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Commentaries

The State of the Art of the Studies on Ultimate Shear Strength and Resistance Mechanism of the Particular Shaped RC Interior Beam-Column Joints

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Keywords: interior beam-column joint, particular shape, eccentricity, ratio of aspect, different floor levels, ultimate shear strength of joint, resistance mechanism

At present, the equations of joint shear strength for the shape of exterior and interior joint are proposed. Nevertheless, these proposed equations do not reflect the influence of aspect ratio of joint, the mechanical behavior of beam-column assemblage with one-sided eccentricity and that of beam-column assemblage with different floor levels on both sides of column. In this commentary, the state of the art of the studies on ultimate shear strength and resistance mechanism of these particular shaped beam-column joints are described.

(1) Beam-column joint with one-sided eccentricity

The failure mode of girder-column subassemblages with eccentricity, as shown in Fig.1, is column torsional failure. The ultimate strength of wide column under combined torsion and shear can be approximately predicted by proposed equation using conventional design practice. The beam-column subassemblage with eccentricity, which beam depth is the same as column depth, is the same failure mode as that without eccentricity because of the small eccentricity.

(2) Aspect ratio of joint (ratio of column depth to beam depth)

The influence of aspect ratio of joint on behavior of beam-column joint is described (see Fig.2). The joint shear strength of beam-column joint with large aspect ratio cannot be estimated by experimental formulas using conventional design practice. From the similarity between the stress state of joint and column, the joint shear strength can be calculated by experimental formula for shear strength of column.

(3) Beam-column joint with different floor levels on both sides of column

In specimens of the joint shear failure mode, the horizontal shear force of the joint zone between one beam axis and the other beam axis in the specimen with different floor levels is larger than that of the joint zone in the specimen with zero distance (see Fig.3). Therefore, the ultimate strength of joint with different floor levels should be estimated by means of the shear force of the joint zone between one axis and the other beam axis. As a result, the ultimate strength of joint relates with the ratio of the distance between one beam axis and the other beam axis to the column depth. Namely, as the value of ratio is smaller, the ultimate strength of joint increases.

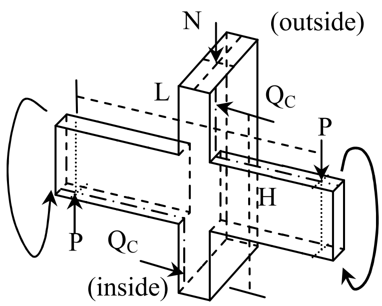

Fig.1 loading model of beam-column assemblage

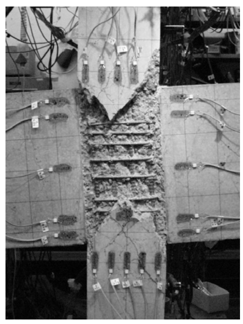

Fig.2 crack pattern at final stage in specimen with aspect ratio 2.0

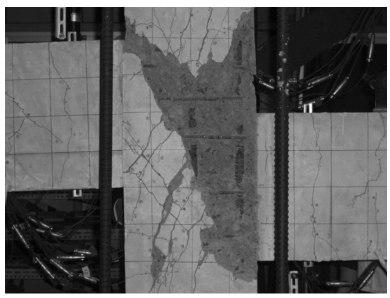

Fig.3 crack pattern at final stage in specimen with the distance of a half beam depth

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Technical reports

Research Study of Actual Quality Conditions of Crushed Stone Powder for Concrete

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Keywords: crushed stone powder, 150-micrometer sieve, moisture content, density, percent flow, activity index, 75-micrometer sieve remains ratio, Methylene Blue absorption

Crushed stone powder can be a promising material used for the purpose of increasing the qualities of concrete. Such crushed stone powder is limited to what passes through a 150-micrometer sieve in which the by-product is separated and/or ground at the time of manufacturing of a crushed stone and/or a crushed sand by dry process in the plant.

Actual quality compatibility conditions studies of crushed stone powder and raw crushed stone powder were carried out in which study items were moisture content, density, percent flow, activity index, 75-micrometer sieve remains ratio and Methylene Blue absorption specified in TR A 0015:2002(Crushed stone powder for concrete).

