Modeling Of Creep For Structural Analysis Foundations Of Engineering Mechanics

The research objective is to develop a comprehensive non-isothermal creep-damage model based on transitions of creep and long-term strength in a wide stress range. The study comprises the following topics: basic assumptions of creep constitutive modeling; conventional isotropic and anisotropic creep-damage models; comprehensive non-isothermal creep-damage models for a wide stress range. The proposed creep-damage model is based on several assumptions derived from creep experiments and microstructural observations for various advanced heat resistant steels. The constitutive equation affects the stress range dependent behavior demonstrating the power-law to linear creep transition with a decreasing stress. To take into account the primary creep behavior a strain hardening function is introduced. To characterize the creep-rupture behavior the constitutive equation is generalized by introduction of two damage internal state variables and appropriate evolution equations. The examples of long-term strength analysis for various industrial components are highlighted to illustrate the importance of the continuum damage mechanics approach for the life-time assessments in structural analysis.

This volume presents the major outcome of the IUTAM symposium on "Advanced Materials Modeling for Structures". It discusses advances in high temperature materials research, and also to provides a discussion the new horizon of this fundamental field of applied mechanics. The topics cover a large domain of research but place a particular emphasis on multiscale approaches at several length scales applied to non linear and heterogeneous materials. Discussions of new approaches are emphasised from various related disciplines, including metal physics, micromechanics, mathematical and computational mechanics.

The Third IUTAM Symposium on Creep in Structures was held at Leicester University in September 1980 thereby continuing the tradition of a ten yearly review of progress in structural creep initiated by the previous symposia held at Stanford University in 1960 and Chalmers University in 1970. The thirty eight papers and their

discussions cont ained in this volume testify to the vigour of research into the creep of structures at the present time. During the last ten years a gradual change of emphasis has occurred in creep research from studies of deformation and stability towards the description of continuum damage and creep crack propagation. At the same time design techniques have developed based upon reference stress techniques and bounding theorems, and a continued interest has been maintained in the development of constitutive equations and in stability studies. All these developments are reflected in the compos ition of the papers in the volume and in the discussions and reviews.
This second part of the work on creep modeling offers readers essential guidance on practical computational simulation and analysis. Drawing on constitutive equations for creep in structural materials under multi-axial stress states, it applies these equations, which are developed in detail in part 1 of the work, to a diverse range of examples.
Modeling of Creep for Structural Analysis
Unified Creep-plasticity Model for Structural Metals at High Temperature. [LMFBR].
A Comparative Study of Existing and Newly Proposed Models for Creep

Deformation and Life Prediction of Si3N4
fib Model Code for Concrete Structures 2010
Proceedings of the CONCREEP 8 conference held in Ise-Shima, Japan, 30 September - 2 October 2008

The modeling of mechanical properties of materials and structures is a complex and wide-ranging subject. In some applications, it is sufficient to assume that the material remains elastic, i.e. that the deformation process is fully reversible and the stress is a unique function of strain. However, such a simplified assumption is appropriate only within a limited range, and in general must be replaced by a more realistic approach that takes into account the inelastic processes such as plastic yielding or cracking. This book presents a comprehensive treatment of the most important areas of plasticity and of time-dependent inelastic behavior (viscoplasticity of metals, and creep and shrinkage of concrete). It covers structural aspects such as: * incremental analysis * limit analysis * shakedown analysis * optimal design * beam structures subjected to bending and torsion * yield line theory of plates * slip line theory * size effect in structures * creep and shrinkage effects in concrete structures. The following aspects of the advanced material modeling are presented: * yield surfaces for metals and plastic-frictional materials * hardening and softening * stress-return algorithms * large-strain formulations * thermodynamic framework * microplane models * localization of plastic strain. Inelastic Analysis of Structures is a textbook for basic and advanced courses on plasticity, with a slight emphasis on structural engineering applications, but with a wealth of material for geotechnical, mechanical, aerospace, naval, petroleum and nuclear engineers. The text is constructed in a very didactical way, while the mathematics has been kept rigorous.

