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Construction Process & Technologies Applied to Parc.1 Project

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Abstract POSCO E&C has completed Parc.1 project successfully. The construction period was 42months, and 1.5 million workers were participated till completion. To meet schedule management and quality control, POSCO E&C has adopted a lot of technologies such as GPS measurement, 3D scanning, vibration control, stack effect control, column shortening control, etc

Keywords Posco e&c, Parc.1, high-rise building, mega column, mega brace

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1. INTRODUCTION

Located on Yeoui-do island, a business and residential district alongside the Han River in Seoul, South Korea, Parc.1 comprises two landmark office towers facing west, the luxury 326-room Fairmount Ambassador Seoul hotel at the eastern end, and, anchoring the entire site, The Hyundai Seoul retail center.

POSCO E&C, one of dominant E&C companies in South Korea, has completed Parc.1 project with his integrated technologies, know-how and high-performance materials for high-rise buildings, ranked in 3rd highest building in South Korea. It took 42months for super-structure and finish work including cladding, and excluding underground work. High-performance steel materials up to 65,000 tons were provided by POSCO which is a holding company of POSCO E&C and top tier steel manufacturers in the world.



Location	Yeouido Business district, Seoul, Korea
Principal Use	General Commercial Area
Site Area	46,465 ㎡
Building Area	24,766 ㎡
Gross Floor Area	629,047.23 ㎡
Building Coverage	53.3% (Max: 60%)
Building-to-land Ratio	791.67% (Max: 800%)
Max. Height	317.7 m
Parking Lots	2,442 Lots
Structure	Steel Framed Reinforced Concrete Structure
Designer	Rogers Stirk Harbour Partners/ Samwoo/ Sia plan
Client	Y22 Project Financial Investment
Contractor	Posco E&C
Scale	Tower 1: 69F, Height 318 m Tower 2: 53F, Height 245 m Retail : 8F, Height 49 m Hotel : 30F, Height 101 m
Contract Amount	1.2 billion US$

Figure 1. Parc.1 project Summary.

Parc.1 was designed by architects, Rogers Stirk Harbour + Partners (RSHP) with co-architects Samoo Architects and Engineers and Siaplan Architects and Planners, in conjunction with Leonard Design Architects, engineers Arup and DongYang Structural Engineers Co. Ltd

2. Structueral Design of Tower

The structure of tower consists of Concrete core and Steel mega columns and braces.

And Mega columns and braces are designed to resist the lateral force such as wind force and earthquake.

This is the first high-rise structural system with mega column and braces in South Korea.

Commonly they have adopted Outrigger system, Outrigger system was adopted in Lotte World Tower (height; 555m) in Seoul and LCT (height; 412m) project in Busan, South Korea.

