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Development of I-Shape Steel Concrete Slab

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Keywords: steel-concrete composite slab, I-shape steel, fatigue durability, wheel-tracking test, crack property

For the steel-concrete composite slab (hereinafter called composite slab), verification which satisfies the demanded performance is required since its detailed specification is not specified in "Specifications for Highway Bridges".

Authors started development of the I-Shape steel composite slab "NS Slab method" in the 2007 fiscal year to launch it onto the market in about one year, and then commercialized the product successfully. The conceptual diagram is shown in Fig. 1. NS Slab has the following features.

1. NS Slab consists of only I-Shape steel in which fillet welding was used, thus it has less parts which pose a problem of fatigue durability.

2. It is unlikely that concrete filling would be incomplete even on longitudinal gradients since I-Shape steel for slab has the upper flange with short projection length and with about 30% of gradient at the bottom.

3. It gives excellent workability and the stable quality since neither work for undersurface of slabs is not necessary nor spacers are not needed for arrangement of bars.

4. Constructions such as loading heavy equipment after panel erection on steel plate covering are possible since panels are flat and have high rigidity.

This paper reports some verification experiments of demand performance for commercialization of NS Slab and also gives the construction report of first adoption of NS Slab to the Miyayama viaduct of The Ken-O Expressway.

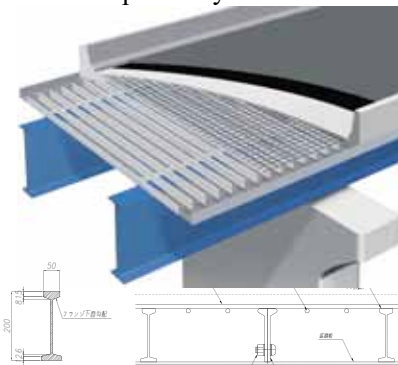


Fig. 1 Conceptual diagram of NS Slab

As design verification of NS Slab, negative bending test for intermediate support part of the slab of continuous girder (Fig.2), wheel-tracking test for intermediate support of the slab before and after re-casting, fatigue tests at weld zone of I-Shape steel, full size procedure test were conducted.

These experiments showed that the crack properties associated with the negative bending of NS Slab is equivalent to competitors' and confirmed that the quality can be recovered by re-casting of concrete.

It was satisfactory in the fatigue durability of the intermittent weld part of the main component about which concerned. It was also confirmed that concrete filling performance satisfies requirements.



Fig.2 Negative bending test for intermediate support of continuous girder

NS Slab was first adopted as the Miyayama viaduct of the Ken-O Expressway as a result of these design verifications. The picture of the completed viaduct is shown in Fig. 3.



Fig. 3 Miyayama viaduct

Construction records

Diagnostic Survey and Renewal Construction of Deteriorated Drainage Pumping Station under Seawater

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Keywords: renewal, alkali-aggregate reaction, chloride attack, water jet, precast form, high workable concrete

Shinkawa drainage pumping station is located at the mouth of the Shinkawa (class B river) which flows through Niigata prefecture.

It has been in service for 40 years, and deteriorated due to alkali-aggregate reaction and chloride attack.

We report results of diagnostic survey, construction method of renewal and measure of improved quality.



