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Resuméoversigt 1993
Summaries of Papers 1993

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AFDELINGEN FOR BÆRENDE KONSTRUKTIONER
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RESUMÉOVERSIGT 1993

*Summaries of Papers 1993

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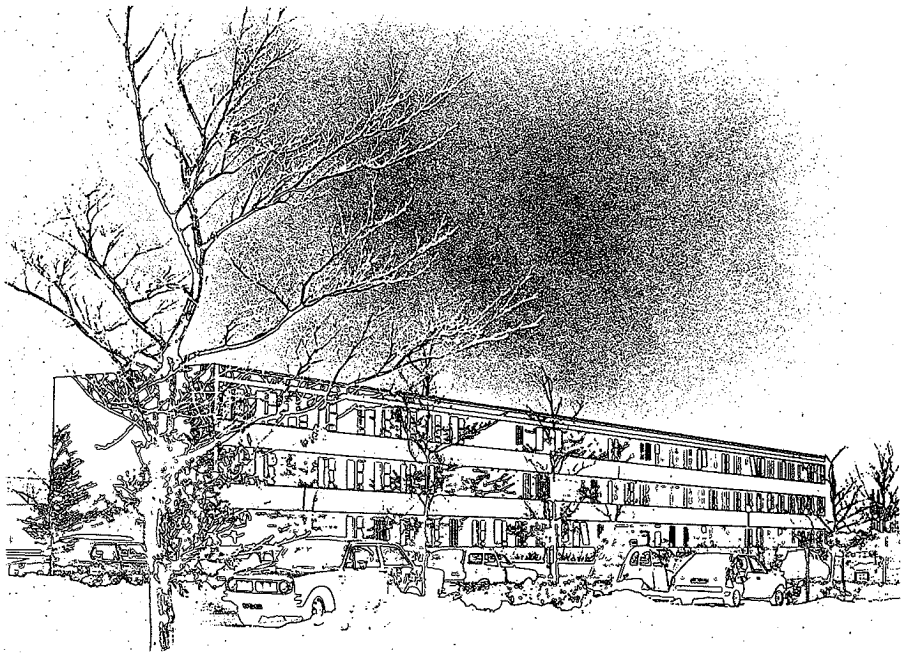

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A publication exchange agreement may be made with institutions working with structural research problems. Please apply for further information.

AGERSKOV, H. and J.B. IBSØ: *Fatigue Life of Repair-Welded Tubular Joints in Offshore Structures. (Udmattelseslevetiden af reparationssvejste rørknudesamlinger i offshorekonstruktioner). Proc. of the International Offshore and Polar Engineering Conference, Singapore, June, 1993, pp. 62-69. (Reprints available).

*Fatigue life of tubular joints in offshore steel structures under stochastic loading is studied. Fatigue test series with various types of stochastic loading that are realistic in relation to offshore structures have been carried through on both full-scale tubular joints and smaller welded test specimens. The test results obtained show a significant difference in fatigue life, determined by the Miner sum, between constant amplitude and variable amplitude fatigue tests. The present paper concentrates on the results obtained on the full-scale tubular joints, with a special emphasis on the effect of repair-welding on the fatigue life.

AGERSKOV, H. and J.B. IBSØ: *Fatigue Life of Plate Elements with Welded Transverse Attachments Subjected to Stochastic Loading. (Udmattelseslevetiden af plader med påsvejste tværafstivninger ved stokastisk last). Proc. of the International Conference on Fatigue under Spectrum Loading and in Corrosive Environments, Lyngby, Aug. 1993, pp. 41-60. EMAS Publishers, West Midlands, U.K. (Reprints available).

*Fatigue damage accumulation in offshore steel structures under stochastic loading is studied. Fatigue test series with various types of stochastic loading that are realistic in relation to offshore structures have been carried through on welded plate test specimens. Four different load spectra with irregularity factors ranging from ~ 0.70 to 1.00 have been applied. The materials that have been used in the present investigation are ordinary offshore structural steels. The test series carried through show a significant difference between constant amplitude and variable amplitude fatigue test results. The values of the Miner sum that were obtained in the variable amplitude test series, generally vary in the range ~ 0.40-0.85. On the basis of these results, a modified fatigue damage accumulation formula is proposed.

AGERSKOV, H., se også IBSØ, J.B. og H. AGERSKOV

AGERSKOV, H., se også LOPEZ MARTINEZ, L., R.I. PETERSEN og H. AGERSKOV

AGERSKOV, H., se også PETERSEN, R.I., H. AGERSKOV, V. ASKEGAARD og L. LOPEZ MARTINEZ

ASKEGAARD, VAGN: Anvendelse af den termoelastiske måleteknik. (*Applications of the thermoelastic measuring technique. In Danish). Afdelingen for Bærende Konstruktioner. Serie I, nr. 110, 1993. 47 s + 30 s. bilag. Kr. 77,-.

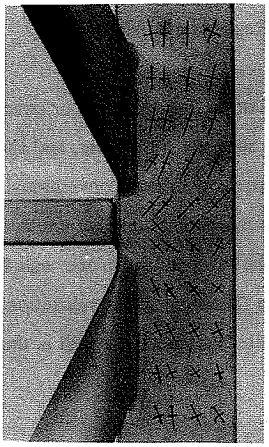
Der er i rapporten givet en kort beskrivelse af den termoelastiske måleteknik. Fejlkilder er omtalt og eksempler på anvendelse er nævnt. Disse eksempler omhandler måling af spændingsfordelingen i et offshore knudepunkt, forudsigelse af forventet position af første revne i udmattelsespåvirket svejst stålprøvelegeme og fastlæggelse af revneforløb. Også måling af små quasi-statiske temperaturændringer er beskrevet.

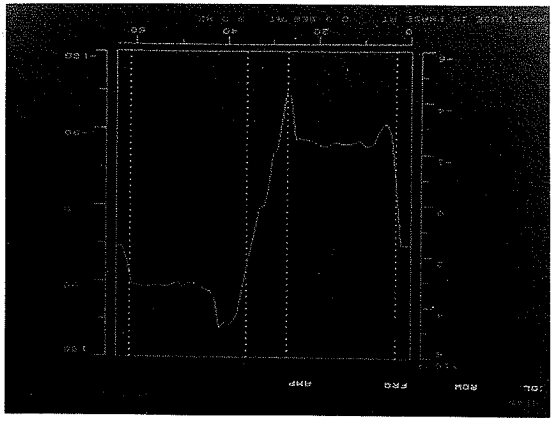
*A short description of the thermoelastic measuring techniques is given. Error sources are described and examples of use of the SPATE system are given. These examples deal with stress distribution in off shore tubular joint, prediction of positions for crack formation and following of crack growth. Also measuring of small static temperature changes are described.

ASKEGAARD, V., se også MUNCH-ANDERSEN, J. og V. ASKEGAARD

ASKEGAARD, V., se også PETERSEN, R.I., H. AGERSKOV, V. ASKEGAARD og L. LOPEZ MARTINEZ

BOGNÁR, LÁSZLÓ, se DITLEVSEN, OVE og LÁSZLÓ BOGNÁR





Knudepunkt i kranudligger.

*Joint in a crane beam.

Ref.: ASKEGAARD, VAGN: Anvendelse af den termoelastiske måleteknik. (s. 6).

BRØNDUM-NIELSEN, TROELS: *Creep Compensating Prestress of Tanks. (Krybningskompenserende forspænding af tanke). ACI Structural Journal V. 90, No. 1, January-February, 1993, pp. 32-36. (Reprints available).

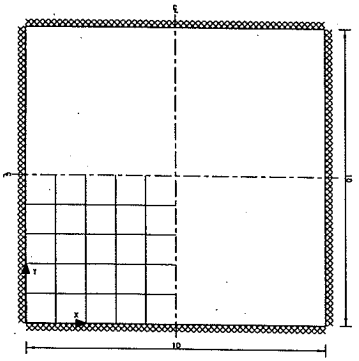
*The adverse effects of stress redistribution due to creep (or concrete stress relaxation), can be reduced by prestressing. The paper suggests a different, and apparently more economical, distribution of the circumferential prestress than that conventionally adopted.

For the typical cases considered, the maximum concrete compressive stresses occur in the radial sections at the base, and they are independent of the wall thickness. They depend on temperature changes, shrinkage, creep (concrete stress relaxation), and specified minimum concrete compressive stress. The required concrete strength is thus also independent of the wall thickness.

Den ugunstige virkning af spændingsomlejring på grund af krybning (eller betonspændingsrelaksation) kan reduceres ved hjælp af forspænding. Der foreslås en ringforspænding, der afviger fra - og øjensynlig er mere økonomisk end - den normalt anvendte. De maksimale beton-trykspændinger i væggen optræder i de radiale snit ved bunden, og de er uafhængige af vægtykkelsen. De afhænger af temperatur-ændringer, svind, krybning (betonspændingsrelaksation) samt krav til minimal betontrykspænding. Den krævede beton-trykstyrke er således også uafhængig af vægtykkelsen.

