQUAKE PREDICTION AND EARLY WARNING SYSTEM THIS BOOK IS A VALUABLE REFERENCE FOR RESEARCHERS AND PROFESSIONALS WORKING IN THE AREA OF EARTHQUAKE ENGINEERING

THIS ABSTRACTS VOLUME INCLUDING FULL KEYNOTE AND INVITED PAPERS CONTAINS THE PROCEEDINGS OF THE 5TH INTERNATIONAL SYMPOSIUM ON CONE PENETRATION TESTING CPT 22 HELD IN BOLOGNA ITALY 8 10 JUNE 2022 MORE THAN 500 AUTHORS ACADEMICS RESEARCHERS PRACTITIONERS AND MANUFACTURERS CONTRIBUTED TO THE PEER REVIEWED PAPERS INCLUDED IN THIS BOOK WHICH INCLUDES THREE KEYNOTE LECTURES FOUR INVITED LECTURES AND 169 TECHNICAL PAPERS THE CONTRIBUTIONS PROVIDE A FULL PICTURE OF THE CURRENT KNOWLEDGE AND MAJOR TRENDS IN CPT RESEARCH AND DEVELOPMENT WITH RESPECT TO INNOVATIONS IN INSTRUMENTATION LATEST ADVANCES IN DATA INTERPRETATION AND EMERGING FIELDS OF CPT APPLICATION THE PAPER TOPICS ENCOMPASS THREE WELL ESTABLISHED TOPIC CATEGORIES TYPICALLY ADDRESSED IN CPT EVENTS EQUIPMENT AND PROCEDURES DATA INTERPRETATION APPLICATIONS EMPHASIS IS PLACED ON THE USE OF STATISTICAL APPROACHES AND INNOVATIVE NUMERICAL STRATEGIES FOR CPT DATA INTERPRETATION LIQUEFACTION STUDIES APPLICATION OF CPT TO OFFSHORE ENGINEERING COMPARATIVE STUDIES BETWEEN CPT AND OTHER IN SITU TESTS CONE PENETRATION TESTING 2022 CONTAINS A WEALTH OF INFORMATION THAT COULD BE USEFUL FOR RESEARCHERS PRACTITIONERS AND ALL THOSE WORKING IN THE BROAD AND DYNAMIC FIELD OF CONE PENETRATION TESTING

ENGINEERING GEOPHYSICS CONNECTS ONSHORE GEOTECHNICAL ENGINEERING CHALLENGES TO THE GEOPHYSICAL METHODS THAT MAY BE APPLIED TO SOLVE THEM UNKNOWN GEOLOGICAL CONDITIONS ARE A RISK IN CONSTRUCTION PROJECTS AND GEOPHYSICAL INFORMATION CAN HELP TO IDENTIFY THOSE RISKS THE BOOK ANSWERS QUESTIONS ON HOW WHY AND WHEN THE INDIVIDUAL AND COMBINED METHODS PROVIDE THE RESULTS REQUESTED FLOWCHARTS GUIDE THE READER TO GEOPHYSICAL METHODS THAT CAN BE APPLIED FOR VARIOUS ENGINEERING CHALLENGES AND THE SOLUTIONS ARE ILLUSTRATED WITH PRACTICAL CASE HISTORIES THE BOOK IS INTENDED MAINLY FOR GEOTECHNICAL ENGINEERS AND GEOLOGISTS BUT ALSO FOR GEOPHYSICISTS OR MANAGERS IN NEED OF AN OVERVIEW OR BRUSHUP ON GEOPHYSICAL METHODS AND THEIR PRACTICAL APPLICATIONS IN ADDITION IT CAN BE USED BY EDUCATIONAL INSTITUTIONS IN COURSES BOTH FOR GEOTECHNICAL ENGINEERS AND GEOLOGISTS

