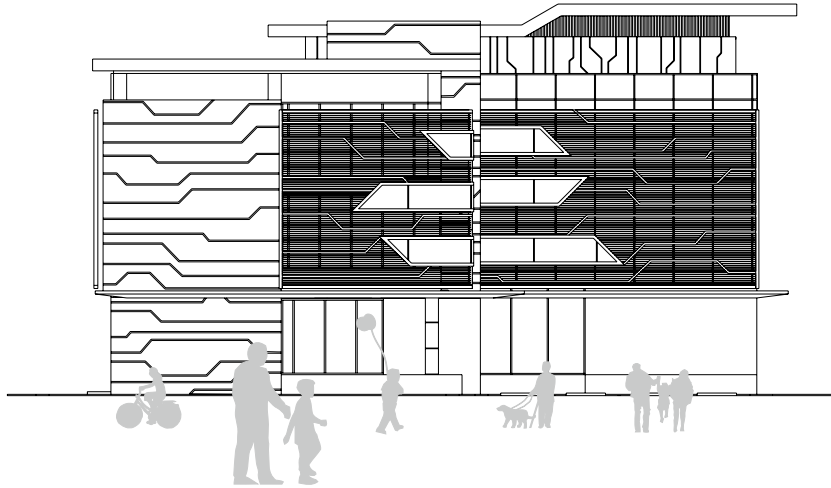




KOREA Engineering & Construction

Beyond safety, Delivering Greater Value,
Korea E&C, the Integrated
Reinforcement Science Leader

KOREA Engineering & Construction

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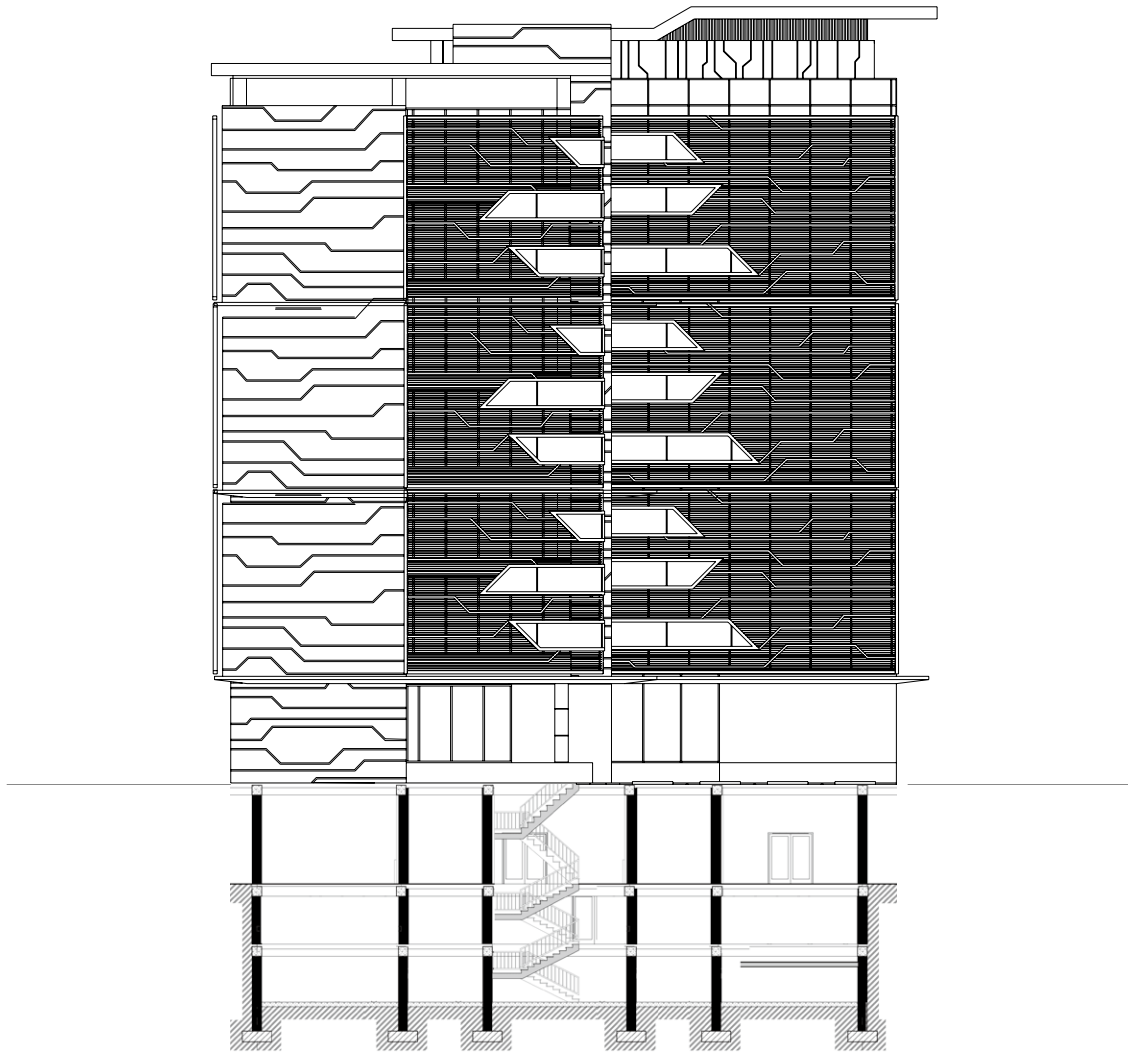
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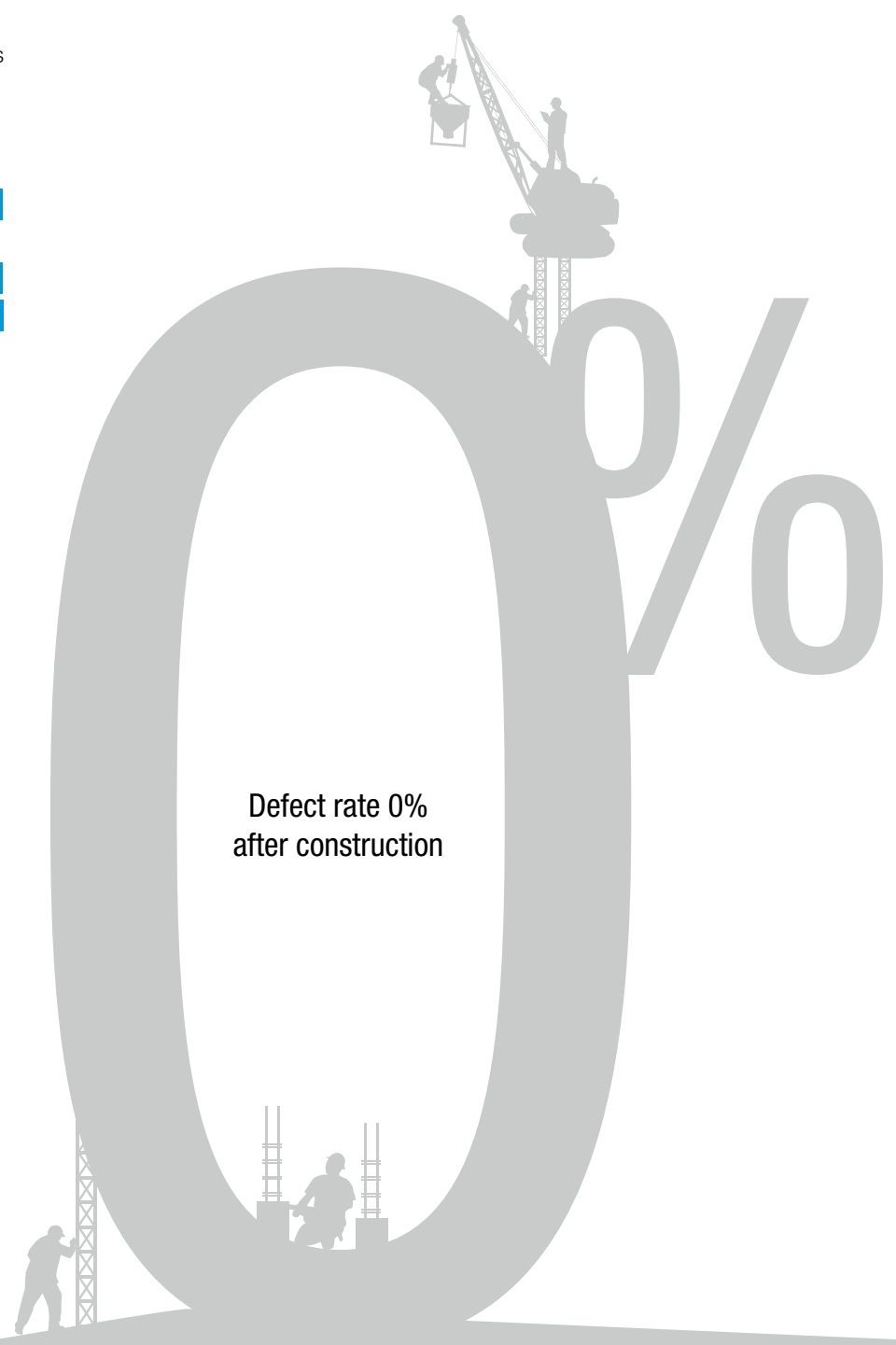
The most importance of structure reinforcement is definite reinforcement and permanent persistency. For this, Korea E&C has not selected material, method of construction, design method which are not consistent with an engineer's pride for instant interests for 17 years. Korea E&C's reinforcement science is to reinforce a foundation by pressing piles, and a structure by binding as wire rope. It is a scientific technology which is no excavation method with measuring and pressing, and no-adhesive bolt tension. Korea E&C's reinforcement science is to erect sloping buildings, to increase story height by extending columns, and to widen area by getting rid of columns.

We enhance customers' relief beyond safety as well as their asset value through defect rate 0% after construction.

Safety value for 17 years.

The key of Korea E&C's reinforcement science is the foundation reinforcement technology to measure and press piles by not using underground excavation but using hydraulic jack, and the structure reinforcement technology to bind column, beam, etc. by using wire rope which is connected to bolt. There is no vibration and noise, and it is possible to work in narrow area due to press piles by using hydraulic jack. Also, it is very scientific technology to measure automatically the history of all piles to be reinforced in the process of pressing, and to examine even the history of existing foundations automatically.

Korea E&C's reinforcement science has continued a legend of defect rate 0% after construction for 17 years as member of framework before and after reinforcement is not separated from natural disaster such as earthquake and long time.

A large, light gray '0%' is the central visual element. Silhouettes of construction workers and equipment are integrated with the number: a crane is on the top right of the '0', a worker is on the left, and another worker is at the base of the '0' near some rebar structures. The text 'Defect rate 0% after construction' is centered within the '0'.

Defect rate 0%
after construction

No.

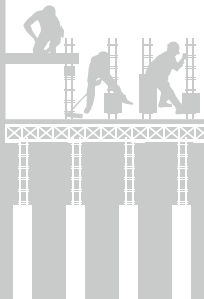


The world's leading integrated reinforcement science company

A New Paradigm in Reinforcement Technology

Korea E&C's reinforcement technology sets a new standard. Its non-excavation, vibration-free, and non-adhesive method enables construction in confined spaces and even while residents remain in place. By retaining existing columns and beams, it is an eco-friendly solution that produces minimal construction waste.

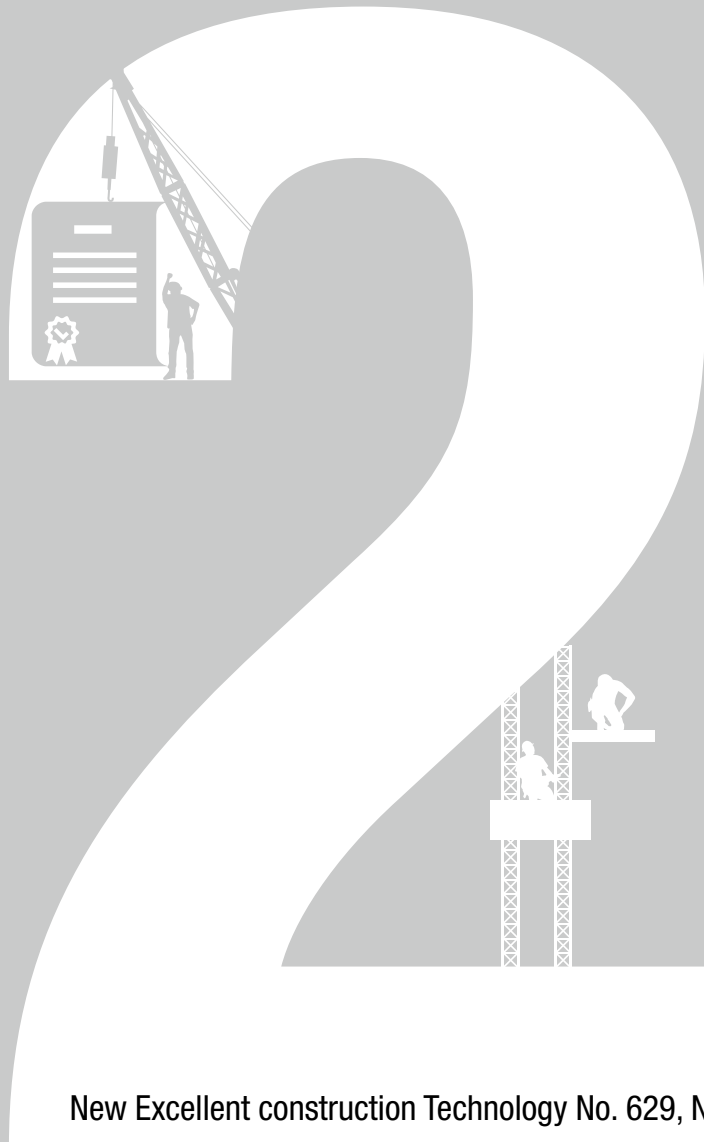
Korea E&C, a global leader in integrated reinforcement science with patents worldwide, has pioneered a new paradigm of premium technology, redefining quality standards.



Two new construction technologies and seventeen patents.

Korea E&C obtained seventeen patents for 17 years. Among them, two patents were designated as new construction technologies by Ministry of Land, Infrastructure and Transport.

Korea E&C's new technology applied in about 200 constructions in overseas countries such as China, Vietnam as well as South Korea is different from existing construction methods. The pressing piles can examine the history of existing foundation automatically and the reinforcement technology to bind has no worry of delamination, which have permanent effectiveness.



New Excellent construction Technology No. 629, No. 682



Rich experiences in domestic and international constructions.

Successful construction world beyond South Korea

Remodeling to extend building's life and improve its value is very necessary all over the world. Particularly, reinforcement of cultural properties is an important work to keep a nation's spirit and culture. Korea E&C had an experience to reinforce Taoist temple which was in the risk of being submerged in China successfully not to sink under water by lifting 1.3m of the building vertically. Korea E&C's reinforcement science which was aired twice in Chinese TV attracted the attention of the public. The engineer's stubborn philosophy who has invested 100% of profit in research and development has led to success of many domestic and international projects.



We realize value beyond safety through reinforcement science by using ‘No excavation’, ‘No vibration’, and ‘No adhesiveness’ method.

Korea E&C has changed innovatively the concept of construction reinforcement technology, and is a specialized corporate of foundation reinforcement under the ground and construction reinforcement on the ground. Korea E&C reinforcement science to press piles with no excavation method by using hydraulic jack was designated as new construction technology no. 629 which is an eco-friendly technology to reinforce foundation without vibration, noise, and dust by Ministry of Land, Infrastructure and Transport. Also, construction reinforcement technology to bind and reinforce by using wire rope and bolt nut was designated as new construction technology no. 682 by Ministry of Land, Infrastructure and Transport, and it changed the concept of construction reinforcement.

The pressing pile can examine the history of existing foundation

automatically differing from existing construction methods, and the reinforcement technology to bind has no worry of delamination, which have permanent effectiveness.

Korea E&C reinforcement science to erect sloping buildings, to increase story height of buildings and to extend areas blocked by bearing walls through scientific method not temporary solutions, which improves asset value of buildings.

Also, it is a specialized and trusty corporate to design even customers' value to relieve through a legend of defect rate 0% after construction.

We will keep doing our best as a leader of reinforcement science to extend building's life and improve construction's value through continuous research and innovation.

Korea E&C Inc. CEO, Doctor of Engineering,
Professional Engineer Construction

Byun Hang Ryong

World Best

Innovative value that Creates Technology

People
Technology
Globalization

Korea E&C has obtained its own technology in existing construction reinforcement field for 17 years. It is a result from setting and keeping a goal of scientific cause analysis and responsible construction. Korea E&C devotes all its energy to find bigger growth opportunity, to improve member's capability to concentrate more on enhancing customer value, and to provide the specialized technology with domestic and international areas and diversify applicable areas.

We will go Korea E&C's way to understand the origin of customer value instead of instant interests and to achieve technology oriented growth.

Human is a key factor of corporate and technology, and corporate' success is determined according to how human's ability is developed and utilized. Korea E&C endeavors to make members demonstrate fully and voluntarily their ability. We secure excellent talented persons, foster them as specialists with the best competitiveness and create new value.

People



Professionalism

All members manage strictly themselves as an engineer, keep learning knowledge related to new technology, and work thoroughly for responsible construction.

Technology-leadership

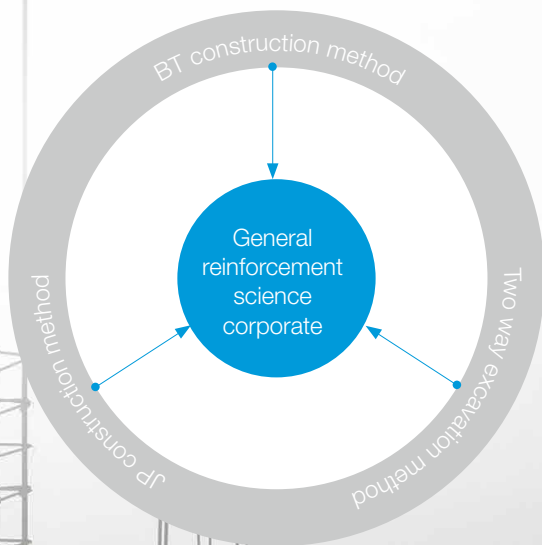
We always keep researching attitude, expect technological change, introduce new technology to domestic and international areas, and lead customers and markets.

Pride

All members say 'No' for the construction request not consistent with engineer's pride, and shall not agree to materials, construction method, or design that is not able to agree no matter what happens.

