Comments by the author of the introductory report

IV

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Commentaire de l'auteur du rapport introductif

Kommentar des Autors zum Einführungsbericht

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1. Ductility of Yield Hinges

It has been shown from a numerical analysis that a large amount of hoop reinforcement confines the covered concrete, and modifies the bending moment-curvature relationship of structural members after the yielding steel bars. The results can serve as a means of determining the amount of hoop reinforcement necessarily to give the required ductility in the amount-curvature relationship for the earthquake resistant design. This may contribute to the establishment of the method of earthquake-resistant design. It still seems necessary to add experiments in order to investigate how the hoop confinement depends on the arrangement of hoop reinforcement and the gradient of compressive strains.

There has also been a contribution in which the curvature of the ultimate state is determined for a column from the stress-strain relation of the concrete.

2. Influence of Fire

Three papers have been presented on the effects of fire. The progress in the discretization process by means of elctronic computers facilitates the determination of the distributions of stresses and strains in a cross-section due to fire, and it has become possible to calculate how the carrying capacity of long and short columns under central and eccentric loading changes with time, the relationship between the endurance time and the size and covering-thickness of a column has been determined numerically. It has also been clarified how the carrying capacity of a column is dependent upon the room temperature which in turn depends actually on the amount of combustibles and ventilation.

When columns in fire are confined in frames, the restraining effects of the surroundings expedite the loss of the strength. A method of analysis and examples have been presented to analyse such cases, and it is emphasized that the whole frame should be analysed in order to determine the fire-resistance of a column in this situation.

Besides, there still remain many points of uncertainty to be analysed on the behavior columns when the floor and beams are on fire.

3. Interaction between Axial Thrust, Bending and Shear

The experimental results have been presented in which a total of 125 specimens was tested in order to investigate the elastic-plastic behavior, in particular the ductility, of reinforced concrete members subjected to constant axial forces, together with the alternate bending moments and shear forces. Qualitative discussions were made as to how the mode of failure influences the

ductility. Further studies seem to be necessary to investigate the mechanism of failure, the carrying capacity, ductility, the amount of hoop reinforcement to insure the strength or ductility, etc., on the basis of such experimental results.

A contribution has been presented on the shear failure of the encased column which is composed of a wide-flange or an open-web steel covered by reinforced concrete. Such a case is dominated by the mode of shear-bond failure, the ductility and the hysteretic characteristics being greatly dependent on the arrangment of the steel. Semi-theoretical formulae have been presented to determine the behavior and mode of mechanism at the attainment of the ultimate strength and after repeated loading with large deformation amplitudes, indicating good agreement with experimental results. The semi-thoretical formulae are to be in corporated into the new Japanese specifications for the design of Composite columns. It still means necessary to collect further date of the resistance of concrete and of hoop reinforcement in shear-bond failure.

Reference (21) of the sixth line in 76 page in the Introductory Report for Theme IV was over-looked ; Reference (21) is to be replaced by " Yamada, M. and Furui, S: STUDY ON THE SHEAR RESISTANCE OF THE REINFORCED CONCRETE MEMBERS SUBJECTED TO AXIAL LOAD, Part I-SHEAR SPAN RATIO, Trans. AIJ,Summary of Technical Papers, Oct. 1966, P.216, (in Japanese).

In order to determine the deformation of a column under combined action of an axial force, bending moment and shear, account should be taken of the deformation due to the slipping of reinforcement and to the shearing in the column, as well as the deformation due to the bending moment and axial force. A paper concerning this effect has been presented, indicating the agreement of the theoretical hysteresis with experiment. However, researches need to be carried out in order to clarify the theoretical back ground for the deformation due to slipping and shear deformation used in the analysis.

A contribution extends to the determination of the carrying capacity of a reinforced beam column under a transverse load acted at the middle. The carrying capacity of this study shows that the ACI moment magnifier formula gives a good approximation, though indicating small discrepancies dependent upon the slenderness of members, eccentricities of the axial forces, the ratio of the tranverse and axial load, etc.

A proposition has been made on the strict determination of the carrying capacity of arches under various loading conditions, as a problem of combined states of stress. This method is shown to give the solution to any accuracy as required.

4. Prestressing of Compression Members

The formula in the British Code determining the additional moment in a slender reinforced concrete column does not necessarily agree well with experimental results, when applied for prestressed long column. Studies have been directed, therefore, to the case of the discrepancy; it has been studied how the behavior of a prestressed column is affected by the slenderness ratios, initial eccentricity and the level of prestressing; a proposition has been presented to the design.

5. Splices

A paper on the joint reinforcement of a precast column has been presented. Since the concrete near the column joint is subjected to a high compression and splitting force, it has been shown that spiral reinforcement is preferable in circular columns, and equally distributed vertical and horizontal reinforcement in rectangular columns; the required amount of the reinforcement has also been proposed.