50 samples were collected and tested. These samples are representative among crushed stone and/or crushed sand manufacturing plants by dry process in Japan. Though only 2 samples of raw crushed stone powders are satisfied to all items, 20 samples of crushed stone powders are satisfied. Ratio of compatibility of items density and activity index is 100% and an item of Methylene Blue absorption, percent flow, and moisture content is getting lower values of compatibility ratio in order.

It is estimated that more than 70% of crushed stone powders are complied with TR A 0015:2002 if both 75-micrometer sieve remains ratio and moisture content are controlled in a production process.

The quality of crushed stone powder is proposed in the first JIS A 5041(Crushed stone powder for concrete) which was published at March of 2009 after withdrawal of TR A 0015.

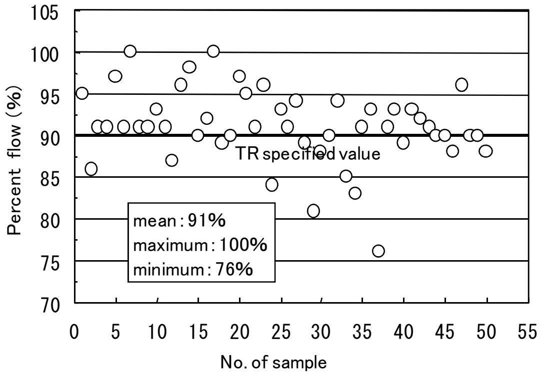

Fig.1 Percent flow (Raw)

Table-1 Actual quality compatibility conditions to TR A 0015:2002 requirements of crushed stone powder

Items	moisture content	density	percent flow	activity index	75-μm sieve remains ratio	Methylene Blue absorption*
Specified value	1.0%smaller	2.50g/cm^{3}larger	90%larger	60%larger	5%smaller	10.0mg/g smaller
No. of sample	50	50	50	50	—	50
mean	1.57	2.73	91.4	68.3	—	7.25
maximum	4.26	3.24	100	75	—	18.7
minimum	0.16	2.57	73	62	—	0.50 lower
No. of compatibility	25	50	38	50	—	39
No. of non compati.	25	0	12	0	—	11
Ratio of compati. %	50	100	76	100	—	78

Note * : Mean value calculation of Methylene Blue absorption was done as 0.5mg/g when the value was lower than 0.5mg/g.

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Construction records

300m-high Tall Building using Concrete Filled Steel Tubes with 150MPa Ultra High Strength Concrete and High Strength Steel Tube

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Keywords: CFT, column, High strength steel, High strength concrete

1. Introduction

The 300m high tall building will be highest building in Japan after the completion of the project's construction. To realize seismic design of the 300m tall building in Japan, 150MPa high strength concrete filled steel tube columns were adopted to support high axial force and huge shear force. And the steel tubes were adopted the high strength steel, of which tensile strength is 590MPa. These utilize of high strength concrete and high strength steel tubes for CFT columns all over the world. The reports describe the outline of the project and the experimental studies for seismic design and construction method.

2. Outline of the project

Fig-2 shows the perspective drawing and the project information. The project 300m-high tall buildings has three classifications of building use. The lower stories use as the department store. The middle stories use as the office. The higher stories use as the hotel and has the observation deck. The huge structure was designed by means of several consideration and structural test and construction test before finishing the design stage. At present, TAKENAKA Corporation and four general contractors have organized the Joint venture and have started the construction works.

3. Outline of seismic design

4. High Strength Concrete Filled steel Tube

Structural test of CFT columns using ultra high strength concrete Fc150 and high strength steel tube, of which yielding strength is more than 590MPa. These experimental studies had done to confirm the seismic performance of High strength CFT columns under sever seismic condition. After structural test, the fire performance tests and construction test using the actual concrete pump system had accomplished to check these performance before the construction works.

5. Summary

The 300m-high tall building will be the highest building in Japan at finishing the project. TAKENAKA CORPORATION had demonstrated the fist actual application to reach the 300m high stage by means of our several technology and engineering works.