AFTER THE DEVASTATING DISASTER CAUSED BY THE TSUNAMI ON 26 DECEMBER 2004 DISASTER MITIGATION AND REHABILITATION HAVE BECOME SOME OF THE MOST PRESSING TOPICS FOR DISCUSSION IN GEOTECHNICAL ENGINEERING AND RELATED PROFESSIONS SOME OF THE MOST IMPORTANT CONTRIBUTIONS TO THIS DISCUSSION WERE MADE DURING THE INTERNATIONAL CONFERENCE ON GEOTECHNICAL ENGINEERING FOR DISASTER MITIGATION AND REHABILITATION THE FIRST OF ITS KIND HELD IN THE ASIA PACIFIC REGION IT WAS ORGANIZED BY THE JOINT WORKING GROUP ON GEOTECHNICAL ENGINEERING FOR DISASTER MITIGATION AND REHABILITATION JW/G DMR WHICH IS SUPPORTED BY NATIONAL GEOTECHNICAL SOCIETIES FROM AUSTRALIA CHINA INDIA INDONESIA JAPAN SOUTH KOREA SOUTHEAST ASIA COMPRISING MALAYSIA SINGAPORE TAIWAN AND THAILAND AND SRI LANKA DISASTER MANAGEMENT ENCOMPASSES DIVERSE TOPICS SUCH AS NATURAL DISASTERS TSUNAMIS EARTHQUAKES LANDSLIDES ETC MITIGATION EARLY WARNING AND PREDICTION SYSTEMS HAZARD MAPPING RISK ANALYSIS COASTAL PROTECTION WORKS ETC REHABILITATION AND RECONSTRUCTION DIFFICULT SOILS AND GROUND TREATMENT DESIGN AGAINST EARTHQUAKES AND OTHER NATURAL DISASTERS ETC AND MANY OTHERS INCLUDING SOIL DYNAMICS LIQUEFACTION STABILITY AND ENVIRONMENTAL PROTECTION THIS VOLUME CONTAINS OVER 100 HIGH QUALITY PAPERS CONTRIBUTED BY AUTHORS FROM PARTICIPATING COUNTRIES INCLUDING KEYNOTE AND INVITED LECTURES DELIVERED BY EMINENT RESEARCHERS AND PRACTITIONERS THE PROCEEDINGS WILL BENEFIT THE GEOTECHNICAL PROFESSION AS A WHOLE IN PARTICULAR THOSE WHO ARE INVOLVED IN DISASTER PREVENTION MITIGATION REHABILITATION AND RECONSTRUCTION WORKS IN ADDITION THE CONTRIBUTIONS WILL ADD IMPETUS TO RESEARCH AND DEVELOPMENT IN THIS IMPORTANT DOMAIN THE LONG TERM GOAL IS TO MITIGATE THE UNACCEPTABLE MAGNITUDE OF DESTRUCTION AND THE NUMBER OF HUMAN LIVES LOST SUCH AS IN THE RECENT 2004 TSUNAMI TRAGEDY

BALLAST PLAYS A VITAL ROLE IN TRANSMITTING AND DISTRIBUTING TRAIN WHEEL LOADS TO THE UNDERLYING SUB BALLAST AND SUBGRADE BEARING CAPACITY OF TRACK TRAIN SPEED RIDING QUALITY AND PASSENGER COMFORT ALL DEPEND ON THE STABILITY OF BALLAST THROUGH MECHANICAL INTERLOCKING OF PARTICLES BALLAST ATTRITION AND BREAKAGE OCCUR PROGRESSIVELY UNDER HEAVY CYC

