Checking Punching Shear Strength By The Aci Code

- Bridge type, behaviour and appearance David Bennett, David Bennett Associates · History of bridge development · Bridge form · Behaviour - Loads and load distribution Mike Ryall, University of Surrey · Brief history of loading specifications · Current code specification · Load distribution concepts · Influence lines - Analysis Professor R Narayanan, Consulting Engineer · Simple beam analysis · Distribution coefficients · Grillage method · Finite elements · Box girder analysis: steel and concrete · Dynamics - Design of reinforced concrete bridges Dr Paul Jackson, Gifford and Partners · Right slab · Skew slab · Beam and slab · Box - Design of prestressed concrete bridges Nigel Hewson, Hyder Consulting · Pretensioned beams · Beam and slab · Pseduo slab · Post tensioned concrete beams · Box girders - Design of steel bridges Gerry Parke and John Harding, University of Surrey · Plate girders · Box girders · Orthotropic plates · Trusses - Design of composite bridges David Collings, Robert Benaim and Associates · Steel beam and concrete · Steel box and concrete · Timber and concrete - Design of arch bridges Professor Clive Melbourne, University of Salford · Analysis · Masonry · Concrete · Steel · Timber - Seismic analysis of design Professor Elnashai, Imperial College of Science, Technology and Medicine · Modes of failure in previous earthquakes · Conceptual design issues · Brief review of seismic design codes - Cable stayed bridges - Daniel Farquhar, Mott Macdonald · Analysis · Design · Construction - Suspension bridges Vardaman Jones and John Howells, High Point Rendel · Analysis · Design · Construction - Moving bridges Charles Birnstiel, Consulting engineer · History · Types · Special problems - Substructures Peter Lindsell, Peter Lindsell and Associates · Abutments · Piers - Other structural elements Robert Broome et al, WS Atkins · Parapets · Bearings · Expansion joints - Protection Mike Mulheren, University of Surrey · Drainage · Waterproofing · Protective coating/systems for concrete · Painting system for steel · Weathering steel · Scour protection · Impact protection - Management systems and strategies Perrie Vassie, Transport Research Laboratory · Inspection · Assessment · Testing · Rate of deterioration · Optimal maintenance programme · Prioritisation · Whole life costing · Risk analysis - Inspection, monitoring, and assessment Charles Abdunur, Laboratoire Central Des Ponts et Chaussées · Main causes of deterioration · Investigation methods · Structural evaluation tests · Stages of structural assessment · Preparing for recalculation - Repair and Strengthening John Darby, Consulting Engineer · Repair of concrete structures · Metal structures · Masonry structures · Replacement of structures

A statistical regression analysis was conducted on 146 selected test results from the literature to evaluate the basic ACI318 two-way shear strength equation, which has not changed since 1963. The basic ACI318 shear equation was established based on a statistical analysis of test results on scaled slab samples that were believed to have failed in shear. Only slabs with square columns, sheared on four sides and without shear reinforcement were needed in this study, resulting in 146 selected test results from 1956 to 2014. The study included slabs with normal and high strength concrete. This study presents new equations for slab punching shear capacity. The effect of several parameters on the punching shear strength is also discussed in this study. A simplified practical punching shear equation is also proposed based on statistical analysis of the experimental results from the database. The new proposed equations include the reinforcement ratio of the slab and the cubic root of the concrete strength. The study also showed that including the reinforcement ratio in the punching shear equation increases its accuracy. The new proposed equations are valid for normal and high strength concrete slabs.