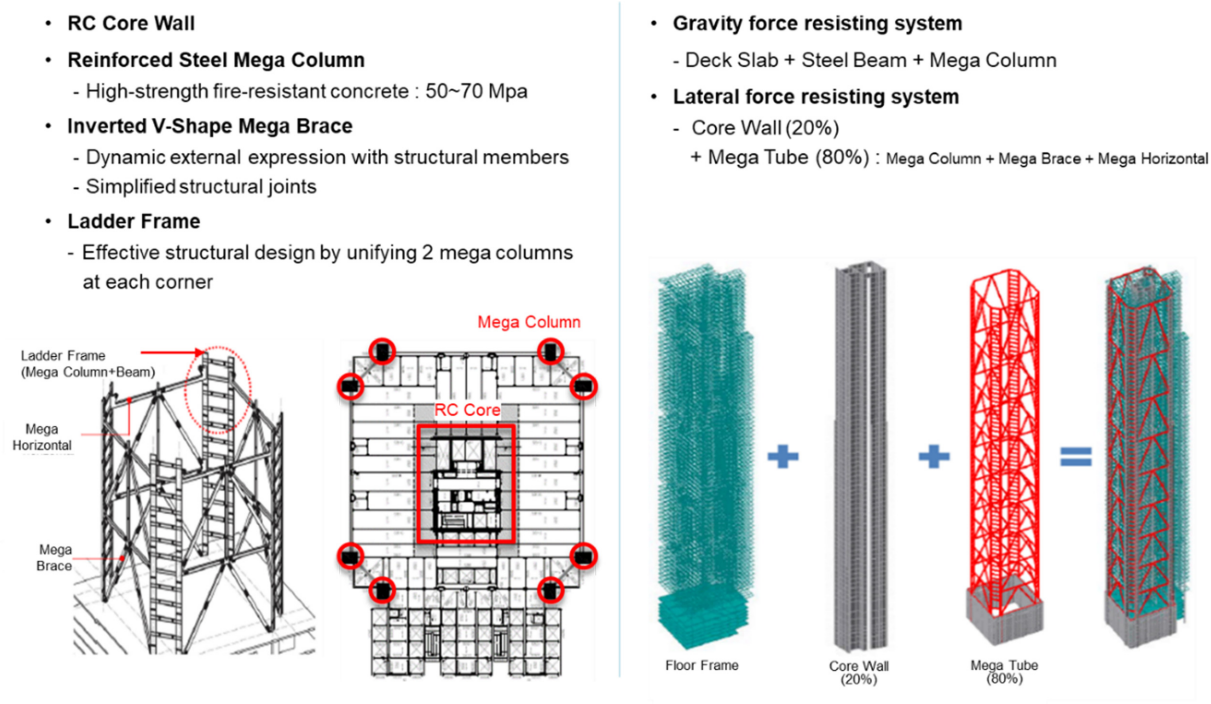


Figure 2. Structural System of Tower.

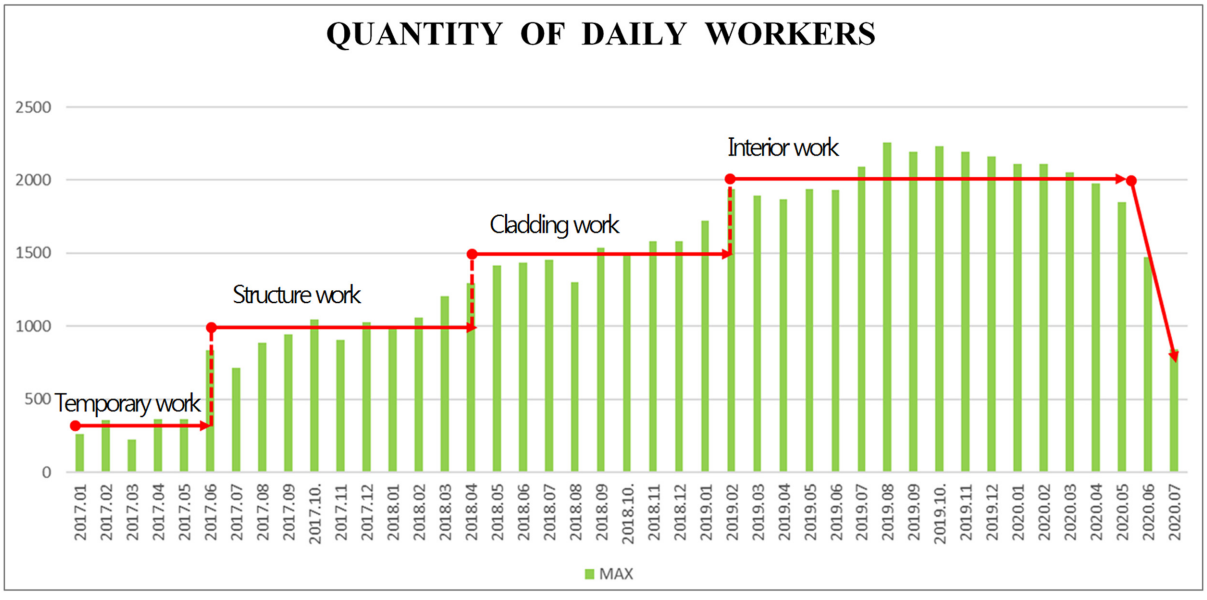


Figure 3. Quantity of Daily Labor Attendants.

