Concrete Journal, Vol.50, No.11, Nov. 2012

Title	Authors
Commentaries/ Revision of Technical Manual: Corrosion Control Measures for Sewerage Concrete Structure	Tomoya KUWAJIMA
Technical reports/ Towards CO_2 Reduction in Repair, Demolition and Recycling of Concrete Structures	Kenji KAWAI, Koichi KOBAYASHI, Atsushi UENO and Yoshitaka KATO
Construction records/ Preservation and Restoration of the Marunouchi Station Building	Masami KAMATA and Takuya DOHI
Construction records/ Construction of CFT Structure Using High Strength Concrete with Moderate Heat Portland Cement ―New Construction of the Shinjuku East Side Square―	KazuhisaYODA, Jin Hwan JEON, Shigeru ASAOKA and Takeshi TODA

Concrete Journal Vol.50, No.11, pp.993-997, Nov. 2012/ Copyright © Japan Concrete Institute

Commentaries

Revision of Technical Manual: Corrosion Control Measures for Sewerage Concrete Structure

Tomoya KUWAJIMA

Keywords: sewerage concrete structure, hydrogen sulfide, corrosion control technology, corrosion prevention technology, corrosion prevention method with sulfuric acid resistant mortar

Sewerage concrete structures including pipelines or pumping stations have the common problem that neutralization of concrete or salt damage decrease concrete durability. In addition, concrete corrosion and deterioration caused by sulfuric acid, generated from hydrogen sulfide gas, is a problem specific to sewerage facilities. In the concrete corrosion caused by sulfuric acid, we can see more cases in where higher densities of hydrogen sulfide gas (H_2S) are generated.

To enhance durability of sewerage concrete structures, effective and comprehensive concrete corrosion control is indispensable. This measure should be implemented based on understanding of the mechanism and actual condition of concrete corrosion which stems from hydrogen sulfide caused by sulfate-reducing bacteria and sulfur-oxidizing bacteria, and need to include planning and design of facilities, construction control of concrete corrosion prevention and operation and maintenance.

In Japan, sewerage facilities have been facing a problem of concrete corrosion and deterioration caused by hydrogen sulfide since 1980s. Japan Sewerage Works Agency (JS) conducted a field survey of facilities and research studies of concrete corrosion prevention technologies and improved technical standard about corrosion control measures. JS published “Technical Manual of concrete corrosion control and prevention for sewerage structures” in 2002. The first edition contains: design specific to the concrete structures which need corrosion control and prevention, anti-corrosion covering method, design and construction of rehabilitation, maintenance of sewerage facilities.

When the first revision was made in 2007, the manual got to reflect the feedback on the corrosion control technologies and clarify the warranty period of concrete structures which corrosion prevention method was applied.

The manual revised second time this year and the contents of revisions are as follows:

1) Add new technology for corrosion prevention.

The first revision includes two existing technical methods for corrosion prevention: coating method and sheet lining method. Corrosion prevention method with sulfuric acid resistant mortar is added as the third solution.

2) Revise the relationship between construction methods and design of corrosion conditions.

3) Effluent treatment is added to a removal work for a particular part of concrete structure deteriorated by corrosion.

Fig.1 contents of technical manual: Corrosion Control Measures for Sewerage Structure:

