

Whole moves Technology for Historic Building Preservation and the Decision Making Process

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Abstract

The main purpose of this study is to discuss the techniques and decision-making processes of integral moving of historic buildings in Taiwan. The study mainly analyzes the details of integral moving of mixed-structure and brick-structure historic buildings; furthermore, to provide an alternative for those which either could not be preserved at the original locations or to be demolished with a much applicable techniques to preserve them.

The major research methods include literature review, case studies, and field researches. Selected cases are those which were successfully moved. There were mixed-structure buildings such as Taipei Workshop, Kaohsiung Railway Station (Vision of Kaohsiung), and the brick-structure building such as the old hall of the Department of Pharmacy, National Taiwan University.

The study discovers that decision-making processes of historic building preservation project in Taiwan are usually influenced and buildings could not be preserved at the original locations due to urban renewal projects. Also, after moving, these buildings serve as exhibition halls. Once the structure of historic building itself is assessed, and it is strong enough to withstand the vibration during the moving, then the technique of CUT-OFF is applicable; on the other hand, if the building structure is weak, then the techniques of UP-DOWN or OPEN-CUT are applied and adjustable due to the conditions on site.

Keywords: Whole moves, Techniques of Up-Down, Open-Cut, and Cut-Off.

1. Foreword

While facing rapid urban development and rising of land price, conflicts between old buildings and new constructions have been emerged. Most historic buildings are under demolition due to the damage and inappropriateness of location and space. For those buildings which are with economical or cultural value, Re-locating these old buildings serves as an alternative solution for heritage preservation, which keeps these historic buildings preserved or reused, instead of being abandoned at the original location, or being demolished. The article is going to generalize and analyze the techniques and strategies of relocating historic buildings with different structures. Through focusing on the concept of integral relocating technology and the ways of construction, a clear information of the process regarding decision-making and key points regarding management will be obtained. This study would like to confirm the completeness and safety of building relocating by applying appropriate techniques; moreover, to create a revolution regarding the

co-existence balance between the contemporary urban development and the historic buildings.

2. The Definition of Integral Re-locating Technology

The definition of integral re-locating technology is to move the building from where it locates originally to a new location. There are various situations which require buildings to be moved away from the original location. The most essential point of this technology is to remain the entirety and functionality of buildings. There is a high demand of professional techniques in building re-locating, and also it is risky. The main body of the building is not allowed to be damaged and the structure needs to be reinforced and firmed within a certain range. There are two ways of building re-locating based on main body re-locating, one is “integral re-locating of main structure” and the other is “integral demolition and re-locating”.

3. Case Study

Generally, there are three ways of re-locating historic buildings based on different techniques and ways of preservation in Taiwan:

(1)Integral Demolition and Re-locating: Construction materials are numbered and reorganized at the new location; however, this will not be discussed in this study..

(2)Integral Re-locating of Main Body: The whole building is moved to the new location for permanent positioning and reuse.

(3)Integral Re-locating of Main Body: The building is temporary moved to where is closed to the original location. After the renovation of construction has been done, the building will be moved back to the original site.

The study mainly focuses on discussing “integral re-locating of main body”; merely, there is still a brief introduction of “integral demolition and re-locating”.

3.1 Integral Re-locating of Main Body: The whole building is moved to the new location for permanent positioning and reuse. (The old hall of the Department of Pharmacy of National Taiwan University)

National Taiwan Hospital was planning to build an 11-story building and 3-story underground as their new conference center and medical research building at where the old pharmacy building located. Due to the lack of space in the eastern hospital area, and also the plots of land are scattered, it is not possible to have another two complete and big enough clearings for the building permit. Therefore, the hospital decided to tear down the pharmacology and pharmacy hall of the medical school at XuZhou Road. However, with the petition of professors and students, and also the investigation of historic building held by the department of civil affairs of Taipei City, the result shows that there is historical significance in these two buildings which should be preserved, and the pharmacy hall is especially valuable. Therefore, the school decided to preserve these buildings and move them 22

meters forward that more closed to the side of XuZhou Road for better coexistence of new and old buildings..