3. Construction process

Parc.1 has been completed on 14th/July/2020, started on 21th/Jan./2017. POSCO E&C employed totally 1.5 million workers to complete Parc.1 project during 42 months.

Construction process can be classified by 4 stages as temporary work stage, structural work stage, cladding work stage, interior work stage.

During temporary work stage, we did maintain and repair temporary equipment and workshop like tower cranes, lifts, auto climbing system forms and etc. which was unused during suspension period from 2010 till 2016 (7years). Average 300 daily workers was engaged at this stage.

On structural work stage, Superstructure work was started, Average 1,000 daily workers have participated in. When cladding work was started, on 16 months from commencement, Average 1,500 daily workers have participated in.

And the last interior work stage was started on 25 months from commencement, Average 2,000 daily workers have been engaged for Parc.1 project.

To optimize construction period for high-rise building, Vertical activities should be well organized. Parc.1.

A picture below shows construction procedure of main works, Prac.1 project.

First Concrete core wall is done, and Steel works follows the concrete core works, and slab works and Curtain wall works will be done in order. This is a Core preceding method usually adopted in high-rise buildings.

For the Core works, we are using Auto climbing system with gang form attached to it. This system climbs up the core by itself with the form. With this system, we could have planned the cycle time of 5days per floor.

Pictures below shows a panorama view of Parc.1 project every 6 months during construction.

4. Engineering and technologies

4.1 Surveying of High Rise Building Using GPS

For the high-rise building over 300m, especially when we survey the coordinate point, GPS technology will be adopted. It is not easy to survey the building under construction far from the building. Because there are so many interfered buildings to block the surveying path.

Parc1 project adopted GPS measurement technology from 27th floor for measuring of upper floors.

4.2 Structural Health Monitoring(SHM) System

Parc.1 will be mandatorily monitored the structural health of this building after completion. That means we will get information on Typhoon, earthquake forced to Parc.1 in real time.

With this system, we can prevent sudden accident or disaster in advance.

Totally 140 gauges have been installed in different part of each building, and these gauges give information about the wind, building sway & tilting, vibration, member's strain & stress and so on.