Title	Contents
The General	①Purpose ②Comprehensive corrosion control ③Range of application ④Reference books ⑤Definitions
Concrete Corrosion/Deterioration at Sewage Facilities	①Mechanism of concrete corrosion ②Condition of concrete corrosion ③Facilities/sections tend to cause corrosion or deterioration
Design for Corrosion Control/Prevention	①Purpose/function of corrosion control and protection ②Design for corrosion control ③Design for corrosion protection ④Classification by/Grading scale of corrosion condition ⑤Technical standard of corrosion prevention by protective coatings ⑥Durability of corrosion prevention by protective coating ⑦Quality standards of coating method ⑧Quality standards of sheet lining method ⑨Quality standards of corrosion prevention method with sulfuric acid resistant mortar ⑩Choice of construction method and design ⑪Design of corrosion prevention method with sulfuric acid resistant mortar
Application of Corrosion Prevention by Protective Coatings	①Previous treatment for concrete structure ②Application of coating method ③Application of sheet lining method ④Application of corrosion prevention method with sulfuric acid resistant mortar ⑤Construction control of corrosion prevention by protective coatings
Rehabilitation of concrete structure	①Purpose of rehabilitation ②Investigation of existing concrete structure ③Diagnostics of existing concrete structure ④Design of rehabilitation ⑤Execution of rehabilitation
Operation and Maintenance of sewage facilities caused corrosion by sulfuric acid	①Purpose of operation and maintenance ②Contents of operation and maintenance ③Suppression of hydrogen sulfide ④Inspection of sewage facilities ⑤Inspection method ⑥Record of operation and maintenance

.

Concrete Journal Vol.50, No.11, pp.1006-1013, Nov. 2012/ Copyright © Japan Concrete Institute

Technical reports

Towards CO_2 Reduction in Repair, Demolition and Recycling of Concrete Structures

Kenji KAWAI[*1], Koichi KOBAYASHI[*2], Atsushi UENO[*3] and Yoshitaka KATO[*4]

Keywords: concrete, environmental impact, CO_2 reduction, CO_2 emission, repair, $LCCO_2$

The Japan Society of Civil Engineers selected "Survey research on technology for demolition, reuse, and repair of concrete structures taking CO_2 reduction into account- zero emissions repair work, and CO_2 uptake technology for concrete-" as a priority research task in 2010. In response to this decision, on June 1, 2010 the Concrete Committee of JSCE organized the type two subcommittee "Subcommittee for survey research on technology for demolition, reuse, and repair of concrete structures taking CO_2 reduction into account" (Subcommittee 219) in order to carry out this research task. Survey research activities were carried out by the subcommittee with the objective of proposing methods for evaluating a total reduction of CO_2 emission in the repair of structures, of surveying technology for an efficient uptake of CO_2 by a demolished concrete, and of investigating methods of reducing environmental impact.

A literature survey was carried out into the cost, service life, and CO_2 emission for various repair measures covered in case studies. By using these results, case studies were carried out for the life cycle cost (LCC), life cycle CO_2 emission ($LCCO_2$), and life cycle waste emission (LCW) up to 100 years after construction, assuming (1) a pre-tensioned PC simple T-beam bridge (spray zone, 0.1km from the sea), and (2) an RC box culvert (0.1km and 0.5km from the sea). Deteriorations of the structures were simulated by calculating the probability of reinforcing rebar corrosion considering the variation of the cover depth, and from the corrosion area, the amount of repair was calculated. The permeation of chloride ion was based on Fick's law of diffusion, and the threshold amount of chloride for the corrosion was assumed to be 1.2kg/m^3. The repair methods included surface coating (preventative), electrical corrosion prevention (preventative), removal of chloride + surface coating (preventative), patch repair + surface coating (preventative), and patch repair + surface coating (corrective). In these repair measures, electrical repair prevention showed the least $LCCO_2$ while its LCC was most expensive. It was also confirmed that not only LCC but also $LCCO_2$ of preventative measures is smaller than that of corrective measures.

To integrate different indices, a method in which the various indices are converted into monetary terms can be considered. As the monetary value of the $LCCO_2$ was about 1% of the LCC, there was no incentive to reduce negative environmental impacts. Therefore, a method of integration was investigated.

Another literature survey was carried out to determine the amount of CO_2 uptake by demolished concrete. It was clarified that the smaller the particle size and the higher the water cement ratio, the faster the progress of carbonation. Also, the amount of CO_2 uptake for actual recycled crusher run particles smaller than 5mm was investigated.