Pic 1--Before and after re-locating of the old hall of the Department of Pharmacy of National Taiwan University

3.1.1 Strategies at Different Stages

The pharmacy halls were built during the period of Japanese domination. Although there are no related literature reviews regarding these buildings, the buildings are investigated and confirmed being built around the age; the labs at first and second floor built later were not the preservation targets. Based on the construction concerns, the floor was tore down and rebuilt. After confirming the preservation parts, the excavating on the edge of the foundation was executed. After re-locating the sewer system, the buildings were discovered as entire brick masonry constructions without ground beams; therefore, new ground beams were going to be built with section steel to withstand the fragile structures; furthermore, to reinforce the structural members and the cracks around doors and windows with concrete, superstrength healant, and putty. The construction applies up-down technique which mainly works by adding new ground beams. The buildings were moved horizontally 4 meters a day with hydraulic synchronous jacks, adding numerous round steel pipes and making pressure-bearing boards to cooperate with the power hoist. During the re-locating process, it is necessary to observe the uneven load problems or cracks of the buildings with naked eyes. Also, the inclinometer was used for measuring brick walls and columns, ground or building subsidence, and the tilt variation. The buildings were moved 22.7 meters north from the original location. After finishing building the new construction, the old and new buildings will coexist harmoniously.

3.1.2 Following Steps of Construction Preservation and Applications

The old hall of department of pharmacy in National Taiwan University was recognized as a historic building in March, 1999. The whole building was built during the period of Japanese domination and it was the first department of pharmacy in Taiwan established by National Taiwan Medical School. Lee Chen Yuan, the academican of Academia Sinica, also established his poisonous serum research center here. The spirit beyond the building itself is much more meaningful and essential. The school intended to turn it into a pharmacology museum in the future. The interior of the old building is currently unused, and the exterior space is shared with the new building

3.2 Integral Re-locating of Main Body: The body of construction is temporary moved to where near the original location. After finishing the renovating construction, the construction will be moved back to the original site. (Taipei Workshop)

Taipei Workshop, located at the intersection of Tacheng Street and Shimin Boulevard, is recognized as the grade three civil historic building which overlapped 4.8 meters with Beimen Station of Taipei MRT Songshan Line and conflicted with its entrance. Additionally, the project of Taiwan Taoyuan International Airport Access MRT System between Sanchong and Taipei was designed to pass through Taipei Workshop underground. The construction process might cause historic building subsidence and cracking. At the same time, Taipei Workshop also located on the planned road of Tacheng Street which conflicted with the road expansion project. To strike a balance between historic preservation and major transportation development, Department of Rapid Transit System planned to move Taipei Workshop 30 meters east south along with Tacheng Street under the preservation and safety of the historic building. Taipei Workshop was temporarily located at the west side of the wartime command center of Taiwan Governor-General Office, and it would be moved back to the original location after finishing the underground construction



Pic 2—Before & after re-locating of Taipei Workshop

3.2.1 Strategies at Different Stages

Taipei Workshop was established in 1909. Its architectural style is Japanese brick masonry with steel structure. There are not reference describing about the basic structure of its body and depth. However, the design, basic structure, and the depth would all influence the excavating, soil retaining, dewatering, and drainage, so the excavating of the foundation is necessary. Also, considering the fact of the history, exploratory trench was undertaken especially. However, due to its nature of Archaeology, there is no further discussion in this study. Before re-locating, there are still several steps needs to be operated first, such as demolishing the additional parts of the construction, reinforcing the structure, designing re-locating techniques, preparing for the measurement of the construction, temporary protection, and repair works. To confirm the related construction materials for sustaining the weight while raising and re-locating, the test of the strength of the rebar-planting and the raising strength of fixture and ground beam were done on other brick buildings which was scheduled to be demolished in the same area after getting the approval of Taiwan Railway. The re-locating applies OPEN-CUT which excavates the basic structure entirely along with the re-locating route, and paves rigid pavement and tracks for dragging the newly-built rigid

tray under the existing foundation to withhold the structure of main body; and then re-locating engineering is executing later.

