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Method Statement for Rectification to L-Shape Windows of HDB Flat in Singapore

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Abstract

The HDB (housing and development board) project with name of Fernvale Lea is located in Seng kang west way, Singapore. Following the consultant drawing, the stack of unit 505 in block 467A was constructed with straight windows at the master bedroom. However, it was found deviating from the sales brochure which HDB offers to the flat owners before the subscription. To put down the issue in a reasonable period in case of delaying the data of owners' check-in, Qing jian South Pacific company Fernvale Lea main-contractor project department adopt a series of construction methods to accomplish the urgent task. According to the updated drawing, the column position should change to supply enough room for installing L-shape window. So hacking the original hollow panel is the first step of construction rectification. After that, new column besides the L-shape window need to be cast in order to support the structure for safety. Installing window frame and providing reliable water proofing need to be done before the architectural work begins. Last but not least, the canopy of each story should adjust to the L-shape window so casting concrete work should proceed in the whole construction rectification process.

1. Introduction

Since the founding of modern Singapore, public housing in Singapore is managed by housing and development board (HDB). The majority of residential housing developments in Singapore are publicly governed and developed in Singapore. Over 80 percent of Singapore residents live in the flat developed by HDB. The policy "Let every Singaporean get the place to live in" proposed by Lee Kuan Yew manages to settle down the housing issue in Singapore. By the influence of the policy, Sengkang N4C24 HDB flat project started in the year of 2012 with the contract value 1.51 billion Singapore dollars. The project N4C24 includes one multi-story car park (MSCP) and eight 26 story building blocks (469A, 469B, 469C, 468A, 468B, 468C, 467A, 467B), which contains 1150 units in total. The estimated overall contract period is 36 months. In August 2014, all the construction work has been finished in the eight blocks. At that time, a difference was found between the construction drawing and sales brochure offered by HDB. To change the existed structure to the drawing style on the brochure, the main-contractor need to adopt a series of construction methods to accomplish the rectification. Figure 1-1 show the original drawing and updated drawing of unit 505's details in 467A. As shown in figure 1-1, the original pollution of column 26PC1 (26 story precast column 1) with the section 250mm × 1000mm is changed in order to supply room for installing L-shape window frame. Gable end wall for the short side of L-shape window where column 26PC1 was

need hacked to 150 mm instead of 250 mm for adjusting the width of L-shape window frame. Casting concrete job in the canopy's short side part corresponding to the L shape window outside the unit is the last step of construction process. Besides that, some M&E (mechanical and electrical) work and waterproofing work is still to be completed before the plaster and painting stage for external walls. M&E worker should replace former electrical trunk with new trunk because of the column 26PC1 hacking. As shown in Figure 1-1, the new column 26C1 (26story column 1) is cast in site with the same section of precast column 26PC1.Figure 1-2 shows the original appearance of unit 505 in 467 A from the outside view. Table 1-1 states the requirement of manpower involved, materials involved and machineries involved in different scopes of activity.