Technology

The basis of general reinforcement science corporate, Korea E&C, is the foundation reinforcement technology and the column reinforcement technology. Although advanced countries such as Europe have similar technology, they don't have advanced technology as much as Korea E&C's. To achieve leading-edge technological advantage, Korea E&C found a research center and has kept investing research and development expense. It has reinvested most profit in R&D for long time and concentrated on accumulating technical skills. As a result, we obtained seventeen patents and two new construction technologies, and produced 45 research papers, which are excellent performances comparing to domestic good universities and specialized research institutions. Now, Korea E&C technology is becoming a standard of global industries. There are many companies to copy easily the hard accumulated skills. However, Korea E&C's tenacity and passion for technology and know-how from lots of successful construction for long time are Korea E&C's future value that no one is able to copy.



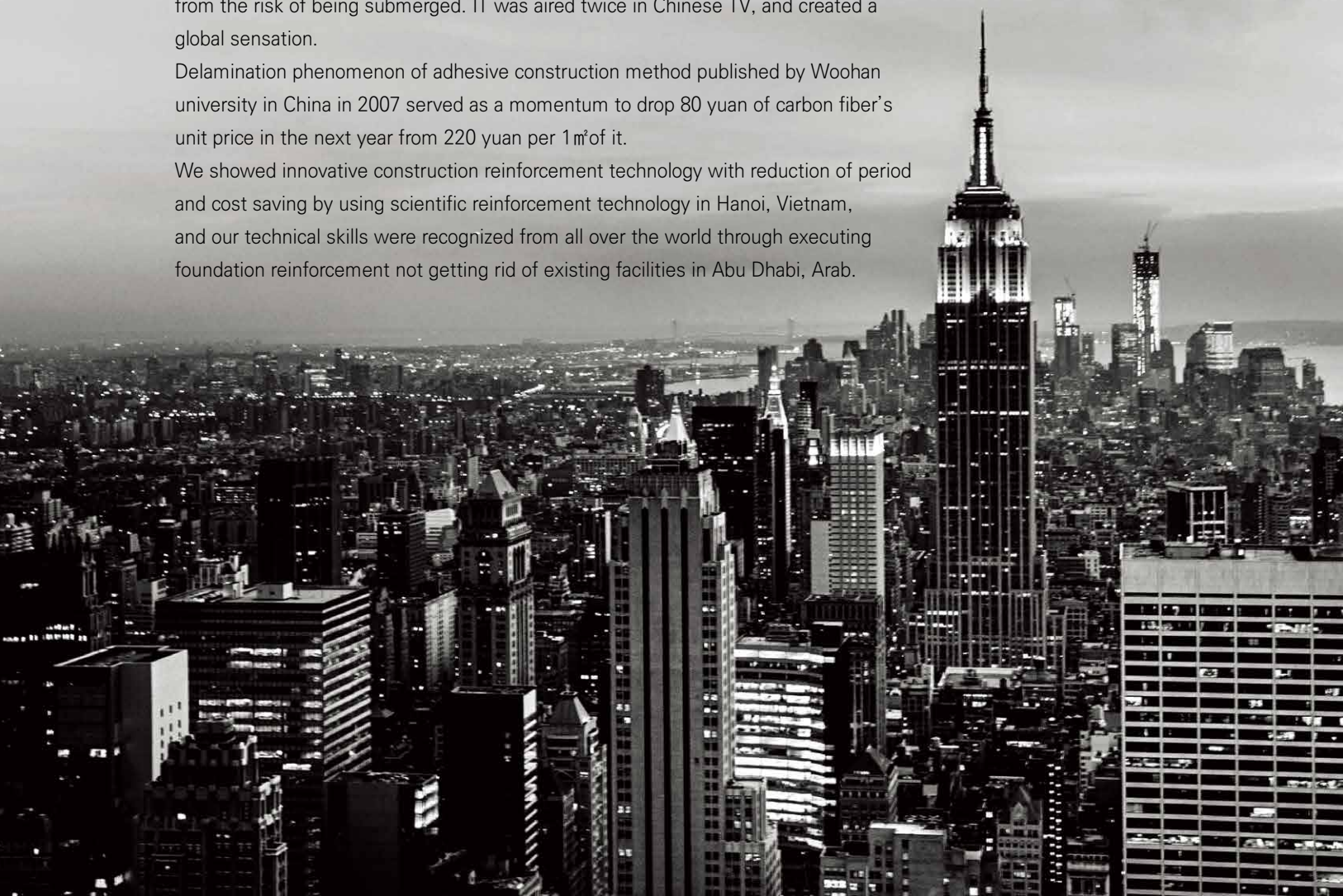


Globalization

Korea E&C has progressed overseas business from starting to enter China in 2008. Korea E&C entered China in 2008, succeeded to lift 1.3m vertically the cultural property, 'Hyunmumyo' in Kwangsi-Chuang, and saved Chinese spirit and culture from the risk of being submerged. IT was aired twice in Chinese TV, and created a global sensation.

Delamination phenomenon of adhesive construction method published by Woohan university in China in 2007 served as a momentum to drop 80 yuan of carbon fiber's unit price in the next year from 220 yuan per 1m² of it.

We showed innovative construction reinforcement technology with reduction of period and cost saving by using scientific reinforcement technology in Hanoi, Vietnam, and our technical skills were recognized from all over the world through executing foundation reinforcement not getting rid of existing facilities in Abu Dhabi, Arab.





Lasting

Durability of Korea E&C reinforcement science is permanent.

The safest method to construct a building on the soft ground is to erect a building on the spot that piles are drilled into the firm ground.

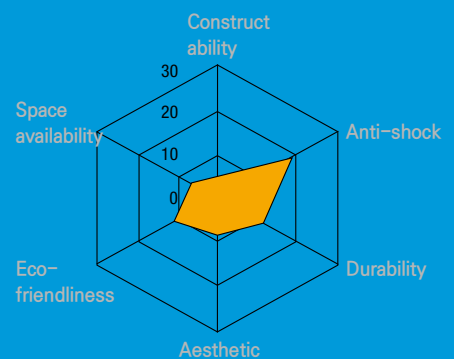
This constructed building is not sloped and destroyed even if underground water level is decreased or the ground is settled.

Korea E&C reinforcement science shows underground condition that is not able to be identified visibly in the process of the construction, and supports fundamentally foundation of a building by using pressed piles into the firm ground through scientific measurement. Korea E&C reinforcement science is permanent because it can resolve fundamental problems of a building.

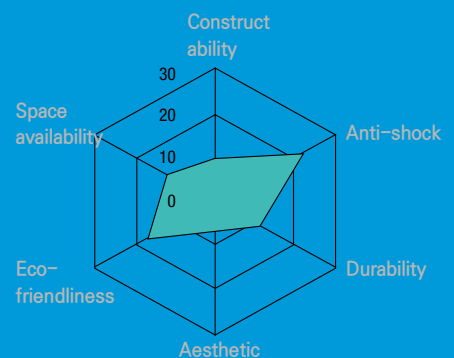
Most existing structure reinforcement technology is to bond fiber or steel sheet by using epoxy.

Fiber or steel sheet with different characteristics bonds the surface of concrete by using epoxy, however, the amount of change of epoxy according to temperature is greatly different from that of concrete, which cause delamination. Also, it is burnt by itself in case of fire, which generated poisonous gas, and it is easily detached by great power like earthquake. However, Korea E&C reinforcement science is different. The effectiveness is permanent even if great power like earthquake is worked because wire rope is bound by tightening as bolt/nut.

Existing cross section extension construction method



Korea E&C column reinforcement





Scientific

Korea E&C reinforcement science is scientific.

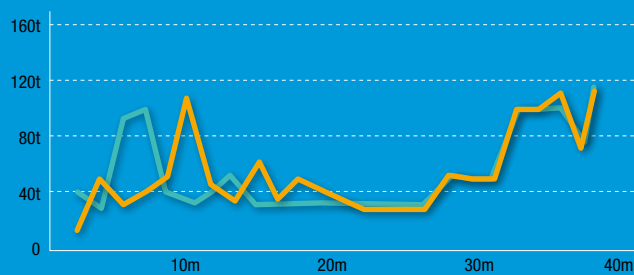
The society has been developed rapidly, and remodeling demands of old buildings have been increased more and more. At this time, rebuilding has been executed frequently by removing existing buildings. Korea E&C reinforcement science is different.

We provide total solution that meets customer's various demands such as parking lot underground extension, ground extension, story height extension, column removal, underground connection by using existing buildings.

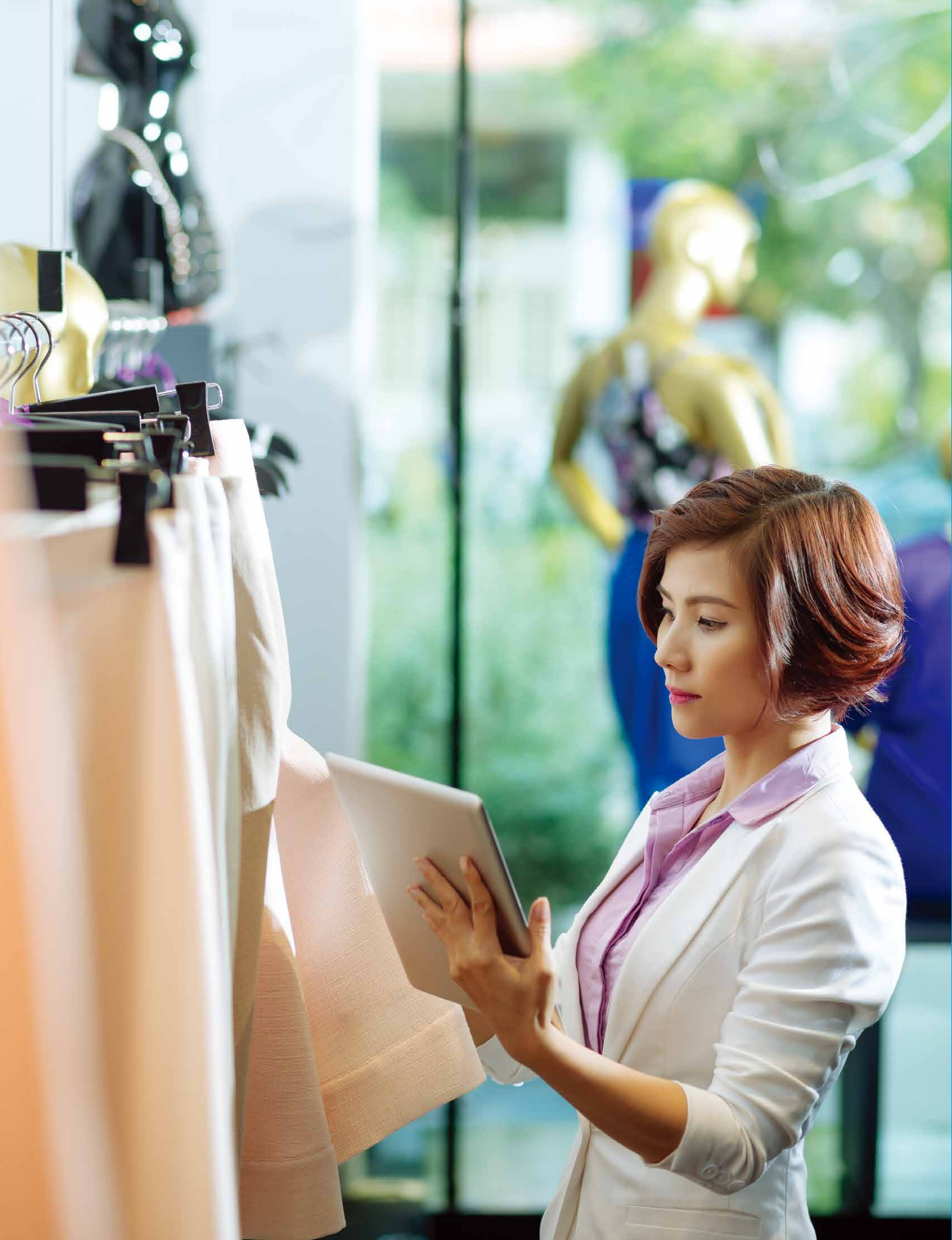
The weight of existing structure is utilized as reaction not drilling and strike by hammer the ground, and piles are measured and pressed by using pressure device and hydraulic jack. At this time, the history of all piles according to pressure load is shown at hydraulic gauge in real time, and it is a scientific technology to examine automatically the history of existing foundation.

Pressure shown at hydraulic gauge measures the ground condition that is not able to be identified visibly as N value. The value is increased more if pile load test is performed.

Pressing is progressed as two stages that individually pressed piles are pressed simultaneously by design load (or weight) after individual press stage to be measured as two times or three times of design load. Korea E&C reinforcement science is a scientific and systematic construction method like that, and minimized a partial disposition moment by close construction up to 100mm of existing wall.



Load Distribution by Depth (Pohang Project Site 2015)



Economical

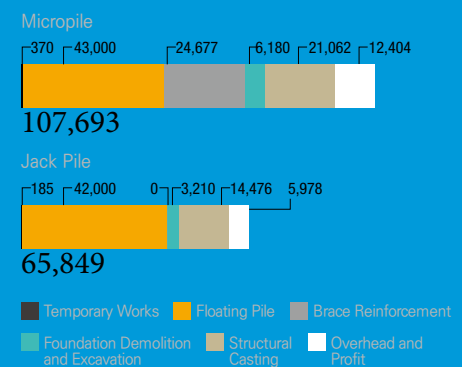
Korea E&C reinforcement science is economical.

Remodeling method to dismantle or remove buildings causes serious noise and vibration, therefore, it is essential that residents should move during construction period. Korea E&C reinforcement science is different.

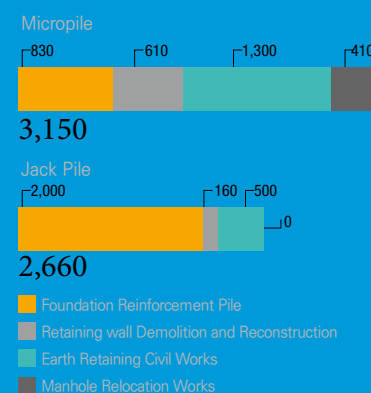
Korea E&C reinforcement science that utilizes existing structure doesn't cause much vibration and noise due to no excavation, and it is possible to work without residents' move. There is hardly economical loss such as business loss by removal, moving expense, lots of waste disposal expense, etc. and time expense can be considered due to short construction period.

Above all, ultimate advantage of remodeling is asset value improvement of the building through extension. It is possible to extend from one basement level to two basement levels, or from five stories on ground to fourteen stories, and extend story height, or remove column as keeping business according to condition of a building. From this, profitability is increased by improving availability of the building.

Elev. Basement Extension(Unit : Thousand KRW)



Foundation Reinforcement(Unit : Thousand KRW)





ECO-Friendly

Korea E&C reinforcement science is eco-friendly

Korea E&C reinforcement science that measure and press without underground excavation of foundation substructure of existing building is an eco-friendly method that doesn't cause vibration, noise and dust. There is hardly environmental waste such as sludge, earth, etc. from excavation construction as well as construction waste because existing column or beam is used. Also, hazardous environment materials like epoxy which generates poisonous gas are not used at all, which keeps residents' healthy after construction. Cement grouting ground reinforcement that has been commonly used all over the world may cause secondary environmental problems. It is a method to insert cement liquid into and reinforce the settled ground, which may harm environment of near location like trees wither because inserted cement liquid flows into adjacent site or drain pipe. Korea E&C reinforcement science is different.

We don't harm environmental value for next generation to improve current value of the building and seek methods that people, environment and building coexist healthily.



Waste Reduction Cost

BT Reinforcement Method
Compared to the Cross-Section
Enlargement Method

65% ↓

Compared to the Steel Plate
Strengthening Method

39% ↓



CO₂ Emissions

Compared to the Cross-Section
Adhesive Reinforcement Method

75% ↓

Compared to the Steel Plate
Adhesive Reinforcement Method

86% ↓



technology

OVERVIEW

Korea E&C has developed new technologies of various models based on reinforcement science. We will achieve cost saving and construction quality by imposing the strictest standard and responsibility at all stages, and create technologies to minimize effects on the environment.

From this, we will enhance customers' asset value, keep their living and life, and establish a foothold as a global general reinforcement science corporate to create customer's future value.

Foundation reinforcement

Jack Pile Technology

JP(Jack Pile) utilizes the weight of structure as reaction not drilling into the ground or striking it by hammer, and measure and press piles by using pressure device and hydraulic jack.

The pressing is performed as two stages such as individual pressing and simultaneous pressure. The piles are measured and pressed individually with two times (or three times) of design load, and individually pressed pile is pressurized simultaneously with design load (or weight). The pressed piles are installed in the pressing device and support definitely the foundation.

JP1

Remodeling for extension

JP2

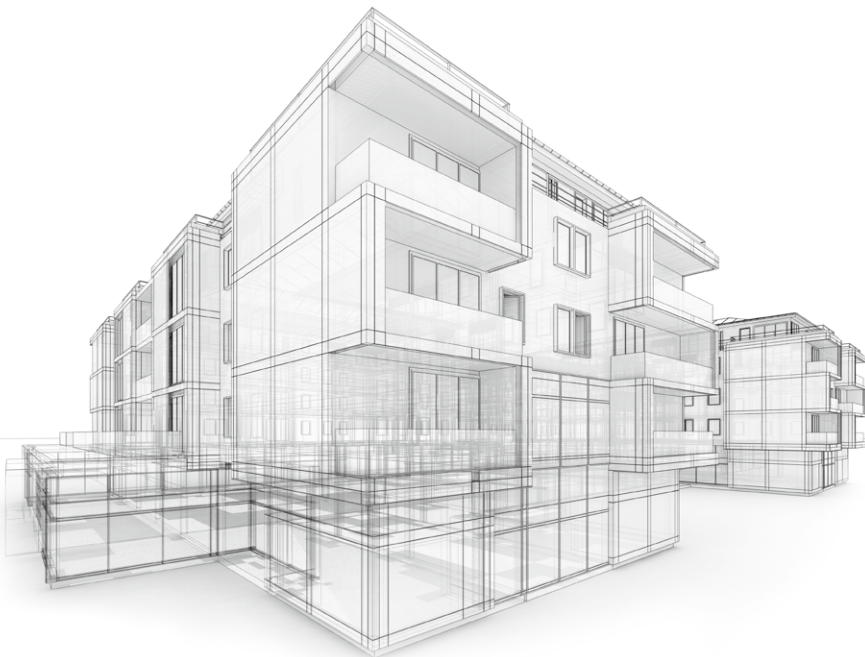
Differential settlement reconstruction

JP3

Structure raise
· story height extension

JP4

Horizontal movement · rotation



Korea E&C reinforcement science effectiveness comparing to existing methods.

