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Architectural Institute of Japan (AIJ) has been publishing the structural standard for RC buildings since 1933, when the seismic force was 10% of the gravity force. The latest revision in 2010 includes: (1) introduction of damage limit state for shear and bond; (2) shortened development length for non-seismic member; (3) provisions for walls with various sections and openings; and (5) design example of a 7-story building with spandrel walls and wing walls.

The allowable shear force of beam for damage limit state is expressed by the solid line in Fig. 1 or Eq. 1

\[ V_d = \frac{2}{3} \alpha \nu_c + 0.5 f_y \left( \frac{A_v}{bs} - 0.002 \right) \]  

(1)

where \( \alpha \) is the parameter determined by Fig. 2 and \( \nu_c \) is the shear strength of concrete determined by Fig. 3. Strength reduction factor is not used in AIJ standard. The broken line in Fig. 1 shows the safety limit (or the shear strength) computed replacing \( 2/3 \) in Eq.1 with 1. The dashed line in Fig. 1 shows the serviceability limit.

The damage limit for bond is determined based on concrete strength.

The development length of non-seismic member is reduced to 0.7 times that of seismic member if the member is not cantilevered.

Shear strength of a wall with openings is computed considering the following failures:

1. Shear failure connecting openings in a story as shown in Fig. 4; and
2. flexural-shear failure connecting openings in multiple stories as shown in Fig. 5, where the models in Figs. 5a and 5b are used to compute the strengths of the first and the second stories, respectively.

Commentaries

Revision of AIJ Standard for Structural Calculation of RC Buildings

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Application of Pressure Welding in Method of Prefabricated Deformed Bars

Junichi KADORIKU*1, Tugihiko YOSHINO*2 and Terukatu SASAYA*3

Keywords: deformed bars, prefabricated deformed bars, joint, pressure welding, demonstrated test

Recently high-rise reinforced concrete buildings have increased, and in these construction sites we have used the method of prefabricated deformed bars. We thought that we did not use the pressure welding in the method of prefabricated deformed bars, but performance of pressure welding machine has improved. Recently we can use the pressure welding in the method of prefabricated deformed bars. In this paper several cases of pressure welding in the method of prefabricated deformed bars and demonstrated test of general column and beam are presented.

Phot.1 Operation state (Column)

Phot.2 Operation state (Beam)

Fig.1 Column specimen

Fig.2 Beam specimen

Fig.3 Stress record (Column specimen)

Fig.4 Stress record (Beam specimen)

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Super thin-type Flat Jack
—Observed again—

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Keywords: Freyssinet, Flat Jack, Narrow spaces, Replacement works of bridge shoes, Seismic control works for building

The super thin-type Flat Jack was invented in 1938 by Dr. Eugene Freyssinet, who is the ancestor of the pre-stressed concrete (PC) technology, and it has been still now world-widely used since 70 years ago. Its structure is a deformable steel vessel made out of two thin steel plates, both of which are troughed at their peripheries and which edges are joined together by welding. At the external edge, two holes for hydraulic injection and air outlet are arranged. The principle is as follows: when a hydraulic pressure is applied from an injection whole, both faces of the jack are deformed separately to yield lifting power. If necessary, cement grouting material can be injected into Flat-Jack by high pressure injection equipment.

The special features of Flat Jack are as follows.
1. Large force can be introduced in various types of structures.
2. Jack has no piston, and also its thickness is fairly thin as flat and so it can be inserted in a narrow space, horizontally or vertically.
3. No trouble, because of its simple design and mechanism.
4. Light weight and easy to handle at site.
5. Cost is inexpensive.
6. Widely applied for a variety of usages.

Typical application fields of Flat Jack are as follows.
1. Jacking up structures.
2. Shifting load from existing foundations or supports to new ones.
3. Adjusting reaction force onto bearings.
4. Its special features and advantages are applicable at narrow spaces because of the thin jack, no breakdown due to a simple structure, light-weight and low cost. This is applied as a support and for movement of heavy structures, and also adjustment of structures deformed by concrete creep. And recently, the cases of applying for replacement of bridge shoes and for installation of the seismic control devices to the buildings are increasing.

From now on, it is expected that any practical usages in the fields of designing and construction planning of structures are developed based on any novel ideas to utilize unique feature of the Flat Jack.

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Key words: high-strength precast concrete columns, Fc=160, predicted and measured axial strains in columns

1. Introduction
The application of high-strength precast concrete columns (where the specified design compressive strength of the concrete, Fc, is over 100 N/mm²) to super high-rise reinforced concrete (RC) apartment buildings has been increasing in recent years.

In this paper, a super high-rise RC apartment building is taken as an example of the use of high-strength precast concrete columns where Fc is 160 N/mm² (the maximum strength adopted in Japan so far). An outline of the building is given and the construction records are summarized.

2. Building outline
The building is shown in perspective in Figure 1, while Figure 2 gives a standard floor plan. Other building details are listed below.

![Figure 1 Perspective of building](image1.png)

![Figure 2 Standard floor plan](image2.png)

- Total floor area: 79,230.30 m²
- Number of stories: B2F, 52F and 2PHF
- Height: 178.9 m

3. Manufacture of Fc=160 N/mm² precast concrete columns
Of the 40 columns in the plan for each floor, the four that bear particularly high axial forces at the 1st floor are high-strength precast concrete columns using Fc=160 N/mm² concrete. These high strength columns have a total volume of about 20 m³ and are clearly marked in Figure 2. Table 1 shows the mixture proportions used in their manufacture.

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<th>W/B (%)</th>
<th>Weight per unit volume (kg/m³)</th>
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<tr>
<td>Binder</td>
<td>Water</td>
<td>Fine aggregate</td>
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<tr>
<td>14.5</td>
<td>1034</td>
<td>150</td>
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4. Measured changes in column axial strain over time
Figure 3 shows how the measured axial strains of the high-strength columns have changed over time. Values calculated using a creep prediction method proposed previously by the authors are also plotted in the figure.

The figure clearly shows that measured values are in good agreement with the predicted ones, so the creep prediction method is suitable for estimating the long-term axial strains in such high-strength precast columns.

![Figure 3 Changes in column axial strains over time](image3.png)

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Keywords: salt damage repair, electric protection against corrosion

Hokuriku Expressway Daikeiji River Bridge is a simple PC post tension bridge started to use in 1972, located 80 meters from the coast, and has been strongly influenced by coming flying salinity. Although we repaired the salt damage as the 1st time in 1983, the re-damage occurred in several years, we repaired it again in 1988 and 1989. The trial construction of four kinds of electrolytic protection; “zonal anode method, electroconductive paints method, titanium mesh method, and zinc sheet method” were executed in descending G2 girder second from the sea side when the bridge was repaired in 1989. we have done a pursuit investigation regularly, and each electrolytic protection method has been evaluated. And we also donated the descending G3 and G4 girder as an examination yard of the electrolytic protection; “internal insertion type and sub-lead spraying method”, and the construction trader's independent management has been executed in 1996 and 1997. However, the lower performance was seen after 15 years passed since the electrolytic protection constructed in 1989, and some part of anticorrosive effect became weak.

According to the result of follow-up survey, economy (LCC), structure, workability, applicability to PC digit, workability of out cable part, anticorrosion property and operation and maintenance respect, we examined the selection of electrolytic protection. As a result, we adopted the electro conductive paints method.

The overall repair of the Daikeiji River Bridge was executed based on the above-mentioned result in 2009 by the conductibility paints method and we were able to bring the problem and the coping process of repairing.(photo-1)