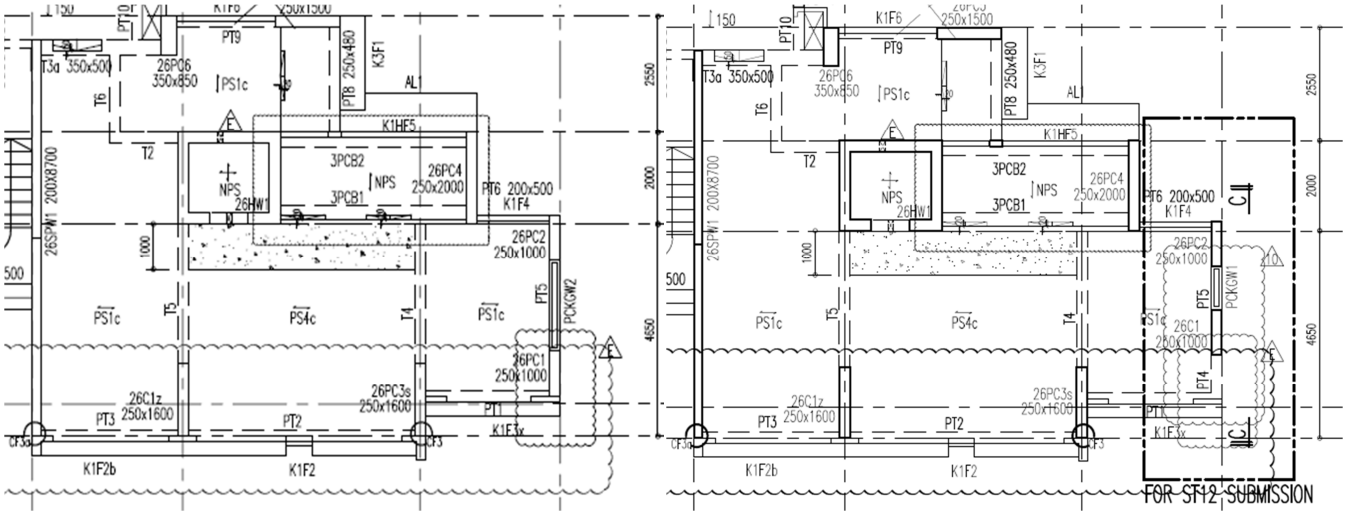

Figure 1-1. *Original drawing and updated drawing of L-shape window rectification in 467A.*

Figure 1-2. *Original appearance of unit 505 in 467A.*

Table 1-1. *Requirements in different construction process.*

Scope of activity	Manpower involved each story	Material involved	Machineries
hollow panel hacking	4 workers + 1 team leader	scaffold	concrete breaker and cutter
new column casting	2 workers + 1 team leader	formwork concrete	tower crane
existed column hacking	4 workers + 1 team leader	scaffold	concrete breaker and cutter
new canopy casting	2 workers	formwork concrete	boom lift
electrical trunk	1 electrical worker	trunk and wire	PM hoist
water proofing	2 workers	k11 waterproofing	boom lift
installing new windows	2 window installers	window grout	PM hoist

2. Construction Process

2.1. Existed Hollow Panel Hacking and New Column Casting

Figure 2-1 shows the existed hollow panel hacking and new column casting construction process at first story. According to the structural consultant's advice, constructing a deep beam at the top of first story before panel hacking is necessary for safety. In this way, the deep beam could support the structure above and transfer loading to the first story column. Demolish the existed hollow panel at first story between the two columns in order to provide room for casting new column. Install four back propping on the ground of first story to make sure working environment is safe during the hacking process. Hack the second story beam inside the unit 505. As shown in figure 2-1, install 2T16 (screw-thread steel diameter 16mm) bottom reinforcement bars at each side of column and the length inserting the column needs to be larger than 600mm, install 2T20(screw-thread steel diameter 20mm) top reinforcement bars along the beams and the length inserting the column needs to be larger than 640mm. Make sure reinforcement bars' lapping length is larger than forty-five times of rebars' diameter and anchorage length is larger than thirty-two times of rebars' diameter to comply with the basic requirement in standard drawing offered by consultants. After removing the hollow panel at first story, install 12T20 rebars and a R10-100(link reinforcement diameter 10mm every 100mm) link cage where the new column is. After checking rebars position, cleanliness, form-work cover, rebars lapping length and anchorage length, seal up the opening with wooden formwork in the condition that reinforcements outstretched for lapping to second story has been prepared. Cast grade 50 (target mean compressive strength =58.25MPa) concrete delivered by concrete mixer truck inside the formwork and prepare a concrete cube (150mm×150mm×150mm) in the same batch of concrete cast the column. Using a vibrator machine when casting the concrete so that the concrete will be dense and hollow part will not appear in the column. Deliver the concrete cube prepared in site to the mechanical laboratory for compressive test. When the compressive strength result of the cube reaches one hunrend percent, it proves that the concrete cast in column in the same batch has reached enough strength as well. After that, remove four propping for the application of next story.