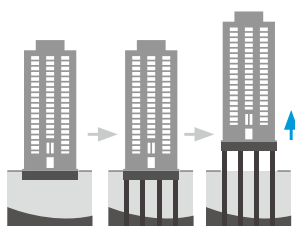
Existing foundation reinforcement construction method

- Noise, vibration, or waste is generated when drilling.
- There are some cases to be settled sequentially when the soft ground is subsided
- It can increase the weight of a building.
- There are piles which are not forms that support the foundation.
- It is difficult to work in narrow area.
- There is no concept of simultaneous pressure.
- It is possible to subside during reinforcement.

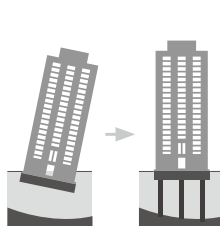
VS

Korea E&C Jack Pile construction method

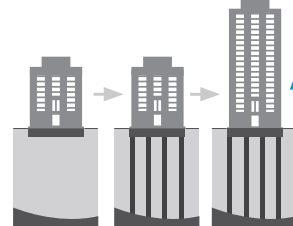
- There are no excavation wastes by pressing not drilling.
- There is no vibration, noise, or dust by pressing as hydraulic jack.
- It is possible to work while residents live in there.
- It is possible to work in narrow area without getting rid of wall, pipe, or equipment.
- Condition of the ground can be measured as N value.
- History of piles is examined automatically.
- History of existing foundation is examined automatically.
- It is possible to work in narrow area less than 1m.
- It is possible to construct closely 0.1m on the wall.
- Piles with various standards are used.
- It is possible to construct horizontal batter piles as well as vertical.



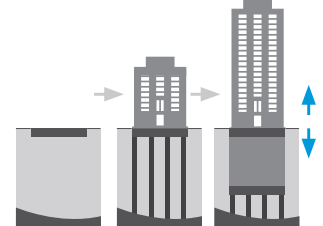
Structure raise and extension



Differential settlement reconstruction



Ground extension

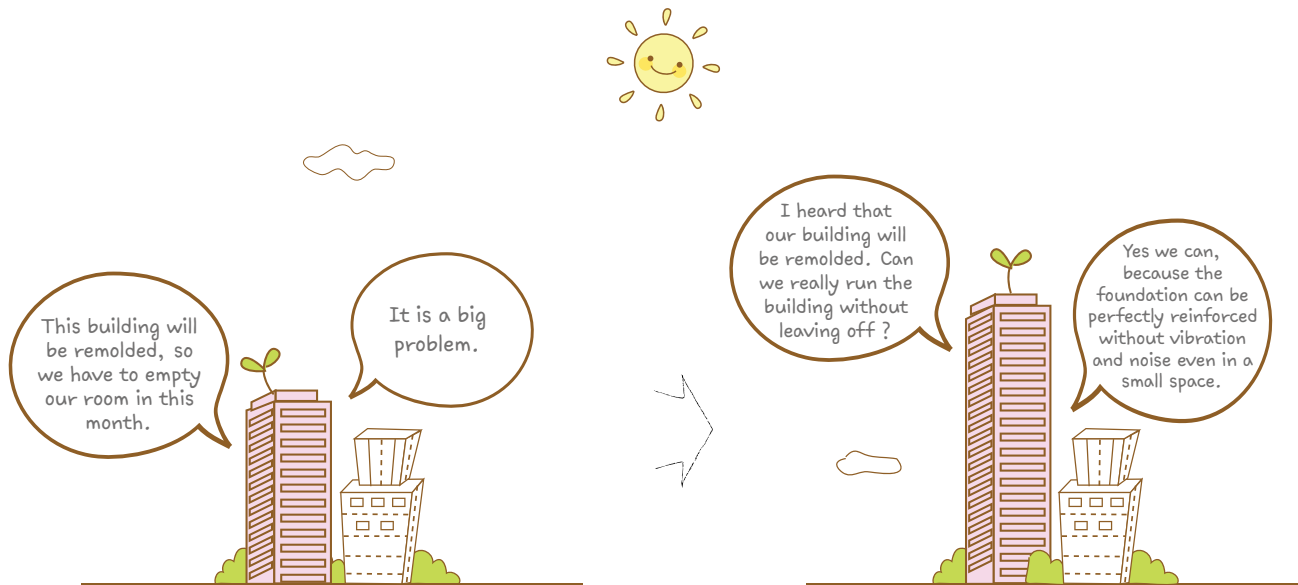
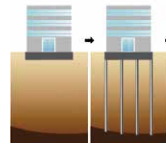


Underground extension

Above Ground Extension

It is the technology which extends an existing building upward from the rooftop after reinforcing the foundation and other structures using Jack Pile without occupants leaving the building.

(New Excellent Technology certification No.629, Foundation Reinforcement)



Possible with KOREA E&C !!



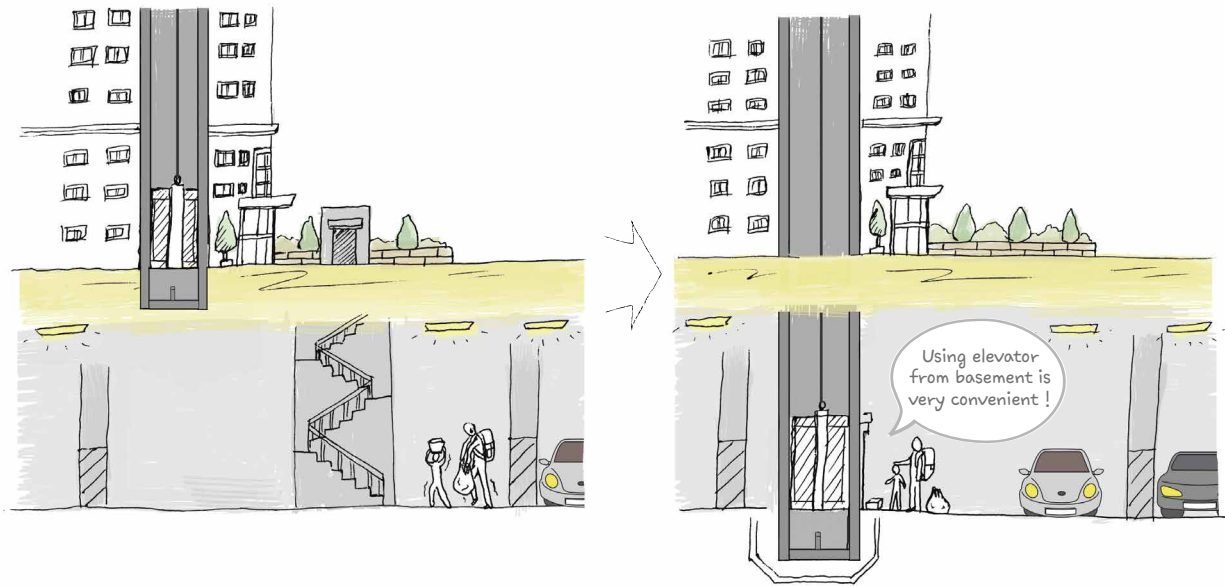
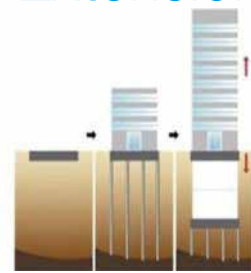
Reinforced the foundation of the existing building with 10 stories and extended vertically to building with 15 stories.(2010, Seoul)

Underground Extension / Elevator Pit Extension

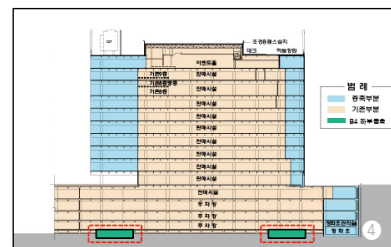
When the building gets underground extension, a thin pile like micropile often ends up being excavated unless it is reinforced by additional bracing process.

However, Jack Pile can excavate underground 5m without reinforcing bracing and form a safely floating structure with smaller load.

(New Excellent Technology certification No.629, Foundation Reinforcement)



With KOREA E&C, it changes !!

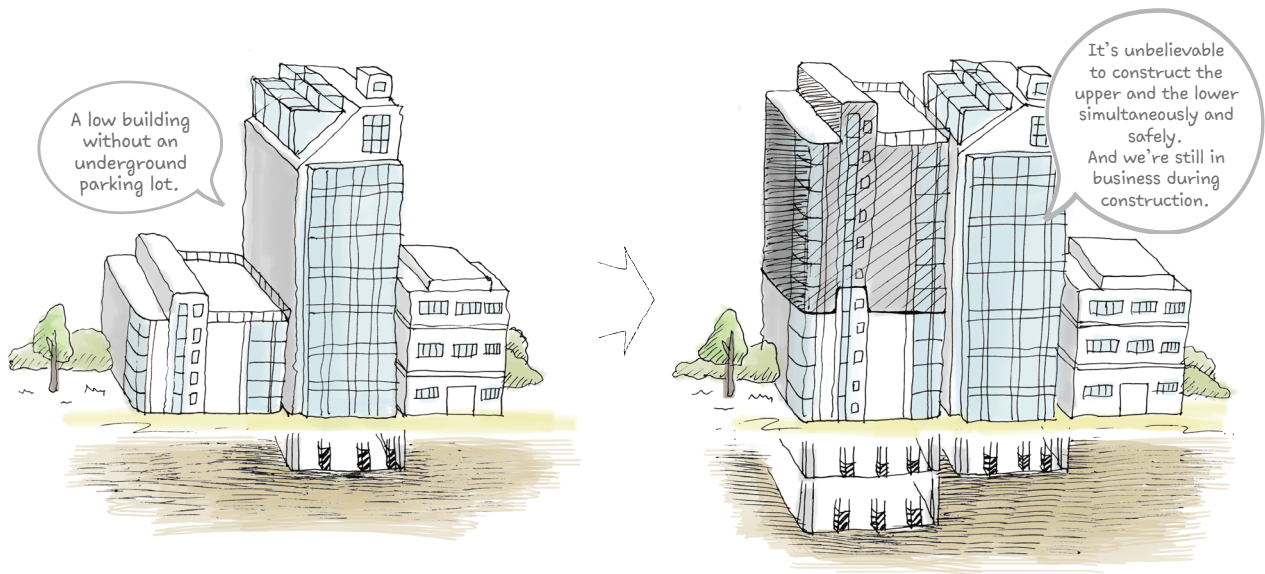
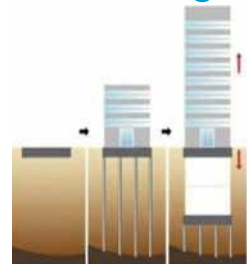


- ① excavated state under the B4 floor.
- ② steel-pipe nail earth retaining wall
- ③ 160 tons pressurization pile is pressed
- ④ elevator pit underground extension

Extension of underground & above ground buildings

This is a technology that constructs both underground parking lot and above ground building, and then extends the two parts at the same time after marking a low structure that does not have underground parking lot into floating structure using Jack Pile.

(New Excellent Technology certification No.629, Foundation Reinforcement
/ New Excellent Technology certification No.682, Structure Reinforcement)



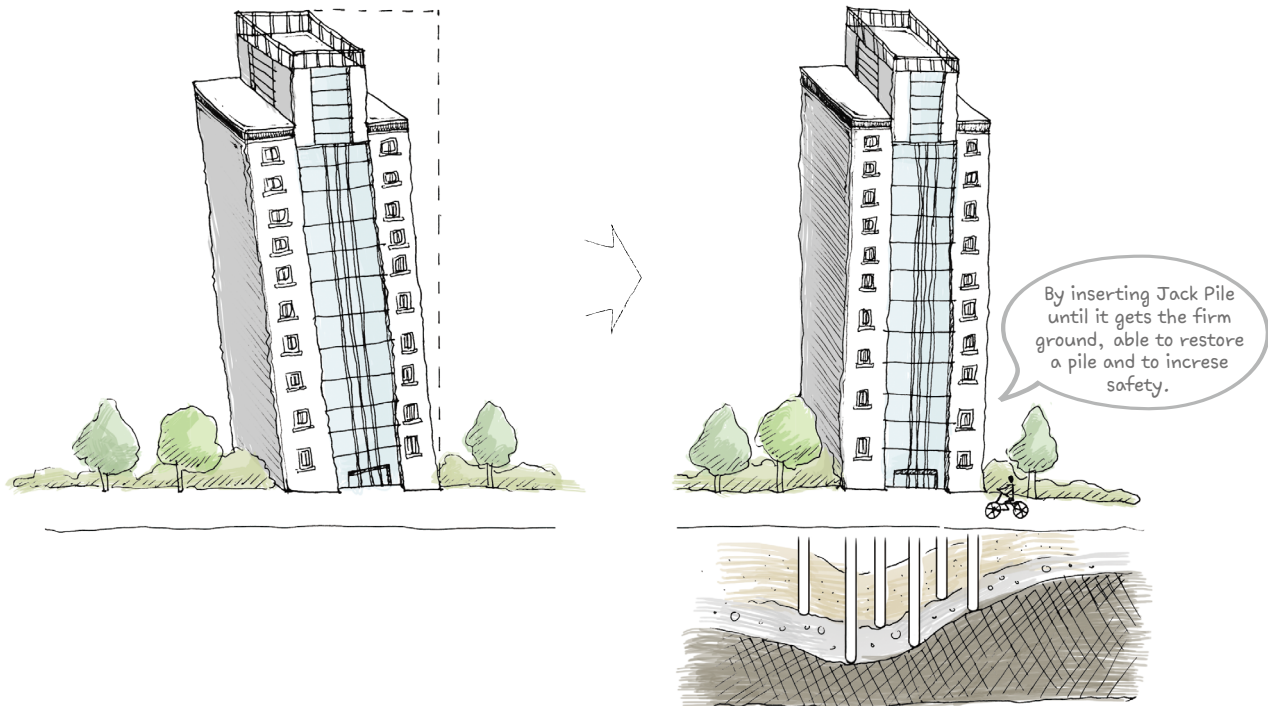
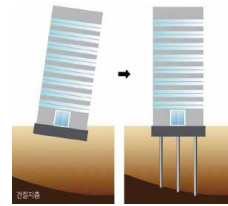
With KOREA E&C, it changes !!



Extended the existing hospital building which had one-story underground and five above the ground into two-story below and fourteen above the ground

Disparity Settlement Restoration

After a building construction is completed, if a structure gets tilted(disparity settlement), the usability and the safety is significantly damaged. Korea E&C can restore a building which is a subject to be demolished by relevant regulation (grade E) to a best structural state (grade A) using Jack Pile. (New Excellent Technology certification No.629, Foundation Reinforcement)



Happiness follows with Korea E&C !!



Before/ ϕ 400PHC construction grade E disparity settlement → After/ Jack Pile press reinforcement grade A restored.

※ The case in the picture above was successfully completed on the boulder store layers which had been unable to be penetrated by concrete pile driving equipment.

Structure reinforcement

Bolt Tension Technology

BT(Bolt Tension) is a reinforcement construction method to improve internal force and seismic performance of ferroconcrete structure columns. It is a method to install T-shape steel sheet (or steel bar) vertically outside of the existing column, and to bind horizontally by prestressing as wire rope connected to eyebolt. At this time, T-shape steel sheet prevents concrete binding and buckling of major steel bar, and delivers load through appropriate settlement. The wire role with characteristics such as high strength and high flexibility with applying prestress makes T-shape steel sheet no-adhesive fix, and it reinforces seismic performance by binding concrete and improving column ductility at the same time. The binding is able to be controlled accurately by torque method through tightening nut. Developed BT and JP technology can form large area by getting rid of column or bearing wall.

BT1
column
reinforcement

BT2
slab
reinforcement

BT3
beam shearing
reinforcement

BT4
column
removal



Korea E&C reinforcement science effectiveness comparing to existing methods.

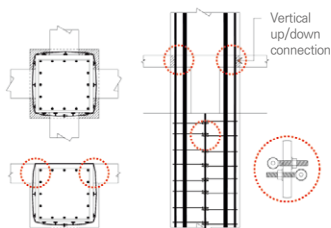
Existing foundation reinforcement construction method

- It can be separated by itself despite chipping or adhesion of the existing column surface.
- The adhesion method using epoxy can make epoxy delaminate by itself.
- Top and bottom floors are not connected because fiber or steel sheet is cut at a slab.
- It is necessary to add fireproofing protection to fiber or steel sheet.
- Column connected to wall can be performed reinforcement work after cutting the wall.
- Adhesive reinforcement part may be separated if earthquake (large loading application) happens.
- In concrete extension, a cross section of column is increased.
- Vertical crack with hoop gapping from H synthetic column, etc. may be generated.

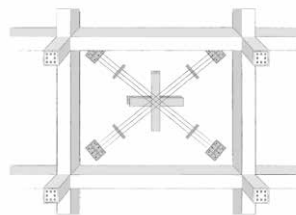
VS

Korea E&C Bolt Tension construction method

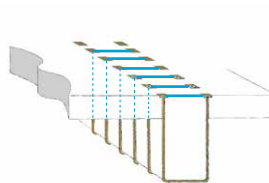
- Reinforcement material is not separated without chipping the surface.
- Reinforcement part is not separated if earthquake (large loading application) happens.
- Top and bottom floors are not separated but connected as vertical reinforcement material penetrates a slab.
- Additional fireproofing protection does not need due to mortar (concrete) cross section extension.
- Even if columns are connected to wall, reinforcement work can be performed without cutting the existing wall.
- Vertical crack without hoop gapping from H synthetic column, etc. is not generated.
- After reinforcement, a cross section of column is not greatly increased.
- Reinforce work can be easily performed for retaining wall of wall type apartment by using column.