To ensure the safety of the process, the whole process is under computational syncing Hydraulic jack system, which is moving slowly with concrete ground beam, section steel tracks, and round steel sticks to the new location. The building was moved 30 meters horizontally and rose for 1.5 meters. At the same time, there are professionals investigating the re-locating construction record and make reports regarding this process.

3.2.2 Following Steps of Construction Conservation and Applications

The architectural style of Taipei Workshop is the combination of Qing Dynasty and Japanese-rule style, which stands out its historic significance. In the near future, the interior of the workshop will be renovated as a gallery of historical photos, audio and video archive. The city government is also planning to move the first German-made steam locomotive “Teng Yun” which was introduced by Liu Ming Chuan, the first Taiwan governor during Qing Dynasty, from its original exhibition hall, National Taiwan Museum to Taipei Workshop. There will be an integral design of the Workshop and the future MRT stations. Now, since the tunnel construction has been finished, Taipei Workshop could be moved back to the original site. Currently, the preservation project is still ongoing with wrapping the exterior with iron sheet, reinforcing the repair, and restoring the old as old; furthermore, investigating and studying the historical document for better restoration.

3.3 Integral Re-locating of Main Body: The building is temporarily moved to where near the original location. While the renovating construction is finished, the building is moved back to the original site. (Kaohsiung Railway Station)

According to the transportation project designed by Kaohsiung City Government, the area was going to be a three-rail union station (Kaohsiung Rapid Transit, High Speed Railway, and Railway). The original project was to demolish Kaohsiung Railway Station, but it happened to be included in the competition of 100 historic buildings at that time; therefore, the demolition project drew people’s attention. Finally, because of the opposition of scholars and public opinion, the city government gave up the idea of demolishing the train station. Later, Railway Reconstruction Bureau of Ministry of Transportation and Communication decided to move away main structure of the train station away for the underground construction. After the construction finished, the station was moved back to the original site. It now temporarily serves as a gallery

3.3.1 Strategies at Different Stages

The train station was built in 1940. Before re-locating, there are five investigations need to be done: development process, construction analysis, structure analysis, currently situation, preservation research, and cultural and historical significance estimation. Finally the main body of construction which is full of memorial significance was left and the additional parts built on demand function would be demolished. Basically, the preservation was about re-locating the main crown structure of the construction. The front of the construction was

preserved and the exterior wall was cut into 4 pieces on the left and five pieces on the right. While preserving and reinforcing the original construction materials and techniques it was built with, the repair was carrying out based on the principle of “restore the old as old” and reuse. Afterwards, to excavate the foundation around the station and reinforce the ground beams. The technique, Open-cut and oblique re-locating are applied on the re-locating. To make sure the good connection and completeness between the old station and the new station, the prime directive is to maintain the front entrance, and some walls of two wings of the station were preserved for exhibition. There were many cutting positions. Cutting, demolishing, and re-locating should be executed without damaging the main body. These would be reorganized after re-locating back to the original sites. Roof tiles were demolished first for specific preservation, and would be restored later. The weight of cutting walls were about 50 to 60 tons (includes steel structure), which needs 25 tons, 160 tons, 200 tons cooperating with the 35-ton trailer and move to the eastern location for permanent positioning



Pic 3—The positions before (left) and after (right) re-locating Kaohsiung Railway Station

3.3.2 Following Steps of Construction Preservation and Applications

Now the train station has been moved to the temporary site and become “Vision for Kaohsiung”. Based on the historical significance of the building itself, citizens could understand better the current situation of their city and future city planning. The purpose of “Vision for Kaohsiung” is to present the past, present, and future of Kaohsiung; moreover, to get citizens understand more about urban development and the blueprint. Except for the exhibition space, some spaces will be outsourced. Industries are responsible for the cleaning of exterior spaces, environment beautification, and also the maintenance fee and utilities.

