

Abstracts

1 Three Dimensional Nonlinear Analysis Method for Concrete

by Kazuhiro Naganuma

New constitutive models are proposed for concrete under triaxial compressive stress focusing on stress-strain relationship and nonlinear Poisson effect based on comparison between present model and experimental results.

At first, past representative failure criteria are investigated in accuracy and applicability comparing with compressive test results of concrete under lateral pressure. Secondly, it is demonstrated that stress-strain relationship including compressive strain softening region is greatly affected by both uniaxial compressive strength and stress enhancement ratio due to lateral pressure. Based on this study, new stress-strain curves are proposed as a function of these parameters. Finally, after indicating that nonlinear Poisson effect is indispensable for rigorous analysis of confined concrete, new equations are proposed for that effect.

2 Studies on Seismic Retrofit of Railway Viaducts Columns using Carbon Fiber Sheet

by Motoyuki Okano, Hajime Ohuchi, Atsushi Kagawa and Masajiro Koga

A great number of RC columns of railway viaducts were severely damaged during the Hyogo-ken Nanbu Earthquake. Various authors have indicated that the main causes of the damage were poor ductility with shear failure. In order to improve these performances, an effective retrofitting method using carbon fiber sheet has been studied. In the retrofitting method, carbon fiber sheets are glued onto the concrete surface around columns by epoxy resin. In the case of railway viaducts, the axial force of columns varies from tensile to high compressive forces in such a huge earthquake. Therefore, two series of structural tests using full scale retrofitted specimens were performed: One was shear tests under tensile force, the other ductility tests under high compressive force, in addition non-linear finite element (FEM) analysis of shear behavior was performed.

The following results were obtained: 1) Shear strength can be improved, and the performances of retrofitted columns can be evaluated by non-linear FEM analysis. An equation of shear strength using the effect rate of carbon fiber was proposed. 2) Ductility can be improved, and an equation of ductility using shear safety margin was proposed. Carbon fiber strand improves ductility a little more effectively than sheet.

3 Steel Tube-Reinforced Concrete Composite Bridge Column (Part 3)

— An Experimental Study on Ductility Capacity of Composite Bridge Column —

by Kouichi Tanaka, Hiroshi Wakama and Hajime Ohuchi

Composite bridge columns with ordinary reinforcement combined with steel tubes as reinforcing steel have been developed in order to reduce construction time and skilled labor. The method has proved to be efficient for columns ranging from 40 to 100 m in height. Significant features of this columns are that several steel tubes are placed inside the section and high

strength strands are set in spiral form instead of ordinary lateral reinforcement. However, seismic design guidelines have to be developed in order to ensure earthquake resistant capacity for this type bridge columns. The present study focuses on the composite action and effect of lateral reinforcement ratio and proportion of cross section for ductility capacity.

The following results were obtained: 1) The maximum loading capacity is more than 95% of the calculated value assuming perfect bond action between steel tubes and concrete, 2) The lateral reinforcing ratio does not affect ductility capacity, 3) The Width/depth ratio of cross section affects ductility capacity and buckling.

4 Anti-vibration Method for Wind-induced Vibration in Cable Arrays of Cable-stayed Bridges (Part 2) — An Experimental Study on the Efficiency of Spacers as Vibration Dampers —

by Toshio Nomura, Akihiro Fujiwara and Masayasu Ito

The vibration of cable arrays in long span bridges, called wake galloping, is induced by wind and there are no established methods for the control of vibration. After conducting an analytical study and completing a field test under no wind conditions and a wind tunnel test, we were able to confirm that it is possible to increase the onset velocity for vibration.

In order to investigate the damping efficiency of spacers, the effects of cable spacing, cable weight, cable diameter and natural frequency of the cable system were studied in a spring-mounted model. A method for predicting onset velocity and amplitude was discussed and the unsteady character of aerodynamic forces was studied. The results demonstrate that, under various conditions, wake galloping is efficiently reduced and the onset velocities for vibration are significantly higher when using spacers. In contrast with general methods, the use of spacers in relatively light cable systems with low natural frequencies proves to be very efficient, but their application in combination with other vibration control devices should be given special attention.