Furthermore, a visualizing method of CO_2 uptake by demolished concrete was investigated and proposed. The sludge cake from a ready mixed concrete plant was used for the experiment. The fresh sludge cake was placed into a gas sampling bag, and then CO_2 was blown into the bag. As time passed, the deflation of the bag can be observed due to the CO_2 uptake. A video of the experiment can be seen at the following URL.

http://www.jsce.or.jp/committee/concrete/download/CO2.wmv

*1 Prof., Dept. of Civil and Environmental Engineering, Hiroshima University, Dr.E., JCI Member
*2 Associate Prof., Dept. of Civil Engineering, Gifu University, Dr.E., JCI Member
*3 Associate Prof., Dept. of Civil and Environmental Engineering, Tokyo Metropolitan University, Dr.E., JCI Member
*4 Associate Prof., Dept. of Civil Engineering, Tokyo University of Science, Dr.E., JCI Member

Concrete Journal Vol.50, No.11, pp.1015-1021, Nov. 2012/ Copyright © Japan Concrete Institute

Construction records

Preservation and Restoration of the Marunouchi Station Building

Masami KAMATA[*1], Takuya DOHI[*2]

Keywords: preservation, restoration, Kingo TATSUNO, brick, quake-resistant structure,

Restoration Plan(Basic Principles)

■As a historic architectural structure to be passed down to future generations, the remaining parts of the building survived through the air-raid during the World War Ⅱ must be preserved in the best condition as much as possible, while missing parts should be restored not to change its original design.

Preservation:-The brick building frame and the steel structures of the existing first and second floors would be preserved, as well the existing external walls of the first and the second floors facing the station forecourt.

Restoration:-The walls for the third floor facing the station forecourt and the tracks, would be formed by constructing a new building frame, and the exterior wall would be restored using decorative blocks, granite and cast stone. -The existing external walls made from cement mortar on the first and second floors facing the tracks would be removed and restored in using decorative blocks, granite and cast stone. -The roof would be restored according to its original appearance with natural slate and copper plates. -The interior of the third and the forth floor of the dome, which can be seen from below, also would be restored to its original appearance.

Structural Plans(Basic Principles)

■To utilize the station safely that contains hotel, gallery, and other purposes, the retrofit type of quake-resistant structure, which isolates the building from the soil would be introduced.

■To preserve this important cultural architectural asset for the future, the existing brick walls and steel floor frame would be used along with the quake-resistant structure, reducing the additional reinforcement.

Facility Plan(Basic Principles)

■The inherent historic value of the building would be effectively utilized, while its original function as a station and a hotel, and additional function as a gallery, would be handed down to future generations.

■We would add adequate designs, functions and facilities to meet the diverse requirements of the present times to use a historic building in new way.

■The space facing to tracks would be utilized as a concourse for passengers and also used in order to keep the function of the station. Therefore means of the all the works on the preservation and restoration would be designed properly in accordance with the timely requirement on the function

Making Tokyo Station Safe to Use for Another Century

Throughout the whole project, four years were taken to work with the seismic base isolation. To build the required underground space, first, the pine piles that had supported the 335-meter (1100-feet)-long brick wall of the station building were removed. In their place, new piles were placed to support the building. Then, the preservation and the restoration were proceeded with the policy in using the original foundation of the structure as much as possible in the contemporary structure.

While the steel columns and beams inside the brick walls were re-used, the cinder concrete used for the slab was removed because of deterioration. The steel frame for the slab was left, by applying new concrete for a floor, and the seismic base isolation was achieved. Here, the goal on the level of the earthquake resistance was to ensure the safety of the building, even if an earthquake as powerful as the Great East Japan Earthquake (March 11, 2011) were to occur, the bricks would be safe. In addition, even an earthquake, which exceeds present records on magnitude, may strike the station, the bricks could have cracks but would never topple. These are the details on the preservation and restoration works realized by accumulated efforts especially in structural works, and, as a result, the station facilitates passengers safety for another century.