4. The Preservation Standard of Integral Re-locating of Historic Building and Strategies

Usually, in Taiwan, the preservation of historic building is based on integral demolition and re-locating of brick and wood structure, and the integral re-locating applies to concrete structure. The construction process could be divided into three stages: preliminary assessment, design, and post-construction. In the primary stage, the integral movability is judged upon field investigation, data collection, structure examination, and structure analysis. In order to get a better understanding of the original structure of the construction, original location, and new location, it is necessary to excavate and investigate the geological conditions and evaluate the safety and reliability of the structure before executing the re-

locating. The reinforcement is undertaken according to the precise calculation, especially to historic buildings, the safety of structure and deformation amount are way much important than ordinary houses. In Taiwan, historic buildings are usually built with concrete, brick and wood. Most of them are courtyards, temples, town halls, stations, and so on. Without reinforcing the structure and fixing it integrally first, the fragile structures and construction materials will often get cracked or even damaged.

4.1 Integral Demolition and Re-locating and Integral Re-locating of Main Body

There is no distance limit in demolition and re-locating. Because it numbers the construction materials and then demolishes them and reorganizes in somewhere else. The key point of this technique is on the preliminary assessment which requires a profound investigation and understanding of the history and architectural style of the building. There are two concerns of the re-locating, one is the completeness of the construction after reorganizing, the other is while the re-locating distance is longer, it might change the environment too much. Therefore, after the re-locating, historic buildings usually won't be used for other purposes but become exhibition halls for cultural relics which needs to be maintained and protected by experts of heritage preservation in a long term and with a great amount of maintenance fee. Also, there is a high demand of professional skills for the demolition of historic buildings. Without dealing it properly, it would cause other damages, even the irreparable results. Disputes would come along as well. Therefore, while executing internal demolition, carefulness and exhaustiveness are needed..

Integral re-locating of main body is the combination of architecture and civil engineering. The basic principle is similar to using hoist to move goods horizontally, which works by turning and raising. The influences it might cause to the surroundings during the re-locating process is a big concern. The re-locating distance is limited. But while the new location is nearer to the original location, the influence it brings to the environment is not that much. Basically, this technique requires cut-off at the ground beams of the construction which separates the construction and the foundation. Install mobile joists at the cut-off, and set new foundation at the new location. Between new and old foundation, there is a re-locating track. After installing the power system, move the construction from the original location to the new location without causing too much vibration. Later, remove the joists and tracks, and connect the construction structure with the new foundation.

Integral demolition and re-locating belongs to the field of heritage preservation which is very complicated on demolition and reorganization. The relevant knowledge and practical experiences of repairing or re-locating traditional, Japanese, and contemporary architecture are required for personnel. The consumption of human power, time, budget are higher, and even the controversy is greater than integral re-locating of main body. Also due to different construction methods, different techniques are applied. If the circumstances is acceptable, it would be better to move historic buildings with integral re-locating of main body which is safer and more complete.

4.2 The Technique of Integral Re-locating of Main Body

There are three techniques of Integral Re-locating of Main Body, such as techniques of OPEN-CUT, CUT-OFF, and UP-DOWN. According to the construction structures, it is necessary to assess basic structure, the weight of re-locating, the subsidence, tilt, cracking of buildings; also, construction materials, decoration situation, and blocks on the route, for a better executing way. While dividing works because of construction process, there are five steps which includes excavating and examining the structure on site, reinforcing the main body, setting up mobile system, re-locating structure, and connecting structure

(1) OPEN-CUT

Based on its literal meaning, OPEN-CUT is to excavate at the bottom of construction, to move along with the route, to re-locate at new locations, and then to install supports and tracks. After re-locating the construction at the new location, the repairment and will be done.

