Seismic Performance of an Existing RC Frame Retrofitted by Preacast Prestressed Concrete Shear Walls

by

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ABSTRACT

This paper describes the seismic performance of a new retrofit method. This new retrofit method is using precast prestressed concrete shear walls on outer frames of an 5 storeys existing reinforced concrete building.

In order to develop this new retrofit method, two types of specimens were carried out. One type is a part of a pressure joint between the shear wall and the existing column or beam, and another is a frame part which is lower 2 storeys of this 5 storeys building.

Key Words: Finishing Mortar
Hyougoken Nanbu Earthquake
New retrofit method
Precast Prestressed Concrete Shear Wall

1. PURPOSE

Since the 1995 Hyougoken Nanbu Earthquake, the retrofits for the old buildings are done but there are few researches about the retrofit method which the resident people can use it continuously during this retrofit.

Therefore, it is needed to develop the retrofit method using a precast reinforced concrete shear wall on the surface of existing reinforced concrete frame structure without taking out the mortar in finishing(Fig.1 and Fig.2).

So, this paper describes the experiments about this retrofit method and these seismic performance. The experiments include the element part which means a part of the shear wall and the existing column or beam(Fig.3, Photo 1 and Table 1), and the frame part which means a 2 storeys shear wall retrofitting the existing frame(Fig. 5, Fig.6, Photo2, Table2 and Table3).

2. OUTCOMES

The element specimens are parts of a shear wall connecting with a column or a beam by prestress bars. The parameter of these specimens is to include the finishing mortar or not between the shear wall and the column or the beam. These specimens make clear the friction property between the shear wall and the column or the beam.

The frame specimen is a 2 storeys precast prestressed concrete shear wall connecting with 2 storeys reinforced concrete frame structure by prestress bars. This specimen is supposed to be a lower part of the 5 storeys old building which is constructed before the building code was modified. And this building's seismicity is appropriately a half of new buildings.

3. CONCLUSIONS

It is possible to use the retrofit method which includes the finishing mortar because the element specimens have the sufficient property to transfer the shear strength between the shear wall and the column or the beam(Fig 4).

And it is made clear that the precast prestressed concrete shear wall is available for the retrofitting the old buildings because the frame specimen has the sufficient performance to increase the seismicity of the old buildings(Fig 7 and Fig 8).

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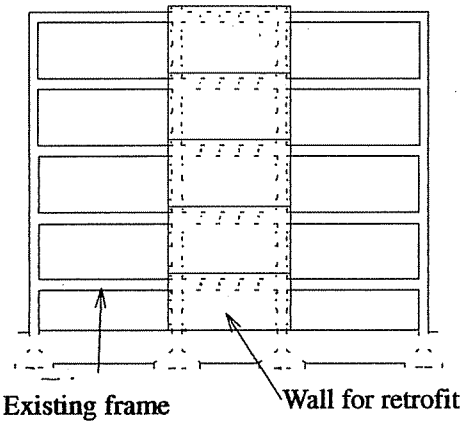