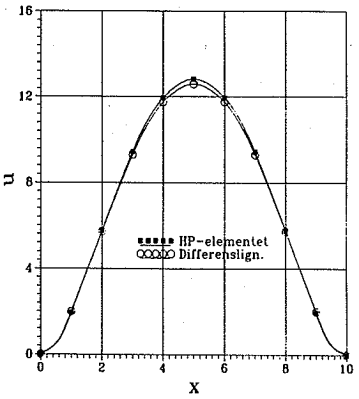
CHRISTOFFERSEN, JENS, LARS JAGD og M.P. NIELSEN: HOTCH-POTCH Pladeelementet. Finite element til beregning af armerede betonplader. (*'Hotch-Potch'-plate element for analysis of reinforced concrete slabs. In Danish). Afdelingen for Bærende Konstruktioner. Serie R, nr. 307, 1993. 43 s. Gratis.

I rapporten beskrives et nyt pladeelement til anvendelse ved FEM-beregninger, der er karakteriseret ved, at bøjnings- og vridningsstivheder er adskilt fra hinanden. Elementet kaldes 'Hotch-Potch'-elementet, da det hverken er et kompatibelt eller et ligevægts pladeelement, men



Fast indspændt kvadratisk plade.

*Square plate with built-in edges.



Nedbøjning langs linien Y = 5.

*Deflection along line Y = 5.

Ref.: CHRISTOFFERSEN, JENS, LARS JAGD og M.P. NIELSEN: HOTCH-POTCH pladeelementet. (s. 8).

er et ligevægtselement for en transformeret plade bestående af en plade uden bøjningsstivhed og et gitterværk uden vridningsstivhed.

Elementet er specielt egnet til beregning af armerede betonplader, og som input-parametre benyttes almindeligt anvendte størrelser fra betondimensionering - f.eks. kan armeringsforhold og armeringsplaceringer i to ortogonale retninger i såvel over- som underside angives. Et tilsvarende ortotropt skalelement er i øjeblikket under udvikling.

Elementet er blevet indbygget i et FEM program kaldet *HP*, og en række testeksempler er blevet gennemregnet.

*The report describes a new slab element used for finite element analysis, which is characterized by the separation of torsional and flexural rigidities. The element is called the 'Hotch-Potch'-element as it is neither a compatible nor an equilibrium plate element but is an equilibrium element for a transformed plate consisting of a plate with no flexural rigidity and a grating-system with no torsional rigidity.

The element is well suited for analyses of reinforced concrete slabs and the element parameters are the same as the parameters commonly used for such. Reinforcement ratios and reinforcement positions in two orthogonal directions in the top and bottom can be specified independently. A similar general orthotropic shell element is under development.

The element has been implemented in the FEA-programme *HP* and a number of test problems have been analyzed.

DAMKILDE, L. and O. HØYER: *An Efficient Implementation of Limit State Calculations Based on Lower-Bound Solutions. Computers & Structures, Vol. 59, No. 6, pp. 953-962, 1993. (Reprints available).

*Limit state problems are formulated in a general finite element format with stress-based elements. The analysis method is based on the lower-bound theorem which states that stress fields in equilibrium not violating the yield criteria are possible solutions. The solution method is to find the optimal stress distribution which maximizes the load. Linearization of the yield

criteria leads to a linear programming problem. In order to have en efficient implementation we have made two improvements compared to previous studies. The first implies that the number of stress parameters are reduced *a priori* via the equilibrium equations, and the second concerns the linear programming problem, where the traditional non-negative parameter requirement is avoided. The method is described via the plane frame problem but has also been implemented for plates.

DAMKILDE, L., O. HØYER and S. KRENK: *A direct Linear Programming solver in C for structural applications, Engineering Mechanics Paper No. 14, R 9304, Department of Building Technology and Structural Engineering, The University of Aalborg, Denmark, January 1993, pp. 1-27.

*An optimization problem can be characterized by an object-function, which is maximized, and restrictions, which limit the variation of the variables. A subclass of optimization is Linear Programming (LP), where both the object-function and the restrictions are linear functions in the variables. The traditional solution methods for LP-problems are based on the simplex method, and it is customary only to allow non-negative variables. Compared to other optimization routines the LP-solvers are more robust and the optimum is reached in a finite number of steps and is not sensitive to the starting point.

For structural applications many optimization problems can be linearized and solved by LP-routines. However, the structural variables are not always non-negative, and this requires a reformulation, where a variable x is substituted by the difference of two non-negative variables, x^+ and x^-. The transformation causes a doubling of the number of variables, and in a computer implementation the memory allocation doubles and for a typical problem the execution time at least doubles.

The paper describes a LP-solver written in C, which can handle a combination of non-negative variables and unlimited variables. The LP-solver also allows restart, and this may reduce the computational costs if the solution to a similar LP-problem is known a priori. The algorithm is based on the simplex method, and differs only in the logical choices. Application

of the new LP-solver will at the same time both give a more direct problem formulation and a more efficient program.

DAMKILDE, L., se også JÖNSSON, J., S. KRENK og L. DAMKILDE

DAMKILDE, L., se også KRENK, S., L. DAMKILDE og O. HØYER

DITLEVSEN, OVE: *Series System Second Order Bounds on Vector Process Outcrossing Rates. Proc. of the 5th IFIP WG 7.5 Working Conference on Reliability and Optimization of Structural Systems, Takamatsu-shi, Kagawa, Japan, 1993, (eds.: P. Thoft-Christensen, H. Ishikawa). IFIP Transactions B12, North-Holland, pp. 47-53. (Reprints available).

*The reasoning that leads to the well-known second order bounds on the failure probability of a random variable series system reliability problem is applied to obtain similar formulae for upper and lower bounds on the mean outcrossing rate of a general vector process out of the safe set of a series system given that the stream of outcrossings satisfies a general regularity condition. It is demonstrated that a direct application of the lower failure probability bound on outcrossing rates can be erroneous.

DITLEVSEN, OVE and LÁSZLÓ BOGNÁR: *Plastic Displacement Distributions of the Gaussian White Noise Excited Elasto-Plastic Oscillator. Probabilistic Engineering Mechanics, Vol. 8, No. 3-4, pp. 209-231, 1993. (Reprints available).

*Slepian model process approximate reasoning is used to obtain representative net and absolute yield displacement processes for the symmetric elasto-plastic oscillator of one degree of freedom excited by stationary Gaussian white noise. Yieldings occur in clumps with yield

increments of alternating sign. Distributions are obtained in closed analytical form for the first yielding in a clump, the subsequent yieldings, and the accumulated net and absolute yielding from the entire clump. Moreover, distributions of clump durations as well as interclump durations are obtained. All distribution parameters are theoretically calculated, that is, no parameters are obtained from estimation using simulated data. Extensive comparisons with simulated histograms show excellent fits. Also comparisons with published predictions from diffusion theory (Fokker-Planck equation based on the stochastic averaging method) show interesting features and good agreement. Finally, an approximate general formula is given for the distribution of the time to the first passage of any given level of net or absolute yielding. This formula is a generalization of a corresponding formula valid for any compound Poisson process of finite second moments.

DITLEVSEN, OVE, se også HANSEN, BENT og OVE DITLEVSEN

DITLEVSEN, OVE, se også JOHANNESEN, J.M. og O. DITLEVSEN

DITLEVSEN, OVE, se også KARLSSON, MAX, JOHANNES M. JOHANNESEN og OVE DITLEVSEN

DYRBYE, CLAËS: Last på konstruktioner. (*Actions on structures. In Danish). Serie F, nr. 140, 1993, 19 s. Kr. 15,- excl. moms.

Grundbegreber i forbindelse med projektering af bærende konstruktioner omtales. Notatet følger de gældende danske normer for sikkerhedsbestemmelser for og last på konstruktioner.

Væsentlige begreber er brudgrænsetilstand og anvendelsesgrænsetilstand. Konstruktioner inddeles i 3 sikkerhedsklasser: lav, normal og høj.

Last defineres, der inddeles efter variation i tiden i permanent last, variabel last eller ulykkeslast. Efter variation i rummet skelnes mellem bunden last og fri last. Efter responset

skelnes mellem statisk eller dynamisk virkende last. Begreber karakteristisk last, sædvanlig last og regningsmæssig last og de dertil hørende begreber lastreduktion og partialkoefficient indføres.

Som eksempler på last omtales nyttelast i bygninger, vindlast på bygninger samt snelast på bygninger.

*Basic concepts used at structural design are introduced. The lecture notes are based upon the present Danish codes for the safety of structures and loads (actions) for the design of structures. Ultimate limit states and serviceability limit states are important concepts. Structures are classified into low, normal or high safety class.