Onshore Structural Design Calculations: Energy Processing Facilities provides structural engineers and designers with the necessary calculations and advanced computer software program instruction for creating effective design solutions using structural steel and concrete, also helping users comply with the myriad of international codes and standards for designing structures that is required to house or transport the material being processed. In addition, the book includes the design, construction, and installation of structural systems, such as distillation towers, heaters, compressors, pumps, fans, and building structures, as well as pipe racks and mechanical and electrical equipment platform structures. Each calculation is discussed in a concise, easy-to-understand manner that provides an authoritative guide for selecting the right formula and solving even the most difficult design calculation. Provides information on the analysis and design of steel, concrete, wood, and masonry building structures and components Presents the necessary international codes and calculations for the construction and the installation of systems Covers steel and concrete structures design in industrial projects, such as oil and gas plants, refinery, petrochemical, and power generation projects, in addition to general industrial projects

Designers' Guide to EN 1992-1-1 and EN 1992-1-2. Eurocode 2: Design of Concrete Structures

Reinforced Concrete

Fibre Reinforced Concrete: Improvements and Innovations II

Enhancement of flat flabs' shear resistance using gabion mesh

Influence of Testing Conditions in Isolated Specimens

Punching Shear Retrofit Method Using Shear Bolts for Reinforced Concrete Slabs Under Seismic Loading

Ultra-high performance concrete (UHPC) is a relatively new type of concrete that exhibits mechanical properties that are far superior to those of conventional concrete and in some cases rival those of steel. The main characteristics that distinguish UHPC from conventional reinforced concrete are its very high compressive strength (20 to 33 ksi), the addition of steel fibers which enables tension to be carried across open cracks without conventional reinforcing steel, and a very high resistance to corrosion and degradation. The mechanical properties of UHPC allow for smaller, thinner sections as compared to conventional reinforced concrete sections. However, as it is a new material, the use of UHPC has been limited to a few structural applications due primarily to the high cost of the material and the lack of established design guidelines. In previous research, a material model based on physical tests was used in conjunction with finite element models to develop an optimized cross-section for a prestressed UHPC girder for bridge applications. The cross-section is a double-tee with bulbs at the bottoms of the webs to accommodate the prestressing strands. As it is envisioned in bridge applications, the double-tees will be placed directly adjacent to one another, and the top flange will act as the riding surface after a thin asphalt overlay is placed. Based on the longitudinal compressive stresses, the top flange of the girder can be quite thin. However, there exists the possibility that a punching shear failure could occur from the application of a point load such as a wheel patch load if the flange is made too thin. The research reported herein was initiated to characterize the punching shear capacity of thin UHPC plates and to develop recommendations on the minimum top flange thickness for the optimized double-tee. Twelve small slabs (45 in x 45 in) were tested to failure to characterize the punching shear strength of UHPC. The variables considered were the slab thickness (2, 2.5, and 3 in) and loading plate dimensions (from 1 in x 1 in to 3 in x 3 in). The results of the testing were compared to several existing models for punching shear. The two equations that predicted strengths most reliably were the current ACI punching shear equation and a modified bolt pull-out equation. After evaluation of the test results, the minimum slab thickness required to prevent a punching shear failure in the top flange due to an 8 in x 20 in wheel patch was determined to be 1 in. Three larger slabs were also tested. These slabs had the same clear span length as the top flange of the optimized double-tee and were loaded with a wheel patch load. The slabs were all approximately 3 in thick and all failed in flexure rather than punching shear. It was concluded that the casting method has a strong influence on the orientation of the steel fibers, which in turn influences the flexural strength in orthogonal directions in the slab. The top flange thickness will be governed by transverse bending rather than punching shear, and the 3 in slabs were not able to support the full wheel load plus impact and load factor. The results of this research help in the continued optimization of a UHPC shape for use in highway bridges. If material use in the girder is minimized, UHPC bridges can become economically competitive with HPC bridges, but offer the benefits of more rapid construction and better durability.

Tubular Structures XVI contains the latest scientific and engineering developments in the field of tubular steel structures, as presented at the 16th International Symposium on Tubular Structures (ISTS16, Melbourne, Australia, 4-6 December 2017). The International Symposium on Tubular Structures (ISTS) has a long-standing reputation for being the principal showcase for manufactured tubing and the prime international forum for presentation and discussion of research, developments and applications in this field. Various key and emerging subjects in the field of hollow structural sections are covered, such as: special applications and case studies, static and fatigue behaviour of connections/joints, concrete-filled and composite tubular members and offshore structures, earthquake and dynamic resistance, specification and standard developments, material properties and section forming, stainless and high-strength steel structures, fire, impact and blast response. Research and development issues presented in this topical book are applicable to buildings, bridges, offshore structures, cranes, trusses and towers. Tubular Structures XVI is thus a pertinent reference source for architects, civil and mechanical engineers, designers, steel fabricators and contractors, manufacturers of hollow sections or related construction products, trade associations involved with tubing, owners or developers of tubular structures, steel specification committees, academics and research students all around the world.