Fig 1 Retrofit of outside wall

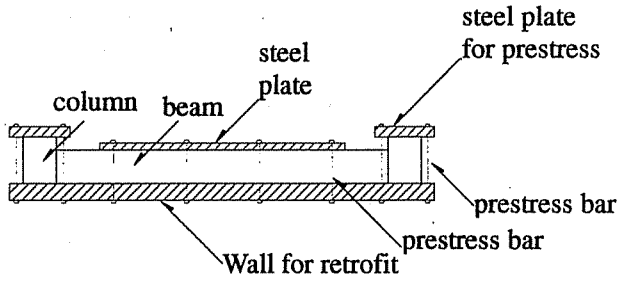


Fig2 Detail of wall and existing frame

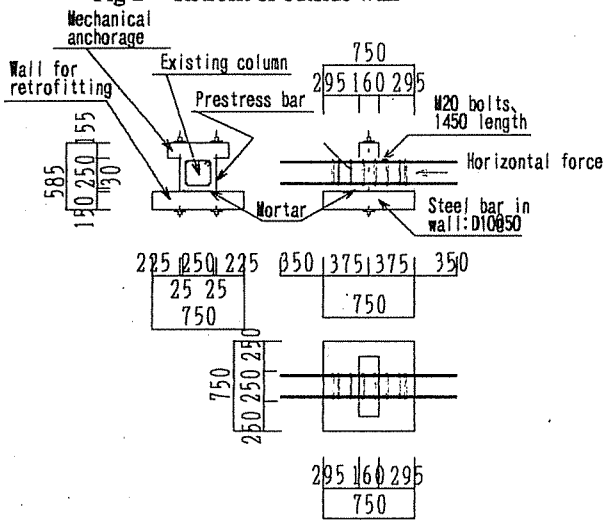


Fig.3-1 Specimen CW-M

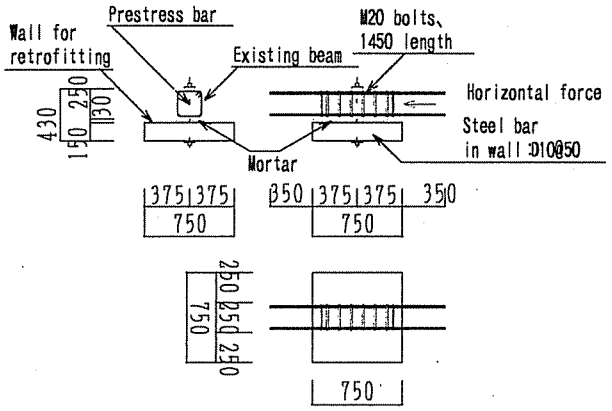


Fig.3-2 Specimen BW-M

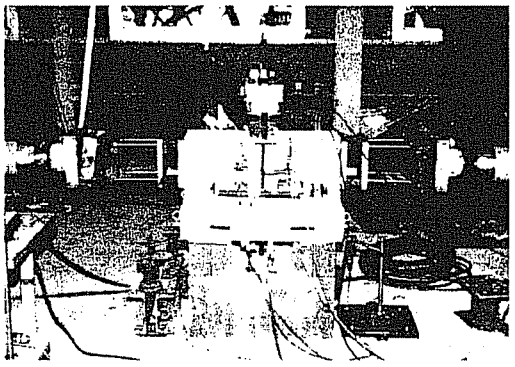


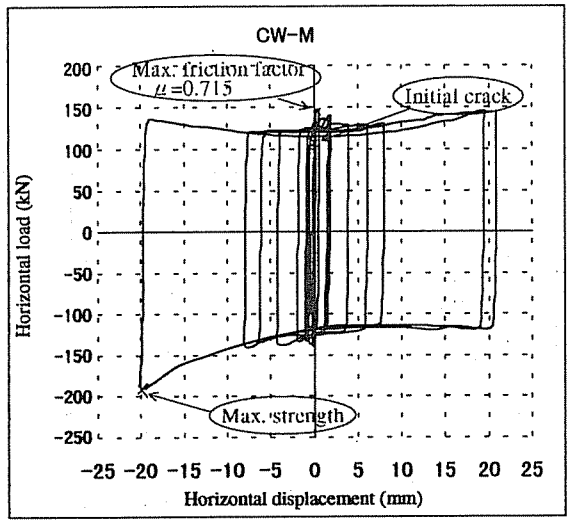
Photo 1 Test of element part specimen CW-M

(Depth of a pressure joint:30mm)