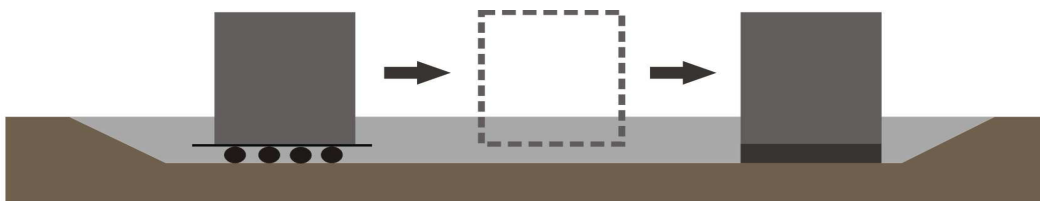
Advantages:

- Simple and easy work
- Shorter construction period
- Less construction expense
- There is neither raising nor lowering in this technique, so the risk is less.

Disadvantages:

- There are earthwork needs to be excavated, dumped, and backfilled for recovery.
- If there are roads on the re-locating route, it would disturb the traffic and the influence it brings might take a long time.

Pic 5—The Schematic diagram of OPEN-CUT



(2) CUT-OFF

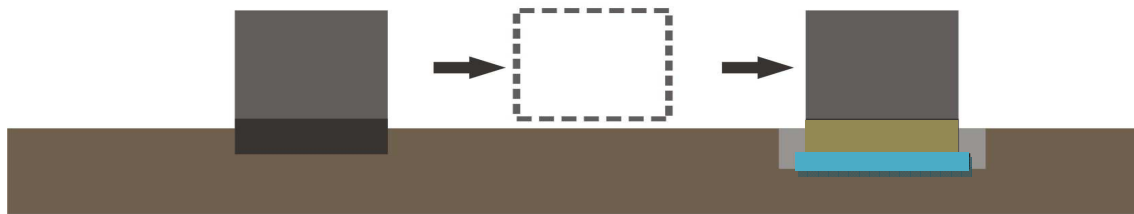
Excavate the ground around the building and cut off the foundation; then replace the supports and move the construction to the new location. Later, connect the original construction with the new foundation, and then repair it.

Advantages:

- The re-locating route is on the ground surface, no excavation, dumping, backfill needed.
- There is neither raising nor lowering in this technique, so the risk is less.

Disadvantages:

- Tough work
- Longer construction period
- Higher construction expense
- Need to cut off the foundation and it is easy to get the original construction



Pic 6—The technique of CUT-OFF

(3) UP-DOWN

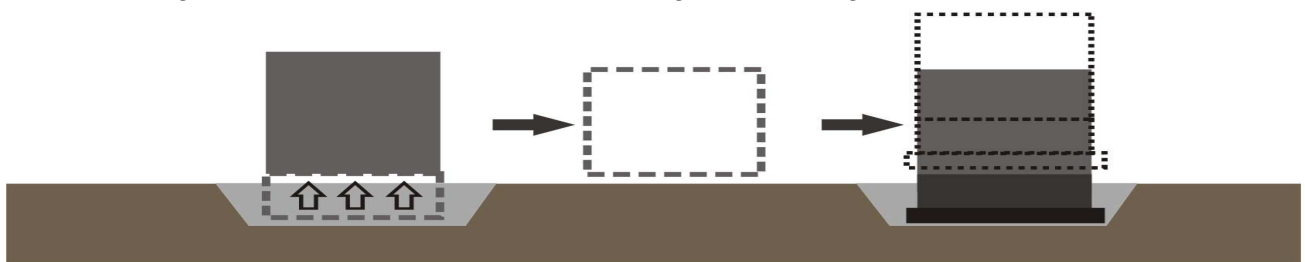
To excavate around the construction and then raise the entire building completely. After re-locating the construction at the new location, the construction should be lower down for connecting with the new foundation.

Advantages:

- The re-locating route is on the ground surface, no excavation, dumping, backfill needed.