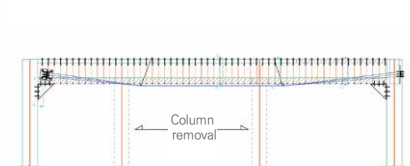
Column reinforcement



Slab reinforcement



Beam shearing reinforcement

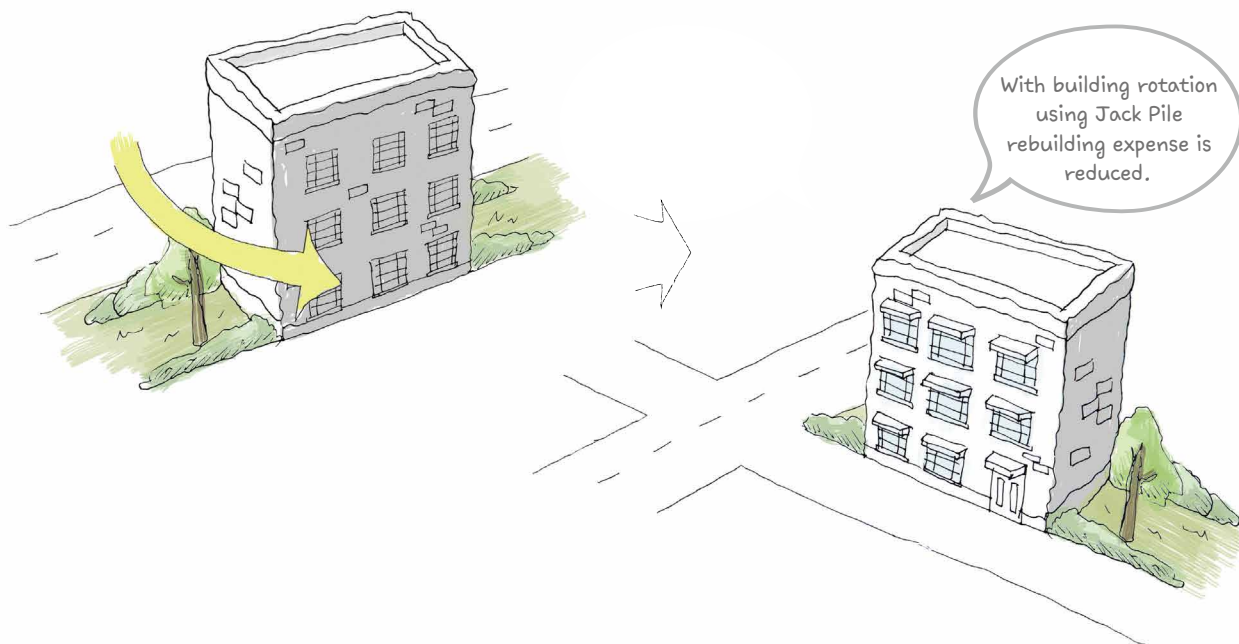
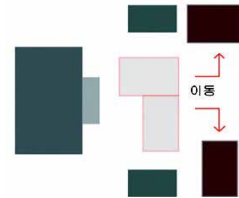


Column removal

Parallel Movement / Rotation

Movement and rotation goes through raising–lifting–moving–lowering process after cutting underground structures such as a foundation, pillar, retaining wall, etc in the state that an existing structure is slightly lifted using Jack Pile. After moving, a pillar is settled in the foundation of a press pile.

(New Excellent Technology certification No.629, Foundation Reinforcement)



The impossible becomes possible with KOREA E&C



↑ Moving a measurement error PC box



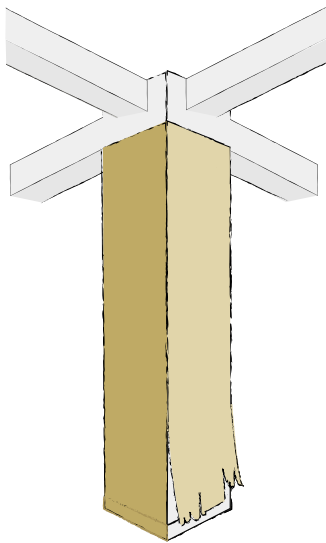
Moving/Rotating Fujian Xiaman in China ⇨



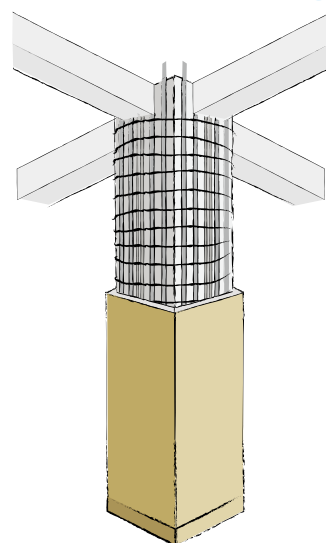
Column Reinforcement

The technology of Korea E&C does not require the process of surfaces chipping and anchor drilling of the current technology. The earthquake resistance capacity and axial force get improved and a column connected with wall is also reinforced easily without cutting, by installing T-shape section steel or reinforcing steel bar on the outside of existing column which is penetrated through slabs of the upper/lower floor and by pre-stressing an eye-bolt connected with a wire-ropes. Also, when this method is applied, a vertical crack caused by tie hoop relaxation which occurs frequently in the H-beam composite column or existing increased section column is perfectly controlled and even buckling of a vertical reinforcing steel is also controlled with this technology, because a vertical reinforcing steel is strongly confined.

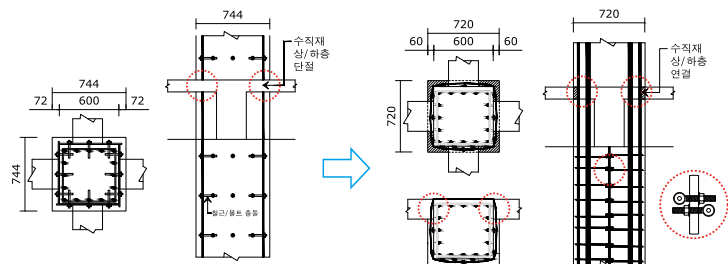
Current construction technology



Bolt Tension technology



Safe with KOREA E&C



Details of Steel plate Column reinforcement with epoxy bonded

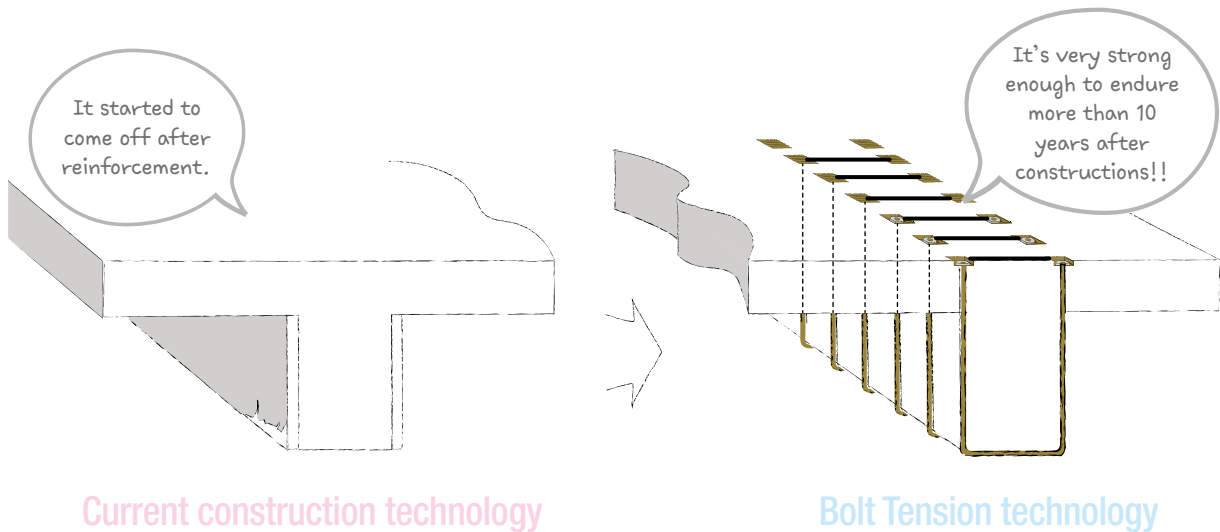
Details of Bolt Tension column reinforcement without bonded

Real image of reinforcing a column using the BT technology

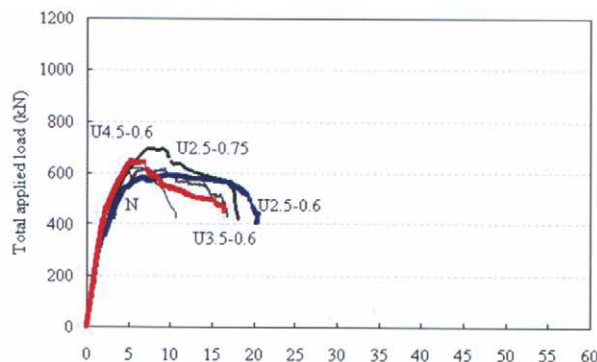
- ① When the increased section is not required(Real image of reinforcing earthquake resistance of a column using T-plate + wire)
- ② When the increased section is required(Real image of reinforcing earthquake resistance of a column using a reinforcing steel bar and wire)

Beam Shear Reinforcement

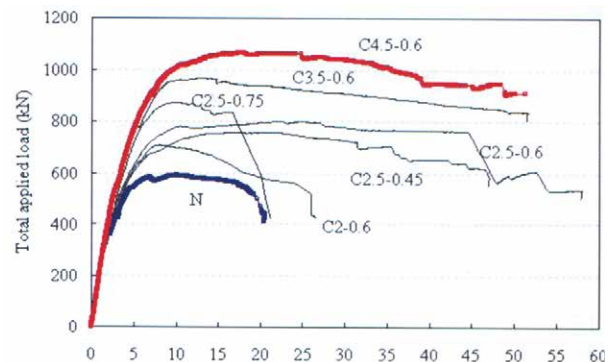
The existing reinforcement method which reinforces a carbon fiber or steel plate on the beam side of T-shape beam with epoxy resin or a bolt turned out to have almost no effect regardless of the state whether a reinforcing material is come off or not. The reason for the discovery is wxplained with the location that neutral axis is in, the inner part of the T-shape beam, is to reinforce the shear reinforcing steel by upper part of the neutral axis and shut it down as much as possible, to make sheer reinforcement effect work.



Confident with KOREA E&C !!



↑ The shear reinforcement effect of settle-on-the-side-of-beam(U type) T-shape beam (Brittle Failure)

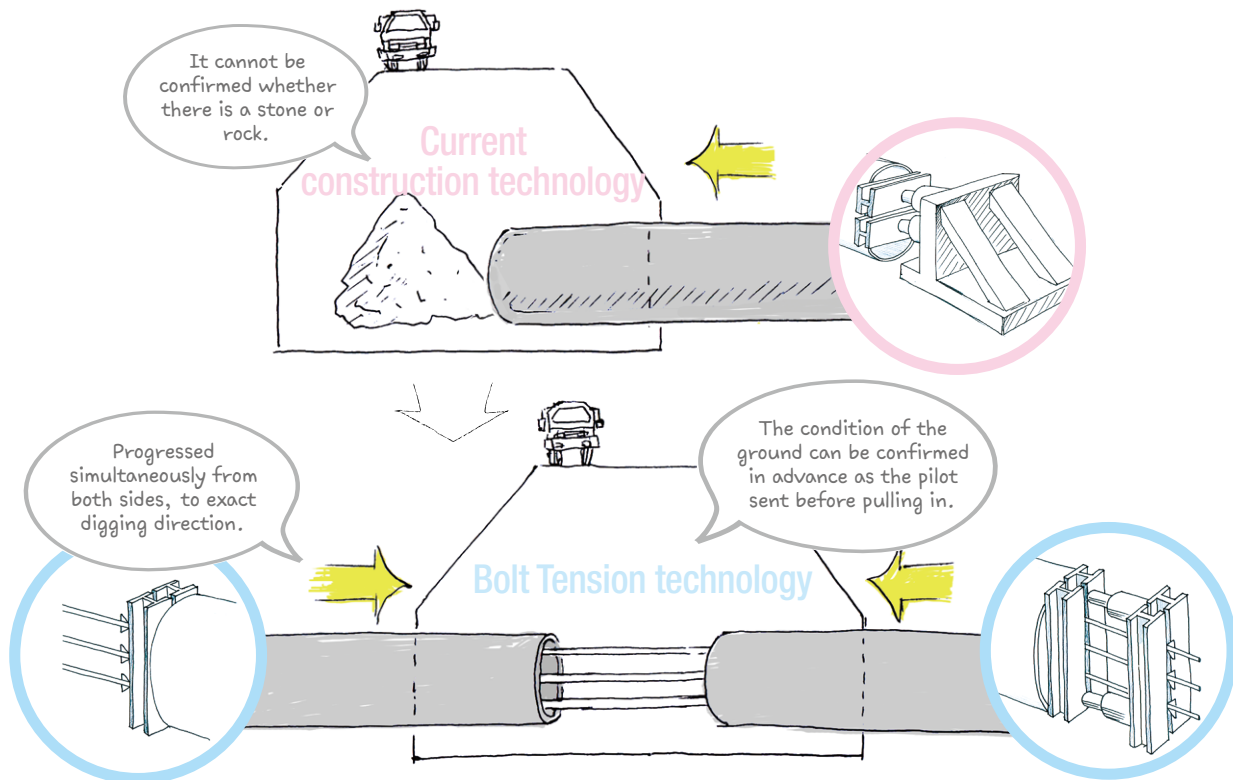


↑ The shear reinforcement effect of beam close-type-settlement (Closed type) T-shape beam (Ductile Failure)

※ As the result of testing with the T-shape beam identical with the actual field condition, the settle-on-the-side-of-beam method has almost no shear reinforcement effect.

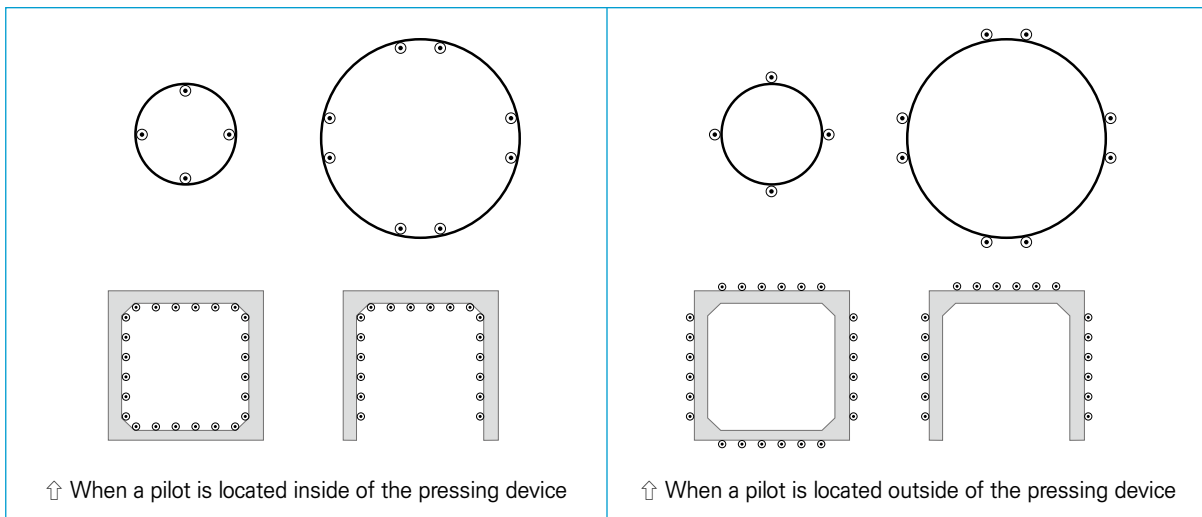
Two-way Digging Construction Method

through most of current technologies follow the process of installing a huge brace and pushing it, Korea E&C has upgraded technology which are able to pull from both sides without a brace so that construction ability, and economic feasibility can be significantly improved.



The technology of E&C is economic and reasonable !!

For a steel pipe (above) and concrete box (below), the number of pilots increases according to the frictional resistance condition.



Two-way excavation method

Forced Pressure of Both Direction Technology

The existing excavation method is to place first a huge concrete retaining wall strut which should be removed after excavation and then to push by using the strut. Naturally, standard of member of framework becomes large and the direction goes wrong in the process of pushing. However, two-way excavation technology needs no concrete retaining wall strut because of pulling at both sides, the standard becomes small because the power is reduced in half than pushing at one side, and it has excellent construct ability and economic effects by inspecting the direction in advance. At first, a pilot for inducement is constructed, and a steel pipe for excavation is pulled at both sides, then the material for inducement is removed after excavation.

Korea E&C reinforcement science effectiveness comparing to existing methods.

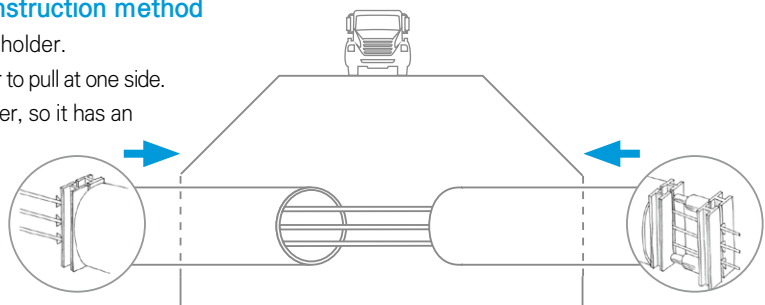
Existing excavation method

- It is necessary to secure a space to install holder.
- It is removed after installing holder.
- Great power is needed because of pushing at one side.
- Member of framework is used as compression member during excavation because of pushing at one side.
- The stratum is not identified in advance, and the direction may go wrong.
- Construction cost and period are increased more than two-way excavation method.

VS

Korea E&C Forced Pressure of Both Direction construction method

- It is not necessary to install and remove a space for the holder.
- The power to pull at both sides is enough in half of the power to pull at one side.
- Member of framework during excavation is tension member, so it has an advantage over compression member.
- The stratum and the direction are identified in advance through pilotdrilling.
- Construction cost and period are saved more than two-way excavation method.



Cast-and-Lower Method for Underground Structures

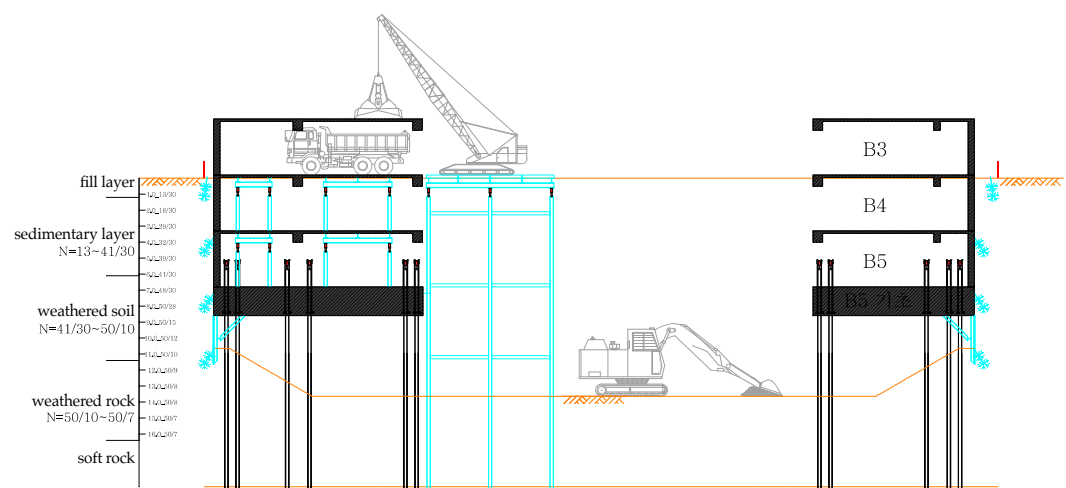
Made Down(MD)

Above-Ground Cast and Lowering Method Using Jack Piles and Guide Walls for Underground Structures.

