



Partially in situ protection of a historic building and a design case combined with new buildings

Protection of external walls of a historic building in the Bund, Shanghai

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Summary

The use of external walls of a historic building as the decorative walls of the new high-rise building is presented here. In situ protection of historic walls has become very difficult due to the restrictions of the construction site, as well as the excavation of the foundation pit. At present, there is lack of similar experience in China. In this paper, a new design method through specific construction measures, computational analysis and experimental verification, is used to ensure that the external walls of the historical building and the new building are connected to each other firmly throughout the entire construction phase. The deformation, strain and dynamic characteristics of the external wall are monitored during the construction process. The latest monitoring data are used to adjust the calculation model and the design method to provide a reliable safety guarantee in the entire construction phase. The design method proposed in this paper will be useful for conservation of historic buildings in situ.

Keywords: in-situ protection, numerical analysis, old buildings, synergy.

1. Summary of the Project

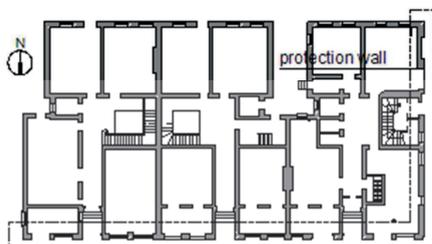


Figure 1.1 Plane position of reserved exterior wall

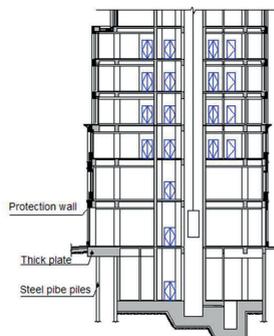


Figure 1.2 Relationship between the reserved external walls and the new building

Meifeng Matheson, built in 1897, is a Victorian-style three-storey brick and wood building (the roof is a separate attic). The structure of this building uses cross walls to bear loads and in shape is substantially rectangular. The total length of the building is 39.4m from east to west; and total width

is 21.0m from north to south; measured floor height is 5.50m, 4.92m, 4.39m and 3.58m respectively. The original drawings of the structure were lost. Under the renovation plan, the external walls of the east and south walls (see *Figure 1.1*) would be reserved as the new external walls of the new building, and the rest will be demolished. In the same position, a new office building to a height of about 60m (14 stories above ground and 1 storey underground) will be built. Reserved exterior walls will serve as the new building's perimeter facade, and also will be connected to the new building. The relationship between the external walls and the new buildings is shown in *Figure 1.2*.

2. Engineering measures

Considering the protection of the external walls in various working conditions, and combined with the construction of new buildings, the proposed construction procedure has twelve steps, which are summarized as follows in *Table 2.1*.

Table 2.1: The twelve construction steps of 3 stages

Stage 1: Demolition of the not preserved part of the historic building	<ol style="list-style-type: none"> 1. Reinforcement of exterior door and window openings; 2. Excavate the external walls on the indoor side and install clamp truss; 3. Pouring pile- pressure backplane, construction steel pipe piles ; 4. Dig brick and replacement foundation; 5. Reinforce the reserved exterior wall, add concrete columns and beams; 6. Install the steel support structure; 7. Demolition of the historic building's internal structure;
Stage 2: Pit excavation stage	<ol style="list-style-type: none"> 8. Pile construction; 9. Excavation and shoring, construction of the new building basement; 10. Integration of the new buildings basement slab with the base slab of the external walls;
Stage 3: Become part of the new building stage	<ol style="list-style-type: none"> 11. Construction of new building from the ground floor to the three-stories and connection the reserved exterior wall to the new building; 12. Dismantle the support steel truss structure.

3. Conclusions

Due to the fact that the current status of the reserved exterior wall is very poor, limited site conditions as well as the construction requirement of the new buildings, protection of the reserved wall becomes very complex. There is a chain-reaction among all construction phases, which means that the foundation substitution, pressuring steel pile, demolition of internal wall and excavation of the foundation pit all have adverse influence on the wall. However by adding reasonable reinforcement, developing an appropriate construction process, supplemented by computational analysis, experimental verification and dynamic monitoring of the entire construction process as well as the development of contingency measures, damage on the reserved wall due to adverse factors can be minimized. In this way using the existing wall as a decorative facade of the new building becomes possible.