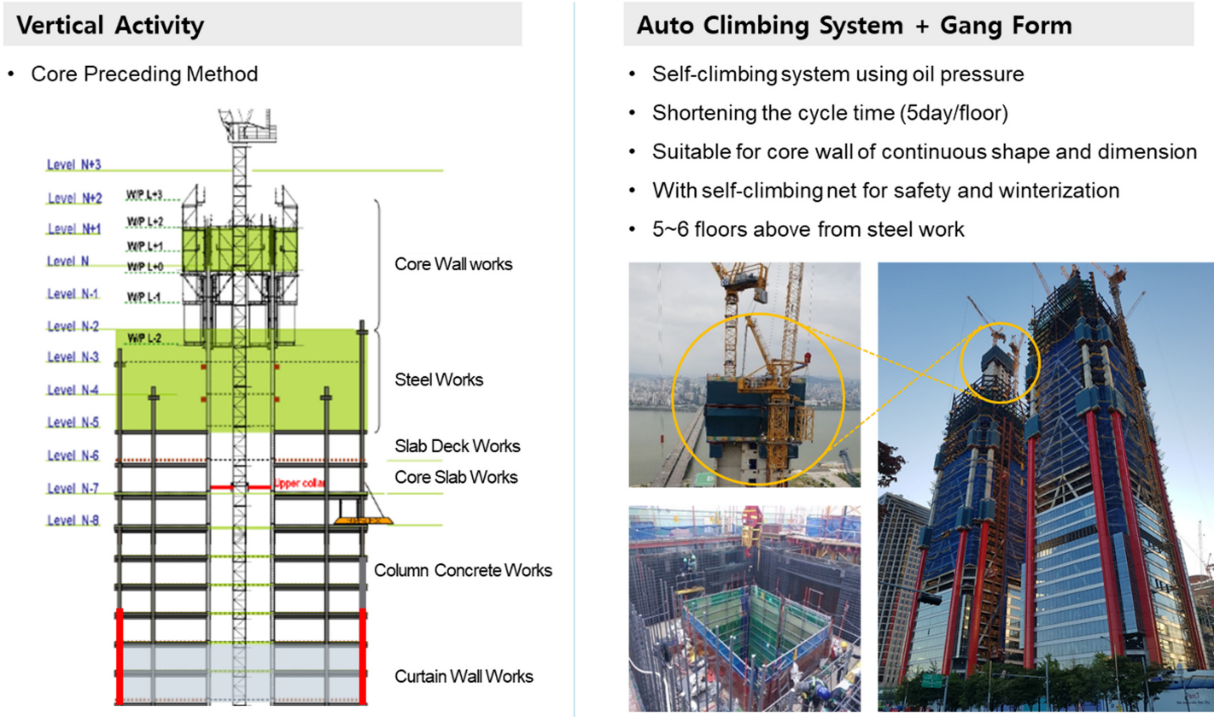


Figure 4. Sequence of Vertical Activities.



Figure 5. Construction Progress.

4.3 Column shortening management

All materials will be shortened when loaded according to its property.

Normally All vertical members of building will be designed considering load balance. That means vertical members will be shortened equally. If that, there isn't

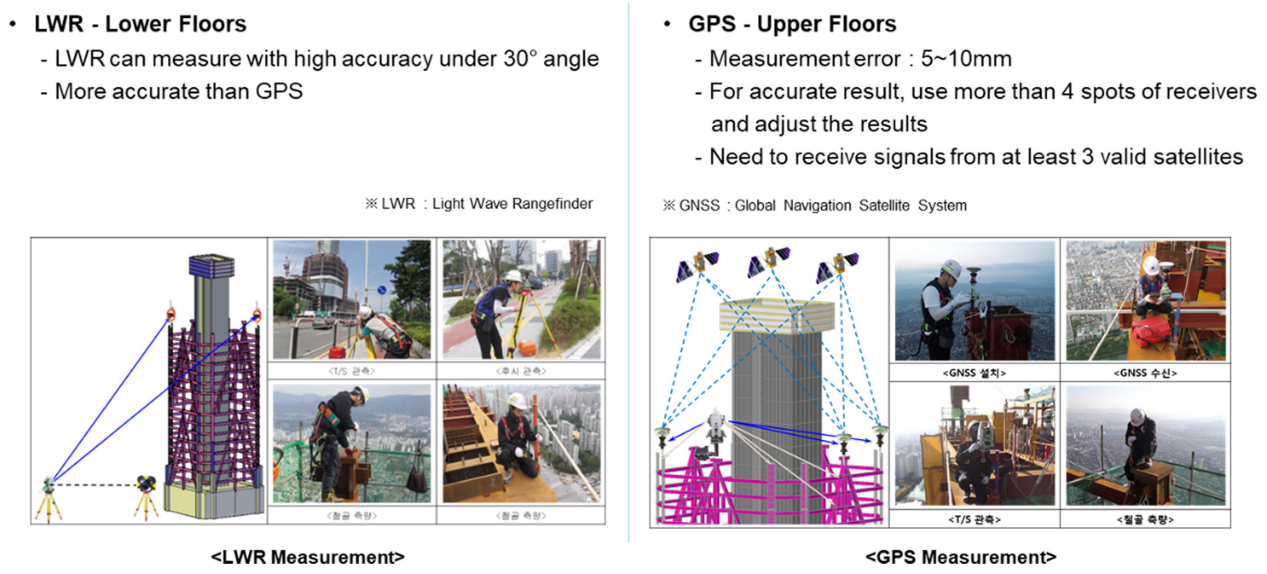


Figure 6. GPS measurement summary.

differential shortening problem.

But for high-rise building, we need special structural members to resist lateral force; wind & earthquake. These members usually cause differential shortening problem.

If we don't manage this differential shortening, At the top floor, the slab will slope inside to outside. We managed shortening issue well with pre-engineering, measuring material properties of shortening, and sensing with 176 stain gauges installed inside columns.