Load is defined, distinction is made between permanent action, variable action and accidental action. According to their variation in space, actions are divided into fixed action and free action. According to the structural response, distinction is made between static action and dynamic action. Characteristic action, ordinary load and design action and the concepts of an action reduction factor and a partial coefficient are introduced.

As examples of actions are mentioned imposed action on buildings, wind action on buildings and snow action on buildings.

DYRBYE, CLAËS, se også NIELSEN, LEIF OTTO og CLAËS DYRBYE

HANSEN, BENT and OVE DITLEVSEN: *Foundation Example of Invalidity of the Upper Bound Limit Theorem in Plastic Theory in Case of Non-fixed Boundary. Proc. of International Symposium on Limit State Design in Geotechnical Engineering, Copenhagen, 1993, pp. 23-29. (Reprints available).

*An infinitely rigid strip footing on an ideal plastic pure cohesion soil with associated flow rule is considered. The footing is loaded eccentrically with a load that has both a vertical and a horizontal component orthogonal to the strip footing.

Among the kinematically admissible failure mechanisms there are mechanisms by which the footing is lifted off the soil surface along the one edge of the footing. It is shown that there is such a mechanism that gives a lower carrying capacity than that obtained by a statically admissible stress field. Thus the upper bound theorem of the plastic theory is violated. The standard indirect proof of the upper bound theorem is examined in order to see why it may fail in case of a non-fixed boundary between soil and structure.

A solution to the carrying capacity problem is obtained by introducing an effective footing width together with an assumption of contact between soil and footing under preservation of the associated flow rule also where lift-off takes place. The effective footing width is defined such that there just accurately is no lift-off for the exact plastic solution obtained for the width reduced footing.

HANSEN, SØREN og HENRIK STANG: Eksperimentelt Bestemte Mekaniske Egenskaber for Fiberbeton. (*Experimentally Determined Mechanical Properties of Fiber Reinforced Concrete. In Danish). Afdelingen for Bærende Konstruktioner. Serie R, nr. 305, 1993. 65 s. Gratis.

Nærværende rapport opsummerer de sidste 3 års arbejde på ABK med hensyn til eksperimentel karakterisation af fiberarmeret betons eller FRC-materialers (FRC: Fiber Reinforced Concrete) mekaniske egenskaber.

Rapporten opsummerer dels mekaniske egenskaber for materialer, som er udviklet i forbindelse med Rammeprogrammet Cementbaserede Kompositmaterialer under Det Materialeteknologiske Udviklingsprogram og dels egenskaber for materialer, som er udviklet i forbindelse med to forskellige Ph.D. projekter udført af Tine Aarre og Esben Thygesen.

Der betragtes udelukkende statiske eller kvasistatiske forsøg. Der fokuseres endvidere på styrke og deformationsegenskaberne i enakset tryk og træk. Disse egenskaber er så vidt muligt bestemt direkte ved enaksede tryk- og trækforsøg. Egenskaberne i enakset træk karakteriseres ved såvel pre-peak som post-peak opførslen; den sidste i form af såkaldte spændings-

/revnevidde-relationer. Der er imidlertid også udført bøjetrækforsøg af hensyn til sammenligning med resultater fra standardlitteraturen, som ofte refererer resultater af denne type.

*The present report summarizes work carried out during the last 3 years at the Department of Structural Engineering at the Technical University of Denmark regarding characterization of the mechanical properties of fibre reinforced concretes (FRC).

The report summarizes mechanical properties for materials developed during the Framework Program Cementitious Composite Materials under the Material Technology Development Program (MUP) sponsored by The Danish Council for Scientific and Industrial Research and The Danish Ministry for Industry. Furthermore, materials developed during two Ph.D. studies carried out by Tine Aarre and Esben Thygesen.

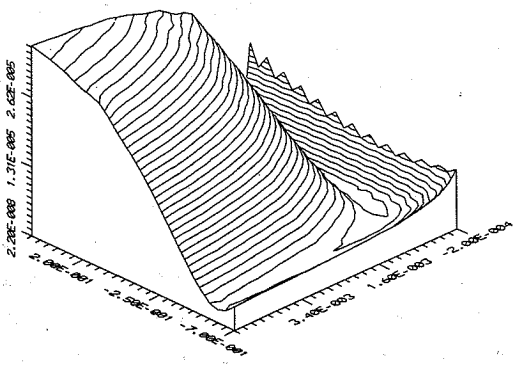
Only static or quasi-static tests are considered here. Furthermore, strength and deformation properties in uniaxial tension and compression are focused on. These properties are determined directly by uniaxial compression and tensile tests. The properties in uniaxial tension include both pre-peak and post-peak properties, the latter in terms of the so-called stress/-crack width relationship. However, three point bending tests have been carried out in order to facilitate comparison with results from standard literature where results of this kind are often referred to.

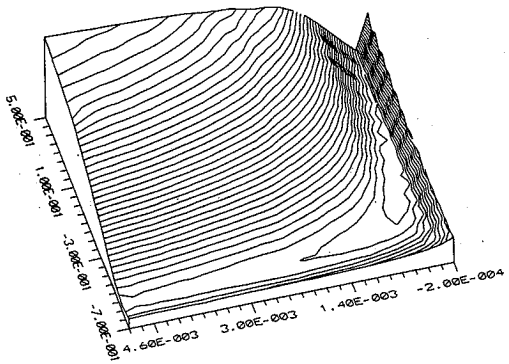
HANSEN, S., se RASMUSSEN, T.V., H. STANG, S. HANSEN og C. PEDERSEN

HÖYER, O., se DAMKILDE, L. og O. HÖYER

HÖYER, O., se DAMKILDE, L., O. HÖYER og S. KRENK

HÖYER, O., se KRENK, S., L. DAMKILDE og O. HØYER





G-funktionens afbildning.

*Plots of the G-function.

Ref.: HANSEN, SØREN og HENRIK STANG: Eksperimentelt bestemte egenskaber for fiberbeton. (s. 15).

IBSØ, J.B. and H. AGERSKOV: *Fatigue Life Prediction of Offshore Tubular Structures under Stochastic Loading. (Bestemmelse af udmattelseslevetiden for offshore rørkonstruktioner udsat for stokastisk last). Proc. of the International Conference on Fatigue under Spectrum Loading and in Corrosive Environments, Lyngby, Aug. 1993, pp. 205-226. EMAS Publishers, West Midlands, U.K. (Reprints available).

*Fatigue life of tubular joints in offshore steel structures under stochastic loading is studied. Fatigue test series with various types of stochastic loading that are realistic in relation to offshore structures have been carried through on both full-scale tubular joints and smaller welded test specimens. The materials that have been used in the present investigation are ordinary offshore structural steels. The test results obtained show a significant difference in fatigue life, determined by the Miner sum, between constant amplitude and variable amplitude fatigue tests. The present paper concentrates on the results obtained in the investigation on the full-scale tubular joints.

IBSØ, J.B., se også AGERSKOV, H. og J.B. IBSØ

JAGD, LARS, se CHRISTOFFERSEN, JENS, LARS JAGD og M.P. NIELSEN

JENSEN, HENRIK ELGAARD, se NIELSEN, PER KASTRUP, HENRIK ELGAARD JENSEN, CLAUS SCHMIDT og M.P. NIELSEN

JOHANNESEN, J.M. and O. DITLEVSEN: *Reliability Analysis of Geometrically Nonlinear Structure by Rigid-Plastic Model. Proc. of th 5th IFIP WG 7.5 Working Conference on Reliability and Optimization of Structural Systems, Takamatsu-shi, Kagawa, Japan, 1993, (eds.: P. Thoft-Christensen, H. Ishikawa). IFIP Transactions B12, North-Holland, pp. 95-103. (Reprints available).

*The self-contradiction in the title of this paper is only apparent because it concerns the application of a particular type of response surface method where the form of the response surface is generated by use of the simple rigid-plastic mechanical theory. The basis is the previously published "model correction factor method". Herein the method is demonstrated to be applicable for efficient and fast reliability analysis of some strongly geometrically nonlinearly behaving frame structures with elastic-plastic constitutive relations.

JOHANNESEN, JOHANNES, M., se også KARLSSON, MAX, JOHANNES M. JOHANNESEN og OVE DITLEVSEN

JÖNSSON, J., S. KRENK and L. DAMKILDE: *A Hybrid Displacement Plate Element for Bending and Stability Analysis. Computers & Structures, Vol. 48, No. 6, pp. 1125-1136, 1993. (Reprints available).

*A hybrid displacement plate element is derived from a modified energy functional based on a variational principle. The higher order curvature terms which generate high energy densities are filtered out by using independent interpolation of curvatures and moments. The inter-element compatibility requirements are relaxed by including element discontinuities in the variational formulation. The accuracy of the element is shown to be excellent in both plate bending and buckling analysis.