The phenomena of creep and fatigue have each been thoroughly studied. More recently, attempts have been made to predict the damage evolution in engineering materials due to combined creep and fatigue loading, but these formulations have been strictly empirical and have not been used successfully outside of a narrow set of conditions. This work proposes a new creep-fatigue crack growth model based on constitutive creep equations (adjusted to experimental data) and Paris law fatigue crack growth. Predictions from this model are compared to experimental data in two steels: modified 9Cr-1Mo steel and AISI 316L stainless steel.

One of the inherent modeling problems in structural engineering is creep of quasi-brittle materials (e.g., concrete and masonry). The creep strain represents the non-instantaneous strain that occurs with time when the stress is sustained. Several creep models with limited accuracy have been developed within the last few decades to predict creep of concrete and masonry structures. The stochastic nature of creep deformation and its reliance on a large number of uncontrolled parameters (e.g., relative humidity, age of loading, stress level) makes the process of prediction difficult, and yet accurate mathematical model almost impossible. This study investigates the potential use of Dynamic Neural Network (DNN) for predicting creep of structural masonry. The main motive of use DNN is that DNN could memorize the sequential or time-varying patterns while training process. Thus, DNN becomes more capable of capturing the time-dependent of creep deformation than the static networks. The results showed that the developed DNN models are able to predict the creep deformation with an excellent level of accuracy compared with that of conventional methods and the static networks models.

A constitutive theory for use in high-temperature structural analysis of breeder reactor components is presented. It is unified in the sense that plastic and creep strains are considered to arise from similar physical mechanisms. The theory is presented in multiaxial terms along with a discussion of its underlying assumptions, its relationship to other theories and the experimental observations upon which it is based and is intended to model. The results of an extensive parameter sensitivity study are reported which provide understanding of the influence of the various model parameters on the critical features of predicted response.

Deterministic and Probabilistic Approach

Creep

3rd Symposium, Leicester, UK, September 8–12, 1980

A New Method to Solve Nonlinear Creep Problems in Structural Mechanics Using Incompatible Isoparametric Finite Elements

Modeling High Temperature Materials Behavior for Structural Analysis

The EURO-C conference series (Split 1984, Zell am See 1990, Innsbruck 1994, Badgastein 1998, St Johann im Pongau 2003, Mayrhofen 2006, Schladming 2010, St Anton am Alberg 2014) brings together researchers and practising engineers concerned with theoretical, algorithmic and validation aspects associated with computational simulations of concrete and

The creep and shrinkage of concrete are complex phenomena which are not yet fully understood and there is a pressing need to solve the fundamental problems of creep and shrinkage and to develop adequate methods of predicting the structural performance of concrete members and structures affected by them. The aim of this book is to discuss the results of experimental research, to summarize various approaches to the prediction of creep and shrinkage, and to present suitable methods of structural creep analysis which allow the creep and shrinkage effects to be simply calculated. Particular attention is paid to methods which are intended for use as design tools. The first chapter deals with the fundamental features of creep and shrinkage of concrete according to the results of experimental research, while the second is devoted to the mathematical modeling of creep and shrinkage of concrete and to the practical prediction of these phenomena. Several practical models for predicting mean cross section creep and shrinkage are also presented.

An extensive and comprehensive survey of one- and three-dimensional damage models for elastic and inelastic solids. The book not only provides a rich current source of knowledge, but also describes examples of practical applications, numerical procedures, and computer codes. The style throughout is systematic, clear, and concise, and supported by illustrative diagrams. The state of the art is given by some 200 references.