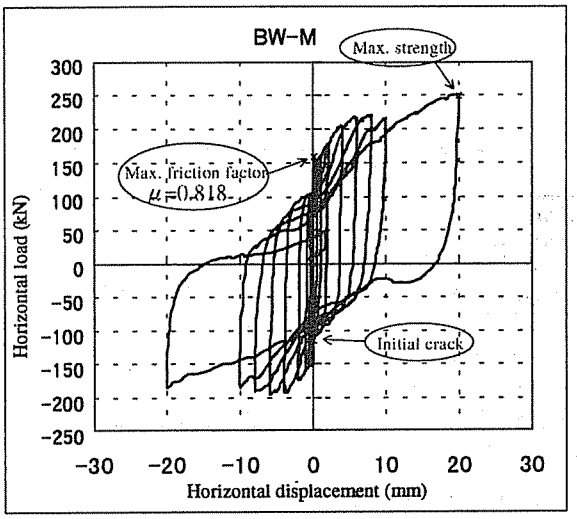
Table 1 Material properties of concrete, mortar and grout

Specimen	Part	σc	Ec
CW-M	column	27.4	2.70
	wall	45.3	2.84
	mortar in a pressure joint	16.7	2.83
BW-M	beam	28.4	2.73
	wall	40.7	2.77
	mortar in a pressure joint	24.5	2.69
	grout	5.8	1.74
CW	column	30.7	2.63
	wall	45.1	2.73
BW	beam	30.9	2.58
	wall	45.1	2.55
	grout	6.0	0.71
CW、BW	paste in a pressure joint	51.4	1.76

notes) σc : compressive strength(N/mm^2)
Ec : Young's modulus $\times 10^4$(N/mm^2)



a) Specimen CW-M
(element part of column and wall)
(Pressure by prestress bars:200kN)



b) Speciment BW-M
(element part of beam and wall)
(Pressure by a prestress bar:200kN)

Fig. 4 Relationship between horizontal load and displacement of element part specimens

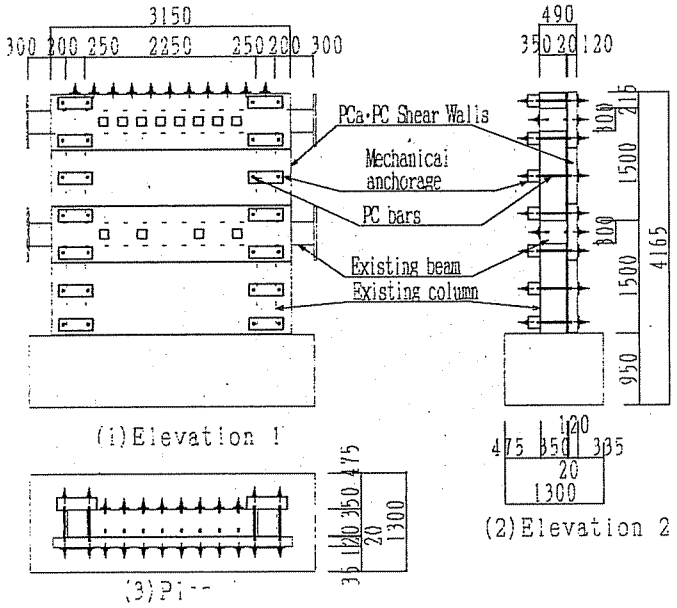


Fig.5 Specimen of frame part

Notes)
(1)Pressure force in horizontal joints of shear walls: 2,040kN
(2)Pressure force between beams and shear walls: 3,170kN
(3)Pressure force between columns and shear walls: 8,000kN

Table 2 Material properties of concrete, mortar and grout

Part	σc	Ec	εc
Concrete of columns and beams	2.7	2.16	2,530
Concrete of PCa·PC shear walls	3.4	2.54	2,300
Mortar in horizontal connections of shear walls	5.3	2.43	2,897
Mortar in prestressed connections between shear walls and a frame	5.7	2.40	3,523
grout	7.3	1.72	5,487

notes) σc : compressive strength(N/mm^2)
Ec : Young's modulus $\times 10^4$(N/mm^2)
εc : stress at compressive strength
$\times 10^{-6}$(mm/mm)