Punching shear of structural concrete slabsTechnical reportFIB - Féd. Int. du Béton

Structural & Construction Conf

High Tech Concrete: Where Technology and Engineering Meet

Applied Mechanics and Civil Engineering VI

Proceedings of Tubular Structures XII, Shanghai, China, 8-10 October 2008

A Study of Punching Shear in Arctic Offshore Structures

High strength concrete FIP CEB Bulletin 197

Objective of conference is to define knowledge and technologies needed to design and develop project processes and to produce high-quality, competitive, environment- and consumer-friendly structures and constructed facilities. This goal is clearly related to the development and (re)-use of quality materials, to excellence in construction management and to reliable measurement and testing methods.

An experimental program was conducted to investigate the structural behaviour of two-way slabs made with Self-consolidating concrete (SCC). Four different SCC mixtures were developed with targeted compressive strength of 30 MPa. Mixtures A and B contained maximum coarse aggregate size of 10 mm, and coarse to fine aggregate ratio (C/F) of 0.70 and 1.20, respectively. Mixtures C and D contained a larger coarse aggregate size of 20 mm, and (C/F) of 0.70 and 1.20, respectively. The properties of the fresh and hardened concrete for each mixture were measured. Each concrete mixture was used to construct three slabs with different thicknesses of 150 mm, 200 mm, and 250 mm. Thus, a total of twelve slabs were tested in the experimental program. All test slabs had a reinforcement ratio of approximately 1.0%. Hence, the main parameters in the experimental program were the coarse aggregate size, coarse to fine aggregate ratio, and slab depth. The structural behaviour of the slabs was examined under static monotonic load with regard to the deformations, strains in the reinforcement and concrete, ultimate capacity, modes of failure, and crack development. The C/F ratio and maximum aggregate size do not show significant influence on the slab deformation characteristics such as deflection, stiffness, ductility and energy absorption, steel and concrete strains and cracking characteristics. The slab thickness has the most significant effect among the test parameters on the behaviour of the test slabs. The depth and aggregate size are the most influential parameters on the capacity of the slab; increasing the slab thickness lead to a decrease in the normalized shear strength of the slab while increasing the aggregate size lead to an increase in the normalized shear strength of the slab. The Critical Shear Crack Theory (CSCT) by Muttoni (2008) is able to reasonably predict the structural behaviour of the test slabs. However, the predictions of the capacity by the CSCT had a high scatter. In addition, the test results did not show any clear trend in the relationship between the aggregate size and the slab rotation. The Canadian Code (CSA A23.3-04), the American Code (ACI 318-11) and the British Code (BS8110-97) give safe predictions of the capacity of the SCC test slabs. The predictions of those codes are more conservative and have less scatter when applied to SCC slabs with 20 mm coarse aggregate size compared to those with 10 mm coarse aggregate size. Therefore, these codes can be safely used to check the punching shear capacity of SCC slabs without the need of any modification to the equations used for such shear check. The predictions of the Eurocode (EC2) are unsafe for most of the slabs with thicknesses of 200 mm and 250 mm. Hence, further research is needed to examine the use of EC2 in the design of SCC slabs for punching shear.

"Twelve peer-reviewed papers demonstrate the continuing advancement in the understanding of dimension stone used in building construction. Topics cover: Strength Testing--addresses testing to determine strength characteristics of dimension stone cladding panels. Design--covers a wide range of topics, including the advantages and disadvantages of three common dimension stone paving installation techniques; the relationships between stone material strength, anchorage strength, and induced stress states for four common dimension stone cladding anchorage configurations; and more. Evaluation and Investigation--provides observations regarding investigations into the causes of dimension stone cladding deterioration and failure. Durability--discusses the complex issue of dimension stone durability using three different approaches; a large-scale European research project to investigate the causes of marble and limestone cladding panel bowing, develop preconstruction testing parameters to assess bowing potential, and assess proposed remedial efforts to reduce or inhibit ongoing bowing; and more."--Publisher's website.

