1947
2017

HYUNDAI
ENGINEERING
& CONSTRUCTION

70 YEARS HISTORY

HYUNDAI E&C
ANNIVERSARY

HYUNDAI
ENGINEERING & CONSTRUCTION

a leader

in

BUILDING,

CONNECTING ——— and

OPENING

up the world

Foreword

Hyundai E&C: Building an outstanding reputation based on tradition and innovation

When Hyundai E&C was first founded in May 1947, its head office was only a small room within the Hyundai Motor Workshop which at the time was just a medium-sized auto body shop. HDEC was founded at the dawn of modern engineering and construction in South Korea and has played a pivotal role in the industry's history.

Hyundai E&C restored roads and bridges that had been ravaged by the Korean War, and constructed many new buildings. In the 1970s, HDEC rode the construction boom in the Middle East, and the profit from this in large part fueled South Korea's economic development. HDEC played a pivotal role in the development of South Korea and has now become a leading engineering and construction company in the global arena.

The 70 Years History of Hyundai E&C is a compilation of our best achievements. As I read through the book, I felt a great sense of pride and gratitude to the past and current members of Hyundai E&C who have helped create these 70 remarkable years of history.

In the Korean language, Hyundai means 'modern' and implies 'latest' and 'refined'. When the company was first founded in 1947, Hyundai was also synonymous with a 'bright future to come' among Korean people. Indeed, the company name, Hyundai, was chosen to promote a spirit of challenge, creativeness and pioneering entrepreneurship which are all required to turn any vision into reality. This book vividly illustrates how Hyundai's founding spirit enabled Hyundai to build such an exceptional history.

There is a Chinese saying 'Learn new lessons by understanding the past'. I am confident that this review of our past will help us successfully navigate our way forward. I hope through this book readers can understand HDEC's past and learn so that the Hyundai E&C name will continue to flourish for many decades to come.

May 2017
Chairman, Hyundai Motor Group
Mong-koo Chung

President Message

From simple beginnings to world leading

This book was published in celebration of Hyundai E&C's 70th anniversary. As a member of Hyundai E&C, I am deeply honored to be a part of creating a comprehensive record of our 70 wonderful years of history.

The 70 Years History of Hyundai E&C provides a panoramic view of the hard work and passionate endeavors of Hyundai E&C members over the past 70 years.

This book is organized by project type which makes it more accessible for readers who are interested in Hyundai E&C's achievements in a particular area. As a part of the construction and engineering industry, we feel a great sense of pride when a project is completed. Our sense of pride is rooted in our understanding that structures we construct, such as buildings, bridges, harbors, roads and plants, will remain as our legacies for many generations to come.

Within the construction industry we take pride in finding new methods and bringing new structures into existence. Although we do not get to engrave our names on the structures we build, our sense of pride is there in our hearts, and we know that we are writing a new chapter in the history of construction.

As we enter the age of the 4th industrial revolution, which will be powered by the fusing of a wide range of technologies, the construction industry must find a new way to continue its business. Fortunately, Hyundai E&C's 70 years of experience finding new and creative methods will help us continue to identify new opportunities and thereby thrive. I sincerely hope the 70 Years History of Hyundai E&C serves as a beacon for an even brighter future.

May 2017
President, Hyundai E&C
Soo-hyun Jung

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HYUNDAI E&C 70 YEARS HISTORY

Note
This 70 Years History of Hyundai E&C provides an in-depth overview of how Hyundai E&C became the top construction and engineering company in South Korea, with a detailed account of its achievements in ten categories including infrastructure, architecture, plants, power plants and R&D.
Names of companies, locations and project titles are expressed following the latest conventions.
The dates in parenthesis are completion dates unless otherwise specified.

Corporate Culture

Project History

THINKING OF
HYUNDAI E&C

Hyundai E&C - Our four core businesses

Established in 1947, Hyundai E&C has become a leading global engineering company over the past 70 years. We have set new standards in our four core businesses which are infra & environment works, building works, plant works, power & energy works.

Hyundai E&C is working to make the world a better place, utilizing its experience and new innovations, guided by its motto of 'We build Tomorrow'.

INFRA & ENVIRONMENT WORKS

BUILDING WORKS

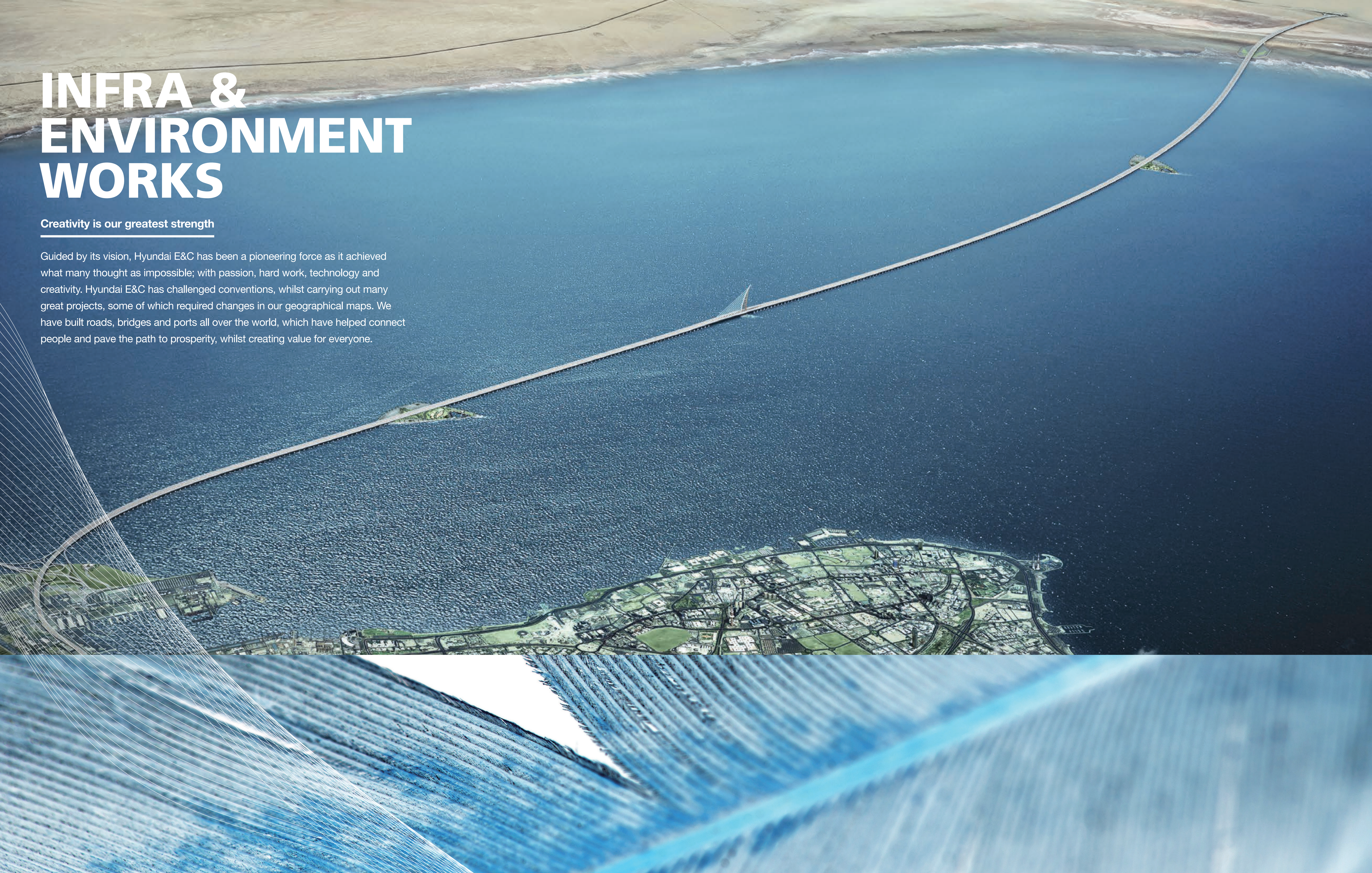
PLANT WORKS

POWER & ENERGY WORKS

INFRA & ENVIRONMENT WORKS

Creativity is our greatest strength

Guided by its vision, Hyundai E&C has been a pioneering force as it achieved what many thought as impossible; with passion, hard work, technology and creativity. Hyundai E&C has challenged conventions, whilst carrying out many great projects, some of which required changes in our geographical maps. We have built roads, bridges and ports all over the world, which have helped connect people and pave the path to prosperity, whilst creating value for everyone.



BUILDING WORKS

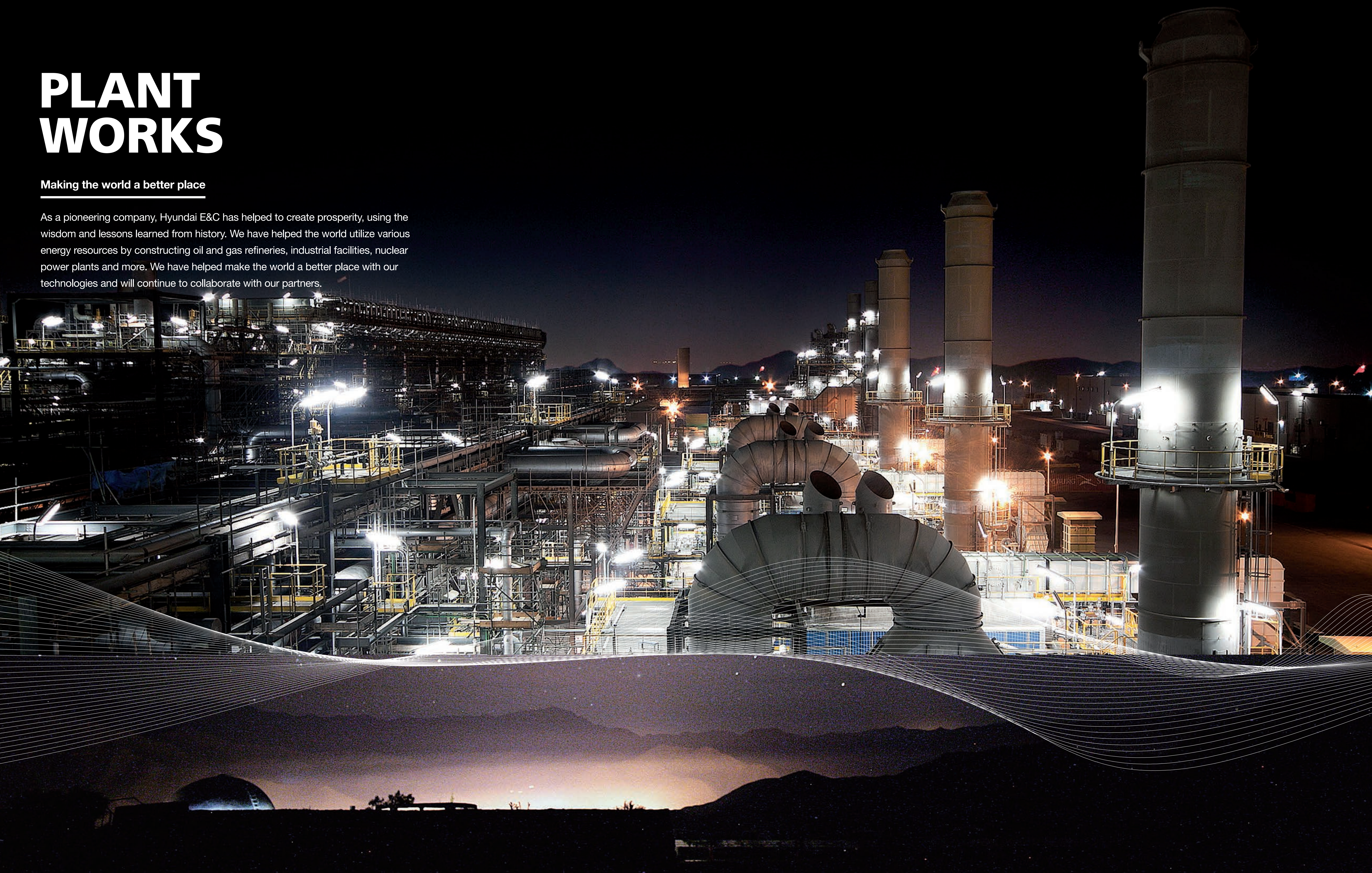
Making better structures for a brighter future for everyone

While technological prowess is a leading source of Hyundai E&C's competitiveness, we take greatest pride in our vision for the long-term welfare of humanity. Therefore, we strive to create buildings which will improve people's welfare. Our reputation for high quality building work was built on our engineering capacity and more importantly on how we regard human welfare within our work. In addition to building commercial buildings, hospitals and schools, we are expanding our business into green buildings and new types of mega structures for the world.