LANDSLIDES IN SENSITIVE CLAYS REPRESENT A MAJOR HAZARD IN THE NORTHERN COUNTRIES OF THE WORLD SUCH AS CANADA FINLAND NORWAY RUSSIA SWEDEN AND IN THE US STATE OF ALASKA PAST AND RECENT EXAMPLES OF CATASTROPHIC LANDSLIDES AT E G SAINT JEAN VIANNEY IN 1971 RISSA IN 1979 FINNEIDFJORD IN 1996 AND KATTMARKA IN 2009 HAVE ILLUSTRATED THE GREAT MOBILITY OF THE REMODED SENSITIVE CLAYS AND THEIR HAZARDOUS RETROGRESSIVE POTENTIAL THESE EVENTS CALL FOR A BETTER UNDERSTANDING OF LANDSLIDE IN SENSITIVE CLAY TERRAIN TO ASSIST AUTHORITIES WITH STATE OF THE ART HAZARD ASSESSMENT METHODS RISK MANAGEMENT SCHEMES MITIGATION MEASURES AND PLANNING DURING THE LAST DECADES THE ELEVATED AWARENESS REGARDING SLOPE MOVEMENT IN SENSITIVE CLAYS HAS LED TO MAJOR ADVANCES IN MAPPING TECHNIQUES AND DEVELOPMENT OF HIGHLY SOPHISTICATED GEOTECHNICAL AND GEOPHYSICAL INVESTIGATION TOOLS GREAT ADVANCES IN NUMERICAL TECHNIQUES DEALING WITH PROGRESSIVE FAILURE AND LANDSLIDE KINEMATIC HAVE ALSO LEAD TO INCREASE UNDERSTANDING AND PREDICTABILITY OF LANDSLIDES IN SENSITIVE CLAYS AND THEIR CONSEQUENCES THIS VOLUME CONSISTS OF THE LATEST SCIENTIFIC RESEARCH BY INTERNATIONAL EXPERTS DEALING WITH GEOLOGICAL GEOTECHNICAL AND GEOPHYSICAL ASPECTS OF SLOPE FAILURE IN SENSITIVE CLAYS AND FOCUSES ON UNDERSTANDING THE FULL SPECTRUM OF CHALLENGES PRESENTED BY LANDSLIDES IN SUCH BRITTLE MATERIALS

GEOTECHNICAL FUNDAMENTALS AND APPLICATIONS IN CONSTRUCTION NEW MATERIALS STRUCTURES TECHNOLOGIES AND CALCULATIONS CONTAINS THE PAPERS PRESENTED AT THE INTERNATIONAL CONFERENCE ON GEOTECHNICAL FUNDAMENTALS AND APPLICATIONS IN CONSTRUCTION NEW MATERIALS STRUCTURES TECHNOLOGIES AND CALCULATIONS GFAC 2019 SAINT PETERSBURG RUSSIA 6-8 FEBRUARY 2019 THE CONTRIBUTIONS PRESENT THE LATEST RESEARCH FINDINGS DEVELOPMENTS AND APPLICATIONS IN THE AREAS OF GEOTECHNICS SOIL MECHANICS FOUNDATIONS GEOLOGICAL ENGINEERING AND SHARE EXPERIENCES IN THE DESIGN OF COMPLEX GEOTECHNICAL OBJECTS AND ARE GROUPED IN 8 SECTIONS ANALYTICAL DECISIONS AND NUMERICAL MODELING FOR FOUNDATIONS DESIGN AND CONSTRUCTION IN GEOLOGICALLY HAZARDOUS CONDITIONS METHODS FOR SURVEYING THE FEATURES OF DISPERSED ROCKY SOILS AND STRUCTURALLY UNSTABLE SOILS EXPLORATION TERRITORY IMPROVEMENT AND RECONSTRUCTION IN CONDITIONS OF COMPACT URBAN PLANNING AND ENTERPRISES ETC CONSTRUCTION RECONSTRUCTION AND EXPLOITATION OF INFRASTRUCTURE FACILITIES IN DIFFERENT SOIL CONDITIONS R D SUPPORT AND QUALITY CONTROL OF NEW MATERIALS DESIGN AND TECHNOLOGY SOLUTIONS IN CONSTRUCTING BASES FOUNDATIONS UNDERGROUND AND SURFACE CONSTRUCTIONS CONDITION SURVEY AND ACCIDENT EVOLUTION ANALYSIS IN CONSTRUCTION UP TO DATE MONITORING TECHNIQUES IN BUILDING CONSTRUCTION AND EXPLOITATION GEOTECHNICAL FUNDAMENTALS AND APPLICATIONS IN CONSTRUCTION NEW MATERIALS STRUCTURES TECHNOLOGIES AND CALCULATIONS COLLECTS THE STATE OF THE ART IN GEOTECHNOLOGY AND CONSTRUCTION AND WILL BE OF INTEREST TO ACADEMIA AND PROFESSIONALS IN GEOTECHNICS SOIL MECHANICS FOUNDATION ENGINEERING AND GEOLOGICAL ENGINEERING