Design of Reinforced Concrete Foundations

Strut-and-tie Model for Punching Shear of Concrete Slabs

Properties, Testing, and Laboratory Exercises, Third Edition

Technical report

Tubular Structures XVI

Combined Punching Shear and Torsional Shear in Reinforced Concrete Slabs

fib Bulletin 81 reports the latest information available to researchers and practitioners on the analysis, design and experimental evidence of punching shear of structural concrete slabs. It follows previous efforts by the International Federation for Structural Concrete (fib) and its predecessor the Euro-International Committee for Concrete (CEB), through CEB Bulletin 168, Punching Shear in Reinforced Concrete (1985) and fibBulletin 12, Punching of structural concrete slabs (2001), and an international symposium sponsored by the punching shear subcommittee of ACI Committee 445 (Shear and Torsion) and held in Kansas City, Mo., USA, in 2005. This bulletin contains 18 papers that were presented in three sessions as part of an international symposium held in Philadelphia, Pa., USA, on October 25, 2016. The symposium was co-organized by the punching shear sub-committee of ACI 445 and by fib Working Party 2.2.3 (Punching and Shear in Slabs) with the objectives of not only disseminating information on this important design subject but also promoting harmonization among the various design theories and treatment of key aspects of punching shear design. The papers are organized in the same order they were presented in the symposium. The symposium honored Professor Emeritus Neil M. Hawkins (University of Illinois at Urbana-Champaign, USA), whose contributions through the years in the field of punching shear of structural concrete slabs have been paramount. The papers cover key aspects related to punching shear of structural concrete slabs under different loading conditions, the study of size effect on punching capacity of slabs, the effect of slab reinforcement ratio on the response and failure mode of slabs, without and with shear reinforcement, and its implications for the design and formulation in codes of practice, an examination of different analytical tools to predict the punching shear response of slabs, the study of the post-punching response of concrete slabs, the evaluation of design provisions in modern codes based on recent experimental evidence and new punching shear theories, and an overview of the combined efforts undertaken jointly by ACI 445 and fib WP 2.2.3 to generate test result databanks for the evaluation and calibration of punching shear design recommendations in North American and international codes of practice.

This volume highlights the latest advances, innovations, and applications in the field of fibre-reinforced concrete (FRC), as presented by scientists and engineers at the RILEM-fib X International Symposium on Fibre Reinforced Concrete (BEFIB), held in Valencia, Spain, on September 20-22, 2021. It discusses a diverse range of topics concerning FRC: technological aspects, nanotechnologies related with FRC, mechanical properties, long-term properties, analytical and numerical models, structural design, codes and standards, quality control, case studies, Textile-Reinforced Concrete, Geopolymers and UHPFRC. After the symposium postponement in 2020, this new volume concludes the publication of the research works and knowledge of FRC in the frame of BEFIB from 2020 to 2021 with the successful celebration of the hybrid symposium BEFIB 2021. The contributions present traditional and new ideas that will open novel research directions and foster multidisciplinary collaboration between different specialists.

The recent worldwide boom in industrial construction and the corresponding billions of dollars spent every year in industrial, oil, gas, and petrochemical and power generation project, has created fierce competition for these projects. Strong management and technical competence will bring your projects in on time and on budget. An in-depth explorat

Mechanics and Design

Dimension Stone Use in Building Construction

Deformation and Progressive Failure in Geomechanics

Proceedings of the International Conference on Concrete Slabs Held at Dundee University, 3-6 April 1979

Rethinking Bridge Deck Longevity and Maintenance with Portland Cement Polymer Concrete