Creep and fatigue are the most prevalent causes of rupture in superalloys, which are important materials for industrial usage, e.g. in engines and turbine blades in aerospace or in energy producing industries. As temperature increases, atom mobility becomes appreciable, affecting a number of metal and alloy properties. It is thus vital to find new characterization methods that allow an understanding of the fundamental physics of creep in these materials as well as in pure metals. Here, the author shows how new in situ X-ray investigations and transmission electron microscope studies lead to novel explanations of high-temperature deformation and creep in pure metals, solid solutions and superalloys. This unique approach is the first to find unequivocal and quantitative expressions for the macroscopic deformation rate by means of three groups of parameters: substructural characteristics, physical material constants and external conditions. Creep strength of the studied up-to-date single crystal superalloys is greatly increased over conventional polycrystalline superalloys. From the contents: - Macroscopic characteristics of strain at high temperatures - Experimental equipment and technique of in situ X-ray investigations - Experimental data and structural parameters in deformed metals - Subboundaries as dislocation sources and obstacles - The physical mechanism of creep and the quantitative structural model - Simulation of the parameters evolution - System of differential equations - High-temperature deformation of industrial superalloys - Single crystals of superalloys - Effect of composition, orientation and temperature on properties - Creep of some refractory metals For materials scientists, solid state physicists, solid state chemists, researchers and practitioners from industry sectors including metallurgical, mechanical, chemical and structural engineers.

Part II. Solution Procedures and Structural Analysis Examples

Proceedings of the Fifth International RILEM Symposium, Barcelona, Spain, September 6-9, 1993

Part I: Continuum Mechanics Foundations and Constitutive Models

Material Modeling and Structural Mechanics

Modeling of Material Damage and Failure of Structures

In order to describe long term creep behavior of structural lumber in a natural environment, a bending test with twenty Douglas-Fir beams subjected to a constant load was set up in an open shed in the Forest Research Laboratory at Oregon State University. Deflections of the beams were measured along with daily fluctuations in temperature and relative humidity. An existing five-element creep model was used to predict the creep strain and compared to the

experimental data. The model did not predict creep behavior of structural lumber in a natural environment. The general observations showed that stiffness of the beams has a strong influence on the magnitude of creep strain, and the creep strain closely follows the fluctuations in air temperature. The mechano-sorptive creep strain in this experiment is likely to be the shrinking and swelling on the surfaces of the beam and is not tied to the moisture content (MC) of the entire beam, which changed very little over a one year period. Four-element Burger model and power law empirical model were modified to include the stiffness of the beams and air temperature effects. Both models fit the experimental data very well.
This book presents various questions of continuum mechanical modeling in the context of experimental and numerical methods, in particular, multi-field problems that go beyond the standard models of continuum mechanics. In addition, it discusses dynamic problems and practical solutions in the field of numerical methods. It focuses on continuum mechanics, which is often overlooked in the traditional division of mechanics into statics, strength of materials and kinetics. The book is dedicated to Prof. Volker Ulbricht, who passed away on April 9, 2021.
This comprehensive treatise covers in detail practical methods of analysis as well as advanced mathematical models for structures highly sensitive to creep and shrinkage. Effective computational algorithms for century-long creep effects in structures, moisture diffusion and high temperature effects are presented. The main design codes and recommendations

(including RILEM B3 and B4) are critically compared. Statistical uncertainty of century-long predictions is analyzed and its reduction by extrapolation is discussed, with emphasis on updating based on short-time tests and on long-term measurements on existing structures. Testing methods and the statistics of large randomly collected databases are critically appraised and improvements of predictions of multi-decade relaxation of prestressing steel, cyclic creep in bridges, cracking damage, etc., are demonstrated. Important research directions, such as nanomechanical and probabilistic modeling, are identified, and the need for separating the long-lasting autogenous shrinkage of modern concretes from the creep and drying shrinkage data and introducing it into practical prediction models is emphasized. All the results are derived mathematically and justified as much as possible by extensive test data. The theoretical background in linear viscoelasticity with aging is covered in detail. The didactic style makes the book suitable as a textbook. Everything is properly explained, step by step, with a wealth of application examples as well as simple illustrations of the basic phenomena which could alternate as homeworks or exams. The book is of interest to practicing engineers, researchers, educators and graduate students.