4.4 Construction BIM and 3D Scanning measurement

BIM is a drawing tool which shows us a 3 dimensional view and more information.

BIM have been used for many purposes such as process simulation, design check, virtual construction in Parc.1 project to improve constructability, to reduce trial and error, and to avoid failure. This trial to use BIM not only as a design tool, but also as a construction tool, was successful. BIM also was a powerful visual tool for safe management.

We used 3D modeling program such as sketch-up,

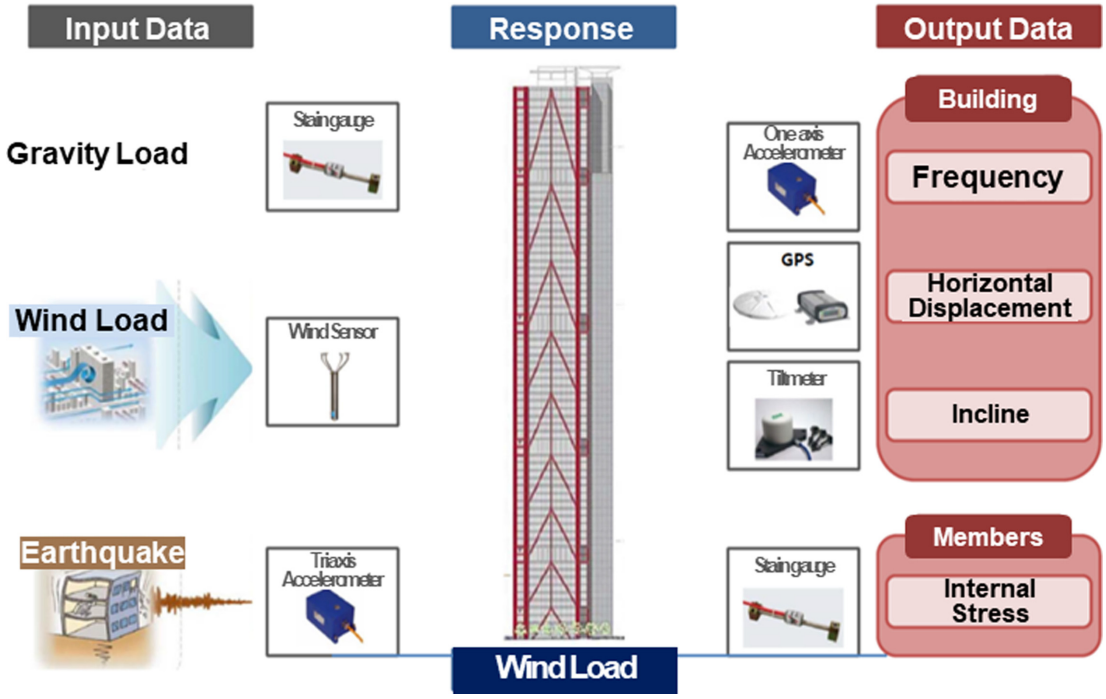


Figure 7. Sensing Lists on SHM.