This study summarizes experimental results of the punching shear behavior of reinforced concrete slab-column connections containing fiber reinforcement. Fiber reinforcement is particularly attractive and beneficial for concrete, especially where shear stresses are involved. Tests are reported on simply supported slab specimens loaded through a stub column to study the effect of several parameters, namely, type, volume, fraction, and aspect ratio of fibers. The experimental tests on reinforced concrete slabs showed that fiber reinforcement can contribute significantly to the enhancement of punching shear strength and ductility of concrete structural members. This increase is function of the fiber volume and fiber type. A simple empirical relationship describing the effect of steel fibers on the punching shear strength of slab-column connections is derived based on the results of this test and other experimental results reported in technical literature.

To assess the two-way shear resistance, or punching shear strength, of reinforced concrete slabs, code provisions fitted from experimental data are typically employed. The experimental data forming the bases of these provisions have generally consisted of isolated slab-column connection tests that seek to represent the negative moment region of a flat plate slab. This research is focused on exploring the variation in the punching performance of slab-column connections when the typical testing conditions used to investigate isolated slab specimen are varied in a manner that produces alternative sectional loading conditions within the column connection region. To accomplish this, an innovative testing apparatus is introduced that permits alternative combinations of slab bending moment to out-of-plane shear force ratios to be applied to the slab-column connection. Results are presented from an experimental program conducted at the Ferguson Structural Engineering Laboratory (FSEL) of The University of Texas at Austin and an analysis is presented comparing the results from the tests with estimations made from current standards, the Critical Crack Shear Theory (CSCT), and also from numerical models. The data obtained from the experimental program are used to scrutinize current design and analysis procedures, and to shed light on the significance of the sectional loading conditions in the light of flat plate connection shear resisting performance.

Punching is considered to be one of the most difficult problems in structural concrete design and mechanical models or theoretical analyses were developed rather late in the history of concrete research attempts. This fib Bulletin reviews the development of design models and theoretical analyses since the CEB Bulletin 168 Punching Shear in Reinforced Concrete - State-of-the-Art Report published in 1985. The role of the concrete tensile strength was specially addressed. In this respect the present bulletin is also following-up the CEB Bulletin 237 Concrete Tension and Size Effects - Utilisation of concrete tension in structural concrete design and relevance of size effect - Contributions from CEB Task Group 2.7 published in 1997. Apart from new theoretical developments a comprehensive databank for comparisons with experimental evidence is included. About 400 punching tests were critically reviewed and evaluated in a consistent manner. This is thought to be the first step towards a generally agreed selection of reliable tests. The evident value of such a data bank is illustrated by comparisons carried out between the data and some of the analytical proposals as well as empirical code formulas. List of contents : (1) Introduction, (2) Code equations, (3) Mechanical models for punching, (4) New developments for mechanical models, (5) Numerical investigations, (7) Comparison of mechanical models and test results of slabs without shear reinforcement, (8) Comparison of code rules and tests of flat slabs without shear reinforcement, (9) Comparison of codes, models and tests of flat slabs with shear reinforcement, (10) Experimental investigations, (11) Summary and conclusions, References, Appendices : (I) Databank on slabs without shear reinforcement, (II) Databank on slabs with shear reinforcement, (III) Comparison of test data with code rules, (IV) Comparison of test data with selected models, (V) Notations.

Punching of Structural Concrete Slabs

The Manual of Bridge Engineering

Tubular Structures XII

Construction Management and Design of Industrial Concrete and Steel Structures
Experimental Testing of Punching Shear Resistance of Concrete Foundations
Advances in Concrete Slab Technology

Advances in Concrete Slab Technology documents the proceedings of the International Conference on Concrete Slabs held at Dundee University on April 3-6, 1979. This book discusses the influence of steel fiber-reinforcement on the shear strength of slab-column connections; sulfur-treated concrete slabs; yield line analysis of orthotropicaly reinforced exterior panels of flat slab floors; and behavior of flat slab/edge column joints. The design of multiple panel flat slab structures; structural behavior of floor slabs in shear wall buildings; shrinkage and cracking of concrete at early ages; and slab construction for HAB system modules are also elaborated. This text likewise covers the direct finishing of concrete slabs using the early age power grinding technique; application of vacuum dewatering to in-situ slab production; retexturing of concrete slabs; and fatigue resistance of composite precast and in situ concrete floors. This publication is a good reference for students and individuals concerned with the practices and research relating to slab technology.