* Numerous line drawings with consistent format and units allow easy comparison of the behavior of a very wide range of materials * Transmission electron micrographs provide a direct insight in the basic microstructure of metals deforming at high temperatures * Extensive literature review of over 1000 references provide an excellent reference document,

and a very balanced discussion Understanding the strength of materials at a range of temperatures is critically important to a huge number of researchers and practitioners from a wide range of fields and industry sectors including metallurgists, industrial designers, aerospace R&D personnel, and structural engineers. The most up-to date and comprehensive book in the field, Fundamentals of Creep in Metals and Alloys discusses the fundamentals of time-dependent plasticity or creep plasticity in metals, alloys and metallic compounds. This is the first book of its kind that provides broad coverage of a range of materials not just a sub-group such as metallic compounds, superalloys or crystals. As such it presents the most balanced view of creep for all materials scientists. The theory of all of these phenomena are extensively reviewed and analysed in view of an extensive bibliography that includes the most recent publications in the field. All sections of the book have undergone extensive peer review and therefore the reader can be sure they have access to the most up-to-date research, fully interrogated, from the world ' s leading investigators. · Numerous line drawings with consistent format and units allow easy comparison of the behavior of a very wide range of materials · Transmission electron micrographs provide a direct insight in the basic microstructure of metals deforming at high temperatures · Extensive literature review of over 1000 references provide an excellent reference document, and a very balanced discussion

Creep and Hygrothermal Effects in Concrete Structures

High Temperature Strain of Metals and Alloys

Creep and Stress Relaxation Modeling of Polycrystalline Ceramic Fibers

Creep and Shrinkage of Concrete

Design and Analysis of Composite Structures for Automotive Applications

A design reference for engineers developing composite components for automotive chassis, suspension, and drivetrain applications This book provides a theoretical background for the development of elements of car suspensions. It begins with a description of the elastic-kinematics of the vehicle and closed form solutions for the vertical and lateral dynamics. It evaluates the vertical, lateral, and roll stiffness of the vehicle, and explains the necessity of the modelling of the vehicle stiffness. The composite materials for the suspension and powertrain design are discussed and their mechanical properties are provided. The book also looks at the basic principles for the design optimization using composite materials and mass reduction principles. Additionally, references and conclusions are presented in each chapter. Design and Analysis of Composite Structures for Automotive Applications: Chassis and Drivetrain offers complete coverage of chassis components made of composite materials and covers elastokinematics and component compliances of vehicles. It looks at parts made of composite materials such as stabilizer bars, wheels, half-axes, springs, and semi-trail axles. The book also provides information on leaf spring assembly for motor vehicles and motor vehicle springs comprising composite materials. Covers the basic principles for the design optimization using composite materials and mass reduction principles Evaluates the vertical, lateral, and roll stiffness of the vehicle, and explains the modelling of the vehicle stiffness Discusses the composite materials for the suspension and

powertrain design Features closed form solutions of problems for car dynamics explained in details and illustrated pictorially Design and Analysis of Composite Structures for Automotive Applications: Chassis and Drivetrain is recommended primarily for engineers dealing with suspension design and development, and those who graduated from automotive or mechanical engineering courses in technical high school, or in other higher engineering schools.

The theory of viscoelasticity has been built up as a mechanical framework for modeling important aspects of the delayed behavior of a wide range of materials. This book, primarily intended for civil and mechanical engineering students, is devoted specifically to linear viscoelastic behavior within the small perturbation framework. The fundamental concepts of viscoelastic behavior are first presented from the phenomenological viewpoint of the basic creep and relaxation tests within the simple one-dimensional framework. The linearity and non-ageing hypotheses are introduced successively, with the corresponding expressions of the constitutive law in the form of Boltzmann's integral operators and Riemann's convolution products respectively. Applications to simple quasi-static processes underline the dramatic and potentially catastrophic consequences of not taking viscoelastic delayed behavior properly into account at the design stage. Within the three-dimensional continuum framework, the linear viscoelastic constitutive equation is written using compact mathematical notations and takes material symmetries into account. The general analysis of quasi-static linear viscoelastic processes enhances similarities with, and differences from, their elastic counterparts. Simple typical case studies illustrate the importance of an in-depth physical understanding of the problem at hand prior to its mathematical analysis.

Predictive modeling of both elastic and plastic material responses in areas such as visco-elasticity, creep, superplasticity, ductile fracture, and fatigue are addressed in these papers from the 1998

TMS Annual Meeting & Exhibition. Materials such as metallic alloys, ceramics, glasses, polymers, and composites are examined.