PLANT WORKS

Making the world a better place

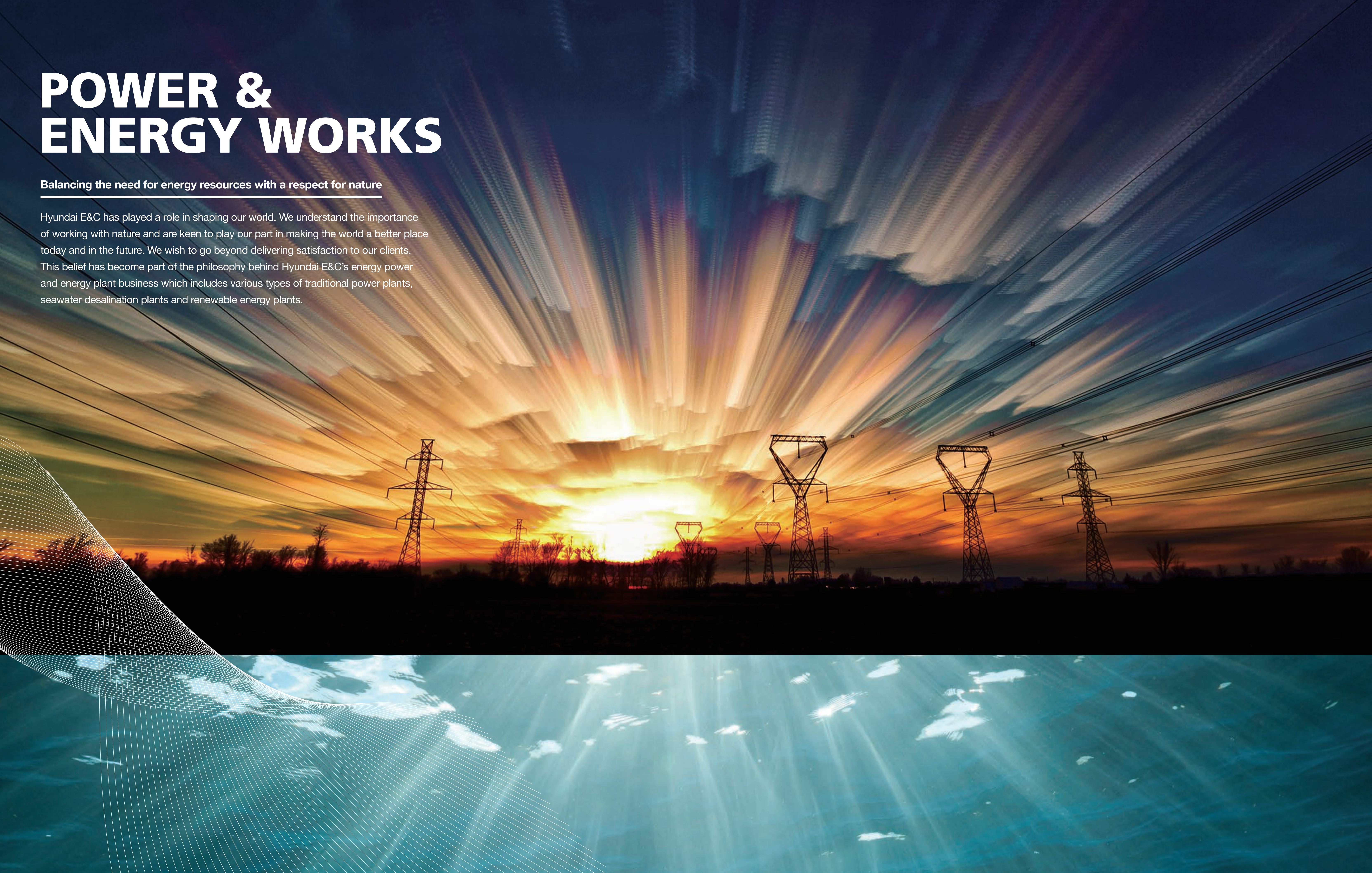
As a pioneering company, Hyundai E&C has helped to create prosperity, using the wisdom and lessons learned from history. We have helped the world utilize various energy resources by constructing oil and gas refineries, industrial facilities, nuclear power plants and more. We have helped make the world a better place with our technologies and will continue to collaborate with our partners.



POWER & ENERGY WORKS

Balancing the need for energy resources with a respect for nature

Hyundai E&C has played a role in shaping our world. We understand the importance of working with nature and are keen to play our part in making the world a better place today and in the future. We wish to go beyond delivering satisfaction to our clients. This belief has become part of the philosophy behind Hyundai E&C's energy power and energy plant business which includes various types of traditional power plants, seawater desalination plants and renewable energy plants.



Creating a virtuous cycle of resources; The vision of the Hyundai Motor Group

H-VALUECHAIN

Hyundai E&C became a part of the Hyundai Motor Group in April 2011. The change of ownership was a significant event in itself and set the foundation for innovation and exciting new possibilities. Joining the Hyundai Motor Group allowed Hyundai E&C to contribute towards a creation of synergy in the group's existing business areas such as automobiles, steel, logistics, financial and IT services, especially through the creation of a virtuous cycle of resources. We strive to grow our business in harmony with our stakeholders while upholding our principles of respect for people and good environmental management.

TOGETHER FOR A BETTER FUTURE

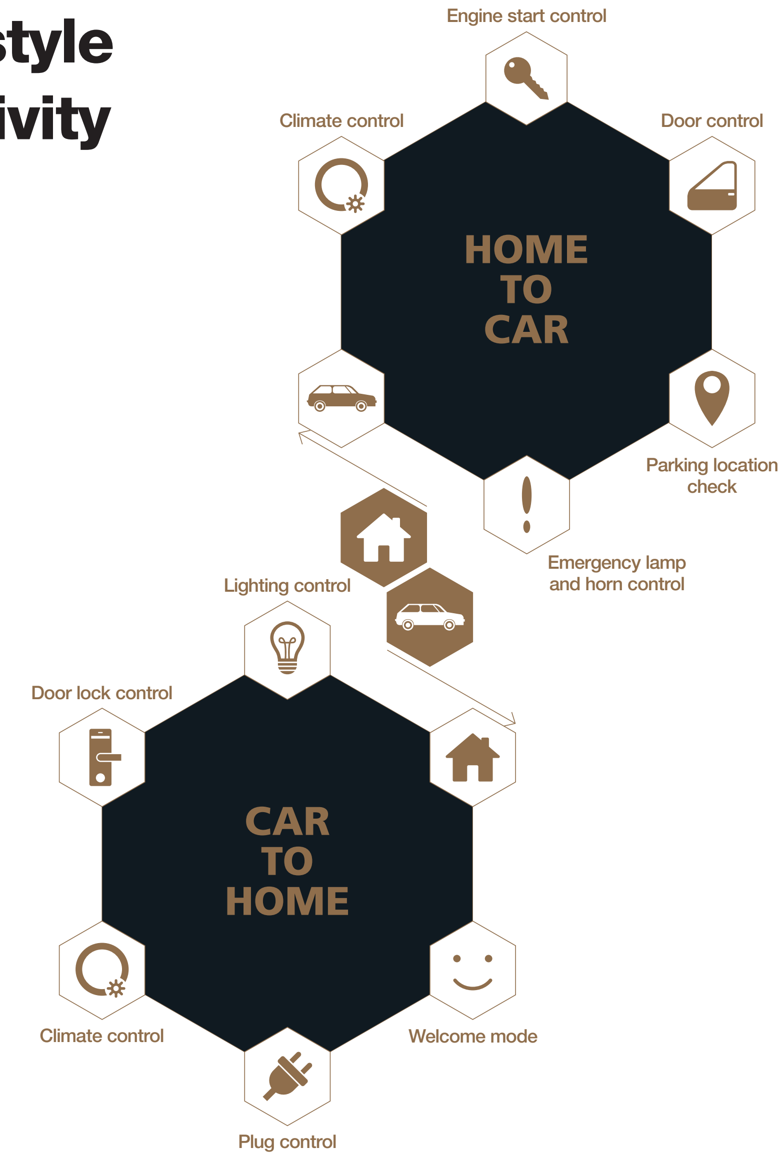
Every day, we benefit from the circulation of resources. For example, we use rain water which is collected, used and then re-circulated in our atmosphere over and over. When Hyundai E&C joined the Hyundai Motor Group (HMG) in 2011 the potential for resources to be circulated within the group was created.
For example, steel parts collected from scrapped automobiles can be used to make steel which is then used in construction, ensuring the resource is re-circulated into the economy. There is also great potential for creating business synergy in logistics, financial services and IT.

Ready to take off

Hyundai E&C believes in making progress by working together. We will continue to strive to become a leading construction and engineering company in the global market, while upholding HMG's principles of respect for humanity and good environmental management.

Creating a new lifestyle with hyper-connectivity

Hyundai E&C is committed to making positive changes in the world. We envision the utilization of technologies such as the Internet of Things (IoT) and Artificial Intelligence (AI) in not just the construction sector but other industrial sectors and in turn how different sectors work together. For example, the steel sector must work together with not only construction but automotive sectors as well as logistics, finance and IT sectors.
Hyundai E&C is striving to position itself at the center of positive change in the world through active engagement.



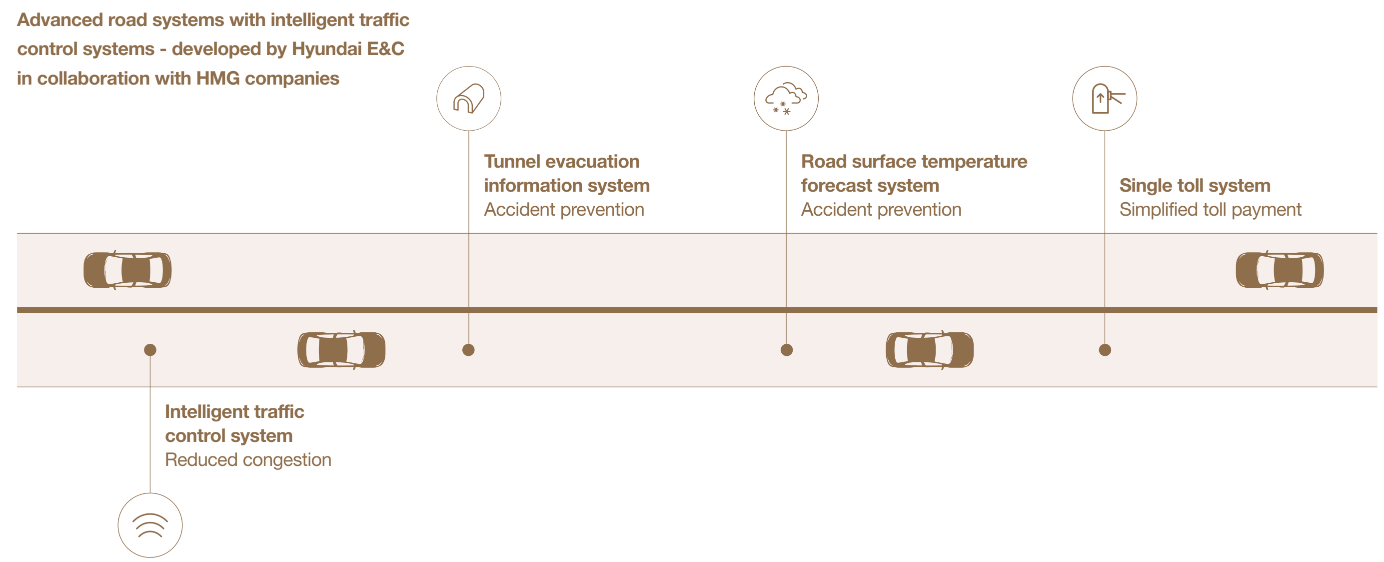
Hyundai E&C - Creating Synergy through collaboration

One example of how successful our team work can be happened when we completed construction of the Green Smart Innovation Center at the end of 2014. When the project began in 2013, it seemed as though we were embarking on an impossible task, aiming to create a building which could detect changes in energy use patterns and the indoor environment whilst optimizing the building's operation's. Nevertheless, Hyundai E&C was able to successfully develop the Smart Building Energy Management System (BEMS) for the Green Smart Innovation Center, thanks to the support of other HMG companies including Hyundai AutoEver.

Using an AI-based ventilation management system and integrated microgrid control system, the Smart BEMS was able to achieve a 25% reduction in annual energy consumption which led to a 50% reduction in the annual energy costs. This achievement was made possible because we rose to the challenge of creating something better and in the process we were able to demonstrate why Hyundai E&C has become a technology leader in the sector.

Mobility market of the future

At the 2017 Customer Electronic Show (CES) held in Las Vegas, Hyundai E&C and Hyundai Motor showcased 'Mobility Vision', their vision of future mobility, where automobiles and



homes are closely linked enabling them to work together. The two companies also showcased a new service which creates synergy between the customer's car and their home, for the present and near future. The service is called 'Home to Car' and 'Car to Home' and allows users to access their home controls from their car and vice versa. For example, users can check the location of their car from home with voice control and control their home air conditioning through the control button in their car.

Such technology can be further developed by combining various technologies such as AI, networking, security protection and home automation. In turn it becomes, clear that the automobiles of the future cannot be developed by automakers alone. Automobiles are the medium that connect homes, offices and cities, cutting edge technologies from many sectors will be required to develop the connected cars of the future.

As part of Hyundai Motor Group, Hyundai E&C is committed to realizing future mobility. We will launch the 'Home to car' service in South Korea by 2018 and will strive to launch the 'Car to home' service, which will work with the autonomous driving system, by 2019.

The boundaries between different industry sectors are becoming less and less pronounced. Hyundai E&C is striving to be at the center of this changing world by investing in the development of technologies which enable a connected smart lifestyle. We are ready to lead future mobility and have indeed already begun.

Making a smart road system

Road systems are constantly evolving. The latest road systems provide a wide range of information to drivers such as where and why certain roads are congested, what type of accidents have happened and how serious they are. This information is available thanks to systems such as the Intelligent Transport System (ITS) created by Hyundai E&C.

Hyundai E&C is the first company to introduce ITS in South Korea. Development of ITS began in 2012 with a new group of researchers within the advanced materials research team, one year after Hyundai E&C joined HMG. In 2013, many companies from within HMG such as Hyundai Motor, Kia Motors, Hyundai Mobis, Hyundai AutoEver and Hyundai MnSoft all worked together on the development.

