

P4 Reflection – Zhenkun Zhang

In the seismic context in Groningen, The project aims at transforming earthquake damaged buildings into new public complexity. Integrate separate buildings together, provide more public space, improves existing architecture quality and structural performance through extra construction system.

Preliminary Research

The preliminary research before P2 mainly focuses on a more architectural and seismic proof solution to retrofit earthquake damaged masonry buildings by using light-weight complementary wood constructions. In this restoration system, structure elements are developed as volume to provide public space. Based on the existing seismic tool box, the research explored the new restoration system in three parts, the first is the retrofit of brick structure, try to solve the conflict of structural behavior between brick structure and wood extra construction, which came to conclusion to improve the flexibility of brick structure through using damping connections. The second part is to provide extra support which is developed from the shoring system in the seismic retrofit. By using folded structure, the extra support could be enlarged into spatial construction. The third part is to renew the heavy indoor elements. A new proposal is made to combine non structure elements with structure, not only solve the fixing problems of interior elements but also provide a flexible interior space.

The research methods for this phase are mainly literature review and research by design combined with small experiment.

Design with further research

The design and the application of research result are based on the special situation in the site, Waffarm, a small village in north Groningen. The frequency low magnitude earthquakes in the area requires certain degree of elasticity of the structure. And the rich building tradition of the north Netherlands make the architecture culture in Groningen valuable to be reserved. Moreover, the losing of public facilities and the increase of vacant buildings in the village make it necessary to make strategies to improve existing stock of masonry buildings and provide more public space for the village. In this case, the project tries to combine the damaged separate brick buildings together through extra wooden constructions to achieve a new multi-function complexity including exhibition, library and restaurant.

I started with the structure scheme which intended to transform the “U” shape brick building into regular structure plan, to divided the building into two separate

structures and then enhance the structure through extra wooden constructions. However, due to the ductility of wood construction and the stiff of brick work, the wood reinforcement may not work when reaching a certain magnitude of earthquake. In this case, within the design process, further research is taken to make a proper proposal to solve the structural conflict. With the help of consulting with ARUP, a more proper scheme has been made. When connected to the new ductile wooden construction, the brick walls could be disconnected and insert new wall-wall connection with dapper device and material, so that the seismic motion could be transferred to the new construction instead of cross walls. Besides, the connected brick wall should be weakened to control the seismic damage, and make sure the new structure performed like a portal frame together with the original brick structure, within this portal frame, the connected brick wall performs like a hinge connection to concentrate all seismic damage in the weaken area which could be maintained after big earthquakes.

Timber is the main material for the new structure, because it's light weight, and its ability of damping via the connections. And using folded plate structure to improve the stability of the structure through the folded form. Moreover, important joints and details has been studied and designed, including new wall-wall connection and the joints of folded construction. All connections take use of the property of steel, the elastic stage and the plastic stage and are replaceable for maintenance. Through the application of damping material and device, the seismic motion could be absorbed and transformed to the new construction.

Within this structure scheme, the interior is attached to the structure elements, to create a flexible space and the continuous from the brick structure space to the wood structure space. All the interior elements are fixed with each other and made by timber frames, and the old heavy brick walls are replaced, in this case the weight of the whole building could be reduced significantly.

The research within this phase is mainly through design. Especially for the structural design, to try out all the mistakes is a very important way to test the proposal and find a proper solution.

The final result of the project is close related to the preliminary research, the study of the new seismic retrofit system, is continued within all the academic year. In the first stage, a concept proposal is made to provide more space and improve structure behavior through the extra wooden construction which including three aspects. In the second phase, all three aspects are further developed to fit in the specific condition of the site. And more study is made to solve the material conflict between brick structure and wood construction, and make the proposal more integrated with the context and more practical for on-site restoration

Social affection

The project is not only a single design. The structure scheme could be a model for other brick buildings in seismic intervention. The new scheme provides a more architectural proposal to retrofit earthquake damaged masonry buildings, not only focus on the structure challenge, but also aims to improve the architecture performance of existing buildings.