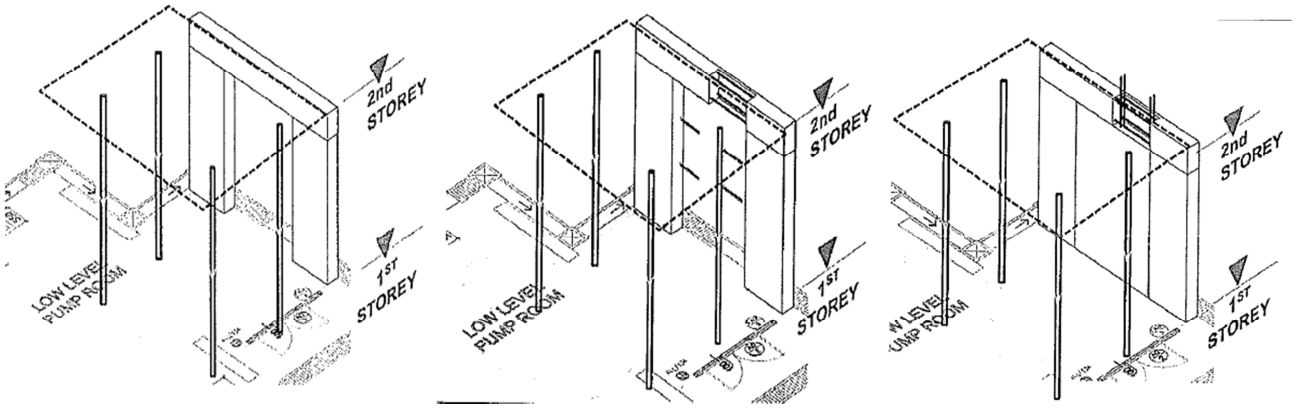

Figure 2-1. *Construction of deep beam at first story.*

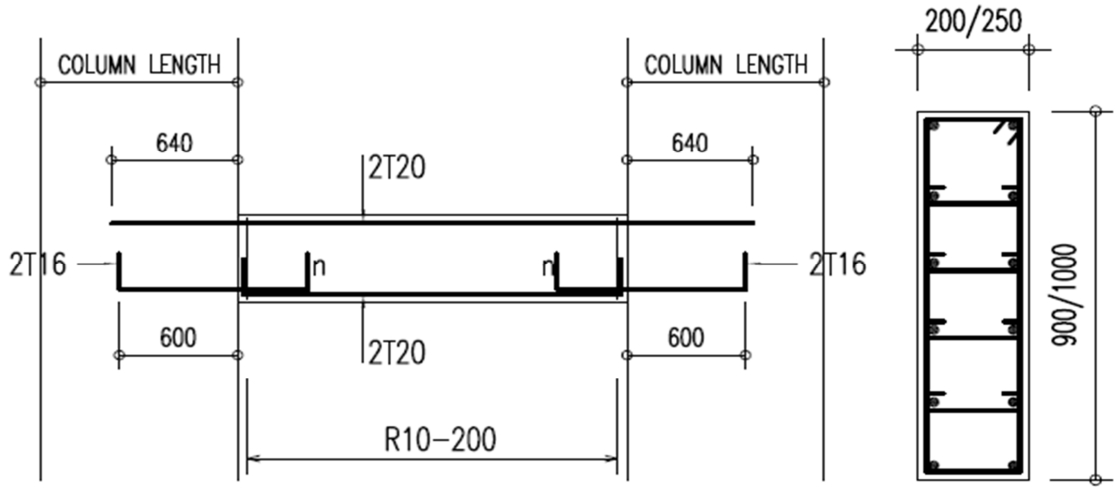

Figure 2-2. *Deep beam and in-site cast column drawing.*

In this way, it forms a rectification loop for existed hollow panel hacking and new column casting until the 26 story finishes. There are still some highlights in the hacking process, including checking the column marker before hacking process, Cutting a 5mm depth gap with concrete cutter before hacking process, controlling hacking depth which can not be more than 180mm, protecting the deep beam rebars and precast floor plank rebars when hacking and cleaning the loose concrete to make existed concrete surface rough after hacking. It is easy for the hacking workers to distinguish the area they work by drawing the mark and cutting a gap on the panel. By protecting rebars in beams and columns, the contractor can make sure the safety of the building. Rough concrete interface will provide reliable surface for casting column of next story to form a stable joint. From the perspective of construction, it will offer a safe and convenient way to accomplish the rectification work basing on the highlights above.

Figure 2-3 shows the rectification construction process detail in site. First picture shows that some rebars protrude from downstairs to achieve the lapping requirement. Second picture shows that the formwork has been closed and fixed for the concrete casting. Third picture shows that a cross support is placed on the end of vertical propping to resist upstairs loading. Fourth picture shows that the safety mesh is fixed on the window opening in case that some construction material drop down. This construction process started in October of the year 2014 and ended in December of the year 2014.