JÖNSSON, J., S. KRENK and L. DAMKILDE: *Recursive Substructuring of Finite Elements. Engineering Mechanics Paper No. 20, R 9330, Department of Building Technology and Structural Engineering, The University of Aalborg, Denmark, August 1993, pp. 1-21. (Reprints available).

*Recursive substructuring takes advantage of the simple repetition of substructures of identical geometry. In each recursive step the problem is transformed into a new problem involving half the number of identical substructures. The computational work involved in factorisation only grows logarithmically with an increasing number of substructures as opposed to conventional methods which grow linearly. For some vector problems the efficiency of recursive substructuring may be further improved by use of symmetry relations. In the present paper the technique is applied in linear buckling analysis of thin-walled beams.

KARLSSON, MAX, JOHANNES M. JOHANNESEN and OVE DITLEVSEN: *Reliability Analysis of an Existing Bridge. Proc. of IABSE Colloquium. Remaining Structural Capacity, Copenhagen, 1993, pp. 19-28. (Reprints available).

*The assessment is described of the remaining structural capacity of an existing concrete bridge. A probabilistic reliability analysis is applied to a simple conventional carrying capacity model for the bridge. This simplified reliability analysis is calibrated by a random effectivity factor to give realistic results. The calibration uses some particularly chosen deterministic analyses of the bridge. These analyses are based on a refined FEM-model of the failure behaviour taking into account that the observed strength throughout the structure differs from what was assumed at the design stage. The cases for deterministic analysis are obtained through the reliability analyses of the simple model.

KRENCHEL, H., se LI, V.C., H. STANG og H. KRENCHEL

KRENK, S., L. DAMKILDE and O. HØYER: *Limit Analysis and Optimal Design of Plates with Triangular Equilibrium Elements. Engineering Mechanics Paper No. 16, R 9321, Department of Building Technology and Structural Engineering, The University of Aalborg, Denmark, June 1993, pp. 1-22. (Reprints available).

*A finite element formulation is developed for limit analysis of perfectly plastic plates using triangular equilibrium elements and linear programming. A simple, explicit formulation of the element relations is presented. For a linearized yield surface the duality theorem of linear programming leads to dual static and kinematic representation of the solution, whereby the traditional lower bound must be interpreted in terms of the admissibility of the static field. Optimization of material properties is also considered. The algorithms are implemented in compact form in a PC environment, and examples illustrate the capability of the approach.

KRENK, S., se også DAMKILDE, L., O. HØYER og S. KRENK

KRENK, S., se også JÖNSSON, J., S. KRENK og L. DAMKILDE

LI, V.C., H. STANG and H. KRENCHEL: *Micromechanics of Crack Bridging in Fibre-Reinforced Concrete. (Mikromekanisk Beskrivelse af Revnedannelse i Fiberarmeret Beton). Materials and Structures, Vol. 26, No. 162 , pp. 486-494, 1993. (Reprints available).

*The stress-crack width relationship has been determined experimentally for concretes reinforced with two types of fibres, steel and polypropylene, of various fibre volume fractions. A micromechanics-based theoretical model is proposed which captures the essential features of the stress-crack width relationships at small crack widths (less than 0.3 mm). Micromechanisms accounted for include the bridging actions due to aggregates and fibres, Cook-Gordon interface debonding and fibre pre-stress. The fibre bridging action involves interface

slip-dependent friction as well as snubbing friction for fibres bridging at inclined angles. Theoretical predictions based on independent parametric inputs compare favorably with experimental measurements of the stress-crack width relationship. Findings in this research provide confidence in the use of the proposed model for materials engineering targeted at prescribed structural performance.

Spændings-revneviddesammenhængen bestemmes eksperimentelt for beton armeret med to typer fibre - stål og polypropylen - med forskellige fibervolumenkoncentrationer. En mikromekanisk model foreslås, som er i stand til at beskrive de grundlæggende karakteristika ved spændings-revneviddesammenhængen ved små revnevidder (mindre end 0.3 mm). De mikromekanismer, som er medtaget i modellen, er tilslagets og fibrenes brodannelse, Cook-Gordon skilleflade-adskillelse og forspænding af fibrene. Fibrenes brodannelse beskrives ved hjælp af flytningsafhængig skilleflade-friktion og 'snubbing'-friktion, når fibrene udtrækkes under en vinkel med revneoverfladen. Teoretiske forudsigelser baseret på uafhængigt parametrisk input giver gode resultater ved sammenligning med forsøg. Resultaterne i denne undersøgelse lover godt for brugen af den foreslåede model til design af materialer med henblik på specielle konstruktive anvendelser.

LOPEZ MARTINEZ, L., R.I. PETERSEN and H. AGERSKOV: *Fatigue Life of High-Strength Steel Tubular Joints. (Udmattelseslevetiden af rørknudesamlinger i højstyrkestål). Proc. of the International Conference on Fatigue under Spectrum Loading and in Corrosive Environments, Lyngby, Aug. 1993, pp. 309-323. EMAS Publishers, West Midlands, U.K. (Reprints available).

*The fatigue life of high-strength steel tubular joints is studied in this investigation. Fatigue tests under constant amplitude and spectrum loading on full-scale test specimens have been carried out. Fatigue tests with a stochastic loading that is realistic in relation to offshore structures have been carried through. The material used has been high-strength steel, with a yield stress of 820-830 MPa. The tests that have been carried out until now indicate some

difference between constant amplitude and variable amplitude fatigue test results. Furthermore, the results for high-strength steel tubular joints indicate some difference in fatigue lives when compared with the results for ordinary offshore structural steel.

LOPEZ MARTINEZ, L., se også PETERSEN, R.I., H. AGERSKOV, V. ASKEGAARD og L. LOPEZ MARTINEZ

MUNCH-ANDERSEN, J. and V. ASKEGAARD: *Silo Model Tests with Sand - and Grain. (Silo model forsøg med sand og korn). Proc. Int. Symp. Reliable flow of particulate solids II, Oslo, 23-25 August 1993, pp. 269-282.

*The model silo has formerly been used for tests with different sorts of grain, but the equipment has recently been supplemented by stress cells measuring normal as well as shear stresses. Tests have been carried out with different heights of falls, inlet rates and outlet rates, with centric inlet or distributed inlet, and with smooth as well as rough wall.

During centric filling different particle patterns are observed at the surface cone, dependent on the inlet rate and the height of fall. These different particle patterns affect the strength of the stored material and thereby the pressures and the flow patterns.

Besides proving the applicability of the new stress cells the experiments have confirmed a number of hypotheses developed on the basis of the former tests with grain. It is, therefore, now possible to put forward a number of conclusions with a higher degree of confidence. The conclusions concern the influence of the filling method, what the strength of the stored material and the flow pattern depends on, why overpressure occurs during discharge etc.

NIELSEN, LEIF OTTO: *A C++ basis for computational mechanics software. (Et C++ basis for programmel til numerisk konstruktionsmodellering). Afdelingen for Bærende Konstruktioner. Serie R, nr. 303, 1993. 43 s. Gratis.

*In the report some C++ classes for matrices, strings and arrays are described. Moreover, a set of C++ functions for parametric input are described. Such tools are after the author's opinion necessary for development of special-purpose FEM-software balancing safety and efficiency requirements.

I rapporten beskrives nogle C++ klasser for matricer, strenge og arrayer. Desuden beskrives et sæt af C++ funktioner til parametrisk indlæsning. Sådanne hjælpemidler er efter forfatterens mening nødvendige ved udvikling af elementmetodebaseret programmel i et kompromis mellem sikkerhed og effektivitet.

NIELSEN, LEIF OTTO: Opgaver i Pladers Statik. (*Problems in Plate bending. In Danish). Afdelingen for Bærende Konstruktioner. Serie F, nr. 138, 1993. 28 s. Kr. 17,- excl. moms.

Opgaver til det indledende kursus i elastiske plader, brudliniemetode for plader og plade buling.

*Problems for the introductory course in elastic plate bending, yield line method for plate bending and plate buckling.

NIELSEN, LEIF OTTO og CLAËS DYRBYE: Bygningsdynamik, EDB-metoder, 3. udgave. (*Structural Dynamics, Application of computers. In Danish). Afdelingen for Bærende Konstruktioner. Serie F, nr. 137, 1993. 86 s. Kr. 30,- excl. moms.

Grundlag for formulering af programmer til beregning af egensvingninger og tvungne svingninger af lineære, viskost dæmpede konstruktioner.

*Basis for formulating programs for calculating free and forced vibrations of linear structures with viscous damping.

