

SUMMARIES OF THE ARTICLES

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Prof. Ir. C. G. J. Vreedenburgh, Chairman of the Section for Reinforced Concrete and Steel Constructions T.N.O.:

Introduction

The purpose of these transactions, which will for the time being appear quarterly, is to give a wide range of publicity to the experience gathered by the Section in the course of its activities in so far as the matters treated are of general interest.

Ir. A. L. Bouma, Editor:

The section for reinforced concrete- and steel constructions T.N.O.

This article gives details of the field of activity of the Section, its methods, organization and constitution, its accommodation and technical equipment. Lastly, a review is given of the research work conducted both in general and by order.

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Experimental research on constructions

After classification of the various stages in the research, such as establishing the method to be applied, carrying out the experimental research and interpreting the measuring results, this article (the first of a series) describes some of the mechanical testing instruments used.

The ultimate bending moment of prestressed concrete girders.

Two formulae for determination of the ultimate bending moment (the first being given by the Association for the Study of Prestressed Concrete and the second by Prof. Ir. G. Magnel of the Technological University of Ghent, Belgium) are discussed and the findings compared with the results of various experiments.

Internal stresses and formation of cracks in steel sections

The formation of cracks in curved steel sections appears at first sight to be inexplicable, as the cracks apparently occur in the pressure zone. However, high initial tensile stresses may exist in such zones. Alternating stresses or the aging-phenomenon in material that is sensitive to these effects may then soon result in rupture.

Method of derivation of a differential equation for circular cylindrical shell-type roofs

The behaviour of a circular cylindrical shell-type roof is governed by a differential equation of the 8th order. By consistently omitting all unimportant terms, we arrive at a very simple and convenient form of a differential equation, which appears to be in fact a combination of the differential equation for a plate loaded in its plane and that for a plate loaded perpendicular to its plane.

The characteristic equation in this case is of the form $(\varrho^2 - \gamma)^4 + 4 = 0$. The complex roots of this equation can at once be written out.

Measurements on a shell-type roof in Rotterdam

This article gives a report on flexion- and elongation-measurements carried out before and during the dismantling of a „butterfly” shell-type roof constructed at the new Central Station in Rotterdam. Measurements were also carried out during a test-loading (line load.) The measurements showed among other things that prior to dismantling the shell is to a large extent self-supporting and that variations in temperature exert a considerable influence upon the distribution of stresses, especially the bending moment stresses.

A critical consideration of the safety of reinforced concrete beams subjected to bending moments.

The safety of the beam is considered with regard to four criteria, viz: safety with respect to collapse, formation of cracks, warning against collapse and admissible deformations. These criteria are presented in the form of graphs to which reference is made in considering how to satisfy these criteria.

A hypothesis to explain fatigue phenomena in tenacious steels

A energy-hypothesis is drawn up on the basis of the progressive decrease of elongation occurring in tenacious steels subjected to a stress beyond the fatigue limit. In this hypothesis, a part of the work done in the damping of vibrations is deemed to be responsible for the formation of cracks. The mathematical formulation of the hypothesis enables the wellknown fatigue characteristics to be expressed in algebraic formulae. On the basis of this theory it is possible to explain various remarkable phenomena occurring in fatigue tests, such as: coxing, the lowering of the fatigue strength in the event of overload; the wide divergencies which are of general occurrence in fatigue tests. Lastly, the theory is applied to railway bridges subjected to dynamic loads.

**The new laboratory of the section for reinforced concrete and steel constructions
T.N.O.**

A brief report of the official inauguration of the new laboratory on 20th November 1953.

An investigation on the effect of concentrated loads on plates

In order to obtain a better insight into the stress-distribution which occurs in plates under a concentrated load and thus to arrive at an improved method of calculation in the particular case of plate bridges, measurements were carried out on a steel model, using electrical strain-gages.

The investigation can in the main be divided into two parts, viz.:

1. An investigation of the influence of the magnitude of the loading-area (i.e. the degree of concentration of the load) upon the moments.
2. An investigation of the stress-distribution in the plate as a function of the boundary conditions and of the location of the load.

The results, which are shown in the form of graphs, are reviewed and in some cases compared with the theoretical results.