In 2014, the project finished its first system the Road Surface Temperature Forecast System. Unlike the existing Road Weather Information System which relies on general weather information, the new system collects a wide range of information such as air temperature, roadside temperature and weather information from the meteorological office and makes an accurate forecast for different sections of the road. The new forecast system is currently used on the 2nd Youngdong highway. The tunnel evacuation information system is another outcome of HMG's ITS R&D working group. Development of such an advanced system was made possible thanks to HMG's capacity for vehicle information processing, IT technologies and infrastructure engineering. HMG will continue to utilize its capacity to create even more advanced systems.

Five core values that built Hyundai's Culture

Hyundai E&C has a corporate DNA which has enabled Hyundai E&C employees to thrive during the past 70 years. The corporate DNA closely reflects the five core values of Hyundai Motor Group which are customer-focus, embracing challenge, collaboration, respect for people and global. Hyundai E&C's corporate DNA has been passed down through generations and has served as a guiding principle for its members.

5 CORE VALUES

The five core values are the cultural DNA embedded in the Hyundai Motor Group and its employees, which serves as the guidelines towards a better future. By upholding the five core values, Hyundai Motor Group plans to foster an outstanding corporate culture which will match Hyundai Motor Group's growing reputation.

CUSTOMER FIRST

We promote a customer-driven corporate culture by providing the best quality and impeccable service with values centered on our customers.

CHALLENGE

We refuse to be complacent, embrace every opportunity for greater challenge, and are confident in achieving our goals with unwavering passion and ingenious thinking.

COLLABORATION

We create synergy through a sense of 'Togetherness' that is fostered by mutual communication and cooperation within the company and with our business partners.

PEOPLE

We believe the future of our organization lies in the hearts and capabilities of individual members, and will help them develop their potential by creating a corporate culture that respects talent.

GLOBALITY

We respect the diversity of cultures and customs, aspire to be the world's best at what we do, and strive to become a respected global corporate citizen.

Powering success:
HDEC's corporate DNA

H-POWER

What are the ingredients of HDEC's corporate DNA?
We can find the answer by reviewing HDEC's dynamic history, technological innovations, nurtured its workforce and exceptional quality. As it moves forward after its 70th anniversary, HDEC continues to evolve and innovate. Here is an overview of HDEC's master plan for its business in South Korea and beyond.

Safety Management

Business priority No.1

There is always the risk of an accident at a construction site: Surrounded by materials and heavy machinery and worked rushing about. Therefore, sustainability of a construction and engineering company heavily depends on managing accident risks and reducing accidents ideally to zero. With safety management as a top priority, HDEC and senior management a number of introduced safety management systems.

Promoting a self-motivated safety culture

The construction crew and engineers working for HDEC always observe the safety rules, from wearing their safety gear to keeping their tools and materials where they belong. Their awareness of safety and adherence to basic safety principles is deeply rooted in their mindset. Indeed, 'safety management by all employees' is HDEC's motto. At HDEC, all crew members take responsibility as safety manager, checking for risks and managing them with the help of the site supervisor. A dedicated safety team also checks sites for risks and take preventive measures as appropriate, further strengthening the safety culture of HDEC.

On the monthly safety management day, detailed safety checks are conducted with participation of company executives along with activities to increase safety awareness and encourage everyone to realize the goal of zero-accidents. At the quarterly Comprehensive Safety Meeting, executives establish HSE strategies by analyzing corporate-wide safety performance, preparing measures and sharing key plans for each business division.

Taking a systematic approach to safety management

A thorough systematic approach is necessary for effective safety management within all parts of HDEC and supplier organizations. For example, HDEC conducts a comprehensive safety check with CEOs of suppliers and labor council members every month. Awards are given to suppliers and employees who demonstrate exemplary conduct in safety management.

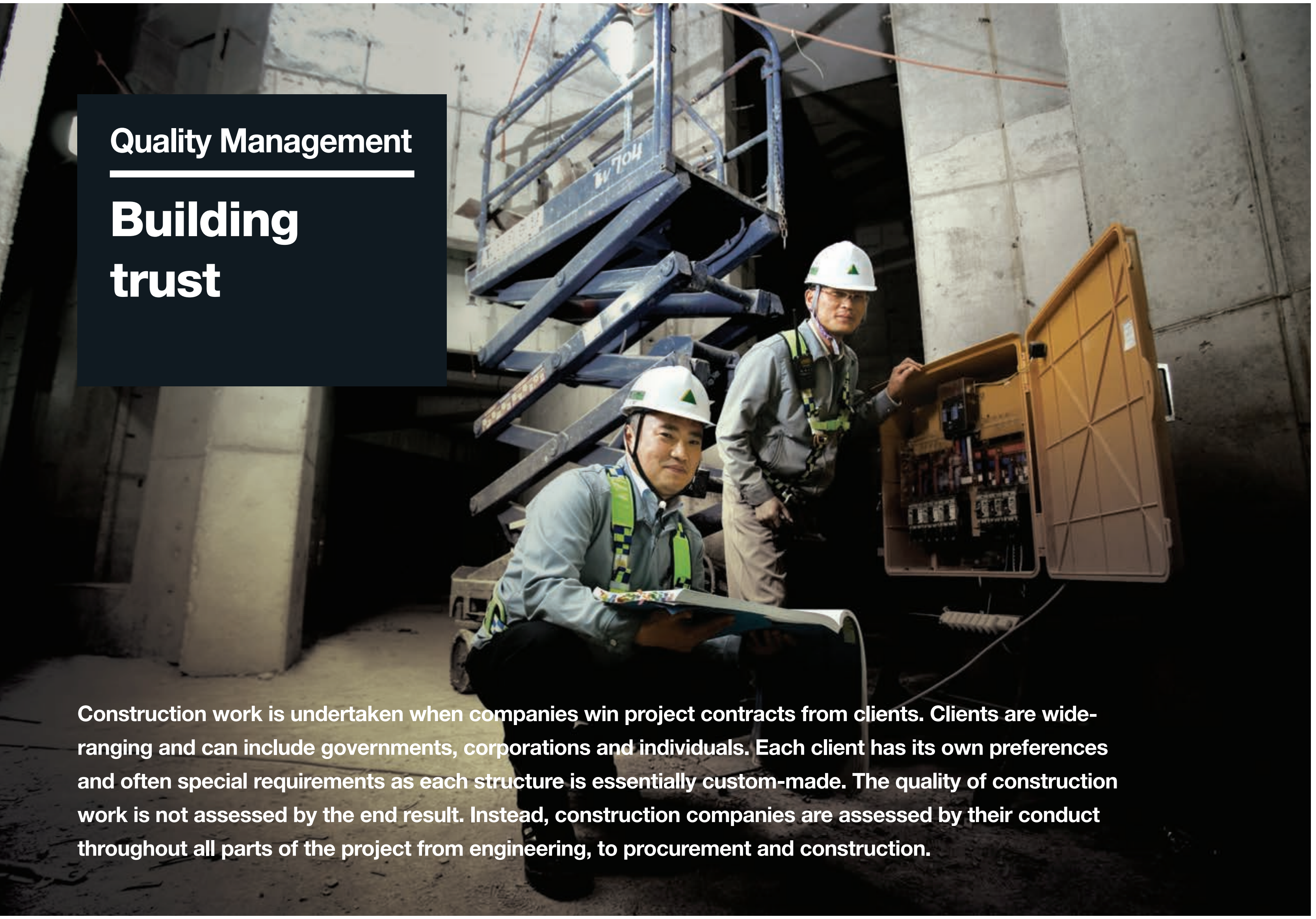
In recognition of the importance of comprehensive safety training for all workers and health checks, HDEC introduced the Permit to Work (PTW) which requires workers to obtain a permit to work in advance by addressing all possible risk factors for all work conducted at sites. Furthermore, mandatory reporting of risks identified during the Permit to Work process through a system named One Page Sheet (OPS) which is in turn reflected in the daily Tool Box Meeting.

HDEC also introduced a Safety Assessment incentive for suppliers with a strong safety management record. The incentives include increased chance in project participation, reduced contract performance guarantee and bonus points in cost competitiveness evaluation results. By contrast, there is a penalty for suppliers and crew members who break safety rules.

HDEC is taking advantage of IT systems to further promote safety. For example, we introduced Mobile Health Safety and Environment (HSE) app, which was hailed as a revolution in safety management. The system allows users to immediately register risks or incidents with photos using their smart phones. Since reporting is done in real-time, it reduces the amount of time between reporting and implementation of mitigation measures. Thanks to the system, identified risks can be addressed in a timely manner.

From zero fatal accidents to zero accidents

In 2015, HDEC strengthened its safety management structure with various measures including the establishment of a comprehensive safety management policy, strengthened safety management organization and introduction of more comprehensive safety inspection. In total 66 billion KRW was spent in the first half of 2015 alone. Thanks to the measures taken, the zero fatal accident goal was achieved and the total number of accidents was reduced by 50 percent. In 2016, the HDEC 12 Safety Golden Rules was introduced as part of efforts to promote collaboration and improved safety. In 2016, HDEC achieved a record low global Lost Time Incident Rate (LTIR) of 0.060 percent. The 2018 goal is to achieve 0.047 percent in LTIR, a reduction of 40 percent compared to the 2014 baseline.



Quality Management

Building trust

Construction work is undertaken when companies win project contracts from clients. Clients are wide-ranging and can include governments, corporations and individuals. Each client has its own preferences and often special requirements as each structure is essentially custom-made. The quality of construction work is not assessed by the end result. Instead, construction companies are assessed by their conduct throughout all parts of the project from engineering, to procurement and construction.

Ensuring great quality is essential in building trust

The chairman of Hyundai Motor Group, Mong-koo Chung once said "Quality is the foundation of competitiveness and an essential requirement for customer safety and satisfaction. It is also the source of our pride and the reason for our existence. We should never compromise when it comes to quality." Achieving high quality and thus customer satisfaction takes a multi-fronted effort especially in projects where there are workers from all over the world, speaking different languages. And prolonged approach need to work together for completion of a project. Once again, quality management in all processes including engineering, procurement and construction is necessary in addition to the civil works and quality construction of the structures.

HDEC was the first Korean construction company to receive ISO 9001 certification in Quality Management in 1993 and has maintained its certification since. HDEC has also received ASME NA/NPT nuclear certifications and KEPIC MN/SN/EN/MH certifications. As the leader of the South Korean construction sector, HDEC has implemented exceptional quality management and certification systems in all projects.

HDEC built the foundation for quality innovation by refining their business processes in construction projects, recently using IT-based solutions. Quality workshops are held in a timely manner to address quality-related issues which have occurred, by working together with quality managers from subcontracting companies. HDEC has also established a close quality management collaboration structure between material suppliers and third party agencies, to ensure sourcing of high quality materials.

Proven track record in quality in Korea and overseas

HDEC aims to deliver the highest customer satisfaction in all projects, with the best construction quality in South Korea and overseas. Quality evaluation is conducted at all sites every year in order to understand client and customer demands and respond proactively. Investment is also made in quality management training programs, tailored to operation needs. Online quality management training programs, which are created using custom-made original training materials, have made a major contribution towards capacity building.

HDEC's efforts with regards to quality improvement have paid off handsomely and been much recognized. In 2016, HDEC received the Quality Excellence Award and the Construction Excellence Award from the Building and Construction Authority (BCA). Hillstate, HDEC's apartment brand received the highest score in the sector in the 2015 and 2016 Korean Standard Contact Service Quality Index survey (KS-CQI). This recognition for Hillstate apartment is testament to how much effort HDEC is making to ensure great quality in all projects, for not only government or corporate clients but individual customers as well.

Quality Management Certifications

ISO 9001 Quality Management System
ISO 9001 is the international standard by the International Organization for standardization, which specifies the requirements for a quality management system. It is widely regarded as an indicator of competitiveness.

- ISO 9001 Quality Management System (English)
  - Certification date: 1st July 1993
- ISO 9001 Quality Management System (Korean)
  - Certification date: 21st June 2005
- ISO 9001 Quality Management System (Singapore)
  - Certification date: 1st July 2005

ASME Certifications
The American Society of Mechanical Engineers is an internationally recognized certification body which sets technical standard for materials, design, manufacturing, installations and nuclear reactor construction. HDEC has received an ASME N-type Certificate for installation of nuclear components and an ASME NPT-certificate for manufacture of nuclear components.

- ASME NA
  - Certification date: 23rd May 1982
- ASME NPT
  - Certification date: 25th May 1982

KEPIC Nuclear Construction
Established by the Korean Electric Association, KEPIC certification is a technical standard for safety, reliability and quality in construction, operation and inspection of nuclear facilities. HDEC has received MN (Mechanical), SN (Structural), EN (Electrical and I&C) and MH (HVAC) certifications.