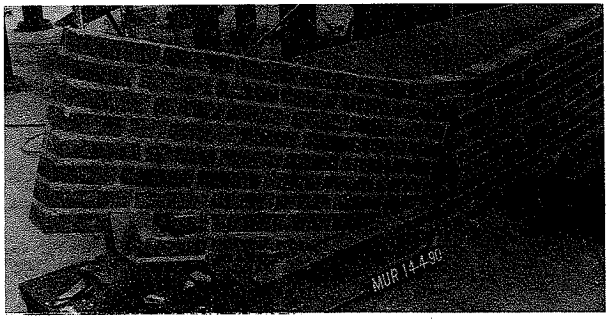
NIELSEN, M.P., se CHRISTOFFERSEN, JENS, LARS JAGD og M.P. NIELSEN

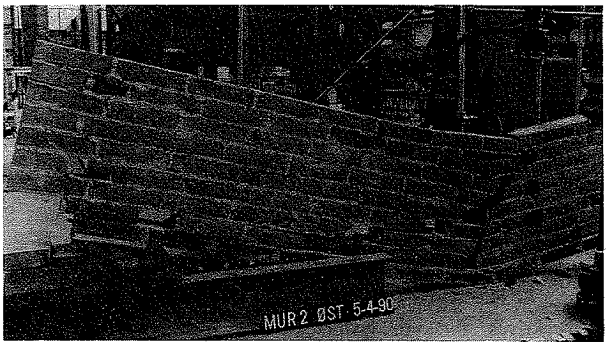
NIELSEN, M.P., se NIELSEN, PER KASTRUP, HENRIK ELGAARD JENSEN, CLAUS SCHMIDT og M.P. NIELSEN

NIELSEN, PER KASTRUP, HENRIK ELGAARD JENSEN, CLAUS SCHMIDT og M.P. NIELSEN: Forskydning i armerede teglbjælker. (*Shear Strength of Reinforced Masonry Beams. In Danish). Afdelingen for Bærende Konstruktioner. Serie R, nr. 306, 1993. 43 s. Gratis.

I denne rapport beskrives forskydningsforsøg med teglbjælker. Trepunkts-belastede teglbjælkers forsøgsmæssige bæreevne sammenlignes med en øvreværdiløsning bestemt vha. Coulombs modificerede flydebetingelse. To forskellige stenstyrker er benyttet.

*In this report shear tests on masonry beams are presented. The carrying capacity determined by three-point load tests is compared with an upper bound solution determined by means of the modified Coulomb failure criterion. Two types of bricks with different strengths have been used.





BS røde sten, forskydningsspændviddeforhold 3.1.

*BS red bricks, shear span ratio 3.1.

Ref.: NIELSEN, PER KASTRUP, HENRIK ELGAARD JENSEN, CLAUS SCHMIDT og M.P NIELSEN: Forskydning i armerede betonbjælker. (s. 25).

PEDERSEN, C. and H. STANG: *Developing FRC Through Integrated Material-Structure Optimization. Proceedings, Building the Future. Innovation in Design, Materials and Construction, The Rôle of Physical Testing. The Old Ship Hotel, Brighton, England, 19-21 April 1993. Joint Institution of Structural Engineers/Building Research Establishment, England, 9 p. (Reprints available).

*The present paper describes a model for the prediction of crack width in concrete structures where the traditional concrete is replaced with Fiber Reinforced Concrete (FRC). The paper furthermore describes the verification of the model through experiments and the experimental procedure used. Finally, the paper discusses some industrial applications of the model and how a model like the proposed can be used both in the development of new FRC-materials and new structures which fully exploit the enhanced properties of FRC-materials as compared to conventional concrete.

Artiklen beskriver en model til forudsigelse af revnevidder i betonkonstruktioner, hvor den traditionelle beton er erstattet af en fiberarmeret beton. Artiklen beskriver yderligere den eksperimentelle verifikation af modellen og den benyttede eksperimentelle teknik. Afslutningsvis diskuteres industrielle anvendelser af modellen, og hvordan en model som den foreslåede kan benyttes til udvikling af både nye fiberarmerede cementbaserede materialer og nye konstruktioner, som til fulde udnytter de fiberarmerede materialers forbedrede egenskaber.

PEDERSEN, C., se også RASMUSSEN, T.V., H. STANG, S. HANSEN og C. PEDERSEN

PETERSEN, R.I., H. AGERSKOV, V. ASKEGAARD and L. LOPEZ MARTINEZ:
*Fatigue Life of High-Strength Steel Plate Elements with Welded Attachments. (Udmattelseslevetiden af plader i højstyrkestål med påsvejste længde- og tværafstivninger). Proc. of the International Conference on Fatigue under Spectrum Loading and in Corrosive Environments, Lyngby, Aug. 1993, pp. 107-130. EMAS Publishers, West Midlands, U.K. (Reprints available).

*Fatigue life of welded plate elements in high-strength steel is studied, with a special view to applications in offshore structures. Steels with a yield stress of ~ 800-1000 MPa were used in test series with constant amplitude loading and with various types of stochastic loading. Thermoelastic observations were used to estimate the stress concentration factor and to follow the initial crack development. The test series carried through show a significant difference in fatigue behaviour between plate elements with transverse and longitudinal attachments. Furthermore, in general longer fatigue lives were obtained on the welded plate test specimens in high-strength steel than from a similar investigation with the test specimens in ordinary offshore structural steels.

PETERSEN, R.I., se også LOPEZ MARTINEZ, L., R.I. PETERSEN og H. AGERSKOV

RASMUSSEN, T.V., H. STANG, S. HANSEN and C. PEDERSEN: *Measurement of Crack Widths in FRC-Structures Using Digital Image Analysis. (Måling af Revnevidder i Fiberarmerede Betonkonstruktioner med brug af Digital Billedanalyse). Proceedings from The International Conference on Nondestructive Testing of Concrete in the Infrastructure. Dearborn, Michigan, USA. June 9-11, 1993. Society for Experimental Mechanics, Bethel, CT, USA, pp. 285-300. (Reprints available).

*The present paper describes a measuring system set up at the Department of Structural Engineering, Technical University of Denmark. The system is able to measure and characterize

surface crack patterns in concrete test specimens and concrete structures. The system is based on digital image analysis. All hardware is standard equipment: video camera, video recorder, and a personal computer. The software consists of a commercially available software package and specially developed software. The system is shown to be able to produce detailed and unbiased results for crack width and crack width distributions in fiber reinforced concrete (FRC) specimens.

Artiklen beskriver et målesystem, som er etableret på Afdelingen for Bærende Konstruktioner, Danmarks Tekniske Højskole. Systemet muliggør måling og karakterisering af overfladerevnemønstre i betonemner og betonkonstruktioner. Systemet er baseret på digital billedbehandling. Al hardware er standardudstyr: videokamera, videooptager og en personlig computer. Det anvendte software består af et kommercielt tilgængeligt billedbehandlingsprogram og et tilhørende specielt udviklet program. Det er eftervist, at systemet er i stand til at producere detaljerede og reproducerbare data for revnevidder og revneviddefordelinger i fiberarmerede betonprøvelegemer.

RESUMÉOVERSIGT 1992: "Summaries of Papers 1992". Afdelingen for Bærende Konstruktioner. Serie R, nr. 304, 1993. 68 s. Gratis.

Resuméer af 46 videnskabelige publikationer m.v., af 1 rapport over eksperimentelle undersøgelser og af 6 eksamensarbejder.

*Summaries in Danish and English of 46 scientific papers etc., of 1 report on experimental investigations, and of 6 final year projects.

SCHMIDT, CLAUS, se NIELSEN, PER KASTRUP, HENRIK ELGAARD JENSEN, CLAUS SCHMIDT og M.P. NIELSEN

STANG, HENRIK, se HANSEN, SØREN og HENRIK STANG

STANG, HENRIK, se LI, V.C., H. STANG og H. KRENCHEL

STANG, HENRIK, se PEDERSEN, C. og H. STANG

STANG, HENRIK, se RASMUSSEN, T.V., H. STANG, S. HANSEN og C. PEDERSEN

TRABERG, SØREN: Opgaver i statik. (*Problems in Statics. In Danish). Afdelingen for Bærende Konstruktioner. Serie F, nr. 139, 1993. 47 s. Kr. 20,- excl. moms.

Forelæsningsnotatet indeholder opgaver, der stilles i det indledende kursus i statik. Det hører sammen med lærebogen: Søren Traberg og Claës Dyrbye, Statik.

*The publication presents problems belonging to the introductory course in statics. The related textbook is: Søren Traberg and Claës Dyrbye, Statics.

2. RAPPORTER OM EKSPERIMENTELLE UNDERSØGELSER

*Reports on experimental investigations

Rapporterne i denne gruppe drejer sig specielt om eksperimentelle undersøgelser. Der kan være tale om rekvirerede undersøgelser (med tilsvarende rapporter i S-serien) eller om andre rapporter om eksperimentelle undersøgelser, som ikke udkommer i serierne R, F eller I.

*These reports deal with experimental investigations. They may be reports on contract work (the S-series), or they may be other reports on experimental investigations, which are not published in the R, F, or I series.

