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**Autor:** Uchida, Naoki / Owada, Seiichi / Taga, Kenzo  
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## Reconstruction of a Department Store Damaged in the 1995 Earthquake

**Naoki UCHIDA**  
Assoc. Dir.  
Nikken Sekkei Ltd  
Osaka, Japan

**Seiichi OWADA**  
Mgr, Structural Dept  
Nikken Sekkei Ltd  
Osaka, Japan

**Kenzo TAGA**  
Senior Structural Eng.  
Nikken Sekkei Ltd  
Osaka, Japan

### Summary

Daimaru-Kobe's Main Building had been expanded in 4-phases since 1925, and had 7 stories above ground, 1 basement (partially 2), and the total floor area of about 34,000 m<sup>2</sup>. The Main Building along with its adjoining West and South Annex buildings, and the 38-ban Annex were loved by many Kobe citizens as a symbol for Kobe-Motomachi. However, the Southern Hyogo Earthquake occurred on January 17, 1995 and destroyed most of its above ground levels, and a fast restoration was keenly desired.

In spite of a reconstruction plan for the entire building, we decided to make use of most of the substructure portion, which did not suffer major damages, for restoration with shorter construction period and more economical construction cost.

### 1. Basic Principles of the Restoration Plan

We established the following principles, hoping this project to lead the restoration plan for the energetic and historical Motomachi streets.

1. Make a comeback by shortest possible construction period.
2. Try to work out with the least possible construction cost.
3. To seek an ideal department store prospecting future needs and necessities.
4. To restore streets integrated with historical architectures.

### 2. Structural Solutions

For the above 1 & 2, reduce the costly and time-consuming underground work by exploiting the external wall and foundation of the Main Building's underground portion that were luckily undamaged.

The aboveground new building was designed to be of rigid steel frame to enjoy its merit, i.e. shorter construction period. The steel frame was rooted to the underground by erecting major columns from B1 floor to ensure earthquake resisting performance of the entire building. Horizontal force will be resisted aboveground by the rigid steel frame and underground by giving sufficient net effective rigidity and strength to the 1F floor slab so that the most part of the shear force be transferred to the underground exterior walls and shear walls. What is intended here is to reduce the stress transferred from the steel column legs to the old columns and beams by decreasing the burden, upon the B1 structure, of the horizontal force from the rigid steel frame.

For the above 3., spans were reviewed. The span is to be about the double length of the existing 6- to 7-meter(approx.) spans, so that square-sales space with visibility can be created.

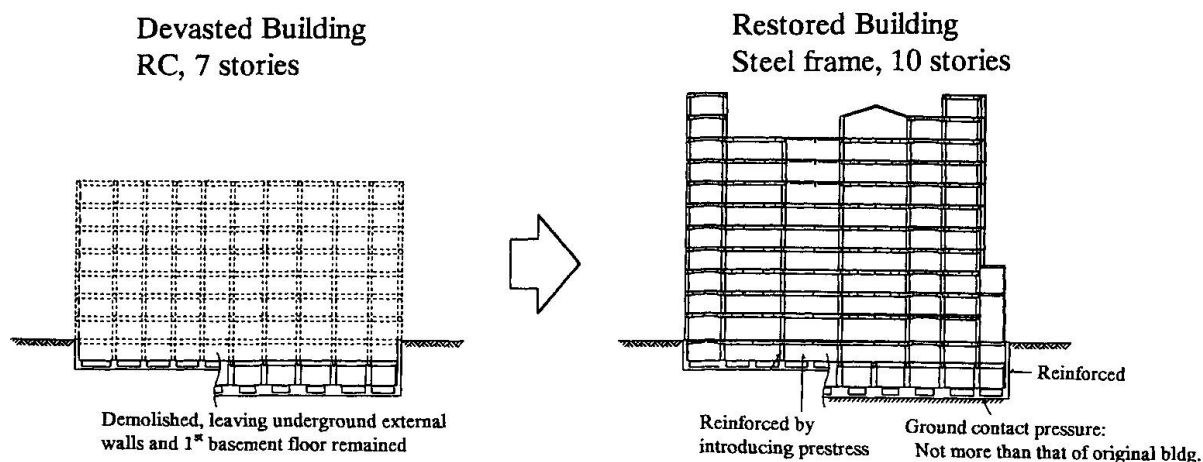


Fig.1 Outline of Restoration Plan

With the enlargement of the span of the aboveground structure, the span of the foundation beams (spread foundations) had to be doubled to about 12 m. This involved the great increase of stress due to subgrade reaction. Further, it was difficult to reinforce lower sides of the foundation beams, which are in tensile zone at their ends. For this, the width of the foundation beams were increased and upper reinforcing bars were sufficiently installed to ensure ultimate strength, and then prestressing was introduced to prevent its cracking and ensure durability.

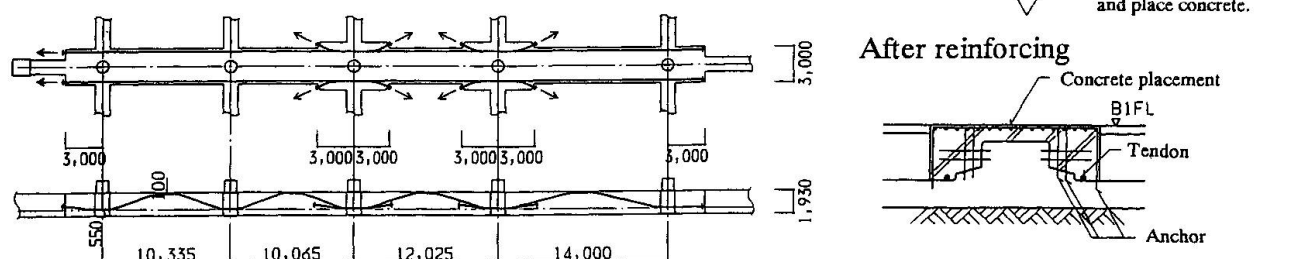


Fig.2 Reinforcement of Foundation Beam by Using Tendons

For the above 4., align the lower levels to the adjoining historical building's height, and set back the higher levels by about 5m. The purposes of these are to pay attention the continuity of the old streetscape skyline.

Setting back the building without decreasing necessary floor area requires increasing the number of floors. The new building has ten aboveground floors, exceeding the original number of seven, with the maximum subgrade reaction being about the same as of the original building by adopting steel frame structural system with light-weight-concrete of the original building.

### 3. Conclusion

The above mentioned solution on structural issues enabled us to realize the principles for the restoration plan, and to complete the construction works with shorter period of 6 to 8 months and construction cost reduction of about 12%, comparing to renovating the entire structure.

Daimaru-Kobe store celebrated its rebirth-grand opening on March 2, 1997, and has been receiving many customers along with a good reputation that it has been a torch for Kobe's comeback.