The application of electrical strain gages during measurements on constructions

This article gives information concerning the principles of strain gages, their application and the methods of measurement employed. It also describes the various circuit diagrams applicable when several strain gages are used, the possibilities afforded, including the embodiment of strain gages in measuring instruments and the use of strain gages on steel and concrete constructions.

Upon the stress distribution in circular cylindrical shell-type roofs

An examination is made of different forms of cylindrical shell constructions such as barrel-type shells, a shed-type and a „butterfly” shell construction. The occurring stresses, moments and displacements are reproduced in diagrams and reviewed. In the case of barrel-type shells of the „long type” the results obtained by the analytical method of calculation are compared with those obtained by the elementary beam method. Moreover, the influence exerted by the length of the shell upon the stresses produced and the importance of the edge girders are specially dealt with. The prestressing of barrel-type shell constructions is also reviewed.

The buckling of latticed struts

On the basis of formulae it is shown in a specimen calculation that the rigidity of the end batten plate in the case of latticed struts with a small number of panels has a preponderant influence upon the total buckling force.

Introduction to statically indeterminate girder constructions in prestressed concrete

The purpose of prestressing is to prevent the formation of cracks in the concrete. As a result of prestressing, the girder undergoes certain deformations. In the case of a statically indeterminate girder, statically indeterminate reactions are produced in this way. The effect of the prestressing is consequently difficult to survey, so that designing is not so simple a matter. The effect of the cable may be formulated as the introduction of a pressure line into a girder, or it may be expressed as an external load. Both these formulations are of equal value, but there are cases in which formulation as an external load is to be preferred. The application of statically indeterminate constructions in prestressed concrete is not always found economical as compared with statically determinate constructions. Owing to the large number of factors involved it is difficult to lay down general rules in regard to this.

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Should the elastic theory or the elasto-plastic theory be used in the calculation of beams subjected to bending loads?

The problem propounded, which is usually expressed by the question: „Should the elastic theory or the elasto-plastic theory be used?” is subjected to a critical examination. This leads to a totally different definition of the problem. The problem as such is found to be far more extensive and complicated than had at first been supposed.

On the other hand, the results achieved by the introduction of a new method of calculation has in the first instance proved to be of practical value mainly in special cases. However, the better insight gained will in the long run also bear fruit in the case of standard reinforced concrete constructions. In connection with the article in the „W.G.S.-Mededelingen” (Transactions of the Section for Reinforced Concrete- and Steel Constructions) 1953 — No. 3: „A critical consideration of the safety of reinforced concrete beams subjected to bending moments”, the requirements to be stipulated for a construction are worked out in detail in the light of the problem as propounded above.

Some of the points dealt with are : the definition and calculation of the ultimate bending moment — a method of calculation whereby the formation of cracks in a girder may be determined — the „safety factor” concept — the influence of the time factor — the manner in which experiments can be introduced — the manner in which experiments has been planned in Germany.

Fire tests on prestressed concrete girders

In collaboration with the Institute for Fire Prevention T.N.O., prestressed girders of a length up to 8 meters were subjected to fire tests. The furnace and procedure are described in this article.

Theoretical and experimental research on side fillet welds

In the following, the stress-distribution in side fillet welds is reviewed. This distribution is first approximated theoretically, after which measured values of the longitudinal stresses in strips welded to each other are taken as basis for calculating the stresses in the welds.

The ratio between the length of the weld and the width of the strip is found to be of considerable influence upon the stress distribution. In the case of short welds a very disadvantageous end fillet weld phenomenon is found to occur which should be avoided particularly in constructions subjected to dynamic loads. In the case of long welds the shearing stresses become concentrated at the ends, which represents a waste of material. An optimum value for the length of the weld is found to be twice the width of the strip.

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Anchoring systems for prestressed concrete

In this article a brief review is given of the most important systems of anchoring. From the factors determining the usefulness of a system the behaviour of systems with wedges and specially the occurring slip is considered. A description is given of a test plant used by the Section. At last the influence of the slip on the prestressing of the wires (stress-decreases) is examined.

Discussion on „A critical consideration of the safety of reinforced concrete beams subjected to bending moments” (Vol. 1 No. 3).

With reference to this article a few remarks has been received, which remarks are published together with the answers.

The stress-distribution in a gusset plate

For the calculation of gusset plates in frame-works, some simple formulae are established on the basis of a theoretical research. The safety of these formulae is considered in regard to the results of an experimental investigation.