Table 3 Material properties of steel bars and prestress bars

Type	σt	Es	εs	σo
Steel bar D19(SD345)	38	1.81	2147	56
Steel bar D16(SD295)	36	1.79	2087	51
Steel bar D6(SD295)	38	1.93	1979	55
Prestress bar φ23(SBPR 1080/1230)	1154	2.03	5685	1247
Prestress bar φ17 (SBPR 1080/1230)	1150	2.02	5693	1238

notes) σt : yield strength(N/mm^2)
Es : Young's modulus $\times 10^5$(N/mm^2)
εs : stress at yield strength
$\times 10^{-6}$(mm/mm)
σo : tensile strength(N/mm^2)

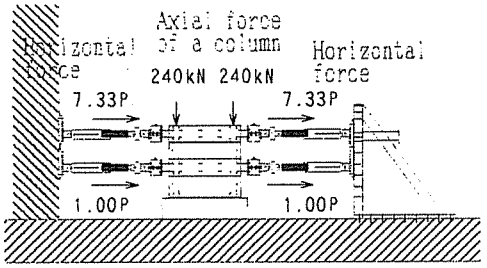


Fig.6 Loading test of Specimen of frame part

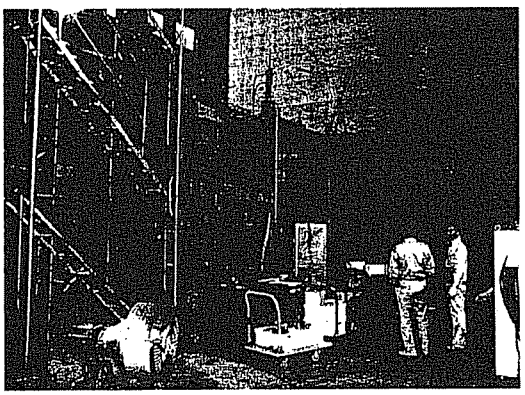


Photo 2 Test of the frame part specimen

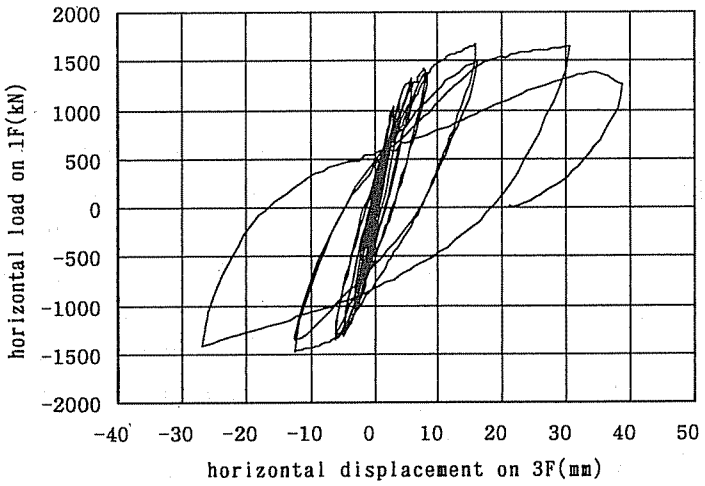


Fig.7 Relationship between load and displacement

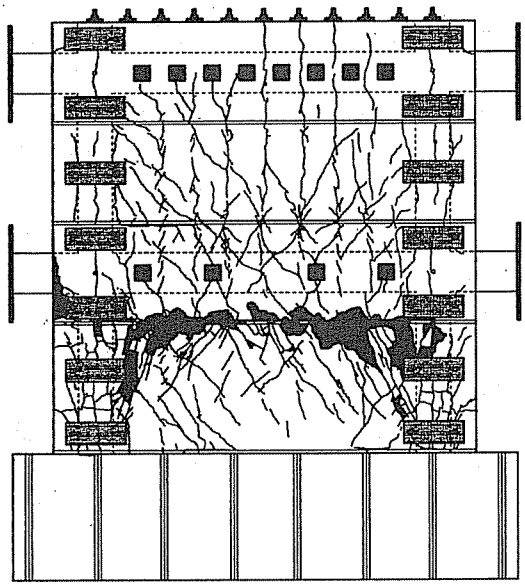


Fig.8 Cracks