MD Effect

- Improved concrete quality through joint-free construction enabled by struts.
- Maximizing underground space with a low-carbon, eco-friendly, temporary-structure-free method.
- It is possible to waterproof the exterior walls of the basement.
- Existing underground structures can be demolished and new ones constructed at the same time.
- Stabilized excavation, over break filling, and cutoff measures are implemented inside the guide wall.
- It can be applied to all soil and ground conditions, from soft ground to rock.
- The method enables efficient underground excavation in sites with uneven earth pressure conditions.

Compared to conventional(CIP+Strut, Slurry wall+Strut), this method offers Improved quality ↑ , Shorter construction period ↓ , Cost reduction ↓ , more efficient land utilization ↑ , fewer civil complaints ↓ , eco friendliness ↑







Business

OVERVIEW

General reinforcement science corporate, Korea E&C's technological leadership and specialization are recognized from overseas beyond the domestic country based on continuous technology development, innovation, and investment in talented persons. Eco-friendly and safe reinforcement science through the cutting edge of technology enhances a building's value. We do our best for all customers to enjoy happy life in more attractive, comfortable and eco-friendly space.

Hyundai department store, Trade center branch

Department store operation was performed as usual, and the foundation substructure of the 4th basement level was excavated. The elevator space was extended under the ground, and vertical extension was completed from the 1st floor on the ground to the 10th floor. Column weight of 800ton was used to the foundation reinforcement inside of the 4th basement level, and the foundation reinforcement was performed to the elevator space, then underground extension was completed.



Before construction

Location Samsung-dong, Gangnam-gu, Seoul

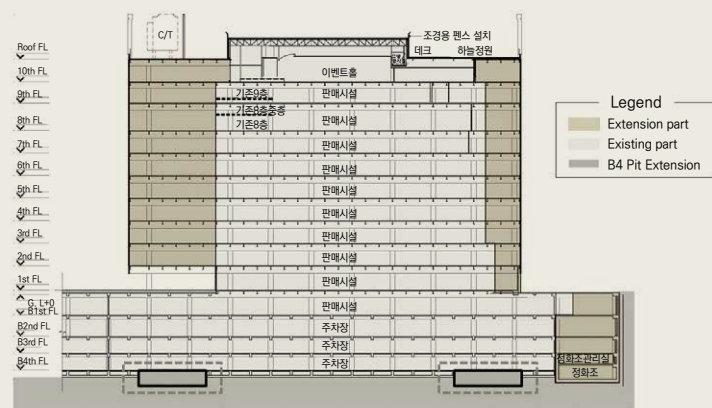
Period 2010~2011(It took one year.)

Extension **Underground extension** – three core areas in substructure of the B4 level.

Vertical extension – Extension from the 1st floor on the ground to the 10th floor by using the foundation reinforcement.

Applied construction method

Underground extension.





After construction

Good culture hospital

Hospital operation was performed as usual without closing it, and remodeling, vertical extension, was completed from the 1st basement level to the 2th basement level, and from the 5th on the ground to the 14th. Reinforcement piles were used to support the existing hospital building and extended the basement, then vertical extension of nine stories was completed safely by reinforcing columns.

Location Beomil-dong, Dong-gu, Busan

Period 2013. 05 ~ 2015. 06
(It took 26 months.)

Extension B1→B2, the 5th floor on the ground → the 14th floor, extension of one level of the basement, and nine stories on ground

Applied construction method

Underground extension-reinforcement pile support, ground extension-column reinforcement



Before construction



Application of no-adhesive binding column reinforcement construction method without using epoxy adhesion.

It was constructed safely in narrow area by underground excavation (Top Down) after placing the 1st floor bottom.



After construction

Seocho-dong building

The operation was performed as usual without residents' move, and vertical extension from the 10th floor to the 16th was completed. The foundation reinforcement of 600 ton column was resolved without underground excavation in narrow area less than 1 m to an adjacent building.

Location Seocho-dong, Seocho-gu, Seoul

Period 2010. 05 ~ 07 (It took 3 months.)

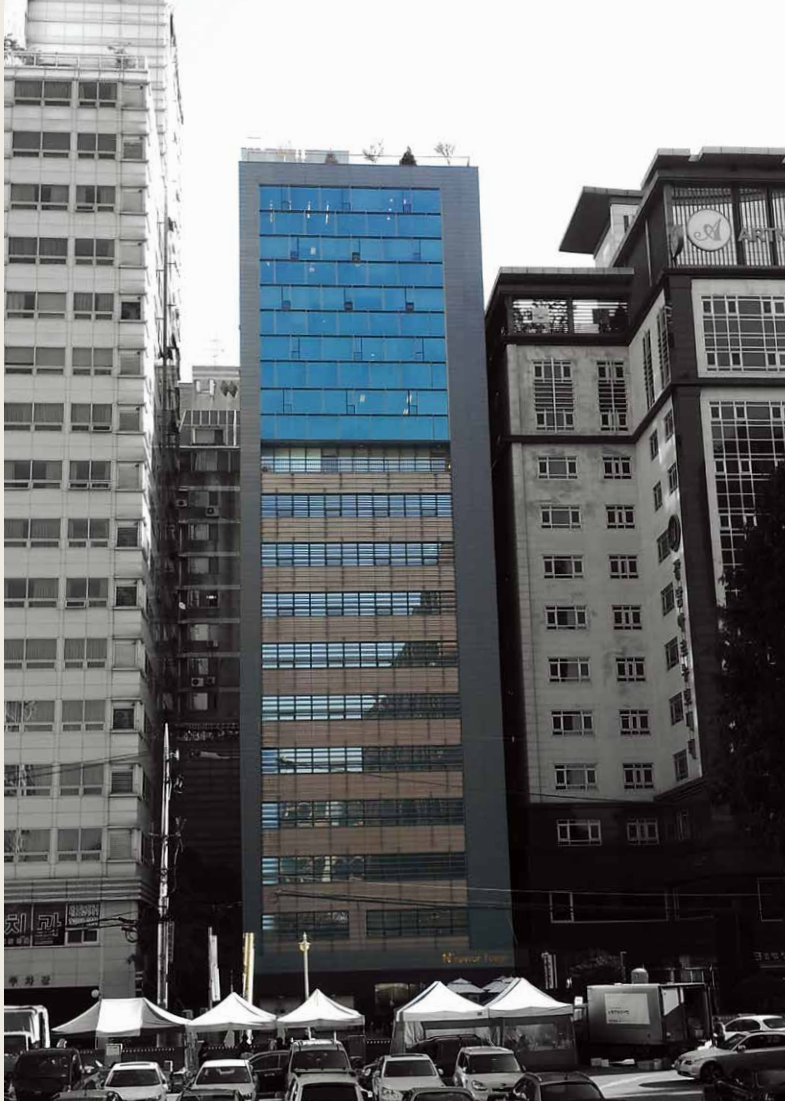
Extension Vertical extension from the 10th floor to the 16th. Six levels extension.

Applied construction method

Foundation reinforcement

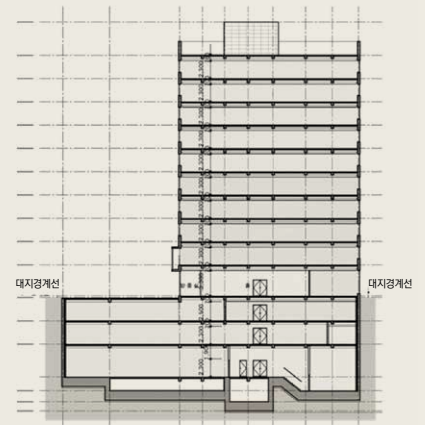


Before construction

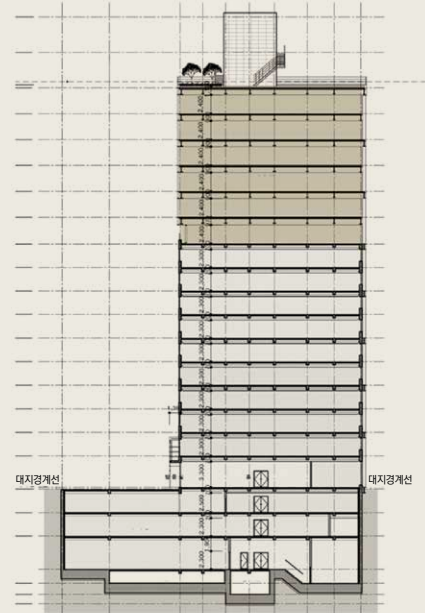


After construction

Before construction



After construction



Seocho-dong building

It is a case to extend story height for a building located in the center of town without residents' move and removal. The columns were cut by applying structure raise technology and not removing auditorium with area 20m×30m and story height 5m, and then it was remodeled as a patium wedding hall with 8m story height. The construction period and cost were reduced, civil complaints were solved, and the value of the building was increased drastically.

Location Nonhyeon-dong, Gangnam-gu, Seoul
Period 2014. 01 ~ 02 (It took 2 months.)
Extension Extension of story height 5m → story height 8m (Extension of story height of 3m)
Applied construction method
Structure raise



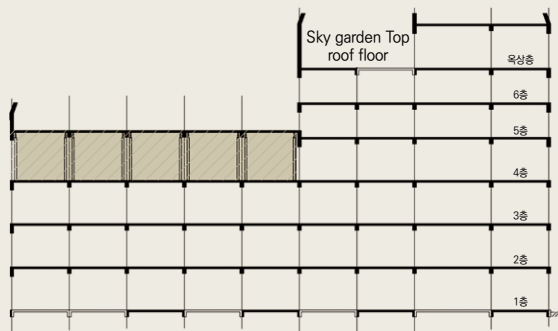
Before construction



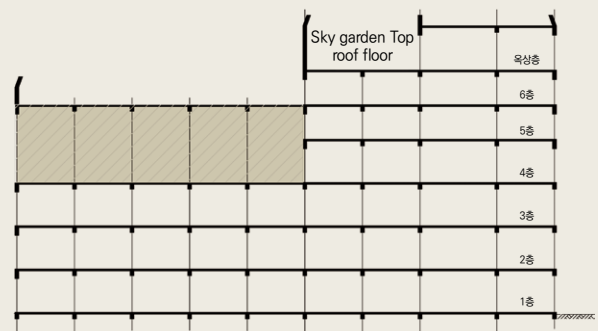
After construction



After remodeling



Cross section before lifting



Cross section after lifting

Pisa apartment in Incheon

The apartment with eight levels was completed in April, 2003, and the building started to slant before the completion. When the building slanted, the ground reinforcement by inserting cement at the bottom of the sloping part was repeated. However, there was no effect although the inserted cement flowed to the next house and the building slanted more and more. The slope was 1/46 before lifting it up by reinforcing piles in 2013. The slope was more serious level than standard E level which orders removal (standard 1/150) to stop using a building. Solid ground was 10m below, and it was estimated that the inserted cement into the soft ground between them brought about a result to increase the weight of the building not reinforce the ground. As a result of computer structure analysis, it was calculated as the bottom area was 2,570 m², and the weight of the building with eight levels was about 2,500 ton. Fifty five steel piles were divided by each 110 ton, which were measured and reinforced, then secured support ability of 6,000 ton. It was reconstructed as a safe building with slope 1/900, A level (standard 1/750).

Location Sungui-dong, Nam-gu, Incheon
Period 2013. 04 ~ 05(it took 2 months.)
Applied construction method
Foundation reinforcement



Before construction



After construction

Slope and level before and after construction

Before reconstruction	
Slope	Level
1/49(left)	E
1/46(right)	E
After reconstruction	
Slope	Level
1/960	A
1/960	A

Sunsa gas station

The construction was performed in 0.5m narrow area that it was practically impossible to perform equipment work. It is an underground extension case with total 6m bearing wall as the existing retaining wall was extended to 3m under the ground in very difficult condition with pilaster strip.

Location Amsa-dong, Gangdong-gu, Seoul
Period 2015. 06 ~ 2015. 08
(It took 2 months.)
Applied construction method
Foundation reinforcement



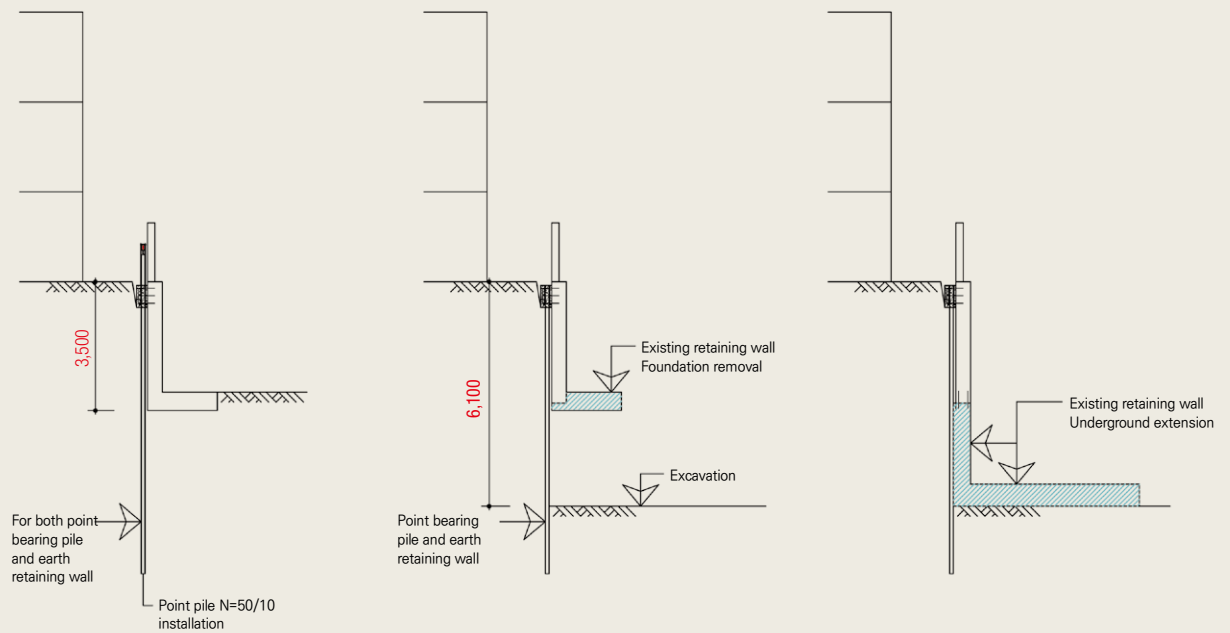
Before construction



Existing retaining wall



Concept and procedure chart of Sunsa gas station existing retaining wall underground extension



Under construction



Pressing piles for point bearing and retaining wall in 0.5m area that it was impossible to access equipment.

After construction



Hannam mansion

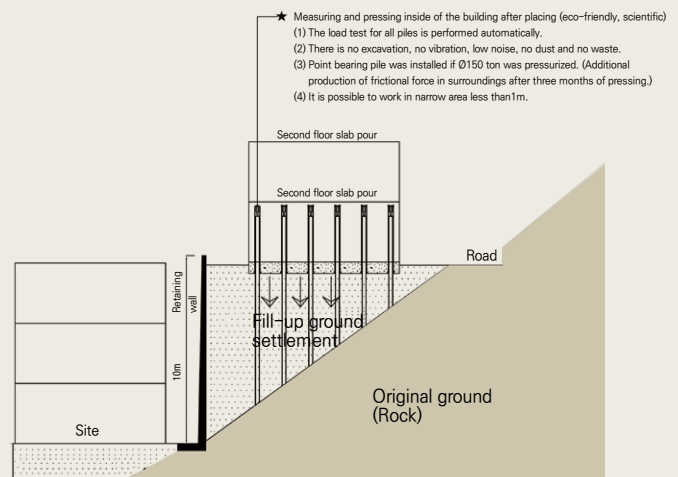
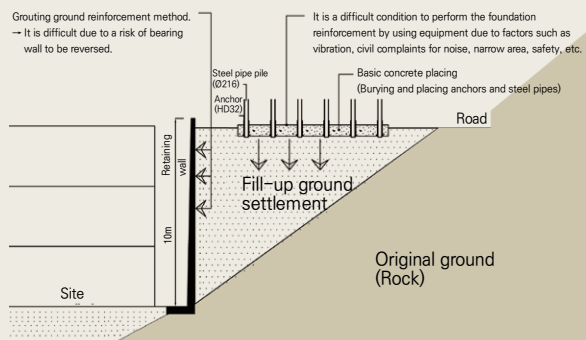
The site of Hannam mansion constructed by high three retaining walls had a fill-up ground with a slope, which has a great possibility to generate settlement. The ground reinforcement method to insert cement into a fill-up ground may cause accidents by pressurizing the bearing wall. It was difficult for the site to apply pile equipment work due to civil complaints such as noise, dust, etc. The site was resolved as the foundation was placed by burying anchors and steel pipe piles, and the piles were pressed during frame construction. This method is very effective to the foundation reinforcement in horizontal extension area which the equipment is inaccessible.