THIS BOOK WILL PRESENT THE SELECT PROCEEDINGS OF THE 8TH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS 8ICRAGEE HELD AT THE INDIAN INSTITUTE OF TECHNOLOGY IIT GUWAHATI BETWEEN DECEMBER 11 AND 14 2024 IT CONTAINS THE LATEST RESEARCH PAPERS COVERING THE CONTRIBUTIONS AND ACCOMPLISHMENTS IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS IN THE LAST FOUR YEARS THE FIVE VOLUMES OF THE BOOK COVER A WIDE RANGE OF TOPICS INCLUDING BUT NOT LIMITED TO SEISMIC HAZARD ANALYSIS WAVE PROPAGATION AND SITE CHARACTERIZATION DYNAMIC PROPERTIES AND LIQUEFACTION OF SOILS PILE FOUNDATIONS OFFSHORE FOUNDATIONS SEISMIC DESIGN OF RETAINING STRUCTURES AND DAMS SEISMIC SLOPE STABILITY AND LANDSLIDES DYNAMIC SOIL STRUCTURE INTERACTION SEISMIC DESIGN OF STRUCTURES FURTHER RECENT DEVELOPMENTS ON THESE TOPICS ARE COVERED IN DIFFERENT CHAPTERS THIS BOOK WILL BE VALUABLE NOT ONLY FOR RESEARCHERS AND PROFESSIONALS BUT ALSO FOR DRAWING AN AGENDA FOR FUTURE COURSES OF ACTION FROM THE PERSPECTIVE OF GEOTECHNICAL EARTHQUAKE ENGINEERING KEEPING THE NATIONAL NEED AT THE FOREFRONT

JUST A FEW METERS BELOW THE EARTH S SURFACE LIE FEATURES OF GREAT IMPORTANCE FROM GEOLOGICAL FAULTS WHICH CAN PRODUCE DEVASTATING EARTHQUAKES TO LOST ARCHAEOLOGICAL TREASURES

THIS REFRESHING UP TO DATE BOOK EXPLORES THE FOUNDATIONS OF INTERPRETATION THEORY AND THE LATEST DEVELOPMENTS IN NEAR SURFACE TECHNIQUES USED TO COMPLEMENT TRADITIONAL GEOPHYSICAL METHODS FOR DEEP EXPLORATION TARGETS CLEAR BUT RIGOROUS THE BOOK EXPLAINS THEORY AND PRACTICE IN SIMPLE PHYSICAL TERMS SUPPORTED BY INTERMEDIATE LEVEL MATHEMATICS TECHNIQUES COVERED INCLUDE MAGNETICS RESISTIVITY SEISMIC REFLECTION AND REFRACTION SURFACE WAVES INDUCED POLARIZATION SELF POTENTIAL ELECTROMAGNETIC INDUCTION GROUND PENETRATING RADAR MAGNETIC RESONANCE INTERFEROMETRY SEISMOELECTRIC AND MORE SECTIONS ON DATA ANALYSIS AND INVERSE THEORY ARE PROVIDED AND CHAPTERS ARE ILLUSTRATED BY CASE STUDIES GIVING STUDENTS AND PROFESSIONALS THE TOOLS TO PLAN CONDUCT AND ANALYZE A NEAR SURFACE GEOPHYSICAL SURVEY THIS IS AN IMPORTANT TEXTBOOK FOR ADVANCED UNDERGRADUATE AND GRADUATE STUDENTS IN GEOPHYSICS AND A VALUABLE REFERENCE FOR PRACTISING GEOPHYSICISTS GEOLOGISTS HYDROLOGISTS ARCHAEOLOGISTS AND CIVIL AND GEOTECHNICAL ENGINEERS

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