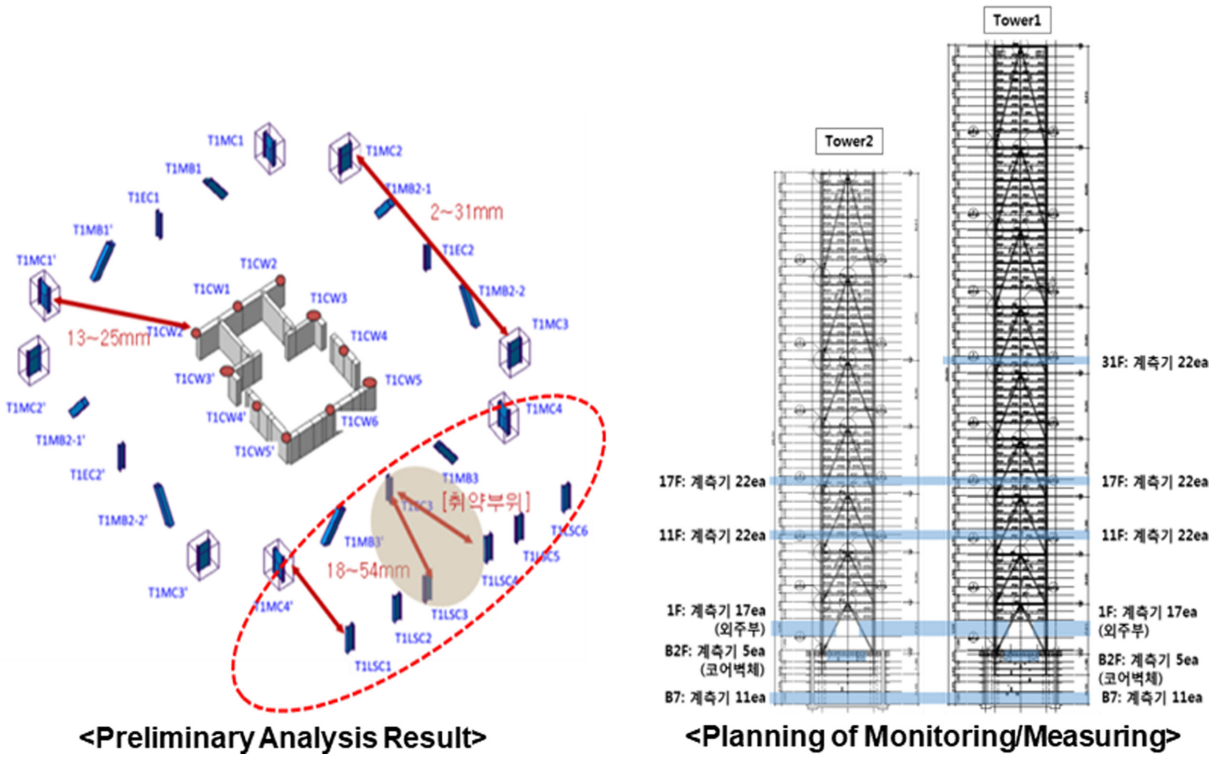


Figure 8. Control of Column shortening.