Fig.-1 Project information

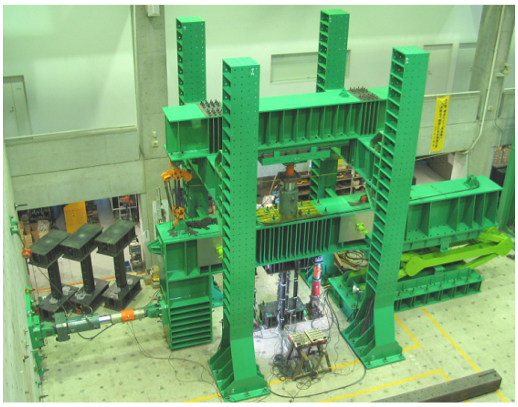

Fig-2 Structural test

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Commentaries

Optimal Design of Self-compacting Concrete for Combining New and Old Railway Viaducts

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Keywords: self-compacting concrete, scaled model, viaduct, filling ability, slump-flow

A new viaduct was constructed next to an old one at Hakata station of Sanyo Shinkansen line. It was required that these old and new viaducts are firmly combined after the construction of the new viaduct.

The new viaduct slab space was completely enclosed by the old viaduct slab, formwork and beams (Fig.1). In addition, this space was extremely congested because of the densely-arranged reinforcing bars. As a result, almost no compaction by vibrator is possible below the old slab. If self-compacting concrete with filling performance of rank 1 was applied, the filling ability was unknown. In view of the problems mentioned above, the filling ability of self-compacting concrete was experimentally investigated.

In order to evaluate the filling ability of self-compacting concrete, laboratory experiments on scaled model were considered. The scaled model form was about half size of real viaduct slab as shown in Photo.1, and the size of reinforcing bar was also half of the actual size. The form was made by plywood and transparent vinyl chloride. The influence of the slump flow values (60cm and 70cm) on filling ability was investigated.

According to observations of each slump flow, it was found that the flowing incline was different from inlet side to old slab side and the flowing incline of 60cm-slump flow was bigger than that of 70cm-slump flow. Furthermore, voids occurred at old slab side in the case of 60cm-slump flow (see Fig.2) while no void occurrence in the case of 70cm-slump flow.

Based on experimental result, the slump-flow was set at 65-75cm and the flowing time for slump-flow was set at 90 minutes or greater for the mixture used in actual viaduct construction. The flow condition was enhanced by setting up some air vents and verified by using transparent forms. As a result, it was possible to observe good filling of concrete. Based on the laboratory experiments on scaled model, optimum self-compacting concrete had been applied to successfully combine new and old viaducts.

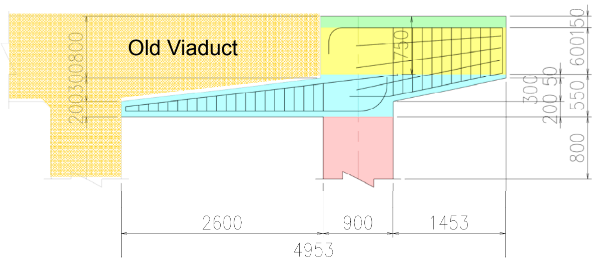

Fig.1 Schematic view of old and new viaducts

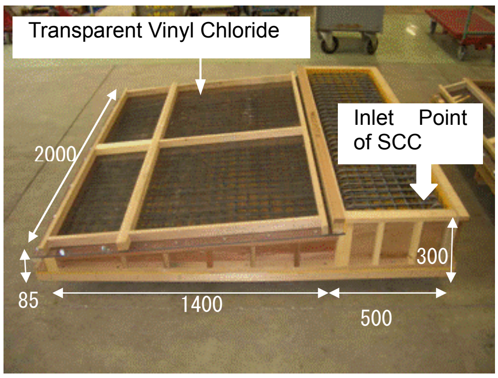

Photo.1 1/2 scaled model form

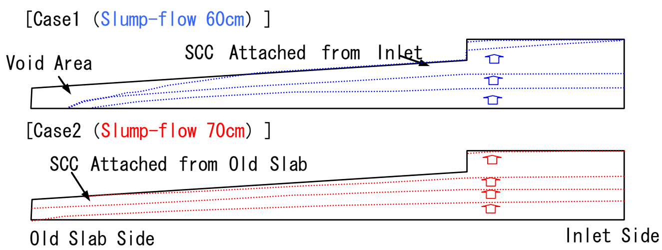

Fig.2 Comparison of filling test for two slump-flow

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