Reinforced concrete slab-column structures are widely used because of their practicality. However, this type of structures can be subject to punching-shear failure in the slab-column connections. Without shear reinforcement, the slab-column connection can undergo brittle punching failure, especially when the structure is subject to lateral loading in seismic zones. The shear bolts are a new type of transverse reinforcement developed for retrofit of existing structures against punching. This research focuses on how the shear bolts can improve the punching-shear capacity and ductility of the existing slab-column connections under vertical service and lateral seismic loads.

The properties of materials provide key information regarding their appropriateness for a product and how they will function in service. The Third Edition provides a relevant discussion and vital examples of the fundamentals of materials science so that these details can be applied in real-world situations. Horath effectively combines principles and theory with practical applications used in today's machines, devices, structures, and consumer products. The basic premises of materials science and mechanical behavior are explored as they relate to all types of materials: ferrous and nonferrous metals; polymers and elastomers; wood and wood products; ceramics and glass; cement, concrete, and asphalt; composites; adhesives and coatings; fuels and lubricants; and smart materials. Valuable and insightful coverage of the destructive and nondestructive evaluation of material properties builds the groundwork for inspection processes and testing techniques, such as tensile, creep, compression, shear, bend or flexure, hardness, impact, and fatigue. Laboratory exercises and reference materials are included for hands-on learning in a supervised environment, which promotes a perceptive understanding of why we study and test materials and develop skills in industry-sanctioned testing procedures, data collection, reporting and graphing, and determining additional appropriate tests.

Fatigue-resistant Design of Cantilevered Signal, Sign, and Light Supports
Statistical Analysis and Modeling of Test Results for Punching Shear of Concrete Slabs Around Square Columns
Fundamentals of Materials Science for Technologists
Proceedings of the 2017 fib Symposium, held in Maastricht, The Netherlands, June 12-14, 2017
Effect of Fibers on the Punching Shear Strength of Reinforced Concrete Slabs
The Magazine of the National Bureau of Standards, U.S. Department of Commerce

This book contains the proceedings of the fib Symposium “High Tech Concrete: Where Technology and Engineering Meet”, that was held in Maastricht, The Netherlands, in June 2017. This annual symposium was organised by the Dutch Concrete Association and the Belgian Concrete Association. Topics addressed include: materials technology, modelling, testing and design, special loadings, safety, reliability and codes, existing concrete structures, durability and life time, sustainability, innovative building concepts, challenging projects and historic concrete, amongst others. The fib (International Federation for Structural Concrete) is a not-for-profit association committed to advancing the technical, economic, aesthetic and environmental performance of concrete structures worldwide.

Primarily Written For The Students Of Civil Engineering And Practising Engineers Involved In The Testing Of Building Materials, The Manual Describes In Straight-Forward And Systematic Manner The Testing Of Engineering Materials. Each Test Given In The Manual Outlines The Objectives, Theory, Apparatus Requirements, Procedures, Precautions, Questions For Discussion And Observations And Calculations. For All The Tests Specified, The Procedure Is Based On The Relevant Indian Standard Code Of Practice Which Is The Usual Accepted Method Of Performing The Tests. The Manual Can Be Used By Students And Field Engineers For Keeping The Record Of Tests Performed In The Laboratory. Since Each Test Requires A Different Reference Of The Indian Standard Codes, It May Not Be Practically Feasible In The Field Conditions And Therefore This Manual Comes Quite Handy For These Situations.It Will Be Invaluable And Indispensable Manual For Imparting Effective Instructions To Diploma And Under Graduate Level Students As Also To Field Engineers.

Applies to the design of building and civil engineering structures in plain, reinforced and pre-stressed concrete. The code (for convenience referred to as EC2) is written in several parts: EN 1992 - 1 - 1; EN 1992 - 1 - 2; EN 1992 - 2; and EN 1992 - 3.