New construction underway on a sloped embankment

Location Hannam-dong, Yongsan-gu, Seoul
Period 2014. 07 ~ 2015. 02 (It took 1 month.)
Applied construction method
 Foundation reinforcement

Construction procedure chart after piling

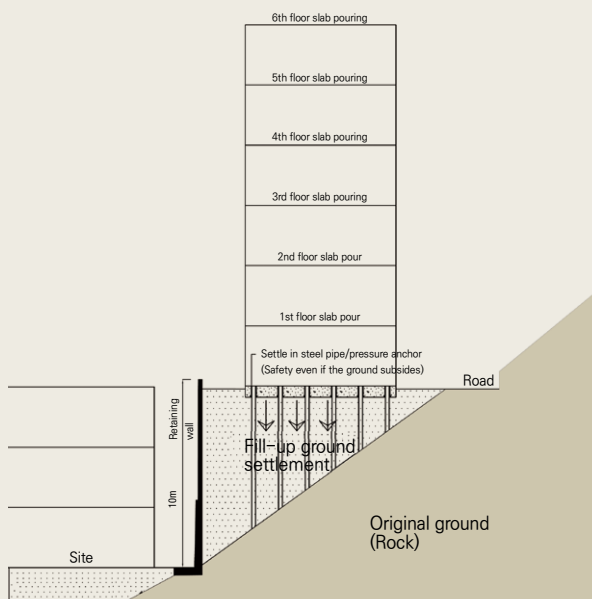




Measuring and individual pressing



Measuring and pressing piles and pressurizing them simultaneously



Pressed pile installation-exposure on the foundation



Pressed pile installation-hiding at the foundation

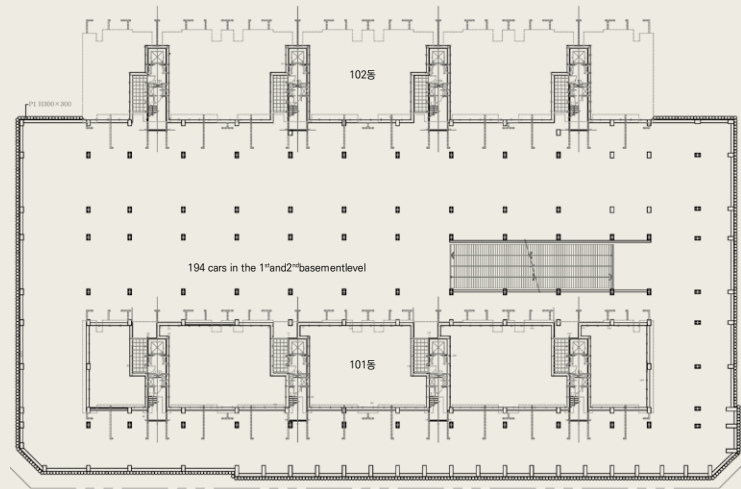
Songpa-gu H apartment

Songpa-gu H apartment underground extension of parking lot.

It is a VE case of remodeling design.

Horizontal boarding was impossible because of not being connected horizontally between underground parking lot and elevator exit in the existing design.

Underground parking lot and elevator exit were connected horizontally by JP pressing pile floating structure construction method, which enabled to board directly. Also, total construction cost was reduced.



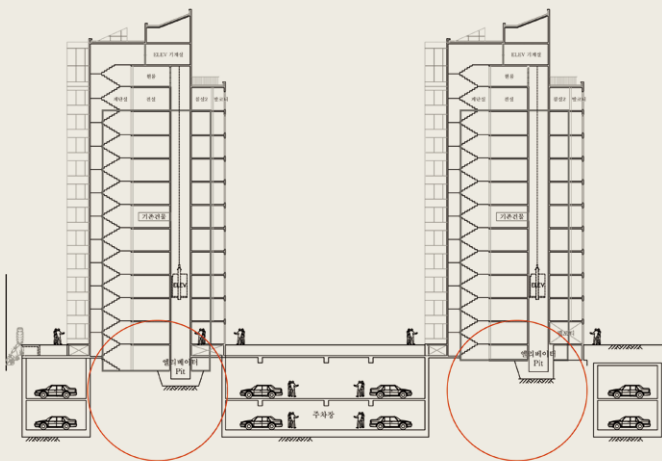
Floor plan for horizontal connection between parking lot and elevator

Location Songpa-gu, Seoul

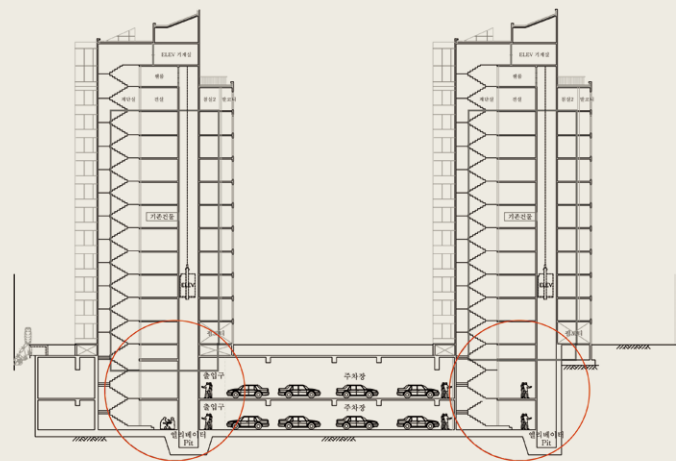
Period 2011

Applied construction method

Extension of parking lot and elevator



It is impossible to move horizontally from parking lot to elevator.



It is possible to board the elevator by moving horizontally from parking.

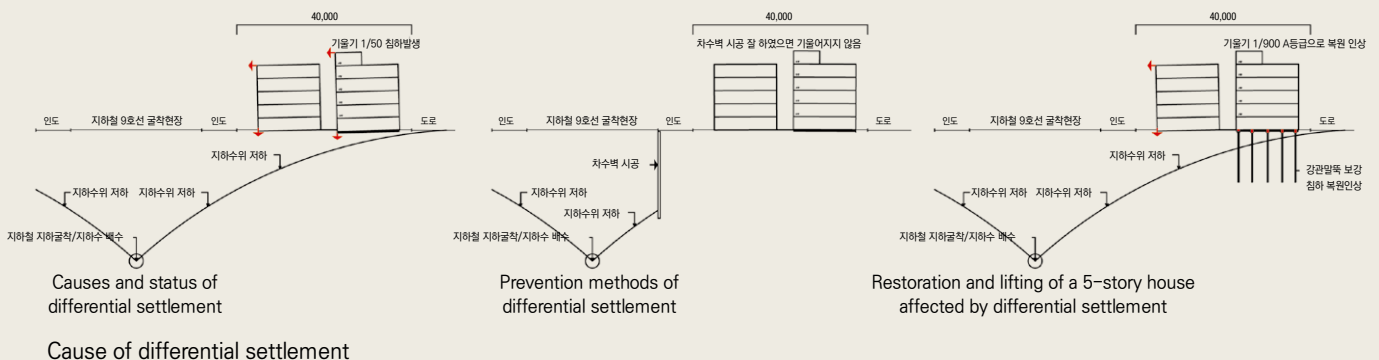
Jamsil Sinkhole settled house

It is a differential settlement case of the adjacent building to the subway construction site which the media mostly broadcasted the sinkhole. It is a case that a five-story multiple dwellings house without piles on the sandy ground slanted under serious E level with slope 1/44 due to underground water dewatering drainage design of the subway and deep excavation of construction site. The sloping building was not a problem in only this site, and many buildings slanted toward the subway site along with subway construction route. The five-story multiple dwellings house with E level and slope 1/44 was reinforced by pressing piles, reconstructed and completed after one month, and got A level.

Location Jamsil, Songpa-gu, Seoul
Period 2014. 09 ~ 10 (It took 1.5 months.)
Applied construction method
 Settlement reconstruction



Before construction



○○ apartment in underground parking lot

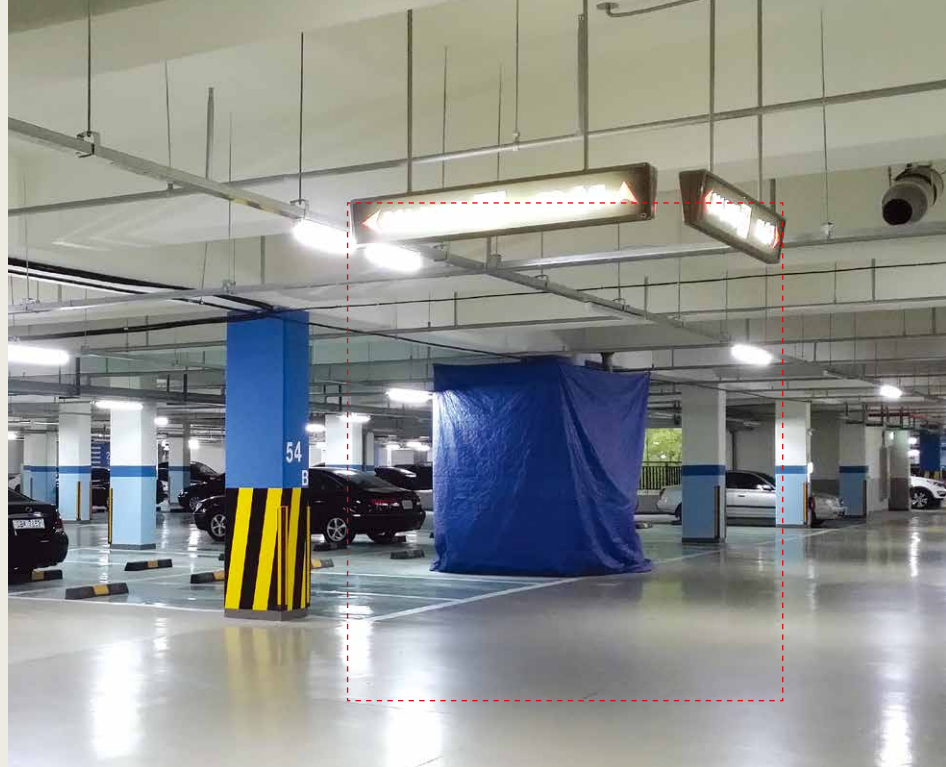
It was an accident that ceiling beam slanted due to pressurized and destroyed columns in underground parking lot columns, and vertical fraction occurred. A gap was made in horizontal hoop due to lack of concrete strength, and vertical steel bar was bent. Sloping beam was jacked up as the original condition, and concrete with lack of strength was removed. Bent vertical steel bar was reinforced by using new one, gapped hoop was removed, and concrete was placed again by binding bolt/nut connected to wire rope. It was estimated that concrete with lack of strength influenced beam placing. The beam was reinforced by using steel sheet, and the surface of concrete condition of the beam reinforced by the steel sheet was not able to be observed. Steel sheet reinforced by using epoxy adhesion has a possibility to delaminate by itself when temperature changes because its coefficient of linear expansion is very different from the concrete's.

Location ○○-si, Jeonnam

Period 2014. 09 (It took 1 month.)

Applied construction method

Column reinforcement



Before construction: Occurrence of pressurized and destroyed columns and sloping beam



Beam reinforced by steel sheet



Vertical steel bar buckling



Column steel bar reinforcement/ binding

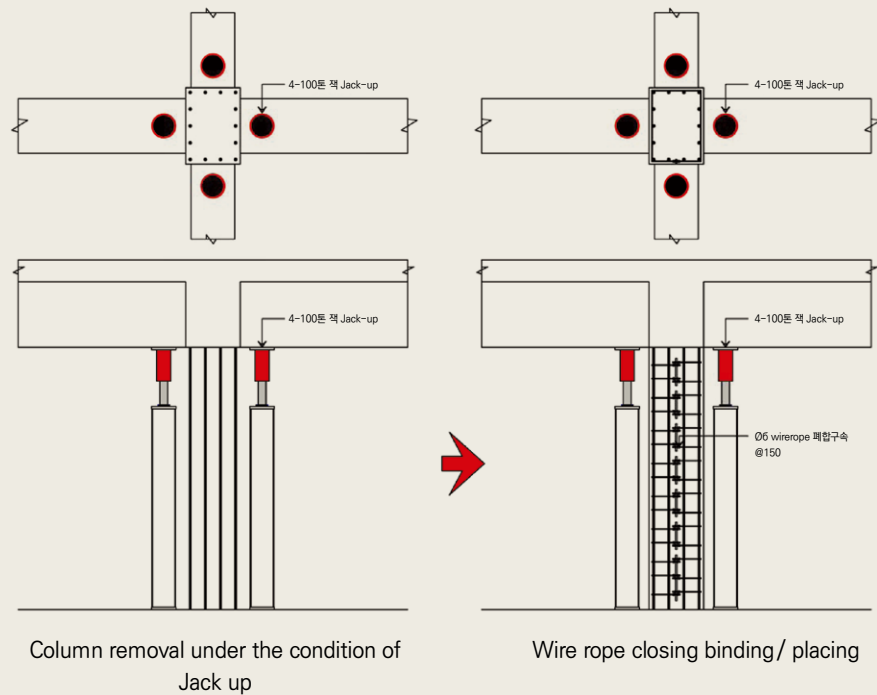


Mold/ placing preparation



After placing/ reinforcement completion

Reinforcement concept chart



Suwon Gwanggyo

It was a building to stop the reinforcement because it slanted more in the middle of CGS reinforcement construction inserting mortar into the ground as the building slanted during new construction. The load of slab in the building delivered to a beam, and this load delivered to the foundation through a column. When the settled building was reconstructed, the available power was determined according to how the foundation was reinforced and reconstructed closely to a column.

Pressing piles can reinforce columns which are apart from 10cm.

Location Suwon Gwanggyo

Period 2013. 03

Applied construction method

Settlement reconstruction



After construction



CGS construction method mortar inlet



Under construction of pressing piles

Nokbeon Catholic church

The construction is to remove bearing wall of basement corridor and to extend space of multipurpose hall. Saddle was installed in the center of upper bearing wall, and no-adhesive tension reinforcement to pull at both sides and different materials synthetic column method were applied. It was performed by a principle of reversed suspension bridge.

Location Nokbeon-dong, Seoul
Period 2010. 03(It took 1 month.)
Applied construction method
 Column reinforcement



The front view of Nokbeon Catholic church



Strand tension and reinforcement state



Under construction | removal by supporting as Jack-up pile

Ulsan SL factory

It is the foundation reinforcement of Ulsan SL factory that settlement occurred continuously after reinforcing the ground, and horizontal setting of production machine was adjusted repeatedly. As a result of the first JP reinforcement in 2010, there was no defect, therefore, the second foundation reinforcement reconstruction was performed in 2012, and the reconstruction was perfectly completed by the third foundation reinforcement.

Location Ulsan metropolitan city

Period The first - 2010. 11,
The second - 2012. 04,
The third - 2013. 03

Applied construction method

Foundation reinforcement,
settlement reconstruction



The first construction | foundation reinforcement reconstruction



The second construction | foundation reinforcement during operation of automobile parts company



The third construction | pile foundation reinforcement while people work inside of the office.

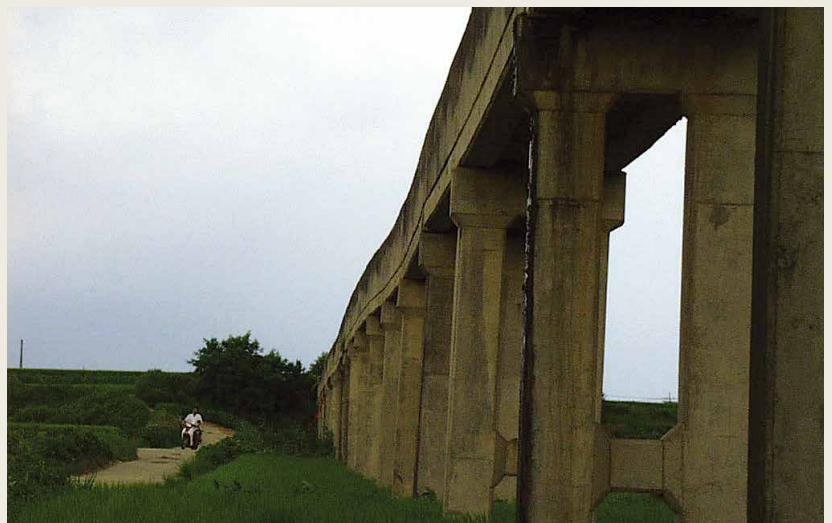


External work of the building

Ulsan SL factory

Life of a ferroconcrete structure is more than 100 years. By the way, damage such as crack, settlement, inclination, collapse, etc. occurred in the aqueduct bridge using bridge bearing with the ferroconcrete structure within a few years. The accident was a common phenomenon of aqueduct bridges constructed in our country, and its reason was to lose construct function of the bridge bearing. However, the bridge bearing which lost the function had not been handled for long time, and inappropriate actions such as crack repair, mortar reconstruction, neutralization prevention, steel sheet reinforcement were repeated. As a result of neglecting Dongsan aqueduct bridge which lost the function, one damage part was increased to three parts for 30 months, Korea E&C investigated damage reasons in advance, and studied and took actions to resolve them not constructed by repairing only damaged results.

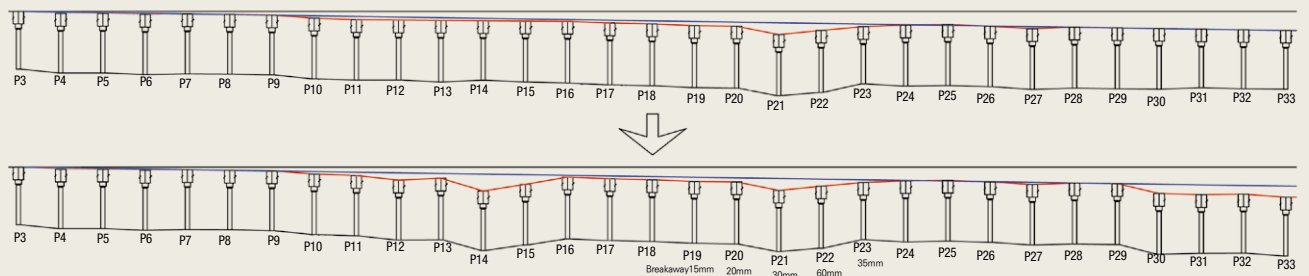
Location Dongang-myun, Naju-gun
Period 2009. 08 (It took 1 month.)
Applied construction method
Settlement reconstruction,
Raise replacement



Before construction



Sloping one part was not repaired, then three parts were increased after 30 months.



Under construction

Gwangju Budong Bridge

Budong bridge constructed in the place which the March First Independence Movement was started in 1933 is the oldest ferroconcrete bridge in Gwangju. The bridge bearing gathered rust after 60 years and lost the construction function, which caused cracks in beams. Although it was reinforced by inserting epoxy and steel sheet adhesion, the bridge bearing of the fundamental reason was not repaired.

Vehicle traffic was forbidden after a few years of steel sheet reinforcement, and it was expected to remove it due to the risk. Korea E&C contributed construction cost to investigate delamination phenomenon of the epoxy adhesion of steel sheet, and performed maintenance work of Budonggyo with the destiny of removal in 2004. The steel sheet was removed first, and the bridge bearing was replaced. The steel sheet was fallen by itself as cutting bolt, which meant it was already separated and dangled from the concrete long time age, and it was invisible to the naked eye because it was covered by the steel sheet. Because it has different coefficient of linear expansion from the concrete's, the adhesive thing may be fallen by itself even if great power such as earthquake is not applied.