Creep and Fatigue in Polymer Matrix Composites, Second Edition, updates the latest research in modeling and predicting creep and fatigue in polymer matrix composites. The first part of the book reviews the modeling of viscoelastic and viscoplastic behavior as a way of predicting performance and service life. Final sections discuss techniques for modeling creep rupture and failure and how to test and predict long-term creep and fatigue in polymer matrix composites. Reviews the latest research in modeling and predicting creep and fatigue in polymer matrix composites Puts a specific focus on viscoelastic and viscoplastic modeling Features the time-temperature-age superposition principle for predicting long-term response Examines the creep rupture and damage interaction, with a particular focus on time-dependent failure criteria for the lifetime prediction of polymer matrix composite structures that are illustrated using experimental cases

Advanced Materials Modelling for Structures

Micro-structural Modeling of Cyclic Creep Damage in Tin-lead Eutectic Solder

Proceedings of the Third International Conference on Theoretical, Applied and Experimental Mechanics

Creep and Damage in Materials and Structures

Dynamic Neural Network for Predicting Creep of Structural Masonry

Today research on creep and shrinkage of concrete is diversified to such a degree that specialists working in different areas sometimes find it difficult to understand one-another. Materials scientists are mainly interested in processes on a microstructural level but they do not necessarily understand the relevance of time dependent deformation in structural design. On the other hand engineers who apply simplified model laws in non-elastic structural analysis are not always in the position to judge the limitations implied in their approach. It is generally realized that further development can be stimulated by a more effective exchange of results and ideas among the different groups involved. In an attempt to bridge this obvious gap in September 1980 there was a Conference organized at Swiss Federal Institute of Technology in Lausanne. The papers presented at this meeting covered the wide range starting with microstructural aspects and mechanisms and including constitutive modelling and structural creep analysis. These contributions together with summaries of two panel discussions are being published in this volume. All serious of the meeting have been introduced by invited lectures. These papers will be published in a special volume "Creep and Moisture Effects in Concrete". This special volume is rather to be a general survey of the different areas covered while the present conference proceedings provide a unique selection of research papers. Nowadays time-dependent deformation of concrete can be taken into consideration realistically by computerized structural analysis.

CREEP, SHRINKAGE AND DURABILITY MECHANICS OF CONCRETE AND CONCRETE STRUCTURES contains the keynote lectures, technical reports and contributed papers presented at the Eighth International Conference on Creep, Shrinkage and Durability of Concrete and Concrete Structures (CONCREEP8, Ise-shima, Japan, 30 September - 2 October 2008). The topics covered

This book contains 12 chapters with original and innovative research studies in the issues related to the broadly defined creep effect, which concerns not only the area of construction materials but also natural phenomena. The emphasis on the discussion of a new trend of experimental creep testing, which binds the classic creep methods to seek the correlation of parameters obtained in tests, deserves particular attention. This book aims to provide the readers, including, but not limited to, students and doctoral students and also the research personnel and engineers involved in the operation of equipment and structural components as well as specialists in high-temperature creep-resisting materials, with a comprehensive review of new trends in the field of creep-exposed materials and their research methodology. The chapters of this book were developed by respected and well-known researchers from different countries.

Creep deformation influences the serviceability limit state as well as the ultimate limit state of timber structures. In order to consider this time-dependent behavior, creep coefficients and rheological models have been developed by various researchers. Comparing the rheological models, quite different temporal deformations are evaluated for a duration of load of 50 years. In order to find the model, which is most suitable to the situation in the region of Tubingen, South-West

Germany, the existing deformations of several beams in roof structures in opened, protected but not heated buildings are measured. By loading the structure the elastic global stiffness of the particular element is determined. So creep coefficients can be evaluated, which should have been used by the engineer in order to get the existing deflection after 50 years. Within the region of Tubingen, on average a creep coefficient of 2.23 was found based on these measurements. However, the standard deviation of 0.97 is quite large. For the numerical evaluation of the time-dependent behavior Toratti's model is modified, so that it matches the measured deformations.