Figure 2-3. *Construction process in site.*

2.2. Existed Column Hacking

After finishing hacking all existed hollow panels and casting new columns of block 467A, 505 unit according to the drawing, remove the propping of each layer for providing next construction process' feasibility. Before the coring process and hacking process begins, verify drawings and check work areas (location) that are schedule to work in accordance with drawing and obtain approval from consultants, submit form "notification of use of statutory equipment" for use of lorry truck crane, ensure that power supply for the equipment is provided according to the required power consumption (220V (13A)/ 380V (60A)) for the coring machine, ensure that water supply for the equipment is provided for the demolition work, disconnect all existing piping, ducting, false ceiling and etc to expose the concrete to be demolished and Install of temporary support and working platform where workers do their coring and hacking job. For the workers who do the coring job, they should check the tools and equipment are in good working condition before commencing work. Only authorized personnel is allowed to operate the cutting tools. Personnel are considered to be authorized if they meet the necessary training and know how to react accordingly to problem and emergency act. Contractor should check and ensure that the work area is properly barricaded to prevent others from entering with danger sign. The operator is responsible for the correct use of the coring drill machine.

As shown in figure 2-4, diamond drill bit is selected on the drill motor because the material quality drilled is 250mm concrete column with rebars 12T20 inside (figure 2-2). The drive power and peripheral velocity of the drill motor is selected properly according to the 120mm diameter hole. Figure 2-4 shows that the window frame's height is 1200mm, So ten concrete cylinder with 120mm diameter are drilled along the vertical direction. There is a chain block hanging over the top beam for delivering the central drilled part of drilled column. There is a hook pulled by the chain block lifting the panel through the anchor fixed on drilled column by expansion bolts. As for the window frame part, the drilled depth is 250mm (the thickness of drilled column). On the other hand, as for the part window frame below, the drill depth is 150mm. Connect power supply to the drive. When motors are being used, ensure that the correct connections for the correct motor and for forward and reverse. Set up the water supply to the core drilling system. A correct cooling water feed is of crucial importance for a satisfactory result. Visually check the core drilling system for damage during the coring process. Each time the electric tool is used, a check must apply to the safety devices which must be in working condition. All

moving parts must not jammed nor broken. Once the drilling procedure is complete, the drill motor can be stopped and secured against unintentional starting up. Then the water feed can be shut off. The structure will be cut into a manageable size for easy handling, central part is delivered by chain block, the other concrete cylinders is delivered by workers. This construction process started in December of the year 2014 and ended in January of the year 2015.

Figure 2-4. *Coring and hacking process of original column.*

2.3. New L-Shape Canopy Casting

As figure 2-5 shows different construction stages of L-shape canopy outside unit 505 in block 467A. Workers are required to coordinate inside the unit and on the boom lift outside to erect propping for supporting the formwork. The propping are used for ensuring the safety of concrete casting outside. Formwork is fixed around the window sill for casting concrete and the rebars arrangement is shown in figure 2-6. Some holes are drilled on the existed column 26PC1 for planting T10(screw-thread steel diameter 10mm) rebars for canopy outside with G5 chemical glue which is used for planting reinforcement in construction process particularly. To make a reliable joint between the existed canopy and the new canopy, the depth of the drilled holes is more than 200mm, twenty times of planted rebars' diameter, to meet the requirement of standard drawing offered by consultant. Concrete surface is required to be rough on the same purpose of planting enough rebars mentioned above, making the joint reliable. D8 (200mm×200mmrebars mesh, rebar diameter 8 mm) is put on the bottom of canopy as shown in figure 2-6. Prepare four concrete cubes for test to monitor the change of same patch concrete' strength after seven days, fourteen days, twenty one days and twenty eight days. After the strength has reached one hundred percent, the formwork and propping can be dismantled because the canopy is a cantilever structure. This construction process started in January of the year 2015 and ended in February of the year 2015.