HANSEN, SØREN, se KRENCHEL, H. og SØREN HANSEN

KRENCHEL, H. og SØREN HANSEN: Lerbaserede Kompositmaterialer. (*Clay-Based Composite Materials). Afslutningsrapport. STVF-projekt, Journal nr. 16-4793. ABK-sag 9021. Mikroporøs Keramik. 14 s.

Der er udviklet en teknik for fremstilling af gennembrændt, mikroporøst keramisk materiale i densitetsområdet ca. 0,85 til 1,75. Materialet er fremstillet ved pulverpresning med påfølgende tørring og brænding af et let fugtet blandingspulver bestående af almindeligt, ubrændt teglværksler og træmel.

Formålet med projektet var at undersøge, om man ad denne vej kunne fremstille lette bagmuringssten med tilstrækkelig styrke til anvendelse ved opmuring af varmeisolerende indervægge i almindelig husbygning. Konklusionen af undersøgelsen var imidlertid negativ. Mikroporøs keramik fremstillet på denne måde får for ringe trykstyrke i det densitetsområde ($\gamma \sim 0{,}5 - 0{,}7$) som varmeteknisk kunne være af interesse.

*A special technique is developed for making a well sintered, microporous ceramic material with densities between 0,85 and 1,75 or lower. This material is made by powder compaction of a mixed powder consisting of ordinary dried clay (as used for forming bricks) and wood flour. The mixed powder is made damp with 10-15% of water. After compaction, the block material is dried and then heated in an electric oven (950° C).

The aim of the project was to produce lightweight bricks to be used for building up heat insulating inner walls in ordinary house building. However, the conclusion of the investigation was negative. Microporous ceramic material produced in this manner has far too low compressive strength when the density is reduced to an acceptable level from a heat insulating point of view ($\gamma \sim 0{,}5 - 0{,}7$).

3. EKSAMENSPROJEKTER

*Final year projects

Da disse afhandlinger kun findes i et enkelt eksemplar, må et nærmere studium af dem foregå på Afdelingens bibliotek efter forudgående aftale. Fotokopier af hele afhandlinger eller dele heraf kan leveres til en pris af kr. 1,00 pr. side.

Yderligere oplysninger om afhandlingernes indhold fås ved henvendelse til den under resumeet angivne lærer.

Anmodning om kopiering kan ske telefonisk på tlf. 42 88 35 11.

*As there is normally only one copy of each of these theses, anyone wishing to study them in detail must do so at the Department's library according to a previous arrangement. Photocopies of entire theses or parts thereof can, however, be supplied at a price of D.kr. 1.00 per page. Orders for copies must be accompanied by a cheque for the amount in question.

Further information on the content of the theses can be obtained by application to the project leader indicated under the summary.

BALTZER, KARSTEN: Friktionslast på stålsiloer. (*Frictional loads on steel silos. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 65 s. + ca. 400 s. app. Fotokopi, kr. 465,-.

Lokale ændringer i en silovægs stivhed som følge af montering af en trykcelle kan medføre lokale trykomlejringer i silomediet ved trykcellen. Disse forhold medfører, at den målte forskydningsspænding på væggen er unøjagtig. Dette problem er søgt løst såvel teoretisk som eksperimentelt.

Der er udarbejdet et elementmetode edb program til at løse problemet teoretisk. Dette program er testet for et sæt inddata (ABK silo), og herefter kan det antages, at spændingerne beregnes korrekt. Der er foretaget beregninger med en ydre lokal afstivning uden på silovæggen.

Der er tilsvarende foretaget forsøg med sand i en silomodel med lokal afstivning. Resultaterne fra forsøgene afviger væsentligt fra de beregnede værdier. Mulige årsager hertil er angivet. Det udførte projekt danner grundlag for fortsatte undersøgelser.

Lærere: V. Askegaard og L.O. Nielsen.

*The mounting of a pressure cell in a thin silo wall may give local changes of wall stiffness leading to errors of the measured stress on the wall.

This problem has been dealt with theoretically and experimentally. Possible causes for the deviations between calculated and measured results are given. The results obtained will form the basis for continued investigations.

Project leaders: V. Askegaard and L.O. Nielsen.

CHRISTENSEN, CLAUS DENCKER og KRISTIAN JØRGENSEN: Strukturel Stabilitet og Imperfektionsfølsomhed. (*Structural Stability and Imperfection Sensitivity. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 204 s. + 245 s. edb-program og dokumentation. Fotokopi, kr. 449,-.

Komplicerede stabilitetsundersøgelser bliver, i konstruktionsøjemed, ofte behandlet ved simplificerede semi-analytiske- eller empiriske formler. Mere veldokumenterede bestemmelser af stabilitetsmæssige parametre vil ofte kunne føre til reduktion af konstruktioners dimensioner samt minimere risikoen for uforudsete konstruktionskollaps.

Bærende konstruktioners opførsel før, omkring og efter bifurkation behandles analytisk og numerisk. Projektet indeholder to dele:

- DEL I Udledning og opstilling af generel asymptotisk teori for elastisk stabilitets- og imperfektionsanalyse. Teorien er den første, som angiver explicitte formler til bestemmelse af buckling- og postbucklingfelter samt stabilitetskoefficienter under hensyntagen til lastled og sidebetingelser (for eksempel ustrækkelighed) ulineære op til fjerde grad i flytningerne. Komplicerede *ad hoc* analyser undgås således.
- DEL II Heri implementeres den i del I opstillede teori i en elementmetode til beregning af plankrumme konstruktioner.

Projektets resultater viser, at det for bjælkekonstruktioner ofte er nødvendigt at benytte tøjningsmål, der er nøjagtigere end dem, der benyttes i sædvanlige "andenordens-teorier".

Lærer: Esben Byskov.

*For design purposes, complex stability computations are often reduced to application of semi-analytic or empirical formulas. More accurately determined stability parameters may often lead to smaller structural dimensions and may also minimize the risk of unforeseen collapse.

Structural behavior before, at, and after bifurcation is treated analytically and numerically. The project contains two parts:

- PART I Development of general asymptotic theory of elastic stability and imperfection sensitivity. The theory is the first that provides explicit formulas for determination of buckling and postbuckling fields and stability coefficients considering load terms and

auxiliary conditions (e.g. inextensibility) that are nonlinear of up to fourth order in the displacements. Thus, complicated *ad hoc* analyses are avoided.

• PART II The theory from Part I is implemented in a finite element code for plane, curved structures.

The results show that for beam structures it is often necessary to utilize a theory that entails strains that are more accurate than the usual "second order" strains.

Project leader: Esben Byskov.

CHRISTOPHERSEN, CLAUS og TONNY HOVBORG: Parameterstudie af dybvands sænketunnel. (*Parametric studies of deepwater immersed tunnels. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 159 s. + 169 s. app. Fotokopi, kr. 328,-.

Teoretisk undersøgelse af sammenhængen mellem konstruktionsmateriale/-type og vanddybdeinterval for sænketunneler. Undersøgelsen omfatter to typer tunneltværsnit (4-sporet vej uden nødspor, 6-sporet vej med nødspor) med og uden varierende top- og bundpladetykkelser.

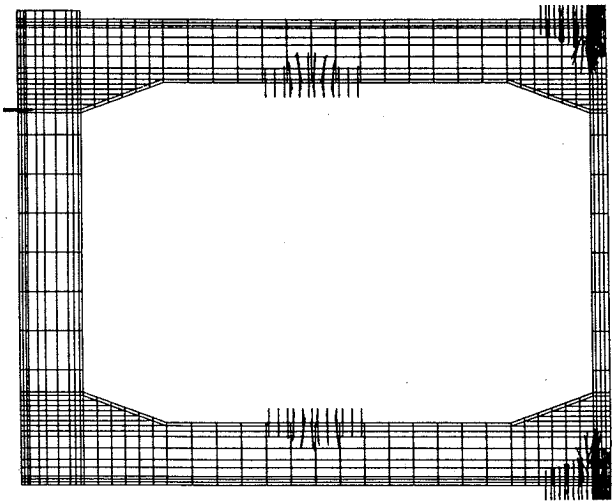
I undersøgelsen indgår både normalstyrke og højstyrkebeton, begge med såvel blød armering som spændarmering.

Lærer: Niels J. Gimsing.

*Theoretical investigation into the relation between structural material/type and interval of waterdepths for immersed tunnels. The investigation comprises two types of cross section (4 lane road without hard shoulders, and 6 lane road with hard shoulders) with and without varying thickness of the top and bottom slabs.

In the investigations both concrete of normal and high strength is considered, as well as regular and posttensioned reinforcement.

Project leader: Niels J. Gimsing.



Revnezoner for E = 20000, β = 0.50 og en lastfaktor på 0.6.

*Crack zones for E = 20000, β = 0.50 and a load factor of 0.6.

Ref.: CHRISTOPHERSEN, CLAUS og TONNY HOVBORG: Parameterstudier af dybvandssænketunnel. (s. 36).