X RILEM-fib International Symposium on Fibre Reinforced Concrete (BEFIB) 2021
Punching Shear in Reinforced Concrete Slabs
Two-way Shear Strength of Reinforced Concrete Slab-column Connections
Onshore Structural Design Calculations
How to Design Concrete Structures Using Eurocode 2
Punching shear in reinforced concrete state of the art report

Presentation of the latest scientific and engineering developments in the field of tubular steel structures. Covers key and emerging subjects of hollow structural sections, such as: static and fatigue behaviour of connections/joints, concrete filled hollow sections and composite tubular members, offshore structures, earthquake resistance,

Applied Mechanics and Civil Engineering VI includes the contributions to the 6th International Conference on Applied Mechanics and Civil Engineering (AMCE 2016, Hong kong, China, 30-31 December 2016), and showcases the challenging developments in the areas of applied mechanics, civil engineering and associated engineering practice. The book covers a wide variety of topics: - Applied mechanics and its applications in civil engineering; - Bridge engineering; - Underground engineering; - Structural safety and reliability; - Reinforced concrete (RC) structures; - Rock mechanics and rock engineering; - Geotechnical in-situ testing & monitoring; - New construction materials and applications; - Computational mechanics; - Natural hazards and risk, and - Water and hydraulic engineering. Applied Mechanics and Civil Engineering VI will appeal to professionals and academics involved in the above mentioned areas, and it is expected that the book will stimulate new ideas, methods and applications in ongoing civil engineering advances.

Bridge deck deterioration in the northern Midwest creates significant costs to state Departments of Transportation (DOT's) in the region. The fundamental cause of the problem is low tensile strength and water permeable reinforced concrete resulting in deck cracking and ultimately reinforcing bar corrosion. Portland Cement Polymer Concrete (PCPC) combined with a design approach tailored to its advantages could virtually eliminate early deck deterioration and the associated costs providing an alternative asset management path for bridge decks. Bridge decks would no longer have to be removed from their substructure every fifteen years and replaced. The results would be higher quality, longer lasting bridge decks with lower life cycle costs. This project will demonstrate the feasibility and methodology of such a strategy. This project will develop a strategy that combines innovative concrete materials, novel design and cost analysis that enhances the longevity and reduces the life cycle cost of highway bridge decks. The project is expected to show significant life-cycle cost advantages to using a high performance bridge deck material.

Power Plant and Energy Processing Facilities
Characterization of the Punching Shear Capacity of Thin Ultra-high Performance Concrete Slabs
Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary (ACI 318R-05)
Technical Report
Punching Shear of Self-consolidated Two-way Slabs
Punching shear of structural concrete slabs

Foundation structures, their testing, and modeling are a wide area to research. A lot of different concrete elements are tested and modeled in the world. Analysis of interaction between the foundation structures and the subsoil has been developed for many years. For the determination of stress in foundation structure, it is needed to determine the influence of the stiffness, respectively, the pliability of subsoil to structural internal forces, and vice versa, how the stiffness of the foundation structure affects the resulting subsidence. This chapter deals with experimental tests of concrete foundation slabs. Tests are carried out at the steel test frame structure by dimension 2 × 2.5 × 5 m, which is placed open air at the Faculty of Civil Engineering in Ostrava. Tested slabs are by dimension 2 × 2 m and have different thickness between 100 and 200 mm. A lot of physical quantities are tested in those experiments and experiments are then multidisciplinary because geotechnical, acoustic, strain gauges, and deformation measurements are conducted. This chapter addresses especially with punching shear analysis and maximum punching resistance. A number of experimental tests of concrete foundation slabs were carried out. Slabs classically reinforced, prestressed, or FRC were tested, but slabs were not reinforced with shear reinforcement. During the experiment, the interaction between the concrete foundation and the subsoil was monitored. Most of the slabs were disrupted by punching shear. If the slab was disrupted by punching shear, dimension and shape of the punching failure were monitored and measured, and results were compared between them. Last but not the least, results from the experiment and results according to design methods used in EC2 are compared in this chapter. The maximum shear design force according to EC2 was lower than the one from the experiment.