Location Nam-gu, Gwangju
Period 2004. 01 ~ 03(It took 3 months.)
Applied construction method
Structure reinforcement



Vehicle traffic was forbidden before construction



After construction



Fallen steel sheet by itself as cutting bolt

Kyunghee Medical Center

The medical center was operated as usual without closing. The front and the back building were connected successfully by executing horizontal underground excavation of 90m into underground joint hole with 3m x 3m. Also, they were connected by supporting the existing building with measuring and pressing piles from a machine room in the 2nd basement level of the backbuilding with ten stories above ground and two underground levels to a piping pit in the 1st basement level of the front building with ten stories above ground and one underground level.



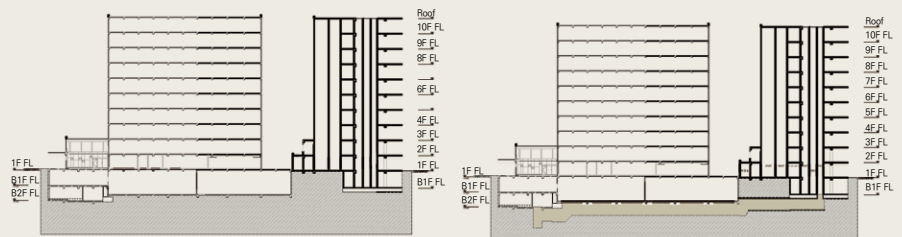
Location Hoegi-dong, Dondaemoon-gu, Seoul
Period 2014. 05 ~ 09 (It took 5 months.)
Applied construction method
 Underground extension of a building,
 horizontal connection



Underground joint hole 90m underground tunnel connection work



Underground joint hole was completed after connecting the underground tunnel connection



After installation of the underground joint hole box

Ulsan hospital

Although the back building was removed and a way of rebuilding was reviewed in case of the Ulsan hospital, the current area might not be permitted in this case. It might secure additional number of legal parking lots. The space made wide by removing internal column of the building facing a road, and raise extension of a building to place newly the 1st floor was executed by cutting and raising column and wall in the 1st basement level of the back building with five stories above ground and one underground level. The value of the entire building facing road was greatly increased by planning to pass cars in to newly placed 1st floor, and by connecting the front and the back building. It had additional benefit with relieved application of the Building Act in securing parking lot, building area, etc. as remodeling extension not the Building Act of rebuilding.

Location Nam-gu, Ulsan
Period 2014. 12 ~ 2015. 06
 (It took 2 months for column removal,
 It took 2 months for raise.)
Applied construction method
 Column removal, raise extension



Before construction



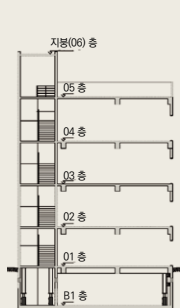
After construction



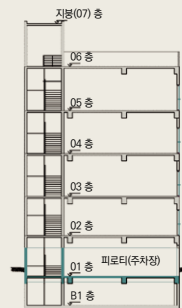
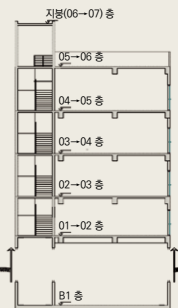
Column removal work by using Jack-up



Column removal work was completed



Before the extension work



After the extension work

Gurye, Hyokok Bridge

Hyokok Bridge was raised to match the level of the dam due to the increased height of the dam from the business to make embankment higher. Most existing methods were to remove bridges even if they were safe, and to rebuild by making bypass. Sometimes, there were many cases to raise only slab.

Rebuilding generated lots of wastes and spent excessive budget, and had a problem of possibility to reverse in occurring earthquake because the cross section of bridge beam was increased if only slab was raised, and the center of gravity moved upward. Hyokokgyo permitted vehicle traffic without bypass and was raised 1.3m the entire bridge with the original shape, which could reduce budget and was recognized as an eco-friendly case without wastes.

Location Gurye-gun, Jeonnam
Period 2012. 01 ~ 03(It took 3 months.)
Applied construction method
Raise



Before construction



After construction

Gwangju Pisa apartment

High-rise apartment with bottom area 800 m², eighteen stories above ground and one underground level, and 144 households slanted to the condition with slope 1/160, D level even if there was no construction around it after 10 years of its completion. The weight of the sloping apartment was 24,000 ton, and it was reconstructed safely by reinforcing with $\phi 216$ steel pipe piles of 474 pieces as residents didn't move and elevators were operated as usual, which obtained B level. The foundation thickness of the apartment was 1m, however, the thickness more than 1m brought a result of increasing weight of the building although the foundation of right two households was placed as 2m, and the foundation of one household was placed thickly as 3m to reinforce the ground. The sloping part of the apartment was right side which the foundation thickness was placed more thickly. Reinforcing soft ground by using top foundation brings about a result to accelerate settlement by increasing the weight of the building as the same reason.



Under construction



After construction

Location Seo-gu, Gwangju
Period 2006. 09 ~ 11(It took 3 months.)
Applied construction method
 Settlement reconstruction

Girl Scout union building

The building had slanted more and more until erecting it in 2009 although the ground reinforcement had been executed repeatedly by using cement grouting construction method for 40 years since it was completed in 1969. It slanted to 387mm before erecting it, and its slope was 1/89 and E level. The building was reconstructed with slope of 1/3,500 and A level in 2009.

Location Ankuk-dong, Jongro-gu, Seoul
Period 2009. 04 ~ 06 (It took 3 months.)
Applied construction method
Settlement reconstruction



Under construction



After construction

Busan special economic zone gas station

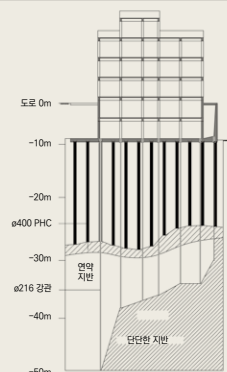
Busan special economic zone gas station located in Busan new port is a building with three stories above ground and one underground level which was constructed by executing $\phi 400$ PHC pile reinforcement on 9m fill-up and soft ground. The reason for the settled building despite using $\phi 400$ PHC piles was that there was the firm ground in the middle of the soft ground, and $\phi 400$ PHC piles were installed in that, then the firm ground in the middle of it was settled together because there was another soft ground under it. It was reconstructed horizontally with A level through $\phi 216$ steel pipe piles passed into the firm ground that $\phi 400$ PHC couldn't pass into, and was pressed up to 40m.

Location Near new port, Kangseo-gu, Busan

Period 2009. 06 ~ 07v(It took 2 months.)

Applied construction method

Settlement reconstruction



Before construction



After construction

$\phi 216 \times 8t$ reinforcement piles were passed into the firm ground and was installed in the firm ground of $N=110/30$. Firm ground Soft ground $\phi 216$ Steel pipe



Gunsan ○○ apartment

The first floor of storage building was reinforced by using $\phi 50$ micropile, however, occurrence of micropile buckling led to a slope of 1/74 and E level before reconstruction. The minimum rule is to support two times of applied load and to be evaluated by pressure test not tension test because piles support the weight delivered to the foundation. The applied weight in one area of the building foundation was less than 30 ton. In this area, tensile capacity of $\phi 50$ micropile was more than 100 ton, however, its compressive strength was less than 30 ton. The building with drooping of 160mm was reconstructed upward 145mm with a slope of 1/786 and A level, however, it couldn't be reconstructed more horizontally because the micropile was pulled by rock anchor.

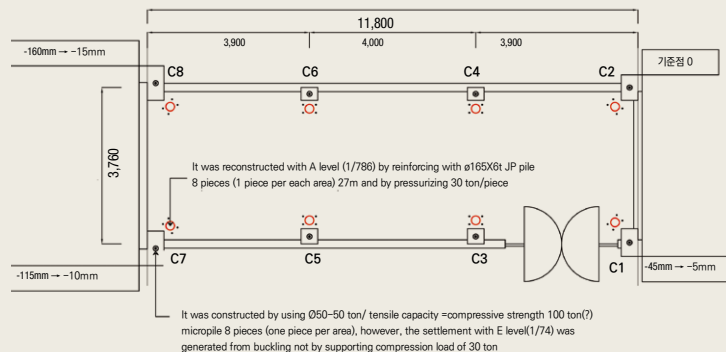
Location Gunsan
Period 2010. 11 ~ 2011. 03 (It took 5 months.)
Applied construction method
 Micropile buckling settlement reconstruction



Before construction



After construction



Ulsan foreign language high school

ø400 PHC pile foundation of a five-story Ulsan foreign language high school building was destroyed from a landslide as retaining wall with reinforced earth couldn't endure water pressure from internal gushout water and was collapsed. It was reinforced as emergency floating structure condition by using ø216 steel pipe piles. The factor to be considered when the foundation of completed existing building is reinforced is to deliver definitely the weight of the building to the pile reinforced without vibration, and to verify the history of all piles by examining them scientifically. The five-story Ulsan foreign language high school building by destroyed piles that was aired to all over the country was safe reinforcement by using JP pressing piles.

Location Ulsan-si
Period 2010. 09 Emergency reinforcement,
 2011. 09~10 (It took 2 months.)
Applied construction method
 Foundation reinforcement



Before construction



After construction

Gwangju ○○ apartment

Columns support compressive load. By the way, it is a special case that tension cracks were generated in six areas among twenty two areas of canopy columns on the 1st floor. The beam on the column was fixed in the apartment, and the column was dangled from the canopy beam as the ground under the foundation was settled, which was resulted from applying tensile capacity to the column. As the accident from tension cracks occurred, the previous design was to reinforce the ground by using CGS, JSP outside of the foundation with out reconstruction plan for the drooped beam, column, and foundation, and to reinforce the column by using steel sheet or carbonfiber. We suggested an alternative design, and the settled foundation and the drooped beam in actual work were reconstructed with the original condition by pressing $\phi 216$ steel pipe pile sand pulling them up.

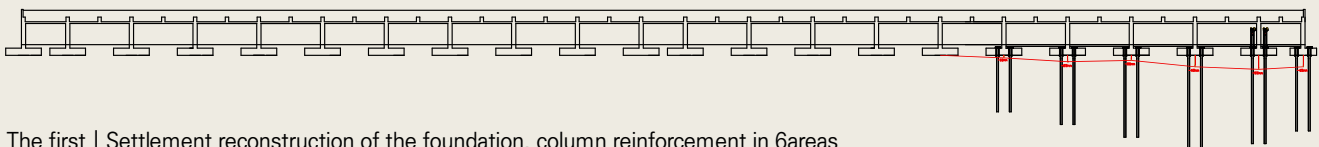
Location Buk-gu, Gwangju
Period 2008. 01 ~ 02 (It took 1 month.)
Applied construction method
 Settlement reconstruction, the
 1st column reinforcement



Before construction



After construction



The first | Settlement reconstruction of the foundation, column reinforcement in 6 areas

Gwangju ○○ apartment

An accident was generated from tension cracks in the column whose foundation was not reinforced after 3 years of the first settlement reconstruction. It was a predictable accident from the ground condition of the site long time ago. At this time, seven areas of the foundation were reconstructed. It was finished by using steel sheet and carbon fiber with totally different appearance and texture from adjacent columns. Korea E&C doesn't execute reinforcement work by using carbon fiber and steel sheet through epoxy adhesion. You are not able to identify visually the surface condition reinforced by steel sheet and fiber, however if you tap it, you can notice easily whether the steel sheet is separated from concrete or not.

Location Buk-gu, Gwangju
Period 2010. 12 ~ 12 (It took 1 month.)
Applied construction method
 Settlement reconstruction



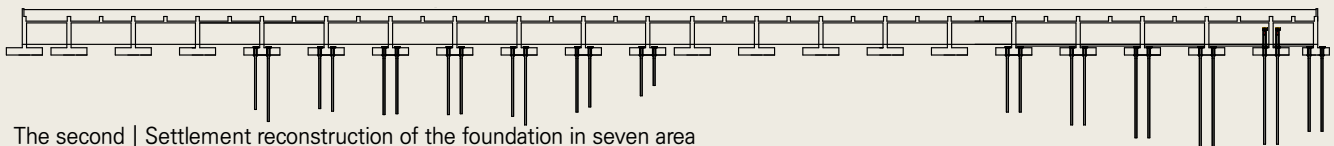
Before construction



Under construction



After construction



The second | Settlement reconstruction of the foundation in seven area

Changwon KBS

Foundation reinforcement and column reinforcement of the transformer room were required to extend a KBS Changwon broadcasting center vertically and horizontally. By the way, there was an important device with gathering lots of wires next to the column required to reinforce, and it was impossible to execute column and foundation reinforcement work unless the device was not moved. Blackout was inevitable in order to move the device, however, it was impossible practically because it generated great cost in a live broadcast. In the middle of concerning to find alternative methods, we completed successfully foundation and column reinforcement without moving of the device as the broadcasting was progressed without blackout by applying JP, BT technology.

Location Chanwon-si, Kyungnam

Period 2011. 11 ~ 2011. 12 (It took 2 months.)

Applied construction method

Foundation reinforcement, column reinforcement



Before construction



After construction

Incheon Villa

A four-story villa constructed with misarrangement of the building due to measurement error on a boundary line was moved to 500mm horizontally. The foundation was installed first in the location to move, the column and the wall was cut and separated from the foundation while a four-story villa was supported by using JP pressed pile with no excavation, and it was moved horizontally and installed.

Location Geomam-dong, Seo-gu, Incheon
Period 2009. 12 ~ 2010. 01 (It took 2 months.)
Applied construction method
 Horizontal movement



Before construction



After construction

Cheondam-dong ○○ apartment

The elevator of Cheondam-dong ○○ apartment with one underground level and thirteen stories above ground extended to the 2nd basement level. The previous design to extend the elevator of the apartment was to support the sixteen story existing apartment by using $\phi 65$ micropile 6 pieces, and to execute the underground extension with excavation. By the way, we found a major problem not to support the building by using the existing installation method of the micropile because the pile was not tension but compressive member of framework. We completed the underground extension by removing the constructed micropile and pressing additionally JP pressed pile.



After remodeling of elevator underground extension

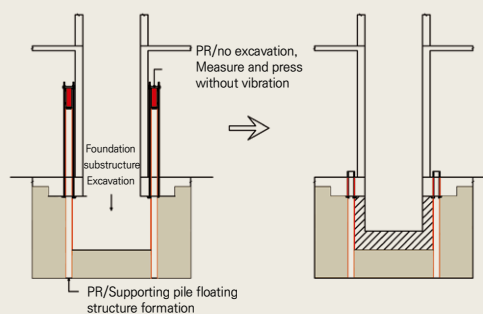
Location Cheondam-dong, Seoul

Period 2012. 12 ~ 2013. 03 (It took 3 months.)

Applied construction method

Underground extension

Pressed pile was constructed again due to micropile installation problem.



Kimpo fire station

Among two buildings with two stories above ground constructed in the soft ground, the police station building foundation—reinforced by using piles was not settled, however, the Lifesaving Service building of Kimpo fire station with two stories above ground foundation—reinforced by using top next to the police station had slanted slightly. For the building foundation—reinforced by using top on the soft ground, the foundation structure was not reinforced due to the increase of top foundation weight. The substructure of the building foundation—reinforced by using top which slanted by itself was the soft ground up to 10m, and somewhat firm ground was under it. The sloping building with bottom area 210m² was reconstructed as a safe building with A level by pressing and reinforcing ø216 steel pipe piles of 30 pieces.

Location Gamam-ro, Kimpo-si, Gyeonggi
Period 2014. 12 ~ 2015. 01 (It took 1 month.)
Applied construction method
 Settlement reconstruction



Before construction



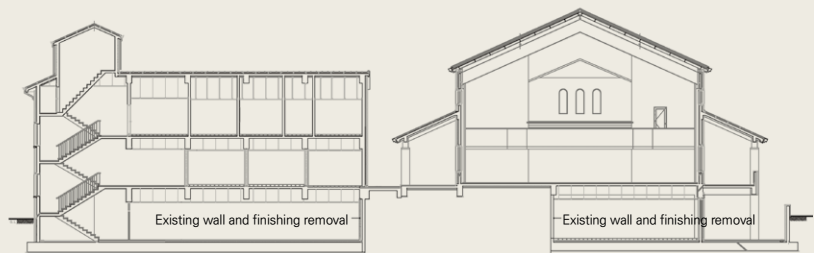
After construction | The settlement was accelerated due to the increase of the weight despite the foundation reinforcement by using top on the soft ground.

Cheongju Bokdae-dong Catholic Church

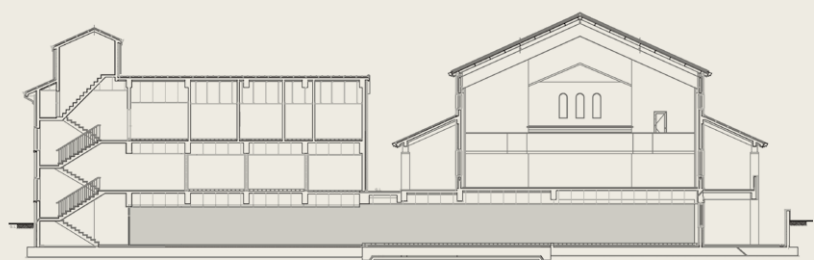
Education hall and the basement of Catholic Church that were blocked by concrete wall and earth were connected horizontally to move directly. The beam was reinforced in condition of Jack-up, old columns were removed by building new ones, and partly settled columns were foundation-reinforced by pressing piles. Of course, the reinforcement methods like carbon fiber or steel sheet adhesion were not used to remove bearing walls and columns because they didn't guarantee the durability and the reinforcement effectiveness. Columns and bearing walls were removed, and the basements were connected by binding as wire rope to examine scientifically the durability and the reinforcement effectiveness and by reinforcing as a tension method with strand.



The front view of Bokdae-dong Catholic Church



Cross section before underground connection



Cross section after underground connection

Location Bokdae-dong, Cheongju-si, Chungbuk

Period 2015. 06 ~ 2015. 07 (It took 2 months.)