GRØNLUND, JAKOB: Analyse af skråstagsbro med kompositdrager. (*Analysis of cable-stayed bridges with a composite deck. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 142 s. + ca. 300 s. app. Fotokopi, kr. 442,-.

Undersøgelse af skråstagsbroer med kompositdrager i både sluttilstand og montagetilstand. For montagetilstanden er specielt undersøgt effekten af forskellige initialopspændinger af skråstagene (før betonpladeudstøbningen). Der er endvidere undersøgt de dynamiske forhold, specielt i de mere ustabile montagesituationer.

Lærer: Niels J. Gimsing.

*Investigations on cable-stayed bridges with composite girders in the final stage as well as in the erection stage. For the erection stage, a special study has been performed on the influence of the initial stay tensioning prior to concrete casting. Furthermore, the dynamic behaviour in the sensitive erection stages has been investigated.

Project leader: Niels J. Gimsing.

HAUGGAARD-NIELSEN, ANDERS BOE: Konstruktioner med ikke-lineære materialeegenskaber. (*Structures with non-linear material behaviour. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 156 s. hovedrapport + 10 s. tillægsrapport. Fotokopi, kr. 166,-.

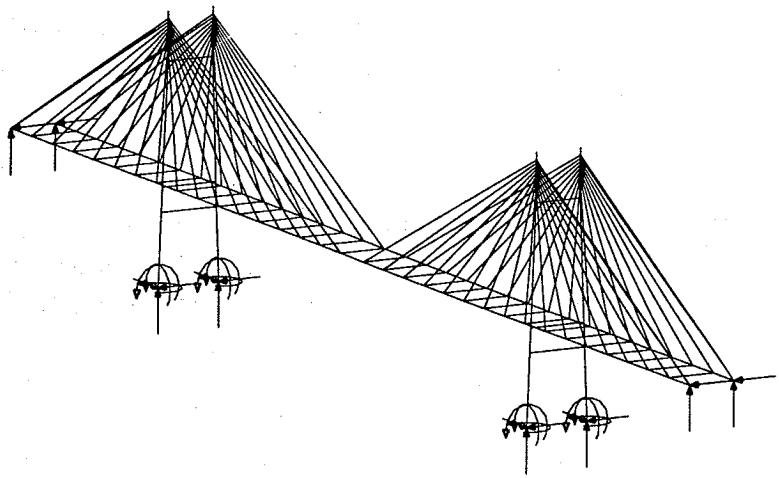
Projektets formål er at beskrive styrke/stivhedsudviklingen i ung beton. I denne fase er der et kompliceret samspil mellem varmeudvikling og revnedannelse, idet hydratiseringsvarmen giver anledning til en ikke-homogen spændingstilstand, der kan forårsage revner.

I rapporten opstilles en generel inkremental elementmetodeformulering for konstruktioner af ikke-lineære materialer. Ved løsning af elementmetodeligningerne anvendes forskellige metoder som sammenlignes. Til verifikation af de opstillede algoritmer beregnes eksempler på konstruktioner med en plastisk materialemodel. Den konstitutive model, der anvendes for beton, er en udjævnende revnemodel, som beskriver softening og lokalisering. Beregninger med beton-modellen sammenlignes med eksperimentelle resultater for et prøvelegeme med en cirkulær kærv, og der opnås god overensstemmelse mellem beregninger og eksperimenter.

Lærer: L. Damkilde.

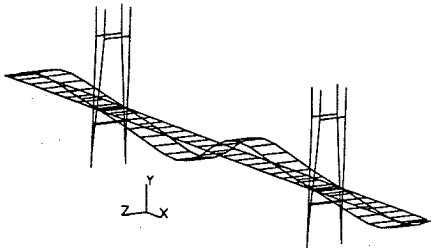
*The aim of the project is to describe the strength/stiffness development in early age concrete. In this phase there is a complicated interaction between heat-development and cracking. This is due to the non-homogeneous stress-state induced by the heat generated from the hydration process.

In the report a general incremental finite element method formulation for structures of nonlinear materials is outlined. The finite element equations are solved in different ways



Bro i udeformeret tilstand.

*Bridge in undeformed state.



Egenfunktion, mode 2, f = 0.38 Hz, T = 2.61 s.

*Vibration mode 2, f = 0.38 Hz, T = 2.61 s.

Ref.: GRØNLUND, JAKOB: Analyse af skråstagsbro med kompositdrager. (s. 37).

which are compared. To verify the algorithms we analyse structures of plastic material. The constitutive model for concrete cracking is a smeared-out model which includes softening and localization. Numerical calculations with the concrete model for a specimen with a circular notch are compared with experimental results, and good agreement is experienced.

Project leader: L. Damkilde.

HOLM, MORTEN og ANDERS THOMSEN: Skråstagsbro over Flinterenden. (*Cable-stayed bridge across the Flinte Channel. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 91 s. + 8 tegn. + 167 s. app. Fotokopi, kr. 258,-.

Projekt til to-etages skråstagsbro over Flinterenden med spændvidde 500 m. Afstivningsdrageren er opbygget som en kompositkonstruktion med det øvre brodæk (for vej) udført i beton, mens det nedre brodæk (for jernbane) er udført i stål. De to dæk er indbyrdes forbundne med skråtliggende gitterdragere.

Hele brooverbygningen er analyseret ved hjælp af en 3-dimensional matematisk model, og en række detailsamlinger er ved FEM analyser undersøgt for spændingskoncentrationer.

Lærer: Niels J. Gimsing.

*Design of a double deck cable-stayed bridge across the Flinte Channel with a span of 500 m. The stiffening girder is made as a composite truss with the upper bridge deck (for road) of concrete and the lower bridge deck (for railway) in steel. The two decks are joined by inclined trusses.

The entire superstructure is analyzed with a 3-dimensional mathematical model, and a number of joints are analyzed with Finite Elements to indicate stress concentrations.

Project leader: Niels J. Gimsing.

HOVBORG, TONNY, se CHRISTOPHERSEN, CLAUS og TONNY HOVBORG

JENSEN, ANETTE: Sikkerhed for trykkede konstruktionsdele. (*Safety of structural members in compression. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 117 s. + bilag 282 s. Fotokopi, kr. 399,-.

I forbindelse med overgangen fra den danske stålnorm, DS 412, til den fælles europæiske stålnorm, EC3, er det for udvalgte trykkede konstruktionsdele søgt at sammenligne beregningsudtrykkene og deres sikkerhed ifølge de to normer.

Lærer: Claus Philipsen.

*In connection with change from the Danish Code of Practice for Steel Structures (DS 412) to the common European Code of Practice for Steel Structures (EC3), the methods of design according to the two codes (design formulae and their safety) have been compared for various types of structural members in compression.

Project leader: Claus Philipsen.

JENSEN, HANNE HØEG: Udmattelse i højstyrkestål. (*Fatigue in high strength steel. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 167 s. + 1 rettelsesblad + 80 s. app. Fotokopi, kr. 248,-.

Eksamensprojektet falder i 2 dele:

1) Litteraturstudium: Højstyrkestål. Fremstilling, udmattelsesegenskaber generelt.

2) Udmattelsesforsøg: Prøvelegemerne består af en hovedplade 8 x 40 x 375 mm med to påsvejste tværafstivninger 5 x 40 x 50 mm. Ståltype WELDOX 700. Prøvelegemerne belastes med en central normalkraft i hovedpladen.

Last med konstant amplitude, spændingsforhold R = 0. Stokastisk last med spektret NARROW64.

Konklusionen på forsøgene er, at det undersøgte højstyrkestål har væsentligt bedre udmattelsesegenskaber end almindeligt konstruktionsstål (Fe 510).

Indflydelsen af svejsningens lokalgeometri på levetiden blev undersøgt. Endelig blev der udført revnemålingsforsøg.

Lærer: Henning Agerskov.

*The final year project is divided into two parts:

1) Studies of literature: High strength steel. Processing, fatigue behaviour in general.

2) Experimental investigations: The test specimens consist of a main plate 8 x 40 x 375 mm with two transverse secondary plates 5 x 40 x 50 mm. Steel type WELDOX 700. The applied fatigue loading is a central normal force in the main plate.

Constant amplitude loading, stress ratio R = 0. Stochastic loading with spectrum NARROW64.

Conclusion: The fatigue characteristics of the high strength steel are significantly better than those of an ordinary construction steel (Fe510).

The effect of the local geometry at the weld toe on the life of the specimens was investigated.

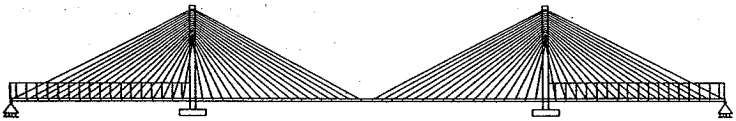
Finally, crack width measurements were carried out.