Figure 2-5. *Construction process of L-shape canopy in site.*

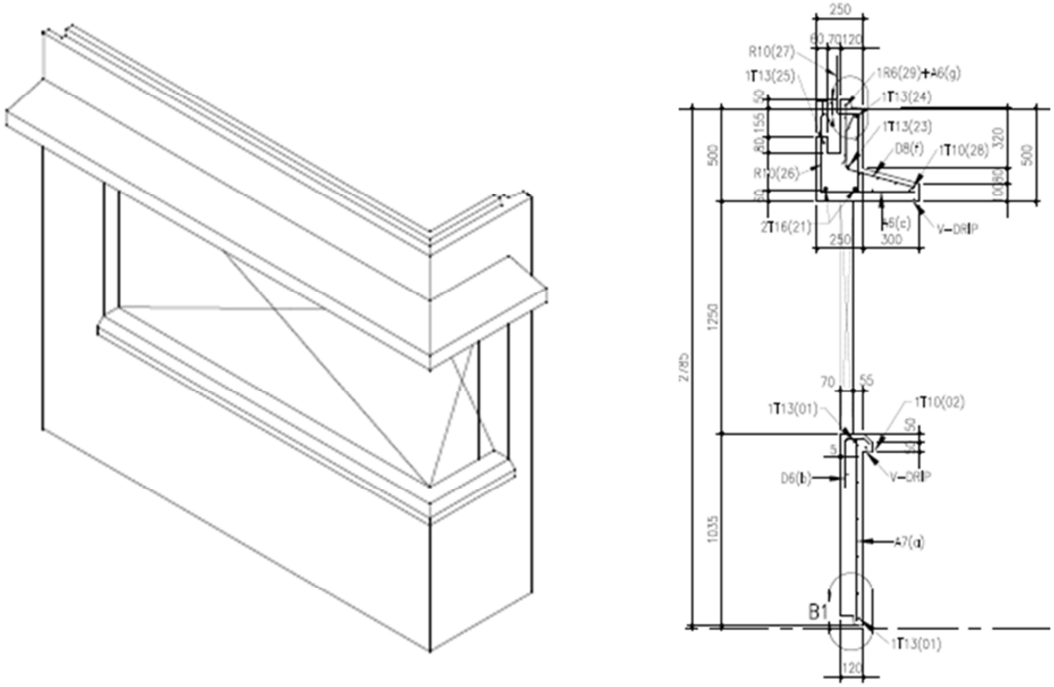

Figure 2-6. *Drawing for the canopy outside.*

3. Grouting and Water Proofing Method

After finishing the construction process above, contractor installs the window frames. grouting work need to be done after installing L-shape windows. As shown in figure 3-1, some wooden formwork is fixed along the window frame for grouting. The formwork is fixed on the wall by steel bolts and sponge strip seals up the gap between window frame and walls along the formwork in case of cement leaking. Reserve some holes in the middle part of formwork to monitor the flow of cement when commencing the grouting process. Using a grouting machine to fill the hollow part between walls and window frames with 280 ECO and using the grouting shooter at the place where grouting is not enough. To be specific, 280 ECO is a high strength, non-shrink grout that is non-corrosive, nonoxidising and free of chlorides and nitrates certified under the Singapore prestigious Green Label scheme. Grout 280 ECO is primarily used for floor patching, bonding new concrete to old and vertical repair.

As shown in figure 3-1, some part of existed column was destroyed because of hacking. So it will cause water leakage in the condition of heavy rain outside which occurs in Singapore regularly. Taking this issue into consideration, waterproofing methods need to be taken to solve the problem. Through the water test in site, it proves that putting waterproofing material outside is far more reliable than inside. To be specific, Put some steel glues after hacking off the vertical joint between facade and gable end wall where majority of water leakage points are, then grout the hacked gap with 280 ECO, brush on K11 waterproofing material at last. K11 is a special cementitious mix of active chemicals that readily reacts with moisture in the concrete to form crystalline structures within the pores and capillary tracts of the concrete.

The electrical workers change the trunk and wires inside the existed column under the L-shape window frame in all story of 467A, unit 505.This construction process started in January of the year 2015 and ended in February of the year 2015.

Figure 3-1. *Grouting gap with 280 ECO and waterproofing process.*

4. Conclusion

Through the construction method statements mentioned above, Qingjian South Pacific Fernvale Lea project department has managed to accomplish the rectification construction to L-shape window of HDB flat in time. The rectification period began as the hacking hollow panel started in October of the year 2014 and ended as the waterproofing process finished in February of the year 2015. The whole rectification process lasted for four months before the flat hand-over date demanded by HDB. Besides the method statements mentioned above, construction machineries involved in the rectification, material involved in the rectification, arrangements of manpower involved in the rectification and safety instructions involved in the rectification are pointed out in this paper as well. The paper offers a construction guide for the issue how to rectify high rise precast structures have been finished already.

Acknowledgements

This work was supported by all the engineers, supervisors and workers in Fernvale Lea 1150 project department of Qingjian south pacific company. The consultants are architects from ADDP company and resident engineers from KTP structural company who offer advice and solution for method statements in the whole construction rectification process. Project manager Geng Tianming and site manager Gao Yunchao pay lots of effort to make sure the task done before the deadline. Through the efforts from all participants, the date of flat handover is not delayed by the rectification process in the final.

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