- KEPIC MN
  - Certification date: 21st Dec. 1998
- KEPIC SN
  - Certification date: 21st Dec. 1998
- KEPIC EN
  - Certification date: 21st Dec. 1998
- KEPIC MH
  - Certification date: 21st Dec. 1998

HDEC R&D

Creating new possibilities

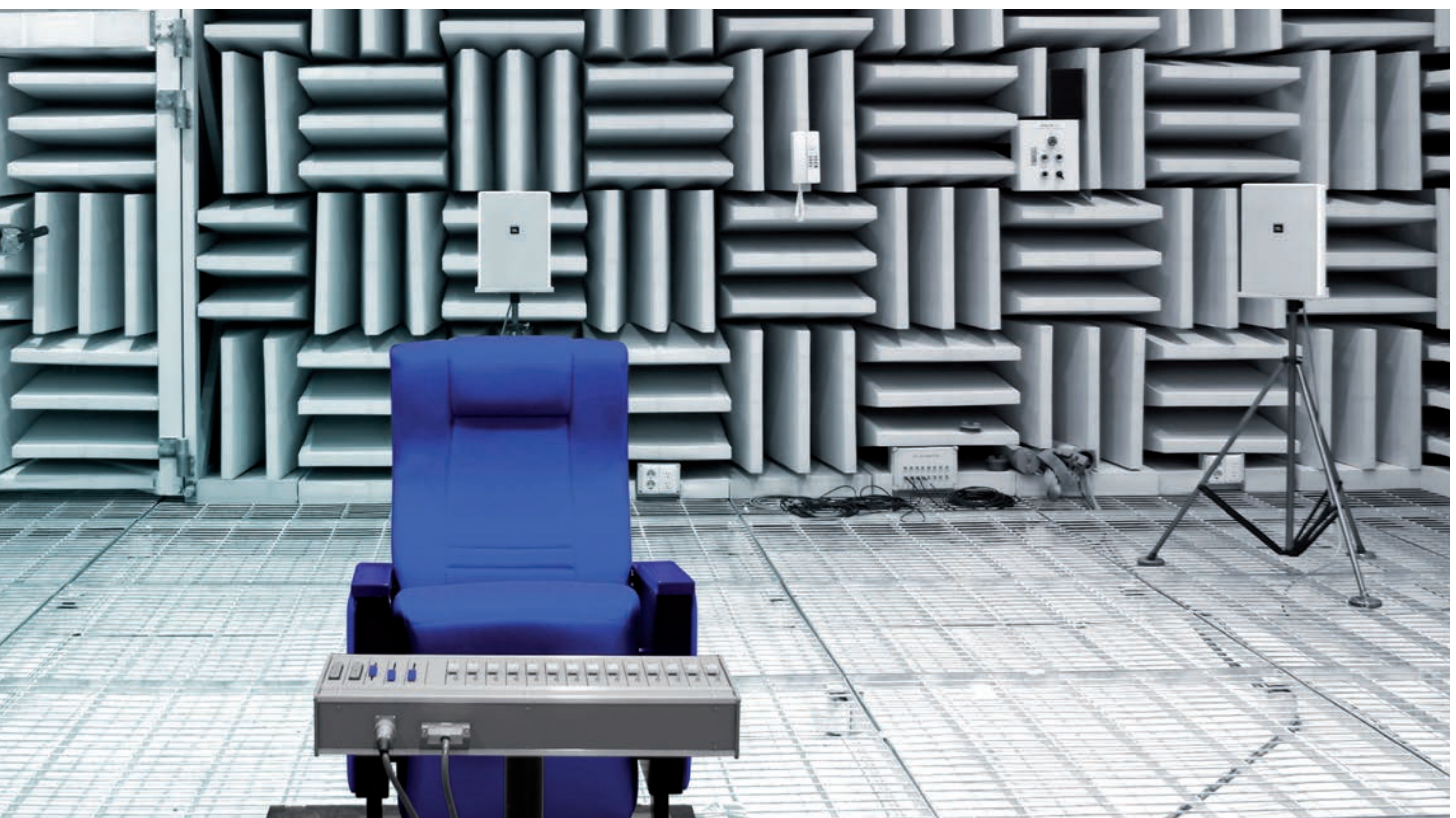
"A house is a machine for living in." was a famous quote found in a book titled Towards a New Architecture by Le Corbusier, one of the pioneers of modern architecture. He believed modern houses are machines just like automobiles, trains or airplanes. The wide variety of new construction technologies created for buildings and the synergies created with other industries prove that Le Corbusier was a visionary ahead of his time. HDEC has embraced new construction technologies to stay ahead of the curve.

Competitiveness in technology: HDEC's R&D programs

Equipped with advanced technologies, today's houses closely resemblance machines. Changes in our homes are proof of such changes made. Advancement in Internet of Things (IoT) technologies allows us to operate our houses like machines including lights, electronics, boilers and gas valves using smartphone apps. HDEC's R&D covers a wide range of technologies beside houses. HDEC has technology leadership in super high-rise buildings, wide span bridges, long tunnels and smart transport infrastructures.

Recently, HDEC expanded its research scope to areas such as environmental services and energy which includes smart building, high quality recycled construction materials, waste water processing, restoration of contaminated soil and nuclear decommissioning. It also launched the 'Connect & Development' partnership with a total of 21 R&D institutions overseas.

In 2016, HDEC established the Nanyang Technological University (NTU) -Hyundai Urban System Centre, a joint research centre created to tackle critical areas for cities. HDEC is also partnering with Jurong Town Corporation (JTC) for restoration of contaminated soil, as well as tunnel boring machine R&D with the Norwegian University of Science and Technology (NTNU). HDEC plans to expand its R&D collaboration with even more partners in the future.



Creating synergy through collaborative R&D with HMG

HDEC is reaching new levels of R&D in order to develop technologies which will help create new business opportunities. HDEC expanded its R&D center into an R&D division in 2011 after it became a part of the Hyundai Motor Group, and has since continued to invest to strengthen its capacity to support the growth of HDEC. In 2016, HDEC spent 18.3 billion KRW on R&D staff salaries, 3.9 billion KRW on R&D expenses and 0.4 billion KRW on purchase of equipment. Recognizing the importance of hiring and training talented researchers, HDEC is making an effort to recruit researchers from around the world.

The R&D division has made significant achievements in 20 R&D projects in areas including intelligent transport systems, smart homes and high-strength steel in partnership with HMG subsidiaries. HDEC R&D division is also actively participating in groups including the HMG R&D strategy committee, hydrogen fuel cell new business development committee, analysis technology exchange group, evaluation technology exchange group and robotics technology committee.

Finding new ideas and talent: Hyundai E&C Technical Forum and Technology Conference

HDEC organized the Hyundai E&C Technical Forum for university students and suppliers, in order to discover innovative new ideas, technologies and talent. The forum is the only construction technology forum organized by a single company and its main focus is to discover Small to Medium sized Enterprises (SMEs) with new technologies ready for deployment and at the same time to provide a useful experience for university students. The forum was initially launched in 2008 as Hyundai E&C Technology Competition. Over 120 ideas had been rewarded for their excellence between 2008 and 2016.

HDEC has been organizing the annual Hyundai E&C Technology Conference for eight years. The conferences aims to share the latest industry trends and to explore new business opportunities. The conference is the only academic construction technology conference in South Korea, where future business models and technologies are discussed.

Hyundai E&C Technical Forum & Technology Conference

	Technical Forum	Technology Conference
Purpose	• Identify SMEs with good technologies and build partnership for win-win growth • Identify and nurture talented university students	• Exchange information on new technologies and identify new business areas through global networking • Explore new business opportunities and expansion into new markets related to forecasted changes in the construction industry
Program	• Technology idea contest	• R&D Division presentation on achievements • Technology trend seminar

Making the zero energy building a reality

A boomerang-shaped Green Smart Innovation Center (GSIC) greets visitors at the gates of the HDEC R&D division in Yongin, South Korea. Designed with a dynamic-looking facade, the building was completed in October 2014, is four story tall and has a total floor area of 2,470m^2.

GSIC

GSIC is a showcase for green and smart building technologies including energy generation, automated building control and integrated management. It generates 25 percent of the electricity it consumes on average and provides as much as 70 percent during off-peak times. GSIC has received South Korea's green building certification as well as the prestigious LEED Platinum certification.

The rooftop solar system of GSIC which generates 185kWh of electricity on average, with maximum generation at 370kWh on the best day. It also has a geothermal and solar heat heater which generates on average 193kWh and 105kWh, respectively. The total energy generation of 483kWh is equivalent to the consumption of 10 households living in a typical apartment block. The generated electricity is managed using a Micro Energy Grid system. Thanks to the in-building energy storage system, the micro grid delivers a saving of 6.8 million KRW annually.

The Building Energy Management System (BEMS) is the software system responsible for the Micro Energy Grid. The in-house developed Smart BEMS has many unique features which are not available in conventional BEMS.

For example, the Smart BEMS analyzes forecast data including the weather and predicts energy generation and consumption and then optimizes electricity cost-saving by managing the operation and consumption/storage level of the two sources. A conventional system simply manages electricity in real-time.

The first advanced BEMS and with the highest rating

Hyundai E&C received the highest possible rating for its Smart Building Energy Management System (BEMS) from the Korean Energy Corporation (KEC). KEC evaluates BEMS on nine criteria and rates the system with one of three grades. A highly sophisticated energy production/consumption and automated control mechanism is a must for receiving the highest rating. HDEC's Smart BEMS received high marks for a number of features including the energy production-consumption management system, AI-based HVAC and optimized micro grid operation mechanism.

HR Management

Working together

HDEC has long believed that it's the people who make or break a company and has invested in human resources accordingly. Today, HDEC employees equipped with HDEC's founding spirit continue to achieve great things and reaffirm HDEC's position as an industry leader.

HDEC's quest for great talent

Talented workers are HDEC's best resource and a great source of pride. HDEC has long believed that it is best to hire talented, enthusiastic and passionate individuals and to then nurture them through well-structured programs.
The 'Innovative Challenger' is a slogan which describes HDEC's vision for its workforce. Innovative challengers are people who overcome seemingly impossible obstacles to create value and become the best in their field. HDEC describes ideal workforce qualities as 'Value Creator, Synergy Builder and Global Developer'. Innovative Challenger combines all three. Hyundai's reputation as a pioneer in innovation and its rise as a global construction industry leader is proof of HDEC's vision of the ideal workforce.

HDEC is hiring an increasing number of locally-based people in the countries that it operates to strengthen its international competitiveness. Recently a major revision to HDEC's personnel system was made to encourage the hiring of local staff for managerial positions.

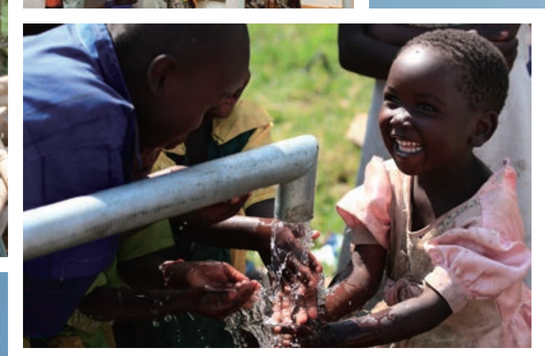
Nurturing talent tailored to HDEC's unique needs

Expertise in a specialty and global business capacity are the two most important qualities HDEC seeks to develop in its staff. To begin with, HDEC is fostering a culture of sustained learning while constantly improving internal training systems which efficiently manage and transfer the knowledge essential for business management. HDEC staff are required to complete a set amount of training in their field of expertise and are also offered extended training as a either on a secondment at another company or to study at an education institute. Other programs include global expert program, technology expert program and site supervisor training program are all offered to foster the next leaders of HDEC.

The HDEC technical training center has been training the construction workforce since 1977 and over 90 percent of graduates have successfully found jobs. The center is recognized as an excellent example of a privately operated training center and has been visited by industry members and government officials from South East Asia and Europe.

Making the world a better place

HDEC takes pride in its strength to overcome obstacles and yet it also strives to support others. As a large public company, its ownership includes employees, national government and many more. HDEC also understands its role as a responsible corporate citizen and strives to help those in need. Hyundai's efforts to support its neighbors will continue as we continue to function builder of structures.



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Sharing Love

Caring for local communities and people in need

The Sharing Love taps into HDEC's expertise as a construction company to benefit local communities and developing countries with activities including improving, living conditions of low-income families. HDEC continues to increase its educational, environmental and cultural support projects in countries such as the Philippines, Vietnam, Indonesia, Uzbekistan, Uganda, Sri Lanka and Colombia. Since 2015, HDEC has been participating in the Happy Move Global Volunteer activities guided by Hyundai Motor Group's social contribution strategy.
Launched in 2011, 'Home Repair Service' volunteers have been undertaking home improvement work for senior citizens who live alone in isolated areas. In 2015, about 90 students carried out their volunteer activities in five regions, making it the largest yet.

••• Home Repair Service Volunteers | Developing Country Clean Water Project | Sharing Love Fund-Raising | Happy Move Volunteer Corps | Hyundai-KOICA Dream Center

02

Sharing Hope

Investing in youth education

The Sharing Hope activities aim to provide educational opportunities and emotional support for children and young people. The Sharing Love Lunchbox program launched in 2009, delivers lunchboxes to children from low income households. Over 340 students have benefited from the program, through mentoring and other education support.
Launched in 2014, the Hillstate Dream Mentoring Corps involved employee volunteers providing scholarship support and career advice to young people from underprivileged households.

••• Hillstate Dream Mentoring Corps | Sharing Love Lunchbox Delivery | Job Experience-Based Volunteer Activity

03

Sharing Culture

Protecting and nurturing cultural heritage

The Sharing Culture activities aim to protect and restore places of cultural and natural heritage. In 2005, HDEC signed a cultural heritage protection agreement with the Culture Heritage Administration and has since participated in various activities including the restoration of Geumcheongyo within Changdeok Palace, a UNESCO World Heritage site. Since 2013, HDEC employees have been conducting Han River ecosystem protection activities as part of the natural heritage protection efforts.
HDEC also opened a volunteer center in Baekdudaegan National Park and then in the Jiri Mountain and Bukhan Mountain. In 2015, HDEC launched the 'Bukchon Village Regeneration Project' which repaired the old walls surrounding the Gyedong elementary school and painted some of the walls to help improve the aesthetics of the Bukchon Village.