Evaluation of Creep Behavior of Structural Lumber in a Natural Environment

Modeling of High Temperature Creep for Structural Analysis Applications

Theory and Applications

Modeling of CLT Creep Behavior and Real-time Hybrid Simulation of a CLT-LiFS Building

Creep in Structures

This book presents the proceedings of the 3rd edition of the International Conference on Theoretical, Applied and Experimental Mechanics. The papers focus on all aspects of theoretical, applied and experimental mechanics, including biomechanics, composite materials, computational mechanics, constitutive modeling of materials, dynamics, elasticity, experimental mechanics, fracture mechanics, mechanical properties of

materials, micromechanics, nanomechanics, plasticity, stress analysis, structures, wave propagation.

This paper summarizes recent experimental results, obtained at Oak Ridge National Laboratory (ORNL), on creep behavior and creep rupture of a commercial grade of Si3N4 ceramic in the temperature range of 1150°C to 1300°C. A uniaxial model capable of describing the behavior under general thermomechanical loading is introduced and compared with existing models. An exploratory extension of the new model to a multiaxial form is then discussed. Issues are also discussed concerning the standardization of data analysis methodology and future research needs in the area related to development of creep database and life prediction methodology for high temperature structural ceramics.

This textbook gives a concise survey of constitutive and structural modeling for high temperature creep, damage, low – cycle fatigue and other inelastic conditions. The book shows the creep and continuum damage mechanics as rapidly developing discipline which interlinks the material science foundations, the constitutive modeling and computer simulation application to analysis and design of simple engineering components. It is addressed to young researchers and scientists working in the field of

mechanics of inelastic, time-dependent materials and structures, as well as to PhD students in computational mechanics, material sciences, mechanical and civil engineering.

The use of new engineering materials in the aerospace and space industry is usually governed by the need for enhancing the bearing capacity of structural elements and systems, improving the performance of specific applications, reducing structural weight and improving its cost-effectiveness. Crystalline composites and nanomaterials are used to design lightweight structural elements because such materials provide stiffness, strength and low density/weight. This book reviews the effect of high temperature creep on structural system response, and provides new phenomenological creep models (deterministic and probabilistic approach) of composites and nanomaterials. Certain criteria have been used in selecting the creep functions in order to describe a wide range of different behavior of materials. The experimental testing and evaluation of time variant creep in composite and nanomaterials is quite complex, expensive and, at times, time consuming. Therefore, the analytical analysis of creep properties and behavior of structural elements made of composite and nanocomposite materials subjected to severe thermal loadings conditions *is of great practical importance. Composite elements and heterogeneous materials, from which they are made, make essential changes to the classical scheme for constructing the phenomenological creep model of composite elements, because it reflects the specificity of the composite material and manifests itself in the choice of two basic functions of the creep constitutive equation, namely memory and instantaneous modulus of elasticity functions. As such, the concepts and analytical techniques presented here are important. But the principal objective of this book is to demonstrate how nonlinear viscoelastic engineering creep theory can be incorporated into the general theory of mechanics of materials so that composite components can be designed and analyzed. The results are supported by step-by-step practical structural design examples and will be useful for structural engineers, code developers as well as material science researchers and university faculty. The phenomenological creep models presented in this book provide a usable engineering approximation for many applications in composite engineering.*

Chassis and Drivetrain

Creep-fatigue Modelling in Structural Steels Using Empirical and Constitutive Creep Methods Implemented in a Strip-yield Model

Fundamental Research on Creep and Shrinkage of Concrete
Computational Modelling of Concrete Structures
Modeling the Long-Term Behavior of Structural Timber

Time dependent strain is an important factor in structural design, since it is often of the same order of magnitude as (or even larger than) instantaneous strain due to loading. Time dependent strain is generally due to creep and/or shrinkage. The time domain of creep and shrinkage can be of relatively long duration. Behavior of creep and shrinkage is actually non-linear over time, but the analysis of such behavior can be simplified by assuming linear behavior on a log scale of time. This can be obtained from a summation of each deformation over successive time intervals by superposition theory using a rate-type creep law, which provides suitable results for long time durations. The Maxwell Chain model, winch is one common form of rate-type creep law, is computationally efficient and suitable for large-scale analyses. Following background discussions, this thesis involves the implementation and basic validation of this type of rate-type creep formulation within lattice models for structural analysis.