Photo 1 Corrosion of rebar

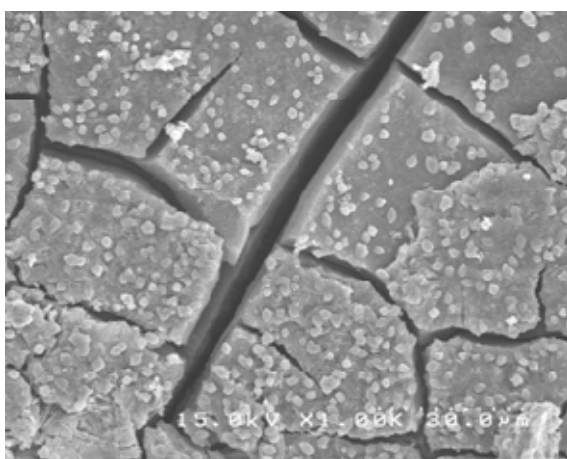


Photo 2 Scanning electron microscope

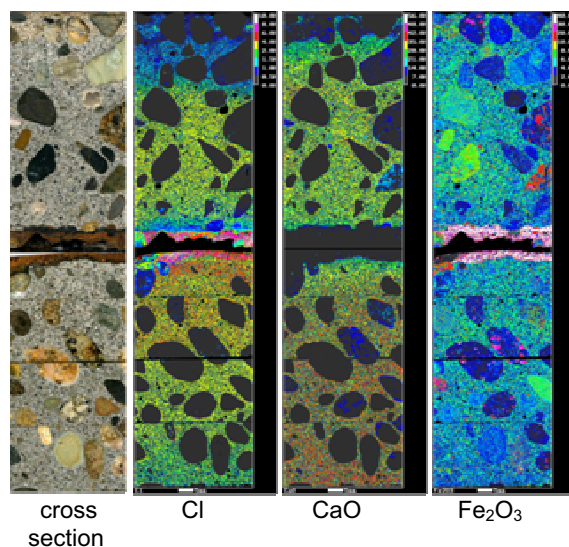


Photo 3 Concentration distribution(EPMA)



Photo 4 Durable precast form

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Application of High Performance Concrete to the Seismic Isolation Retrofitted Building while Maintaining Full Operations

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Keywords: high performance concrete, super plasticizer, retrofitted building

1. Introduction

A new high performance concrete (New HPC) has been developed to meet the requirement of filling concrete, without honeycombs and initial defects, for the structural members with crowded reinforcements and complicated shapes. New HPC was applied to the seismic isolation retrofitting construction of Hiroshima joint government building (Photo. 1) while maintaining its full operations and is briefly introduced in this paper. This technology obtained a Performance Approval of Building Technology by the evaluation of the third party.

2. Production of New HPC

This concrete, with a targeted slump flow of 45 to 55 (± 7.5)cm, enables a dense concrete structure with a slight compaction. After inspecting a JIS ready-mixed concrete at discharge on site, a newly developed superplasticizer is added and agitated as shown in Fig. 1. The superplasticizer comprises a polycarboxylic acid type water reducing agent and a premixed polysaccharide derivative free from the set-retardation, and shows a thickening effect at low doses. It can be applied to various types of concrete because the fluidization can be made on site.

3. Execution points

The construction conditions charged the following special requirements as shown in Fig. 2, which were examined through laboratory experiments and a mock-up test using New HPC.

- Because the new beams support the existing ground floor slab, concrete had to be placed through a 200mm-gap set under the slab. Hence the concrete had to be placed without the help of rod vibrators.

- Because the existing structure is enclosed with a new structure, reliable filling of concrete needs to be assured. Results were satisfactory and these technologies were applied to the real constructions.

4. Concluding remarks

New HPC showed much better fluidity and fill-capability than those of the normal concrete and simplified the complicated concrete construction. Finish was also satisfactory as shown in Photo. 1. The

honeycomb free surface was realized partially using form vibrator. The slump flow and the compressive strength during the construction were well controlled. Overall amount of the new high-fluidity concrete used in this construction was 420m³.

The quality of the proposed concrete was approved by the third party representing the Minister of Construction. The quality evaluation was performed in terms of fluidity, materials segregation resistance and compressive strength.

The above construction records and the approval will be of great help in the dissemination of the proposed concrete to another buildings and in the promotion of high quality concrete structures.

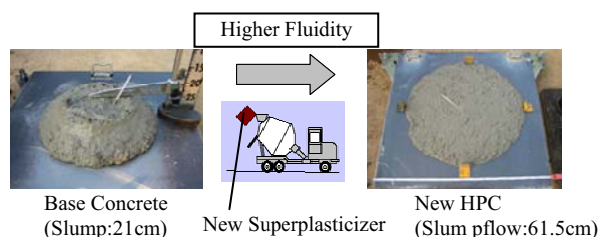


Fig.1 Production Method of New HPC

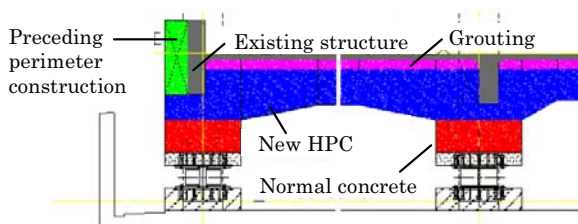


Fig.2 Typical Seismic Isolation Structure



Photo.1 Exterior View and Finished Beams

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