••• Cultural Heritage Protection Activity | Palace Restoration Project | Bukchon Regeneration Project | National Park Volunteer Center Funding Support

Walking the talk win-win growth

Strong relationships with suppliers are yet another important sources of HDEC's competitiveness. Over 70 percent of the 30 largest construction companies have disappeared in the past 50 years. HDEC was able to survive in this highly competitive environment because it chose to work with others as a responsible partner. HDEC has always valued close communication with its partners and sharing the fruits of its collaborative endeavors. HDEC's effort to achieve shared growth with its business partners has led to great results so far and will continue to do so.

01 Weathering the storm together
Financial Support

In 2010, HDEC signed Win-win Growth and Fair Trade Agreements with suppliers. Since 2010, HDEC begun to make revamped effort to reduce financial burden of supplier struggling since 2012. First, HDEC created the Win-win Growth Fund of 20 billion KRW and provided loans to 60 suppliers with an interest rate of only 1.5 percent. The loan program was strongly welcomed by suppliers. The Win-win Growth Fund has become a standard part of the supplier support program and HDEC has created a Win-win Growth Fund each year with a budget of 20 billion since 2010 with the exception of 2011 when the fund was even higher, 28 billion. HDEC also accelerated the processing of supplier payments to ensure that payments are made within 13 working days. In 2012, HDEC set up the organization of Suppliers Council, creating a comprehensive network of suppliers which were previously only organized at a project level. In 2016, the number of suppliers who had the contract performance deposit requirement reduced to 50 percent was significantly increased from a baseline of 20 companies to all suppliers rated as 'H Leaders'.

02 Supporting
Overseas Expansion

In April 2010, HDEC launched a special training program for suppliers that are interested in expanding their business overseas. According to the feedback received after the first year of the program, suppliers found the training helpful in understanding international business negotiation, relationships with locally-hired staff, purchasing and even the geopolitics of the Middle East. In 2010, HDEC also launched the Supplier's Overseas Site Visit Program which was designed as a capacity building program for high-performing suppliers, with programs to share operation know-how and also to help them find business overseas. All expenses are paid by HDEC.

03 Sharing knowhow
Training Service

HDEC provides a wide range of training programs in quality, industrial process and ethical business management, to help suppliers increase their business. In 2015, 945 people from 927 suppliers participated in the training programs which included an overseas business expansion support session. HDEC also supported the organization of supplier's council and offered a CEO seminar and a win-win growth seminar for all suppliers, as well as for subgroups of suppliers. Technology development support and transfer of HDEC's technologies are another important part of the HDEC's supplier support program. HDEC has been hosting the Hyundai E&C Technical Forum since 2008. In 2015, HDEC opened 15 patents for suppliers free of charge, in order to help them improve capacity.

04 For supplier's benefit
Welfare Support

HDEC has a number of supplier benefit programs. Employees from suppliers are offered free health checkups and discounts on more comprehensive health check-ups at specialized hospitals. The quarterly supplier's conference, for each sector, are also organized to provide updates on supplier policy and supplier management systems and to collect feedback and suggestions. Annual supplier's meeting and CEO seminars are also held for the CEOs and employees of suppliers in order to strengthen supplier relations for win-win growth. Suppliers which have made an outstanding contribution towards cost reduction as well as quality and completion deadline management are awarded at the event. Award-winning suppliers receive benefits including overseas site visits and, bonus points in contract bidding.

Promoting transparency

Ethical Management

Ethical business management is a prerequisite to sustained business growth. Since the early days, HDEC has positioned itself as a leader in ethical business management in its sector. In addition to promoting business transparency internally as a responsible corporate citizen, HDEC has also made an effort to have a positive influence on the ethical business management of its suppliers.

Promoting effective ethical business management
HDEC established a code of ethics in 1999 and announced its Ethical Management Charter in February 2005 in order to share HDEC's vision with stakeholders and promote ethical business management. HDEC makes regular updates to its ethical management charter in order to reflect stakeholder demands and the latest industry trends.

Strengthening policy and organization In April 2011, HDEC became a part of Hyundai Motor Group which led to further strengthening of its ethical management including a restructuring of the organization. The new bribery act which became effective in September 2016 led to further strengthening of ethical management practices including the establishment of a compliance support team within the management support division, which signaled HDEC's drive for full compliance.

Changing perception Since 2005, HDEC has organized a wide range of activities to raise awareness about ethical business management among stakeholders. Employee corporate ethics in February 2005, an event declaring HDEC's commitment to complying with the corporate ethics code of practice was held. In October 2005, a similar event was organized to declare HDEC's voluntary commitment to the non-ethical conduct for suppliers. Since then, all employees have signed the ethical conduct commitment document each year. In 2016, executives were required to personally sign the document and obtain legally-binding notarization. Nearly all 2,000 HDEC suppliers are also required to sign a similar documents to renew their commitment to ethical management compliance each year. HDEC also offers online and offline courses on ethical business management to raise awareness about ethical business management and strengthen the compliance culture amongst employees and suppliers alike, all year around.



Feedback-based communication to ensure implementation HDEC has been employing feedback-based communication, such as the awareness survey, to strengthen the implementation of ethical management practices. Since April 2015, HDEC has been undertaking a company-wide survey to check employee awareness of ethical management practices and to gather improvement ideas. HDEC has been taking measures to address the issues identified in the survey and to improve implementation. In 2015, HDEC introduced an antitrust and fair trade policy which bans HDEC from participating in illegal or unethical business conduct including price fixing, bid fixing, market allocation and collective boycotting. The policy also requires full compliance with anti-corruption measures in all countries of operation and is expected to significantly lower the number of non-compliance incidents in the future.

Continuous inspection and management Established on 20th August 2012, the Cyber Audit Office (www.audit.hdec.kr) provides a variety of information such as on ethical management codes, various regulatory guides and cyber education. It also collects information on irregularities, reports on unfair trade practices and system improvement requirements in real time and transparently processes them. We have opened an English Cyber Audit Office and operate a hotline for overseas sites reporting. Other online content raising employee awareness includes Ethical Management Cyber Education and Audit Cases and Customer Voices, which were created to make the site more than a mere reporting site.

Fair trade: The foundation of a fair society
HDEC has implemented an internal fair trade compliance program for the promotion of business transparency. In 2014, six training sessions were held to raise awareness on the importance of fair trade compliance. Clear guidelines on fair trade compliance and the latest news on fair compliance are posted on the company intranet. In October 2014, HDEC became the first company to establish the 'Sustainability Management Guidelines for Suppliers' in South Korea, for systematic sustainable supply chain management. As a part of awareness raising, HDEC has selected 7 core elements of the Fair Trade Compliance Program and implemented internal training and preventive education from external experts.

Fair Trade Training Program

01	Subcontracting Law	**Site Supervisors and Managers Working in South Korea** Law on the Fairness of Subcontracting, Recent Policy Direction, Law Enforcement Trends, and Related Issues
02	Illegal Internal Transaction Prevention	**Purchasing and General Affairs** Regulations on internal transactions within the Fair Trade Act
03	Anti-Cartel	**Sales Staff** Construction bidding collusion laws and case studies, Employees code of conduct and cautionary measures
04	Display-Advertisement	**Housing Sales and Public Relations** Understanding of Display and Advertising Laws and Violation Cases

Responding to the demands of the times as a global citizen

HDEC is paying attention to the problems humanity faces such as climate change, population growth, energy and water shortages and resource exhaustion. HDEC recognizes that building a ‘Sustainable Habitat for Humanity’ with its eco-friendly construction products and construction technology is a mission of the times for HDEC as a global construction company. HDEC’s effort for sustainability has been recognized worldwide with various awards.

2012 ISO 50001 certification

The ISO 50001 is an international standard for energy management certification, launched by the ISO in June 2011. (HDEC is the first construction company to receive certification.)

Since 2012 Carbon Management Sector Winner for 5 consecutive years

Since 2015 Carbon Management Honors Club for 3 consecutive years

Carbon Disclosure Project (CDP) works with shareholders and corporations to collect information on the GreenHouse Gas (GHG) emissions of major corporations and to publish them. CDP also collects water use data and impact on biodiversity. HDEC was selected as the Carbon Management Sector Winner of the Industrial Materials Sector, for five consecutive years and Carbon Management Honors Club, which consists of the five top performing companies, for three consecutive years.

2011, 2012 CRRA awards

Corporate Register Reporting Awards (CRRA) were developed to identify and acknowledge excellence in reporting by the UK-based Corporate Register (CR).

2009 First joined DJSI Korea

2010 First joined DJSI World and remained for 7 consecutive years

2013 First positioned as industry leader in construction and engineering and remained for 4 consecutive years

Dow Jones Sustainability Indices (DJSI) is a global sustainability performance evaluation indices launched in 1999. HDEC is the only construction company which has remained in DJSI World for 7 consecutive years.

HYUNDAI E&C AROUND THE WORLD

HDEC's expansion into the world

HDEC's global expansion is a record of challenges. We planned our next step with great passion and foresight and implemented our plan with unwavering determination and speed. HDEC's overseas work began with the Pattani Narathiwat highway project in Thailand in 1966. As of mid-2017, HDEC has completed over 800 projects in 59 countries all over the world, including Antarctica, making an ever increasing mark on the world.

HDEC's countries of operation

6 continents
59 countries

Source: International Contractors Association of Korea

NORTH AMERICA & PACIFIC

- Guam (US)
- USA
- Canada
- Papua New Guinea
- Fiji
- Australia

MIDDLE & SOUTH AMERICA

- Venezuela
- Brazil
- Uruguay
- Chile
- Columbia

EUROPE

- Netherlands
- Russia
- Romania
- Bulgaria
- England
- Turkey

AFRICA

- Ghana
- Libya
- Mozambique
- Algeria
- Uganda
- Egypt
- Cote d'Ivoire
- Tunisia

MIDDLE EAST

- Lebanon
- Bahrain
- Saudi Arabia
- United Arab Emirates
- Yemen
- Oman
- Jordan
- Iraq
- Iran
- Qatar
- Kuwait