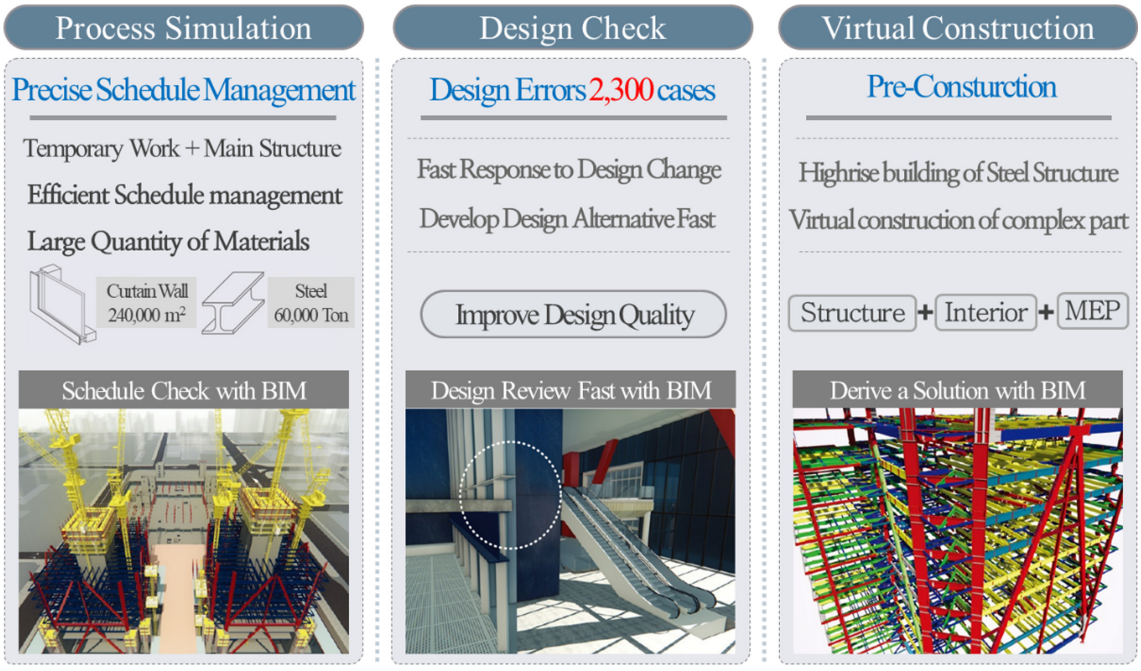


Figure 9. Application Cases of Construction BIM.

archi-cad, Revit, tekla, Navisworks, etc.

3D Scanning was performed on the basement area up to 260,000m^2 to verify structure as built, and also to be performed superstructure and diagonal members of high-rise tower, huge space frame to build up accurately according to the drawing.

5. Conclusions

Parc.1 project has several features to differentiate other projects built before in South Korea.

Most of all, Parc.1 adopted mega column and mega brace as a structural system to resist lateral force. POSCO

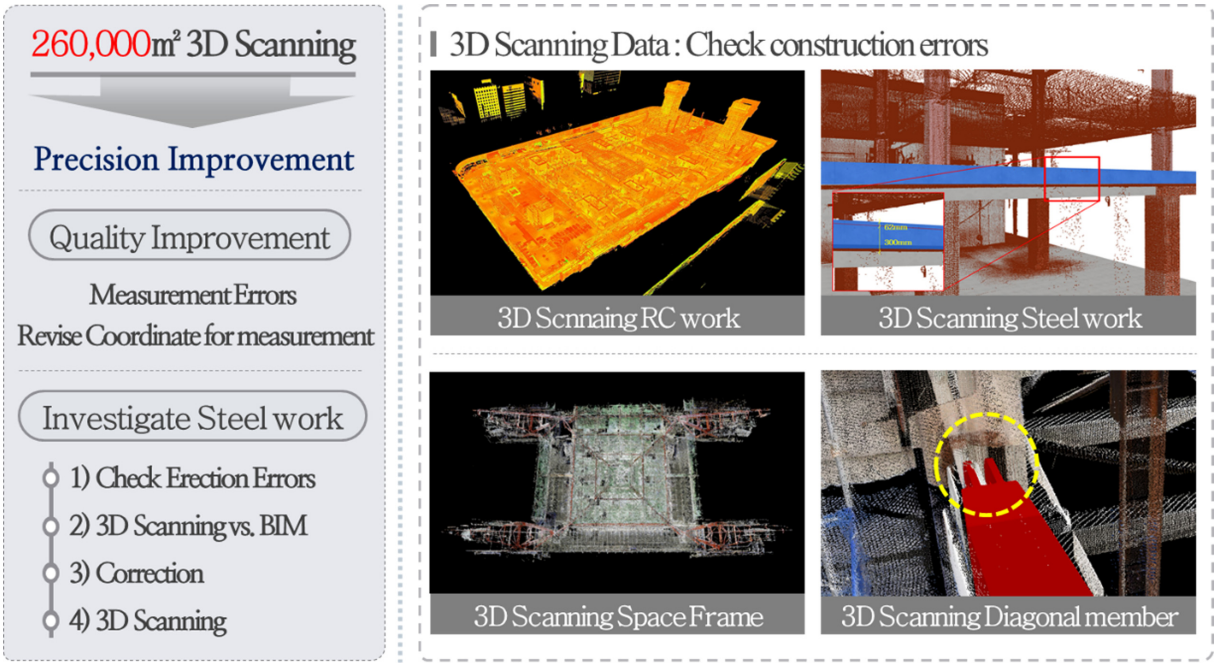


Figure 10. Cases of 3D scanning on Parc.1

E&C focused on precise construction and schedule management to complete on time. To achieve those goals, GPS measurement, 3D scanning, and Core wall preceding methods have been performed.

POSCO E&C has completed Parc.1 project successfully on time. And now, Parc.1 has ascended real land-mark in Seoul, South Korea.