5 Development and Application of Automated Construction System (BIG CANOPY) for High-rise Reinforced Concrete Buildings

by Noriyuki Furuya, Koji Hamada, Kohei Kurita, Tatsuya Wakisaka, Yasuo Inoue
Takashi Shiokawa, Kyoji Yoshino and Kyoichi Hishikawa

The all-weather automated construction system, called BIG CANOPY, has been developed to reduce the total cost of high-rise reinforced concrete building construction, and was applied to a 26-story reinforced concrete condominium project located in Chiba prefecture in 1995 for the first time in the world. This automated construction system consists of four major technologies: a) Synchronously climbing all-weather temporary roof; b) Parallel material delivery system with one construction lift and three overhead cranes carrying three transfer hoists; c) Prefabrication and unification of construction materials; and d) Material management system using database system linked with CAD system.

Consequently this automated system is confirmed effective when used at the site, because of using extensive prefabrication and unification of construction materials and of employing all round workers. It ensures good quality, improves the working and environmental conditions, reduces the construction period, manpower, and wastes, and improves overall productivity without increasing construction cost.

6 New Green-cutting Method of Concrete Surface with Retarder Sheet that will Dissolve in Alkali Water —— Development of the Green Face Method ——

by Hiroyuki Kawashima, Takayoshi Hirata, Shigeyuki Sogo and Isao Aihara

The technique of exposing aggregate on a concrete surface is used in both construction joint treatment and exposed aggregate finishing. In the case of exposing aggregate after the existing concrete hardens, the surface is scraped with a wire brush or by chipping, or roughened by applying a retarder by a high-pressure air and water to it. However this method of applying a retarder is not usually effective because of rainwater and aging.

The authors have developed a method of exposed aggregate by washing the concrete surface (Green Face Method) using a retarder sheet, which is made of unsaturated polyester and have the characteristic of retarding hydration of a concrete surface for a few weeks.

This paper describes an experimental comparison of the Green Face Method with the chipping method in terms of retarder effect and dynamic performance. This method may be effectively used in both vertical construction joints and construction joints and exposed aggregate finishing.

7 Improvement of Formwork Release from Concrete in Sliding Form System

by Akiko Okuda, Takeshi Kawachi and Masahiro Moriya

In the Sliding Form System, it is necessary to reduce the adhesion of formwork materials to the concrete surface. In this study, experiments were carried out to clarify the adhesion phenomena between the concrete and surface materials of formwork and to improve release of formwork from the concrete surface.

The following results were obtained:

1) Shearing adhesion force between mortar and steel was the highest of all materials tested and some of the surface materials had a low shearing adhesion force to mortar.

2) According to the results of indoor and field tests, polytetrafluoroethylene (PTFE) is particularly useful as a surface material of formwork in terms of formwork release, durability and economy. Polypropylene (PP), polyvinylchloride (PVC) can also be used.

8 Development of POLYMAS Method on Earth Pressure Balance Shield —— Quality of New Polymer and Ability for Excavated Soils ——

by Yukio Yamashita and Kaneyuki Takano

A new shield tunneling method is required that is safe and more efficient for pumping transportation of shield excavated soils. Sand soils cannot be transported. When bentonite is used as a fluid soil, it is difficult to separate the bentonite from mixed soils. In the foam-injected shield tunneling method, it is difficult pump-transport excavated soils due to the elastic contractibility of foam. We developed a new shield tunneling method using a polymer having the principal ingredient CMC to solve these problems, called the POLYMAS (POLYMER Added Shield) method. This method can easily separate polymer from mixed soils. And allows pumping transportation from sand soils to gravel soils. This paper describes the experiment results with the POLYMAS method, and shows that this method is effective.

9 Driving Control of Steel Pipe Pile by Hydraulic Hammer

by Mamoru Sahara, Yusuke Ishii, Hirotoishi Sei and Yusuke Miyazaki

Driving construction of steel pipe pile by hydraulic hammer was planned for a thermal power plant on reclaimed land. The site plan was large (320m × 220m). Soil exploration results suggested that the bearing stratum depths varied in the site. We used two types of hydraulic hammers with different falling mechanism to drive 7,200 piles in a short period. We clarified the boundaries of the different bearing stratum depths and difference in driving efficiency between the two types of hammers in order to satisfy the required pile capacity and to drive in the planned period.

This paper shows the results of the driving tests conducted to solve these problems, and demonstrates a practical driving control method based on the results. We formulated the relationship between driving energy and N-value, and showed using this formula that the driving control method was more rational.