ASIA

- Nepal
- Taiwan
- East Timor
- Macau
- Malaysia
- Mongolia
- Myanmar
- Bangladesh
- Vietnam
- Brunei
- Sri Lanka
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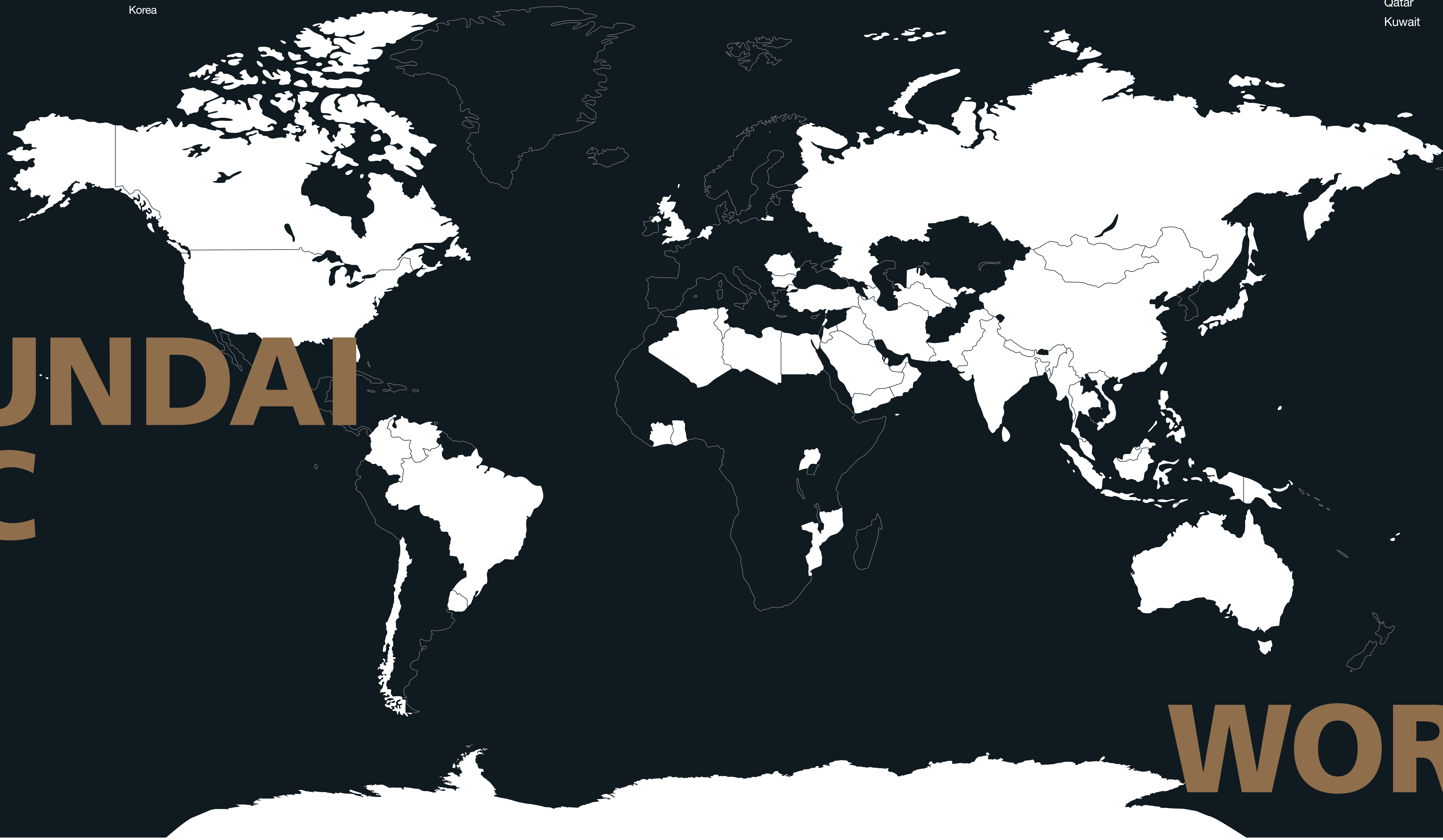
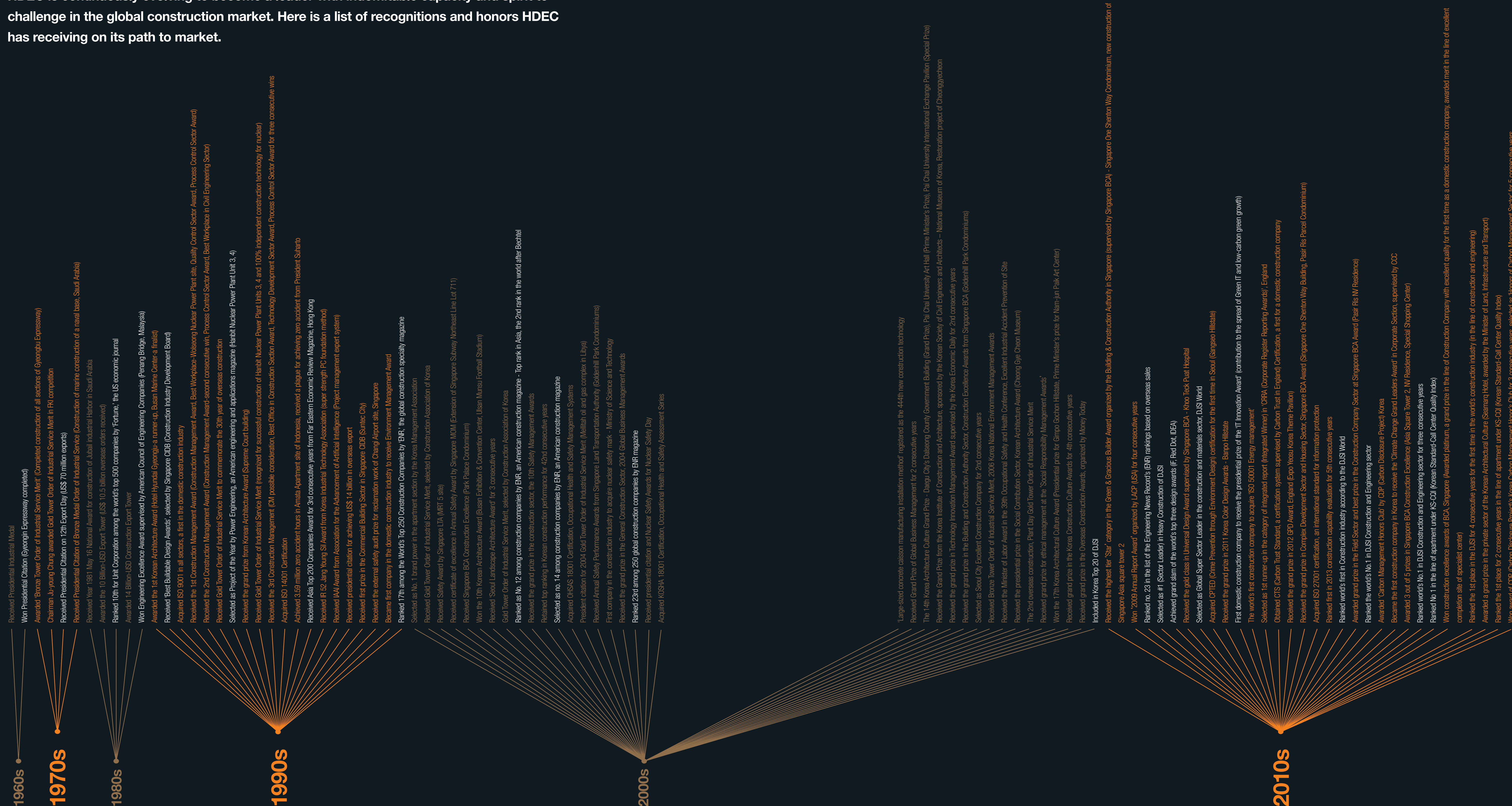
- Thailand
- Turkmenistan
- Pakistan
- Philippines
- Hong Kong



Hyundai E&C Award Records

HDEC is continuously evolving to become a leader with indomitable capacity and spirit to challenge in the global construction market. Here is a list of recognitions and honors HDEC has receiving on its path to market.



Project History

MARITIME INFRA–STRUCTURE

Some says that nature is God's greatest invention. The natural world consists of land masses and oceans. Throughout the ages, many civilizations have thrived along our coasts. In the past the coast was often perceived to be the borders of the world, as people did not have the means to travel beyond them. However, much has changed in recent times.

Crossing the boundary of land and the ocean

01

Jubail Industrial Harbor, Saudi Arabia (December 1980)

Today, large ships crisscross the oceans keeping us connected. Our harbors require advanced docking facilities, unloading cranes, warehouses and pipelines in order to allow ships to load and unload goods which can then be transported inland. Building these facilities required the creation of new land and in turn has changed the coastline.

Changing the world map

Hyundai E&C: Early days in marine infrastructure

Hyundai E&C began their first infrastructure project with the construction of the 1st dock of Incheon harbor in 1959, commissioned by the Far East District of the US Army Corps of Engineers. The experience from the project allowed HDEC to acquire the skills required for construction of numerous harbors since.

During the 1960s, HDEC increased its capacity by carrying out construction of the breakwater for Yokji harbor and Jinhae harbor which were part of South Korea's 1st and 2nd national economic development plan. In 1963, HDEC was commissioned by the US Navy to carry out dredging works which once again provided valuable experience. HDEC purchased two large dredging ships named Hyundai #1 and #2, with engine power of 2,250hp and 4,000hp respectively. In the 1970s, the two ships allowed HDEC to carry out many dredging projects including Bunbury harbor in Australia.

HDEC carried out a wide range of projects in the 1970s from construction of breakwaters and piers, to dredging and shore protection works, helping HDEC to quickly build its capacity in the international market.

In 1973, the first oil shock created a serious worldwide economic downturn including in South Korea. Searching for new opportunities, HDEC and all major South Korean construction companies quickly began to seek opportunities in the Middle East market as oil producing countries began to build their infrastructure using the oil money. Thankfully, the Middle East construction market exploded and the South Korean companies emerged as key players in the market.

By 1975, HDEC was already involved in construction of the Bandar Abbas Mobilization Drill Shipyard in Iran, Arab Shipbuilding & Repair Yard in Bahrain and marine works for the Saudi Arabian Naval base. Winning such projects were significant achievements, given HDEC's status as a new player in the market. Yet, it was becoming increasingly clear that much larger constructions projects were looming in the horizon as the Middle East was accumulating an incredible amount of wealth with its oil.

Jubail Industrial Harbor: Taking on an epic challenge

In July 1975, HDEC obtained intelligence that Saudi Arabia was preparing to build an industrial harbor. Built for export of crude oil from Jubail in the Eastern region of Saudi Arabia, the harbor project was expected to be worth up to 1 billion USD. The size of the project was unprecedented in the construction industry and it was instantly regarded as the largest civil engineering project of the 20th century.

The Jubail project presented a great opportunity for HDEC which was hoping to raise its profile in the Middle East market. Winning the Jubail project would instantly boost HDEC's profile in the market. However, the chance of HDEC winning the project was slim.

Nevertheless, this did not stop HDEC bidding for the Jubail Industrial harbor project. It was a decision based on mentality that there is no way to slay the dragon without entering the dragon's lair. The decision to participate in the bid was made in February 1976, only seven months before the bidding deadline.

The road to success was full of

Marine Works for the Saudi Arabian Naval Base, Saudi Arabia (December 1978) obstacles. First, HDEC had to qualify as a bidder. The South Korean government mobilized its full diplomatic resources and helped HDEC meet the qualifications for bidding.

The next obstacle was providing the financial guarantee of 20 million USD set by the Saudi Post. Thankfully, the National Bank of Bahrain, which worked with HDEC on the Arab Shipbuilding & Repair Yard agreed to provide the financial guarantee.

It was a complicated business and the National Bank of Bahrain borrowed 10 million USD from a US bank and then obtained a financial guarantee of 20 million USD from the National Commercial Bank of Saudi Arabia using the 10 million USD as collateral.

After much deliberation, HDEC decided to make the bid at 870 million USD which was 30% lower than the 1.2 billion USD which HDEC initially considered. HDEC originally considered bidding at 900 million USD but made a 5% additional cut to increase its chance of winning. Moreover, HDEC promised to complete the construction six months earlier than the deadline. At the very last minute, the HDEC staff responsible for the bid increased the price by 60 million USD because they realized that the credibility of the bid could be damaged if the price is too low.

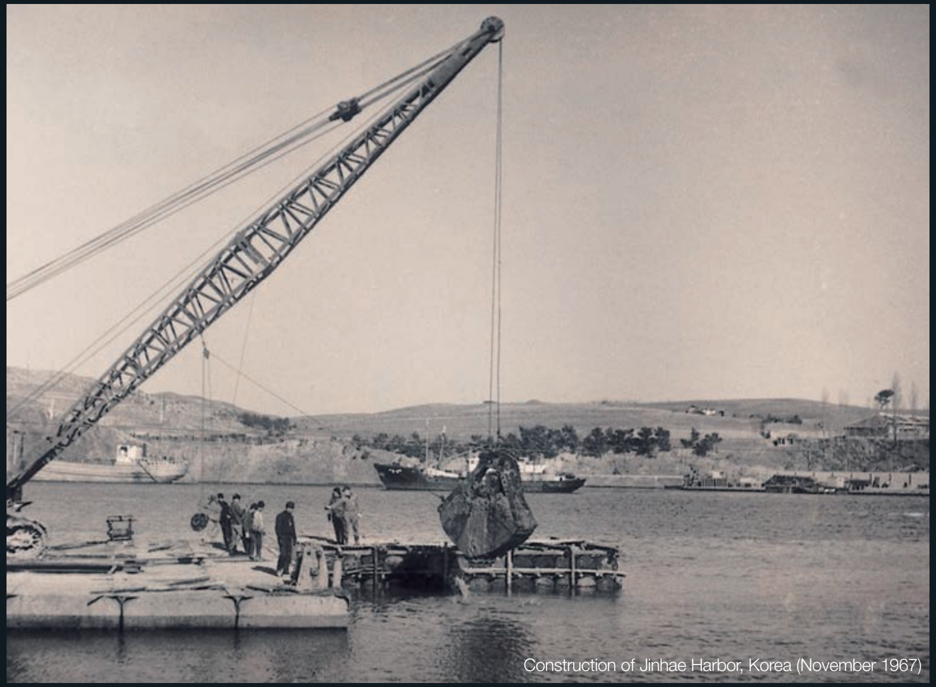
"HDEC of South Korea won the bid for the Jubail Industrial Park construction project. HDEC was placed third in the overall assessment and had the lowest bid price. However, the board was especially impressed with HDEC's plan to cut construction time by six months."

The announcement regarding the Jubail Industrial Harbor construction project was made on 16th February 1976 and shocked the world, as the winner was neither a US or a European company but HDEC from South Korea. The HDEC executives and staff who attended the announcement event could not even believe that they had actually won the bid.

HDEC had won the bid for the largest civil engineering project of the 20th century. The project began with

Arab Shipbuilding & Repair Yard, Bahrain (February 1978)

Bandar Abbas Mobilization Drill Shipyard, Iran (November 1993)



Construction of Jinhae Harbor, Korea (November 1967)

Dredging Project Bunbury Harbor, Australia (March 1975)

Jubail Industrial Harbor, Saudi Arabia (December 1980)

Making the bet of a lifetime

16th February 1976 10 AM was a historic moment for HDEC; this was the moment that the HDEC executive in charge of bidding for the Jubail Industrial harbor made the bid. Chairman Chung was startled as the tense looking executive told the chairman that he had personally raised the bid by 60 million USD from the agreed 870 million USD.
A few moments later, chairman Chung patted the executive on the shoulder in acceptance of his decision; the rest is history.

Yanbu Oil Port, Saudi Arabia (January 1983)

HDEC carrying out preparatory works for six months which were finished by December 1976. A temporary harbor and concrete manufacturing plant were built during this period for shipment and preparation of the necessary materials.

Finding a suitable aggregate mine to source the necessary materials for the harbor's construction was another important task that had to be completed before construction began. This proved to be a significant challenge as the Jubail region does not have stony mountains. European companies at the time were sourcing aggregates from the Dhahran mountain which is 150km away from the harbor site. However, HDEC successfully identified a suitable mining site for aggregate only 20km away from the site.

Overcoming an insurmountable challenge

The work began in January 1977 and consisted of construction of a breakwater, a pier, shore protection and an open sea tanker terminal. The construction of the Open Sea Tanker Terminal (OSTT), which is large enough to accommodate four 300,000 ton oil tankers, was a decisive part of the project. HDEC signed a partnership agreement with Brown & Root, a leading OSTT technology company to ensure successful construction.

HDEC sourced 89 jackets, each measuring 18 x 20 x 36 meters and weighing 400 tons, from the Hyundai Shipbuilding Company. The jackets were built in South Korea and then shipped over 10,200km. The shipping operation required two barge ships with a 15,800 ton and 5,500 ton capacity each, in addition to a 10,000-hp tugboat. This rather unconventional combination of vessels made a total of 19 trips through the treacherous waters of the Pacific and Indian Oceans carrying an average load of 6,000 tons and taking over 35 days for each journey.