Disadvantages:

- The most difficult technique among these three techniques
- The longest construction period
- The most expensive
- With higher construction risk due to the raising and lowering



Pic 7—The technique of UP-DOWN

4.3 Considerations and Key Points of Integral Re-locating of Historic Buildings

Generally, there are three essential points of integral re-locating of historic building.

(1) The protection and preservation of surroundings of the construction are included. The planning of the whole area is supposed to scheme out before the re-locating project. Environment protection comes first. If the environment could be recovered and renovated, then recovery comes first. Unless it is impossible for recovery, then building re-locating is the least option.

(2) Constructions preserved following its history, functions, outcome, and decoration are supposed to be conserved especially; such as Kaohsiung Railway Station, Taipei Workshop, and so on.

(3) Some constructions which only have additional parts which worth of preserving could be partially demolished and then undertake the re-locating. After re-locating, it could also connected with the design of new constructions.

Many historic buildings are lack of maintenance for years; therefore, the structures are greatly damaged. Due to the lack of original designs and documents, the assessment is done with the investigation on site. If the risk of re-locating is way too high, then demolition re-locating could be considered. The key points of re-locating are: reinforcing the structure, replacing, setting tracks, and connecting and fixing.

(1) Structure Reinforcement: Usually, the structure of historic buildings are seriously damaged due to its age. Therefore, before re-locating, the structure assessment and reinforcement are required to be done, which could avoid the damages during the re-locating. Take Taiwan as an example, the common historic buildings could be classified into three kinds: traditional wood structure, brick-wooden structure of Ming and Qing Dynasty, and the masonry and concrete buildings of the period of Japanese dominant.

Wooden structure: The structure components are brick tiles, wood frame, stone drum, square tiles, brick-stone foundation, stairs, and foundation with a mixture of lime, clay, and sand. Roof and wood frame are supposed to be reinforced.

Brick-wood structure: After Ming and Qing Dynasty, most brick-wood structures of wood frame, brick walls, wood stairs, wood floor, and tile roof. Need to pay attention to wood frame, floor and stairs.

Others: During the period of Japanese Rule, masonry and concrete buildings are now still functional. The structures are complete and able to use normally. There is no further reinforcement needs to be done usually. If the reinforcement is needed, the premise is the outcome.

(2) Replacement: Most historic buildings in Taiwan are low-rise, the weight is light, and the bearing of replacement is little; but the wholeness of structure is bad. Therefore, the strength of foundation needs to be increased.

(3) Railway technique: Most historic buildings needed to be relocated are small. The total weight is light but the entire structure is bad. Thus, it is very sensitive to the vibration. Therefore, the foundation of tracks needs to be strong enough. While excavating the foundation, the influences happened between the upper part of the construction and the original foundation are essential. The excavation of large area should be avoided.

(4) Connection and fix: The most direct way to preserve the original construction.

The wholeness of integral re-locating could not be decreased. While constructing the re-locating speed could not be too fast. Also, the supervision needs to be improved. Except for consulting with the construction design department, it is necessary to negotiate with relevant people of heritage preservation.

5. Conclusion

There are two factors influencing decisions regarding integral re-locating, which are social and economic factors. On the perspective of economic factor, if the construction is still functional, and there is no safety or space concerns, the re-locating expense is one sixth of the total of demolition and new construction. On the perspective of social factor, except for the historic sites being protected by law, it is very expensive to move and repair other buildings which also have memorial or historic significance. Most owners choose to demolish the buildings, but that causes unpredictable cultural loss. Based on most people's opinions of the society, it is much easier to demolish and rebuild those buildings than to move them. Unless there are strong opponents from the public or the construction itself incidentally arouses most people's vibrations, the re-locating could be possible. After re-locating, most historic buildings serve as exhibition halls, and based on the investigation, the operation of exhibition hall could not really afford the maintenance fee actually. Some buildings even become absent or damaged without repair eventually. Therefore, while making the decision of building re-locating, the following plan of how to use and maintain the building is necessary and essential; otherwise, it would fail the goodwill from the beginning.

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