This monograph presents approaches to characterize inelastic behavior of materials and structures at high temperature. Starting from experimental observations, it discusses basic features of inelastic phenomena including creep, plasticity, relaxation, low cycle and thermal fatigue. The authors formulate constitutive equations to describe the inelastic response for the given states of stress and microstructure. They introduce evolution equations to capture hardening, recovery, softening, ageing and damage processes. Principles of continuum mechanics and thermodynamics are presented to provide a framework for the modeling materials behavior with the aim of structural analysis of high-temperature engineering components.

This book develops methods to simulate and analyze the time-dependent changes of stress and strain states in engineering structures up to the critical stage of creep rupture. The objective of this book is to review some of the classical and recently proposed approaches to the modeling of creep for structural analysis applications. It also aims to extend the collection of available solutions of creep problems by new, more sophisticated examples.

CLT-LiFS is an innovative hybrid structural system. This type of structure has emerged as a promising structural system for mid-rise to tall wood buildings in the seismic areas. CLT-LiFS is made by integrating post-tensioned Cross Laminated Timber (CLT) panels with Light Frame Wood Systems (LiFS). The post-tensioned CLT panels can provide excellent load bearing and self-centering capacity. And the LiFS can dissipate a large amount of energy through the slip of fasteners when it deforms. The behaviors of CLT-LiFS have been studied through a series of experimental tests under cyclic loading protocols and earthquake motions at different hazard levels using real-time hybrid simulations. Results from the experimental tests showed that the CLT-LiFS performed well under MCE (Maximum Considered Earthquake) hazard level with the maximum drift less than 1%. To obtain a good self-centering performance, the post-tensioned tendon force in CLT panels needs to be maintained at a desired level in long-term until the earthquake hits. Under the creep behavior, the post-tensioned force in the tendon will reduce as a function of time and moisture content in CLT panels. In this dissertation, a moisture content diffusion model was introduced by applying Fick's law to estimate the moisture content migration in CLT panels under the variation of environmental relative humidity. A numerical model combined with data from a series of moisture content experiments were used to obtain the moisture content diffusion coefficients for CLT material. The four-element creep model was also proposed. This creep model could predict the creep deformation of CLT panels versus time under variations of ambient environmental conditions. A 3D finite element model (FEM) was developed with an integration of the creep and moisture content diffusion model to predict the tendon force of post-tensioned CLT panels versus time. This FEM model was used to predict the loss of tendon force in CLT panels. This tendon force loss did not include the instant loss at the beginning due to anchor slip or other factors.

Creep, Shrinkage and Durability Mechanics of Concrete and Concrete Structures, Two Volume Set

Inelastic Analysis of Structures

Modeling the Mechanical Response of Structural Materials : Proceedings of a Symposium Sponsored by the Structural Materials Committee, Held at the 127th Annual Meeting of the Minerals, Metals, & Materials Society in San Antonio, Texas, February 15-19, 1998

Discrete Model of Creep in Concrete Materials and Structures

Creep and Fatigue in Polymer Matrix Composites

Since 1984 the EURO-C conference series (Split 1984, Zell am See 1990, Innsbruck 1994, Badgastein 1998, St Johann im Pongau 2003, Mayrhofen 2006, Schladming 2010) has provided a forum for academic discussion of the latest theoretical, algorithmic and modelling developments associated with computational simulations of concrete and concrete structure

Presents the proceedings of the 5th RILEM International Symposium, held in Barcelona in September 1993. The papers discuss creep and shrinkage of concrete, and should be of interest to cement and concrete technologists and researchers, as well as structural engineers.

Creep and Shrinkage of Concrete Elements and Structures

Phenomenological Creep Models of Composites and Nanomaterials

Physical Fundamentals

Fundamentals of Creep in Metals and Alloys

Viscoelastic Modeling for Structural Analysis