The Saudi Arabian government officials and supervisors found both the unconventional shipping and installation equally impressive. At the time, installing 400 ton jackets at the desired location, 30 meters underwater, was thought to be impossible. The convention at the time was to install jackets and then to manufacture beams that were custom-made after the jacket installation. However, HDEC's high-precision installation with an error margin of under 5 centimeters allowed for the installation of pre-made beams, speeding up the installation significantly.

After successful completion of the Jubail Industrial Harbor, HDEC won the contract for the Yanbu LNG sea terminal, building upon its strong track record. HDEC also won the majority of the other infrastructure projects near the Jubail Industrial Harbor.

HDEC has successfully completed a series of projects in Saudi Arabia; Port of Ras al Ghar (1978), Yanbu LNG sea terminal (1981), Yanbu Oil Port & Deballast Facilities (1983), Zuluf Marine Oil and Gas separation facility (1986). Projects completed by HDEC in other regions include the Port of Shuaiba in Kuwait (1979), the Port of Fujairah in UAE (1982) and the Port of Ras Lanuf in Libya (1983). Over time, HDEC redrew the coastal lines of the Middle East with its infrastructure work.

Successful completion of the Jubail Industrial Harbor project in Saudi Arabia, regarded as largest civil engineering project of the 20th century by many, positioned HDEC as a leader in the global construction industry. The project required an impressive capacity to carry out both land and marine construction and engineering work on a large scale, which provided HDEC with the necessary credentials to win many large projects in other parts of the world. A large number of projects were commissioned in the Middle East and HDEC was able to win many.

Creating new land: Seosan reclamation and Saemangeum seawall

Seosan Reclamation Project, Korea (February 1984)

Land: Our ultimate heritage

Seosan has served as a port for maritime travel between Korea and China since as early as the 4th century. Ships have transported rice from the fertile lands of the Honam plains to Seoul, the capital of South Korea, since the 14th century. However, the sea of Seosan, is full of dangers with its powerful currents and hidden rocks, which together have sunk many ships.

The first attempt to reclaim the tidal wetlands of Seosan was made by the Japanese who were occupying South Korea during the Japanese colonial era (1910-1945). The initial plan for a seawall linking Seobu-myeon of Hongseong-gun and Damam-ri of Nam-myeon was conceived by Japanese officials. However, the strong current and high tides

Seosan Reclamation Project, Korea

Seosan Reclamation Project, Korea

presented challenges that could not be overcome at the time.

In the 1960s, the South Korean government made the second attempt to reclaim the wetlands as part of its 2nd national economic development plan. The Korean government successfully managed to secure funding from overseas and the assistance of Dutch engineers. Nevertheless, it ended in failure.

After two failed attempts, it was HDEC's turn. The project required tens of billions of dollars and came with a high risk of failure. Furthermore, there was also the risk of making a loss even if the land was successfully reclaimed, due to the high costs. The challenge was largely ignored because it was thought to be cheaper to buy a larger area of more fertile land for the same amount of money that would need to be invested.

Nevertheless, Ju-young Chung, the chairman of HDEC was determined

Seosan Reclamation Project, Korea (February 1984)

Seosan Reclamation Project, Korea

to make the project a success. The son of a poor farmer, Chung spent his youth helping on the farm and growing to love the land. However, it was more than this that drove him to take on the challenge. He believed that there was much more value in creating new land compared to buying existing land considering the long-term benefits to future generations and South Korea.

The Seosan Reclamation Project began in April 1982 with section B. The success of the project depended on the successful construction of a seawall which would be 25 spans 1,228 meters in length and 25 meters in width. Rocks and aggregate totaling 190m^3 were dumped into the sea every day for six months, by 140 15-ton trucks. On 25th October 1982, the Chairman Ju-young Chung supervised the filling of the last 70 meter gap.

The work began at 9:00 pm while the tide was low and proceeded at a furious pace. Sunrise came at 5:15 am, revealing the new land spanning over 6,280 hectares. The day marked the birth of a newly created land mass for the first time in South Korea.

HDEC began construction of the second seawall at district A in July 1983. The 2nd seawall, which spans between Chang-ri and Seobu-myun, was 6,476 meters long, much longer than the first seawall of 1,228 meters, between Chang-ri and Damam-ri.

After a lot of brainstorming, HDEC came up with a new process using an old oil tanker to block the water whilst pouring aggregate to quickly fill the last remaining gap of the second seawall. Although the idea sounded absurd at first, careful review by HDEC, Hyundai Heavy Industries and Hyundai Merchant Marine indicated that it was actually feasible.

On 25th February 1984, the press gathered at the Seosan reclamation project site to witness the historical inaugural run of the new construction technique using an oil tanker. The Clear Water Bay, a 322 meter long 226,000 ton oil tanker, was brought to

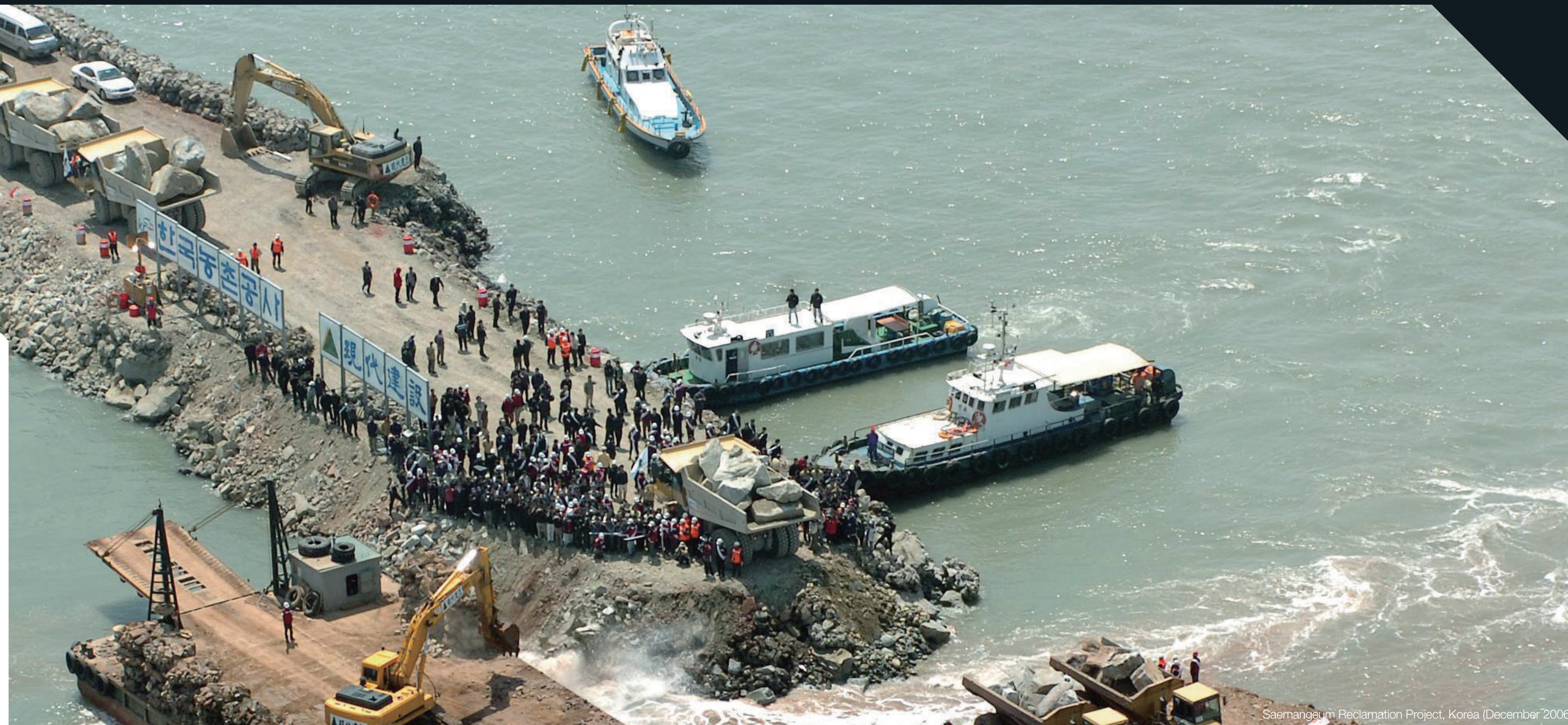
Seosan Reclamation Project, Korea

the site yet it could not be maneuvered into the 270 meter long gap in the new seawall.

The fast current around the Seosan coast pushed the giant oil tanker around. Chairman Chung was on board the ship and directed the maneuvering operation. The tanker was finally brought to the desired position and countless trucks began to dump the aggregate filling in the gap and the work continued throughout the night.

Despite all the hard work, the Chairman Chung and HDEC staff experienced a sour defeat the next morning as the Clear Water Bay tanker was pulled away from the seawall by the tide. Everyone involved was saddened by the failure. “Well, what are we waiting for? Get the tanker back in position. Put some more water in the tanker so it can sunk deeper”, Chairman Chung directed.

The work resumed immediately. The Clear Water Bay tanker was repositioned and blocked the powerful west sea. Over 14 days, 3.6 million tons of rock and soil, which required 514,300 trips by 15 ton trucks was poured into the sea to complete the seawall. After completion of the



Saemangeum Reclamation Project, Korea (December 2006)

Saemangeum Reclamation Project, Korea


Sihwa Development Project, Korea (March 1992)

second seawall, a vast new land spanning 9,663ha was revealed in district A. The combined size of district A and B is 16,000ha which increased the size of South Korea by one percent.

Ushering a new era of west coast

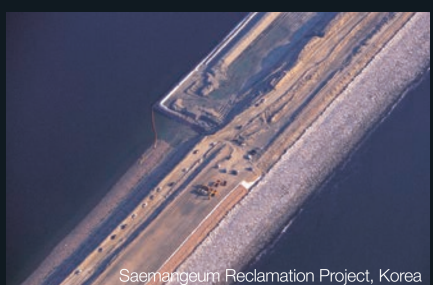
The first step in the Sihwa development project was reclamation of wetlands in Siheung, Hwasung and Ongjin-gun and thereby creating 17,300ha of new land for an industrial park, residential towns and farms. The project was the first step in developing the west coast of South Korea and HDEC was commissioned to construct the first Sihwa seawall. The work began in June 1987 and lasted for six years and seven months.

Once again, construction of the seawall was the most challenging part of the project. The seawall which would connect Oido island and Debudo island needed to be 12,700 meters long more than twice the length of the second seawall built as part of the Seosan project. The maximum tide was 10.3 meters high and the water current was expected to be as fast as 7.5 meters per second.

HDEC first attempted to fill the final gap to complete the seawall in December 1993 and failed. However, the seawall was successfully completed on the second attempt. Work began at 2:00 pm on 24th January 1994. The operation required 350 trucks with capacities ranging from 15 to 22 tons and seven large ships, which carried

23,000 5-ton wire-cylinders, 50,000 2-ton wire cylinders and 78,000m^3 of aggregate.

In 1992, the Saemangeum Reclamation Project, which aimed to create 40,100 hectares of land, the largest reclamation project began. The name of the project combined two nearby plains, Mangyeong plain and Gimjae plain, as the reclaimed land would link these two areas.


Saemangeum Reclamation Project, Korea

The seawall which spanned between Daehang-ri and Gunsan-si would be 33 kilometers long, making it the longest seawall in the world. HDEC was commissioned for the second sub-site linking Garyukdo and Sinsido among the four sub-sites.

The second sub-site was by the mouth of both the Dongjin and Mangyeong rivers, which made the seawall's construction the most challenging among the four sites. In addition to the 9,936m long section of seawall, there was to be drainage sluice gate, sluice gate for sea water, miter gate, fishway and low level drainage facility. HDEC successfully closed the two final gaps of the seawall, demonstrating its superior capacity.

The closing works was done based on HDEC's detailed analysis and research which should how quickly closing work needed to be done to avoid excessive loss of aggregate to the tide. The precise details of how construction should be carried out was obtained through simulations conducted using water current speed and quantity collected at the site.

Compared to previous projects, more advanced equipment was used. For example, twelve 35-ton trucks out of twenty available in South Korea were used. Likewise, for the first time bottom hopper barges were employed for more efficient deployment of wire-cylinders.

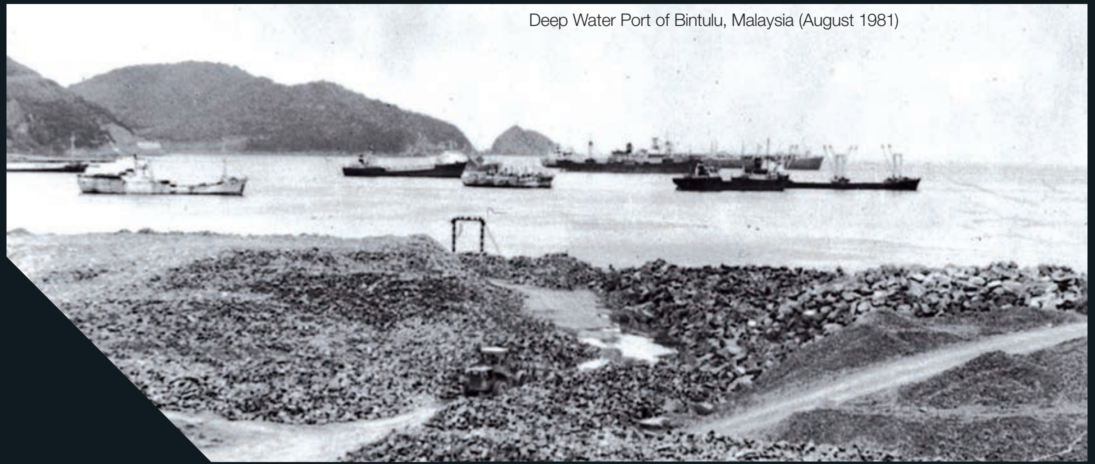
In addition to construction of the 2nd sub-site of the Saemangeum seawall, HDEC also won the contract for construction of the Sinsi sluice gate which was completed in 2006. Ultimately, HDEC completed construction of both sluice gates of the Saemangeum seawall. HDEC also carried out waterproofing work for Dongjin 1 sub-site (completed in December 2015) and the 1st phase of construction work for the breakwater of the first sub-site, making a major contribution towards the success of the Saemangeum project.