*1 Deputy Manager, Tokyo Construction Office, East Japan Railway Company.
*2 Group Leader, Group of Restoration of Marunouchi Station Building, Tokyo Construction Office, East Japan Railway Company.

Concrete Journal Vol.50, No.11, pp.1022-1028, Nov. 2012/ Copyright © Japan Concrete Institute

Construction records

Construction of CFT Structure Using High Strength Concrete with Moderate Heat Portland Cement

—New Construction of the Shinjuku East Side Square—

KazuhisaYODA[*1], Jin Hwan JEON[*2], Shigeru ASAOKA[*3] and Takeshi TODA[*4]

Keywords: CFT, high strength, moderate heat portland cement, pumpability, correction value

The concrete-filled steel tube (CFT) construction provides strength-additive characteristics, hence a cost cutting for steel amount results in a requirement for a higher concrete strength. A high-strength concrete fill using a moderate-heat portland cement with a compressive strength of 80N/mm^2 for CFT structure, which was greater than that normally used with a design strength of 60N/mm^2, was developed and applied to the real structure.

Use of moderate-heat portland cement for CFT structure was expected to bring a drastic cost cutting compared to silica fume cement that has been normally used for CFT structures of the same strength class, while its higher viscosity was a major concern during constructions. It was also necessary to determine the structural performance correction value taking account of the possible strength loss around the CFT diaphragm.

Among the tasks mentioned above, the problem with high viscosity of the fresh concrete was able to be controlled by evaluating the pumpability quantitatively in terms of the apparent viscosity using a vane type rotary viscometer as shown in Fig. 1. The other problem with the structural performance correction value was also solved by proposing a structural performance correction value obtained form the inspection of the variation of compressive strength in the tube of the model CFT specimens (Fig. 2). This enabled the mix design of the moderate-heat portland cement concrete for CFT structure and led to get the approval of the third party representing the Minister of Construction. This report introduces the outline of the technical development and its applications to the real structures.

Photo1 Concrete slump-flow

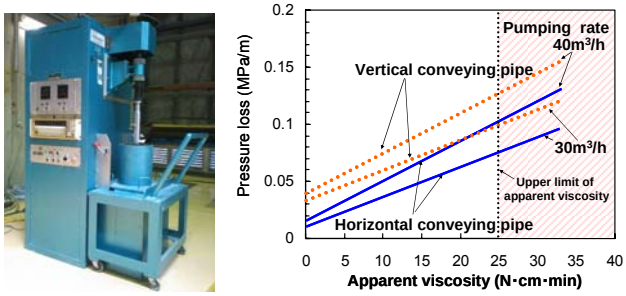

Fig.1 Relationship between viscosity and pumpability

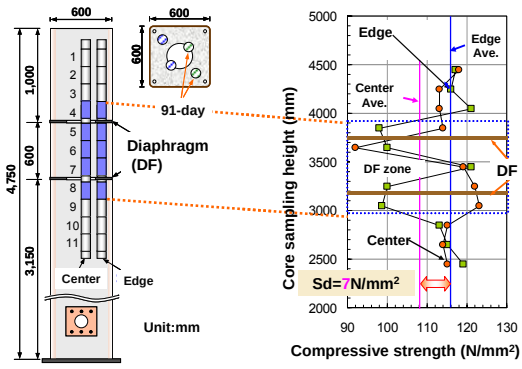

Fig.2 CFT specimens and changes in compressive strength

*1 Chief Research Engineer, Kajima Technical Research Institute, Dr.E., JCI Member
*2 Senior Research Engineer, Kajima Technical Research Institute, Dr.E., JCI Member
*3 Deputy General Manager, Building Construction Management Div., Kajima Corporation, JCI Member
*4 Construction Site Director, Tokyo Architectural Branch, Kajima Corporation