Project leader: Henning Agerskov.

JØRGENSEN, KRISTIAN, se CHRISTENSEN, CLAUS DENCKER og KRISTIAN JØRGENSEN

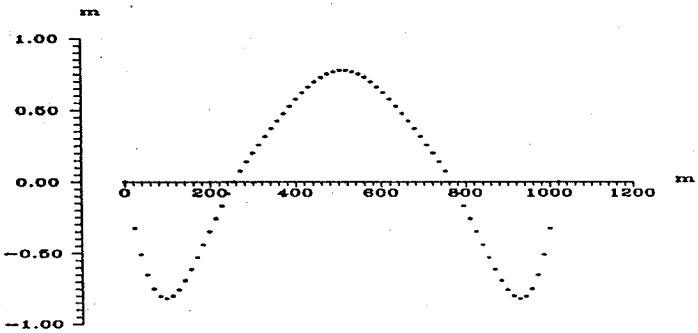
MORBECH, KAJ BENNY og MICHAEL FRIIS OLSEN: Parameterstudier af skråstagsbroer. (*Comparative studies of cable-stayed bridges. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, 132 s. + referencer + bilag. Fotokopi, kr. 132,-.

Projektets væsentligste formål var at undersøge indflydelsen af forholdet mellem sidefagets og hovedfagets længder (S/H-forholdet) på skråstagsbroers opførsel. Med udgangspunkt i en



Trafiklast på sidefag.

*Traffic load on side spans.



Udbøjning af drager.

*Deflection of stiffening girder.

Ref.: MORBECH, KAJ BENNY og MICHAEL FRIIS OLSEN: Parameterstudier af skråstagsbroer. (s. 42).

eksisterende japansk skråstagsbro (Tsurumi Fairway broen, der har det usædvanlige høje S/H-forhold 0,5), er der foretaget sammenlignende beregninger af den japanske bro og et antal bromodeller, som minder om den japanske bro, men som har mindre S/H-værdier. Ved beregningerne er der taget hensyn til endelige flytninger og til nedhængseffekten for skråstagene (ulineære beregninger). Det konkluderes, at det optimale S/H-forhold ligger omkring 0,3 - 0,4, hvilket stemmer med de værdier, som normalt anvendes for skråstagsbroer, men som er lavere end værdien for den japanske bro.

Lærere: Niels J. Gimsing og Hugo Møllmann.

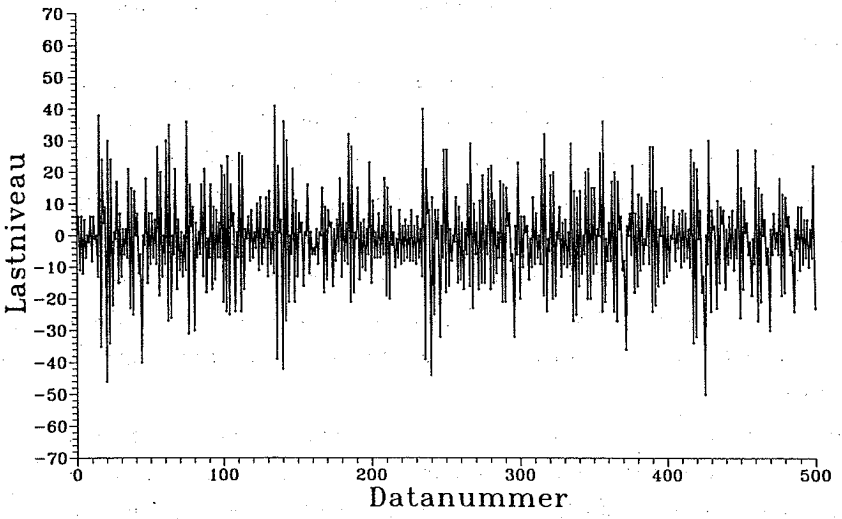
*The main purpose of the project was to investigate the influence of the ratio of the length of the side span to that of the main span (the S/M-ratio) on the behaviour of cable-stayed bridges. Using an existing Japanese cable-stayed bridge as a reference (the Tsurumi Fairway bridge, which has the unusually large S/M-ratio of 0.5), comparative calculations were carried out for the Japanese bridge and for a number of bridge models of similar type as the Japanese bridge, but with smaller S/M-values. The effects of finite displacements and cable sag in the stays were accounted for in the analysis (nonlinear calculations). It was concluded that the optimal S/M-ratio has a value of about 0.3 - 0.4, which is about the same as the values normally used for cable-stayed bridges, but smaller than the value for the Japanese bridge.

Project leaders: Niels J. Gimsing and Hugo Møllmann.

NIELSEN, JETTE ANDKJÆR og TINA VEJRUM: Udmattelse i stålkonstruktioner udsat for stokastisk last. (*Fatigue in Steel Structures at Stochastic Loading. In Danish). Eksamensprojekt, Afdelingen for Bærende Konstruktioner, 1993, Del I: 171 s. + 92 s. bilag + 140 s. app. + 100 s. data (= 10 ruller), Del II: 107 s. + 141 s. app. i alt 751 s. Fotokopi, kr. 751,-.

Projektet er delt op i to dele: Én vedrørende brolast og én, der omhandler et rørknudeforsøg.

Delrapport I, Brolast, omhandler udmattelse i forbindelse med trafiklast på en bro. Der er udført et antal udmattelsesforsøg med en målt spændingshistorie. Denne er fremkommet på



Målt spændingshistorie klargjort til udmattelsesforsøg.

*Measured stress history prepared for fatigue tests.

Ref.: NIELSEN, JETTE ANDKJÆR og TINA VEJRUM: Udmattelse i stålkonstruktioner for stokatisk last. (s. 44).

basis af en uges kontinuerte målinger af trafikkens belastning af et nærmere angivet punkt på længderibberne i den ene af Farøbroerne. Pga. de store datamængder, som skal håndteres, er der udviklet et program til styring af datalogger samt løbende sortering af data. Endvidere er udviklet programmer til efterbehandling samt statistisk analyse af de målte spændingshistorier. Resultaterne af udmattelsesforsøgene tyder på levetider på den usikre side i forhold til dimensioneringsreglerne i henhold til Palmgren-Miners formel.

Delrapport II, Rørknudeforsøg, omhandler et udmattelsesforsøg med en dobbelt T-samling udsat for en stokastisk lasthistorie svarende til bølgelast. Spændingerne ved svejsefoden er bestemt dels ved strain gage målinger dels vha SPATE udstyr. De observerede levetider ligger på den sikre side sammenlignet med levetiden beregnet i henhold til DS449.

Lærere: H. Agerskov og R.I. Petersen.

*The project is divided into two sections: One concerning bridge loading and one dealing with a tubular joint.

Part I, Bridge Loading, deals with fatigue in connection with traffic loading on a bridge. A number of fatigue tests has been carried out with a measured stress history corresponding to bridge loading. This stress history is based on one week's continuous measurements of the strains from traffic at a specific spot on the longitudinal stiffening ribs in the Farø Bridge. Due to the large amount of data, a programme has been developed to control the datalogger and to sort the data simultaneously. Furthermore, programmes have been developed for the statistic analysis of the measured stress history and for preparing this for the testings. The results of the fatigue tests indicate that calculating the fatigue life according to the Palmgren-Miner rule may be unconservative.

Part II, Tubular Joint, deals with the fatigue test of a double T-joint subjected to a stochastic loading corresponding to a wave spectrum. The stresses at the weld toe are measured by strain gages and by SPATE equipment. The observed fatigue lives are on the safe side compared to the fatigue life calculated according to the Danish code DS449.

Project leaders: H. Agerskov and R.I. Petersen.

OLSEN, MICHAEL FRIIS, se MORBECH, KAJ BENNY og MICHAEL FRIIS OLSEN

RIBER, HANS JØRGEN: *Strength analysis of the 470 sailing boat. (Styrkemæssig analyse af 470 jollen). Eksamensprojekt, Institut for Skibs- og Havteknik og Afdelingen for Bærende Konstruktioner, 1993, 269 s. Fotokopi, kr. 269,-.

*The thesis deals with the strength analysis of the olympic 470 sailing boat. A finite element method program handling fibre glass shells is developed in order to perform this analysis. Full scale tests with the 470 hull are performed to verify the numerical model.

Project leaders: J. Baatrup, Chr. Aage and C. Philipsen.

En olympisk 470 jolles stivhed og styrke undersøges. Der udvikles et FEM program til brug ved beregning af glasfiber skaller, og der foretages eksperimentelle fuld skala forsøg med en 470 jolle.

Lærere: J. Baatrup, Chr. Aage og C. Philipsen.

THOMSEN, ANDERS, se HOLM, MORTEN og ANDERS THOMSEN

VEJRUM, TINA, se NIELSEN, JETTE ANDKJÆR og TINA VEJRUM

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