Based on the 1995 edition of the American Concrete Institute Building Code, this text explains the theory and practice of reinforced concrete design in a systematic and clear fashion, with an abundance of step-by-step worked examples, illustrations, and photographs. The focus is on preparing students to make the many judgment decisions required in reinforced concrete design, and reflects the author's experience as both a teacher of reinforced concrete design and as a member of various code committees. This edition provides new, revised and expanded coverage of the following topics: core testing and durability; shrinkage and creep; bases the maximum steel ratio and the value of the factor on Appendix B of ACI318-95; composite concrete beams; strut-and-tie models; dapped ends and T-beam flanges. It also expands the discussion of STMs and adds new examples in SI units.

Progressive failure has been a classical problem in the field of geotechnical engineering and has attracted considerable attention in connection with slope stability and foundation problems. It is associated with strain localization or shear banding and is also related to damage in material structures. As knowledge of the progressive failure mechanism increases, it is now necessary to establish effective communications between researchers and engineers. The International Symposium on Deformation and Progressive Failure in Geomechanics provided an opportunity for discussing recent advances in this area. A total of 136 papers were contributed from 22 countries. As well as these, the symposium proceedings also contain 8 interim technical reports on the subject by the members of the Asian Technical Committee of the International Society for Soil Mechanics and Foundation Engineering and the Japanese Geotechnical Society National Committee on Progressive Failure in Geo-structures.

A New Punching Shear Strengthening Technique for Reinforced Concrete Slabs at Interior Slab-column Connections
General Rules and Rules for Buildings and Structural Fire Design
Behavior of Reinforced Concrete Slabs Subjected to Combined Punching Shear and Biaxial Tension
Dimensions
Proceedings of the 16th International Symposium for Tubular Structures (ISTS 2017, 4-6 December 2017, Melbourne, Australia)
Laboratory Manual on Testing of Engineering Materials

Master's Thesis from the year 2018 in the subject Engineering - Civil Engineering, grade: very good, Mekelle University (Ethiopian Institute of Technology), course: Msc in structural engineering, language: English, abstract: This thesis presents study of punching shear capacity of flat slab-column junctions. A three dimensional nonlinear finite element program based on 8 node solid elements was used to carry out the nonlinear analysis of flat-slab models with and without gabion-mesh. The effect of gabion arrangements for punching and the ultimate load prediction for each was presented in this thesis. The results obtained from abaqus were compared to code prediction results, and the failure mode also compared to experimental and code predicted failure modes. The predicted mode of failure and other responses are in a good correlation to euro code predicted values. In addition to punching gabion has greater resistance to flexure by increasing the stiffness of the slab. Finally it is concluded that using hexagonal gabion mesh at tension part is easy, effective and can solve construction difficulty of drop panels and one layer gabion can reduce 10mm of slab thickness. Punching strength is a critical point in the design of flat slabs and due to the lack of a theoretical method capable of explaining this phenomenon, empirical formulations presented by codes of practice are still the most used method to check the punching resistance of slab-column connections. Flat slab is a reinforced concrete slab supported directly by concrete columns without the use of beams. This type of slab is appropriate for most floor situations and also for irregular column layouts. Because of its aesthetic view, simplicity for construction, reduction of foundation cost, this becomes very common and competitive structural system for cast-in-place slabs in buildings. Flat plates allow easy and flexible partitioning of space and reduce the overall height of tall buildings. But since the load is directly transferred from slab to column due to high localized force at the column punching effect or punching shear failure is critical. This type of failure is catastrophic because no visible signs are shown prior to failure. To increase the punching resistance of the flat slab several methods have been used, such as drop panel, column capital, column head and shear reinforcements such as shear stud and stirrups. In our country Ethiopia the first three mechanisms are used to increase the resistance of punching shear in flat slabs but shear reinforcements are being used in other countries such as America and British.