10 Development of Method for Protecting Earthworks from Muddy Water and Dust

by Masami Kurihara, Takayuki Ueno and Kiyoshige Nishibayashi

During earthworks for housing sites or road construction, the environment near the site is often damaged by muddy water and dust with minute soil particles on rainy or windy days. The authors have developed a method of protection from flowing muddy water and blowing dust, by sprinkling water with a low concentration solution of some emulsion such as a water repellent agent or film forming agent. Many artificial rainfall tests and blowing tests showed that this simple method protects from muddy water and dust. It was confirmed by site tests that the method is applicable to various full-scale earthworks.

11 Development of Solidification Method using "Mixing in Tube System"

by Tatsuyuki Matsuo and Kiyoshige Nishibayashi

Mud or slurry is usually mixed with hardening agent using various apparatuses driven by mechanical energy, and is solidified. Generally, these apparatuses are big but do not have such a large capacity. The "Mixing in Tube System" has been studied in order to make mixing apparatus smaller and to increase its capacity. This system uses jet mixer driven fluid energy. In the jet mixer, materials are sucked into a tube by negative pressure when fluid is jetted from its end, are mixed with fluid in the tube, and transported.

The authors have developed the following three "Mixing in Tube System", and confirmed the effectiveness of the jet mixer by experiments:

- 1)Improvement system of dredged mud (sucked material is mud, jet fluid is cement slurry),
- 2)Liquefaction system of coal ash (sucked material is coal ash, jet fluid is cement slurry), and
- 3) Solidification system of slurry (sucked material is cement powder, jet fluid is slurry).

12 A Study on Indoor Thermal Environment and Reduction of Air-conditioning Load in Atriums by Natural Ventilation

by Yoshihide Suwa

Recently, several kinds of buildings having atriums in lounges or entrance halls have been constructed. However, these require huge amounts of air-conditioning energy, and the thermal condition in these atriums is generally quite delicate. In this research, a simplified model for predicting the thermal environment in large indoor spaces with openings was developed, and the reduction of air-conditioning load by natural ventilation was studied.

It was found that optimum control of openings was an effective way to reduce cooling load over the long term from spring to autumn. This paper outlines the developed model and results of the study.

13 A Study on Improving Comfort in Super High-rise Buildings —— Factors of Indoor Comfort Based on Questionnaire Survey ——

by Machiko Watanabe, Setsuko Yoshino and Yasuyuki Miyagawa

The aim of this study was to establish a design method to provide comfortable living spaces in super high-rise buildings, through the research on the indoor environment of a high-rise building and its effect on human psychology and physiology. The major finding results were as follows:

1) The higher the floor levels, the better the evaluation of beauty, brightness, and openness. On the other hand, it was pointed out that the height of residence may decrease the frequency of opening windows and children's going outside.

2) The space should be designed in visual terms so that residents do not suffer fear of the height, including in case of earthquakes, a spacious layout, lighting equipment with less swinging, and garden plants in the windows are all beneficial.

3) It is desirable to employ a variable air velocity or temperature control system, as well as install artificial windows in a high-rise and highly airtight building so that residents do not suffer claustrophobia and lack of variety.

4) Facilities should be installed and designed matching a higher floor in a high-rise building; it was claimed that the backward rush of air from a ventilation opening extinguished the flame in a heater when there was a strong wind.

From review of the literature, considerations and measures in the design of a comfortable living space in super high-rise buildings in the future are presented.

14 Development of Ecological Sea Water Purification System by Rubble Mound (Part 4) —— On-site Experiments to Quantify the Sea Water Purification Effects under Various Flow Rates ——

by Shuji Miyaoka, Hirokazu Tsuji, Mamoru Ishigaki and Makoto Kobayashi

In recent years, water pollution and eutrophication in enclosed seas have become serious problems. We have designed a sea water purification system that utilizes the self-purification capability of nature. In essence, a part of a polluted sea area is enclosed with a rubble

mound. Due to tides, waves and so on, the sea water passes through the mound, and, this time, the water is purified by physicochemical and biological processes.

We constructed a model facility in Mikawa Bay to verify the water purification efficiency. Approximately 40 days after the construction of the facility, the water purification effects became evident. However, it seemed that the effects of purification would vary with the velocity of the sea water permeating the mound, so pumping experiments were carried out to evaluate the effect of water load.

Even when the sea water of the internal water area was pumped out, the concentration of chlorophyll in the internal water area was lower than that of the external water area. The facility mound removed 70% of the chlorophyll of water outside while the residential time of sea water in the mound was an hour.