Applied construction method

Foundation reinforcement, column removal, underground connection

Kyungnam settlement box

As the underground path box was constructed through the soft ground was reinforced by using site placing mortar column pile and soil was filled up on it, the path box and the site placing mortar column pile were settled together. It was reconstructed by pressing $\phi 216$ steel pipe piles of 160 ton after the basement reinforcement. The filled up soil on the box was removed to decrease the weight of the reconstruction, it was reconstructed and soil was filled up again. It was reconstructed with difficulty because frictional force in surroundings of the site placing mortar column pile and the box was applied to the load in reconstruction.

Location Kyungnam
Period 2015. 03 ~ 04 (It took 2 months.)
Applied construction method
 Settlement reconstruction



Before construction

Under construction of settlement box



Suseo SRT station passenger's way

The previously designed story height of KTX Suseo station passenger's way (46m×68m) was 4.8m. By the way, passenger's way was in the 1st basement level, therefore, the story height was increased to 3m from 4.8m to 7.8m considering the appearance of the building.

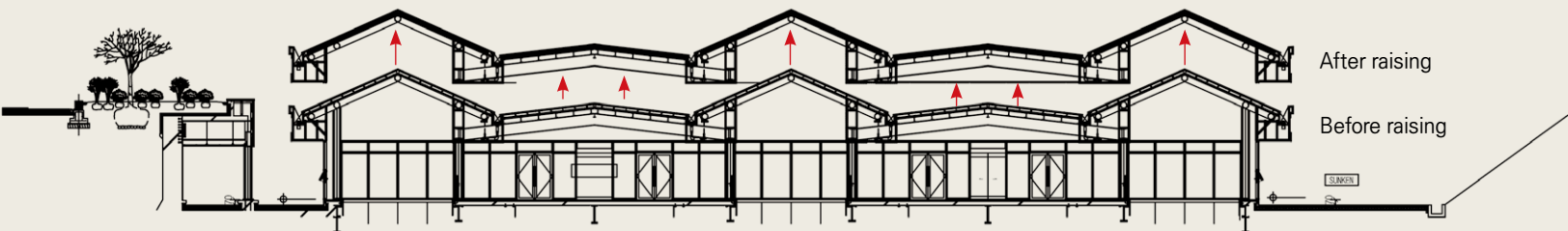
Location Suseo station, Gangman-gu, Seoul
Period 2015. 08 (It took 1 month.)
Applied construction method
Raise



After story height 4.8→7.8m; Raise



After column cutting 3m and raising



Cross section before and after raising

Seosan Hanhwa total factory

ø400 PHC concrete piles with design capacity of 60 ton in every area of pipe rack column were constructed, however, lack of the capacity was examined due to the increase of facility, and it was reinforced. It was impossible to construct piles by using the existing facility due to previous pipes, therefore, 20 ton piles of 2 pieces were reinforced additionally per one area of the column.

Location Seosan, Chungnam
Period 2015. 08 ~ 09(It took 1.5 months)
Applied construction method
 Foundation reinforcement



Current status of Pipe Rack Foundation reinforcement location



Column foundation reinforcement within dotted line



Foundation reinforcement after the increase of the cross section by reinforcing shearing bar

Anyangcheon Stream railroad bridge

The foundation of the railroad bridge reinforced by measuring and pressing without excavation in the low space and through ø318 steel pipe piles was installed during rail operation.

Location Anyang-si, Gyeonggi
Period 2013. 11 ~ 2014. 06 (It took 8 months)
Applied construction method
Foundation reinforcement



The front view of Anyangcheon Stream railroad bridge



Under construction



Gwangju Nodae-dong commercial building

Originally, the beam of Nodae-dong commercial building should have been constructed with width 400m×height 900m, however, it was wrongly constructed with width 400m×height 600m by mistake. which resulted in the difference of 3.375 times, therefore, it was a situation to reconstruct after removal. Upper steel bar of the beam was constructed suitably, therefore, only lower steel bar of the beam was constructed newly to match the height of 900m. Then it was reinforced without removal after placing concrete by applying BT technology which abolishes and binds by using wire rope not to separate old and new concrete.

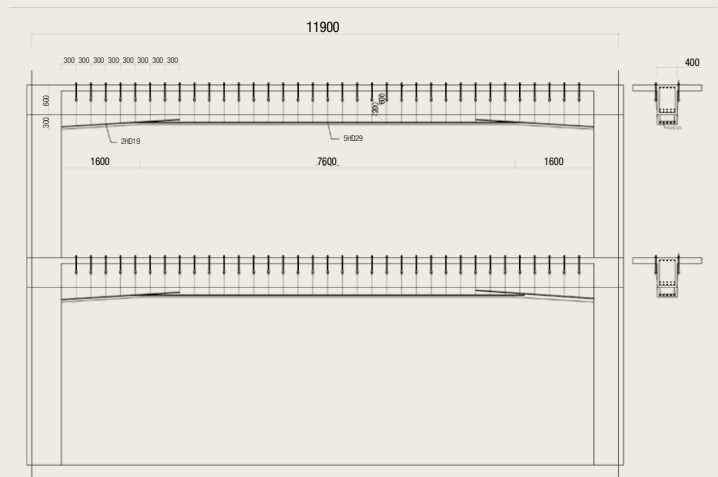
Location Nam-gu, Gwangju
Period 2009. 08 (It took 1 month.)
Applied construction method
 Beam reinforcement



After construction | Slab top and bottom



The front view of commercial building



Cross section of beam reinforcement

Asan punching settlement building

It is an eight-story sloping apartment in Asan that became famous due to broadcasting all over the country through KBS, MBC, SBS, YTN, etc. The reason was broadcasted as piles were not fully stuck due to the lack of piles. By the way, the building resulted in not settlement but punching accident. It was a false report by site evaluation specialist's misdiagnosis. It is a serious problem that most specialists think its reason was settlement even now. Although the bottom concrete was settled together when the building was settled, the bottom concrete of this building was not settled, and columns drilled into the bottom concrete and stuck in the ground or destroyed. The settlement is a problem of the ground, however, punching is a problem of ferroconcrete structure that column is installed in the foundation. Among two buildings in Asan that was misdiagnosed as settlement, the one was collapsed during removal, and the other one was demolished. After two months, an accident with the same type was generated again in a eight story apartment in Gwangju, it was putch-reinforced by using JP and BT technology differing from the first diagnostician's reinforcement method report, and was recreated as a safe building by reinforcing from E level to A level.

Location Asan-si, Chungnam

Period 2014

Applied construction method

Punching reinforcement, settlement reconstruction



No settlement occurred in the first floor foundation, but punching failure at the column supports caused the structure to tilt.



Two buildings are shown distortedly due to column punching settlement.



Under punching reinforcement and reconstruction

Wando Saengil island beach

Wando Saengil island beach office building was expected to be removed due to lack of soil in the foundation substructure from typhoon and slanting, however, it was foundation-reinforced by pressing piles and raising 2.5m. Even if soil of the foundation substructure was carried away again from typhoon, it was recreated as a safe building with no worry of slanting again.

Location Saengil island, Wando, Jeonnam

Period 2013. 04 ~ 05(It took 2 months.)

Applied construction method

Foundation reinforcement, raise



Before construction



After construction



Songdo campus

Songdo campus underground up to 15m was very soft ground, however, the firm ground was 20~30m below. The building was built on the concrete piles which were stuck into the firm ground due to the soft ground, and the path between small buildings, joint hole, was built on the paved top foundation with top shape on the soft ground. The building constructed on the piles which were stuck into the firm ground was not settled, however, the joint hole constructed on the top foundation was settled. By the way, the connection part was destroyed because the joint hole couldn't be settled at the area connected the building. It was evaluated that the ground under the top foundation was soft up to 15m despite the top foundation reinforcement on the soft ground, and the weight of the top foundation was added to that of the joint hole, which brought about a result to accelerate the settlement. It was reinforced at the outside of the joint hole because various pipes were installed tightly in the internal joint hole. The joint hole was foundation-reinforced by extending the cross section and by pressing steel pipe piles in order not to be settled in the connection part because the joint hole had no additional foundation.

Location Songdo, Incheon-si
Period 2010. 01 (It took 1 month.)
Applied construction method
Foundation reinforcement



The front view of building under construction



Under construction | top foundation reinforcement, settlement, joint hole, pile, basement reinforcement

Jeonnam Shinpyunggyo

It is a site that it was constructed on the bridge without steel sheet or expansion bridge bearing like the aqueduct bridge, slab was raised, and the rubber support with high elasticity was installed. The bridge bearing was installed after 3 spans slab bridges were pressed simultaneously and raised by utilizing slab weight as reaction, and by utilizing the piles as reaction after pressing piles.

Location Heanam, Jeonnam
Period 2009. 08 (It took 2 months.)
Applied construction method
 Raise replacement



Under construction



Under construction



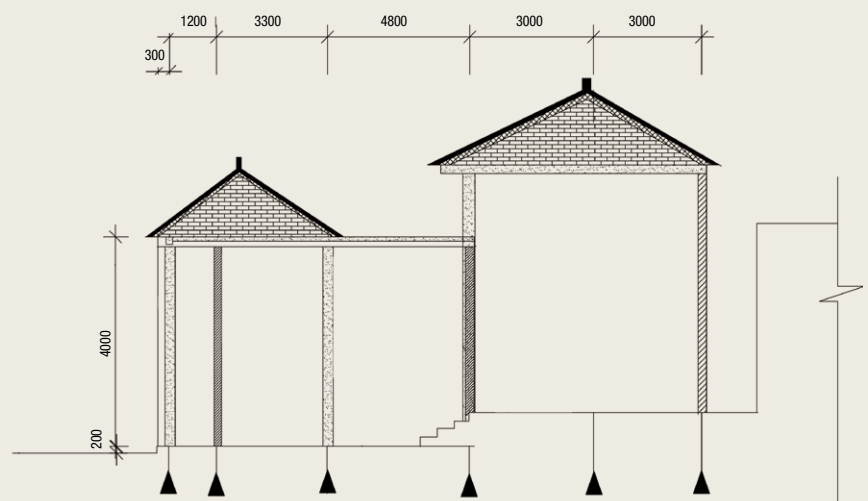
China Wangojin Hyunmoomyo

It is a case of 1.3m raise because of flooding occurrence as complex near 'Hyunmoomyo' temple built in Wangojin, Haju-si, Nanning, China was developed. The temple had brick structure on the boulder not concrete foundation, there was a courtyard in the center, and it was extended horizontally with different bottom height. The temple was built 200 years ago, and the culture property had a very difficult condition for raising because its foundation was brick structure on boulder not ferroconcrete structure, there was a courtyard in the center, and it was extended horizontally with different bottom height. It was safely raised with original shape, and the process of raising was aired by Haju TV in China.

Location Wangojin, Haju-si, Nanning, China
Period 2008. 07 ~ 08 (It took 2 months)
Applied construction method
Cultural property raise



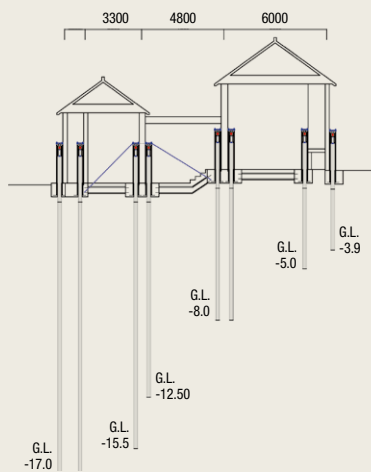
Before construction



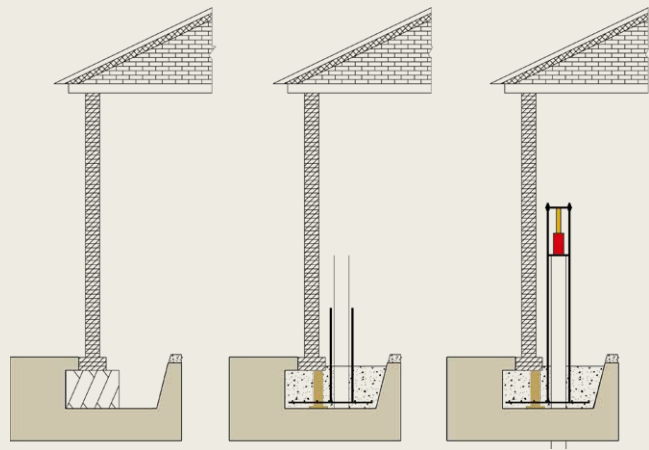
Cross section before raising



After construction



Foundation reinforcement for raising



Boulder-foundation change

Vietnam Lotte mart Dongda branch

Structure reinforcement work was executed because the working load was increased by remodeling to use the building which had been used as a department store as a mart and installing elevators. The previous design of the building for structure reinforcement of column, beam, and slab was to bond steel sheet or carbon fiber by using epoxy. Bending of slab and beam was tension-reinforced by using a steel wire, shearing of column and beam was bound and reinforced by using wire rope, then it was finished successfully with satisfied expense and period.

Location Hanoi, Vietnam

Period 2013. 11 ~ 12 (It took 2 months.)

Applied construction method

Column, beam, slab reinforcement



The front view of Hanoi Dongda branch



Complicated ceiling of the existing building



Wire rope binding column reinforcement

Abu Dhabi, oil-refining facility

It is a case of settlement reconstruction and foundation reinforcement for oil-refining facility and equipment settled due to sea level rises from global warming and soft ground settlement. Settlement reconstruction and foundation reinforcement were executed without removal of equipment and pipe in the condition that oil-refining facility and equipment were constructed complicatedly, and without pollution near the site. The construction period takes more than one year for foundation reinforcement and replumbing by removing pipe and equipment. However, it had been completed for three months without removal of pipe in the site.

Location Abu Dhabi, Arab Emirates

Period 2015. 08 ~ 10 (It took 3 months.)

Applied construction method

Foundation reinforcement, settlement reconstruction



The front view of site



Under construction



Milestone

2021

2021

Basement expansion of apartment parking(B1 to B3 basement extension at Ogum Anam Apartment, Songpa, Seoul)

2020

MOU with Hyundai Engineering & Construction-Remodeling Projects and Adjacent Construction in Urban Areas
Implementation of MD Application System-Landfill, Vertical Shaft, Urban Areas.

2019

Patent No. 1960413; Underground Construction Method(MD)
Patent No. 2132792; Recharge(Groundwater Level)

2018

Underground expansion of existing buildings(Hyundai Parking Lot, Gangnam, Seoul; Soongsil University Student Union Building)

2017

At Pohang Gas Station, $\phi 400$ PHC piles affected by settlement were lifted.
At Gwangyang Steel Works $\phi 600$ PHC piles with tensile damage were subjected to lowering operations.

2016

BT confinement reinforcement of columns damaged in the Gyeongju earthquake
Lateral translation(Bupyeong Villa, Cheongju retaining wall)
Lifting of a settlement-affected building in Incheon caused by micropile buckling
In-place lowering operation of Sun Cruise 2 Hotel, Jeongdongjin

2015

Change of address, 210, Gwangnaru-ro, Seongdong-gu, Seoul
Win Korea agreement (The Win + Korea E&C)
Column, bearing wall removal, underground excavation, underground connection (Cheongju Bokdae-dong Catholic Church).
The world's first underground level cutting and raising a building with five stories above ground and one underground level, and extension of one level (Shinjeong-dong, Nam-gu, Ulsan).
No vibration rock crushing equipment development.
Overseas construction business registration (oil-refining facility plant foundation reinforcement, settlement reconstruction, Abu Dhabi, Arab Emirates).

2014

Underground extension and ground extension while the hospital was operated. (Busan Good Culture hospital, B1→B2, 4 fl.→14 fl.)
Column cutting, story height extension, remodeling (Seoul Gangnam YMCA, Jeonbuk Okjeongho lake pump station).
Kyunghee Medical Center joint hole box underground connection.

2013

New construction technology designation, no. 682 'Column reinforcement construction method'.
Green technology certification, no. GT 13-56 'Column fireproof reinforcement construction method'.
 $\phi 609$ recharge steel pipe piles load test, $\phi 609-40m$ pressing (complex piles: PHC+ steel pipe).
Trenchless two-way excavation system development that temporary wall for propulsion is not necessary.
'Pisa apartment' TV broadcast (KBS 9pm, MBC 8 pm, SBS 8 pm, YTN).



2012

Green technology certification, no GT 12-93 'Column reinforcement construction method'.
The Minister of Land, Transport and Maritime commendation 'Kim Jun Seong'.

2011

New construction technology designation, no. 629 'Foundation reinforcement construction method'.
Patent registration, no. 1026731, existing building underground extension construction method.
Received industry-academe partnership award, Foundation of industry-academe partnership
'earthquake-proof reinforcement design development of brick masonry building by using wire rope'.
Master registration in Northeast Forestry University, Heilongjiang, China 'Byun Hang Yong'.

2010

Excellent proposal selection, Korean Federation of Industry-Academe Partnership 'earthquake-proof reinforcement technology development of ferroconcrete column' 2009.
The world's first raise 1m of the entire Wandaegyo bridge.
Received new technology award, Korean Institute for Structural Maintenance and Inspection, 'A study on eco-friendly reinforcement technology of structure by using wire rope'.
Received technology award, Korean Institute for Structural Maintenance and Inspection, 'PR & BT eco-friendly reinforcement technology development'.

**2009
2008**

The world's first 'Boulder-foundation Hyunmoomyo 1.3m raising' Haju TV broadcasted.
Nanning, China.

2007

Patent registration, no. 621669, pile pressure structure raise construction method
Patent registration, no. 807810, cross section extension, pile pressure foundation reinforcement, settlement reconstruction, raise construction method.
Patent registration, no. 763634, Wire Rope Eye-bolt Tension shearing and earthquake-proof reinforcement construction method.

2006

Patent registration, no. 589975, Wire Rope Eye-bolt Tension shearing reinforcement construction method.
Presidential citation 'Representative, Byun Hang Yong'.
INNOBIZ corporate certification.
The world's first 'Nineteen-story differential settlement apartment reconstruction' Real TV broadcasted

2004

Patent registration, no. 453108, reaction utilization pressing method, PCT registration, U.S. and China registration

2003

Ministry of Science and Technology new technology no. 1472 certification (Patent no. 414448, Wire Rope Eye-bolt Tension reinforcement construction method)

1999

Established structure reinforcement specialized corporate Korea E&C of existing structure. (Facility maintenance and management)

1999



KOREA Engineering & Construction

All buildings in the world are for people. People's safety who use a space and various values that they can enjoy in that. Korea E&C has made efforts to seek innovation of reinforcement science for the values. The reason that Korea E&C's reinforcement science is eco-friendly and scientific, and its effectiveness is permanent and economical is that we think customer and people's life in a space are important. Korea E&C's first innovation and mind for customer value is to create various values beyond safety of a building.

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