Saemangeum Reclamation Project, Korea (December 2006)

The HDEC's participation in major maritime infrastructure began with construction of the Jubail Industrial Harbor in 1976 and led to many other projects in the Middle East in the following decade. Next came the maritime construction boom in Southeast Asia in the 1980s, which began for HDEC with the deep water port of Bintulu, Malaysia.

Reshaping the coastline of Southeast Asia

Deep Water Port of Bintulu, Malaysia (August 1981)



Another beginning in the Strait of Malacca

Work on the deep water port of Bintulu began in October 1979 and was completed in August 1981. It was a relatively small contract with a budget of 7.38 million, yet it was an important contract as it was the first project HDEC had won in the region. The work consisted of foundation work, dredging, construction of two breakwaters of 1,100 and 2,100 meters in length and a 150 meter long sheet pile for the Jetty pier for oil transport.

In 1981, HDEC won its first contract in Singapore. At the time, Singapore was beginning to emerge as a major port city for international trade thanks to its location between the Pacific and Indian Ocean. HDEC won the contract for the Pulau Tekong Land Reclamation project in spite of fierce competition from Japanese and Dutch companies. The successful completion of the project had special significance as it then lead to many other projects in Singapore.

The project aimed to create 560 hectares of land through reclamation which required 28 million m^3 of aggregate. HDEC completed the project eight months prior to the deadline and gained a strong reputation in the market.

In order to speed up the progress of the project, HDEC deployed its own dredging ships Korye and Geumgang and they operated 24 hours a day. The two ships made 135 round trips altogether, between the Pulau Tekong construction site and Batam Island. Ten more dredging ships were from other companies and motor boats for communication were deployed in the the Strait of Malacca, ensuring HDEC company flags were visible all along the strait.

HDEC also began the Changi Airport expansion project in June 1982 and successfully completed it two

Employing all means for successful delivery

The greatest challenge for the Bintulu project was finding the means to transport the necessary resources. At the time, there was neither a well-built road nor long air strips which ruled out the use of both trucks and large airplanes. As a last resort, light airplanes were suggested, but they proved to be too costly and unable to carry large equipment or materials. Rocks were a precious resource in Bintulu and the best available were soft rocks which would weaken when submerged in water. HDEC was able to build an embankment large enough to build a two lane road and applied sheet piles in order to construct the Jetty. However, even soft rocks could not be sourced during the later part of the project and rocks had to be transported from a quarry 50km away from the work site.

Pulau Tekong Land Reclamation Project, Singapore (December 1984) months earlier than originally agreed. The project consisted of reclamation of 180 hectares of wetland and bank protection works. Approximately 12 million m^3 of aggregate and 325,000 man days were employed to complete the project. HDEC won contracts for many other projects in Singapore including reclamation for the Changi Car Ferry terminal (completed in January 1989), and the 2nd and 3rd phase of the Sungei Punggol reclamation works (completed in April 1989).

Taking on large-scale marine infrastructure projects in Singapore

Construction of the Brani container terminal turned Brani island into a globally recognized port. The work began in February 1990 and was completed in September 1994. The terminal has five container berths, four berths for refueling and restocking of water and various other facilities, with a maximum annual processing capacity of 3.8 million TEU.

On 21st October 1992, the Brani container port opened with three out of the five berths completed. The Singaporean Prime Minister hosted the opening celebration, one year before planned completion day and this helped ensure HDEC became a trusted partner of the Singaporean government.

Construction of the Brani Container Terminal, Singapore (September 1994)

Construction of the Brani Container Terminal, Singapore

Phase 2 Reclamation of Changi Airport, Singapore (March 1998)

In 1993, HDEC won the contract for the 2nd phase of the reclamation for the Changi airport project. The work aimed to reclaim 540 hectares of wetland and required 76.41 million m^3 of sand, 0.62 million m^3 of shore protection structures, making it the largest project HDEC has taken on in Singapore. HDEC developed a custom soft ground reinforcement method which utilized sand and compression of marine clay for the works. In June 1996, HDEC won the third phase reclamation works for the Changi airport project. Winning the third contract made HDEC the sole company to carry out the reclamation works for the project.

In October 1995, work on the 2nd phase of the Pasir Panjang container terminal began. Completed in March 2002, this was HDEC's first marine infrastructure project which employed the caisson method. In geotechnical engineering, a caisson is a watertight retaining structure. Caissons are built on the ground and then used to construct foundations by filling them with sand, gravel or concrete.

The project included the reclamation of 250ha of land, dredging of 3.27 million m^3 of sand and use of 1.78 million m^3 of ground improvement materials. A total of 88 large caissons with dimensions of 30m (W) x 16m (L) x 19m (H) and 5,000 tons in weight each, were utilized. The caisson method was also employed in the 3rd and 4th phase of the works for the Pasir Panjang container terminal which resumed in 2007. HDEC employed 150 caissons, weighing 11,500 tons each, demonstrating its technological advancement.

HDEC's marine infrastructure work in Singapore continued with a number

Phase 3-4 Constructions of Pasir Panjang Container Terminal, Singapore (April 2013)

of projects including the 1st phase of the Pulau Ayer Merbau reclamation project (completed in Feb. 2009), the 4th phase of the Jurong and Tuas View (completed in Dec. 2010) and the Chahwan Melayu reclamation project (completed in Jan. 2015).

Among all of the projects, construction of the undersea oil storage facility within the Jurong petrochemical complex, stands out as one of the three largest oil storage facilities in the world. Built on reclaimed land, the facility consists of an oil export terminal on the ground and an underwater oil storage facility. The two facilities are linked by two vertical pipelines which measure 26 meters in diameter and 126 meters in length. The two pipelines are connected to small pipeline terminals which are linked to underground caverns containing various types of oil.

The Jurong oil storage facility is a unique facility and nothing like it had ever been built before. Any new advanced technologies were required as the operations are conducted underground. The caverns are surrounded by a lattice of water-filled tunnels and boreholes — a “Water Curtain” — to prevent oil seepage by hydrostatic pressure and undesirable movement of oil mist movement along the rock joints.

Changing the map of Singapore with new technologies and methods

By 2014, HDEC has been an important part of the 6 percent increase in Singapore’s land territory through reclamation work and port construction. Thanks to this achievement, HDEC earned a reputation as the company which had redrawn the coastline of Singapore.

The Tuas Finger One reclamation project, which began in August 2014,

The 4th phase of the Jurong and Tuas View, Singapore (April 2017)

Building a mountain on the flat lands of Singapore

Singapore is built on a flat delta and therefore does not have any mountains. However, it now has a 60 meter tall man made mountain. The mountain was formed as HDEC piled the rocks from the underwater oil storage project on the spot. The HDEC employees involved in the oil storage project visit their mountain at the beginning of each year and wish for good luck and the successful completion of the project.

is expected to even further strengthen HDEC's reputation by redrawing the coastal lines of Singapore once again.

The Tuas Finger One project is also significant to HDEC as it is the fourth project involving the use of large scale caissons. The project is in progress and a total of 91 caissons 40 meters wide by 28 meters high and 30 meters long, each weighing 18,000 tons will be employed. HDEC will have installed 426 caissons by the completion of the Tuas Finger One project which will be more than twice as many as its closest competitor.

HDEC's frontline workforce and R&D center have jointly developed a new curing method for prevention of thermal cracking of concrete. The Tuas Finger One reclamation work is expected to be completed by January 2019 and expected to lead to the commissioning of Tuas Finger 3 and 4 projects. HDEC is also involved in the 2nd stage of the Pulau Tekong reclamation project (to be completed in 2023) and various other projects which all have a part in redrawing the coastal lines of Singapore.

Ongoing achievements in the Middle East

HDEC became less active in the marine infrastructure sector in the Middle East since the mid 1980s, as Southeast Asian firms began to be active in the market. Nevertheless, HDEC has remained active in the market, for example with new contracts recently in Kuwait. For example, the construction of a new oil pier for docking of five oil tankers at the Shuaiba port began in September 2000. It was the first project which HDEC led as an EPC company. HDEC successfully completed the project which required a comprehensive set of skills in areas including construction and electrical works.


Al-Zour LNG Import Terminal, Kuwait (February 2021)


Tuas Finger One reclamation project, Singapore (January 2019)


Boubyan Seaport Project (Phase-1), Kuwait (February 2014)

Successful completion of the new oil pier project helped HDEC win the expansion contracts for the 5th and 6th piers in 2005, helping HDEC maintain its market dominance in the Middle East.

Recently, Kuwait announced a long-term development plan to develop Boubyan island near the border with Iraq as a free economic zone. Called 'The City of Silk', the project is expected to create the biggest new city in the region and serve as a logistical and trading center. As part of the project, phase 1 of the Boubyan Seaport Project was commissioned and HDEC successfully completed the works at two different sites.

The project includes construction of a 1,700 meter long pier and docks for small ships and breakwater, as well as creation of a complex spanning 1.87 million m^2 in area. HDEC employed the combination pile wall method which employs large steel pipe piles, 2,540mm in diameter and steel sheet pile, once again demonstrating its technological prowess. A wide variety of ground improvement techniques were also employed for improved quality and reduced construction time.

In March 2016, HDEC won the contract for the Al-Zour LNG import terminal, worth 2.93 billion USD. The import terminal has facilities including a regasification plant which turns liquefied natural gas back into a gaseous state for transport through the pipeline.

The Al-Zour LNG Import Terminal is located 90 kilometers south of Kuwait city, the capital of Kuwait. The project involved reclamation of 530,000m^2 of wetland and construction of a regasification plant with a daily processing capacity of 3,000 billion BTU and eight LNG storage tanks which have a combined capacity of 225,500m^3. Other facilities including water pipelines, built with high-density polyethylene pipes 2,500mm in diameter, and docks large enough to accommodate two 290,000-ton LNG tankers were included in the project.

Recently, the number of new large scale projects in the Middle East has declined, largely due to the prolonged low oil price. Given the situation, the Al-Zour LNG Import Terminal project carries great significance as it increases HDEC's chance for winning new projects. The terminal is expected to be completed in February 2021.

GALLERY
MARITIME INFRASTRUCTURE

Oil Port & Docking Facilities (new oil pier project)
July 2004
Kuwait

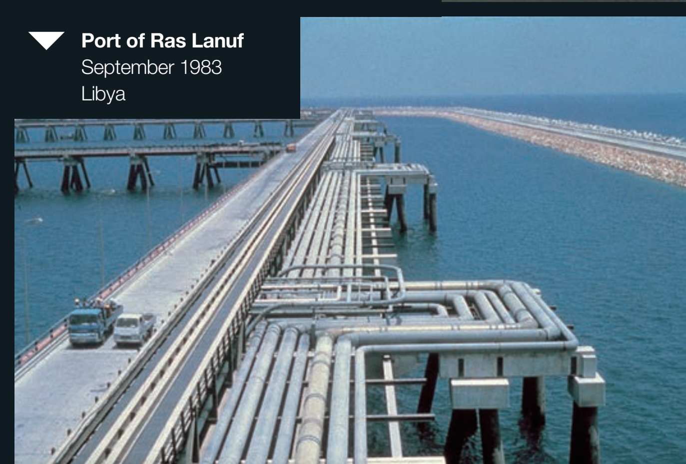
Khalifa Port Hinterland
June 2012
UAE

Nhava Sheva Harbors
July 1990
India

South Seawall of Ulsan New Port
May 2009
Korea

Construction of Busan New Port
June 2001
Korea

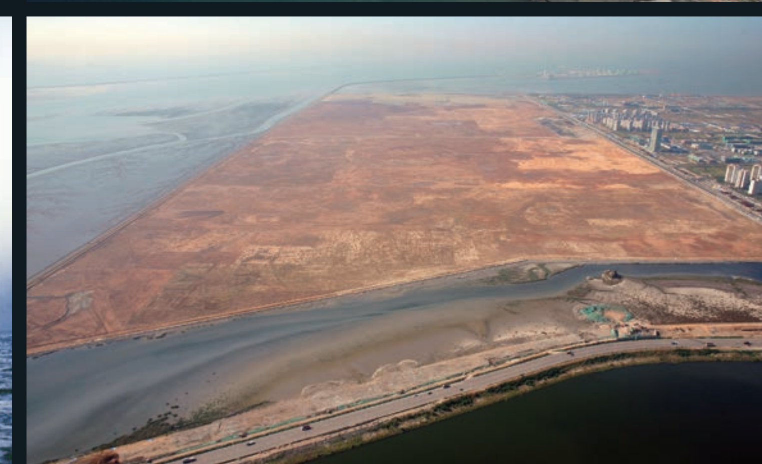
Port of Ras Lanuf
September 1983
Libya



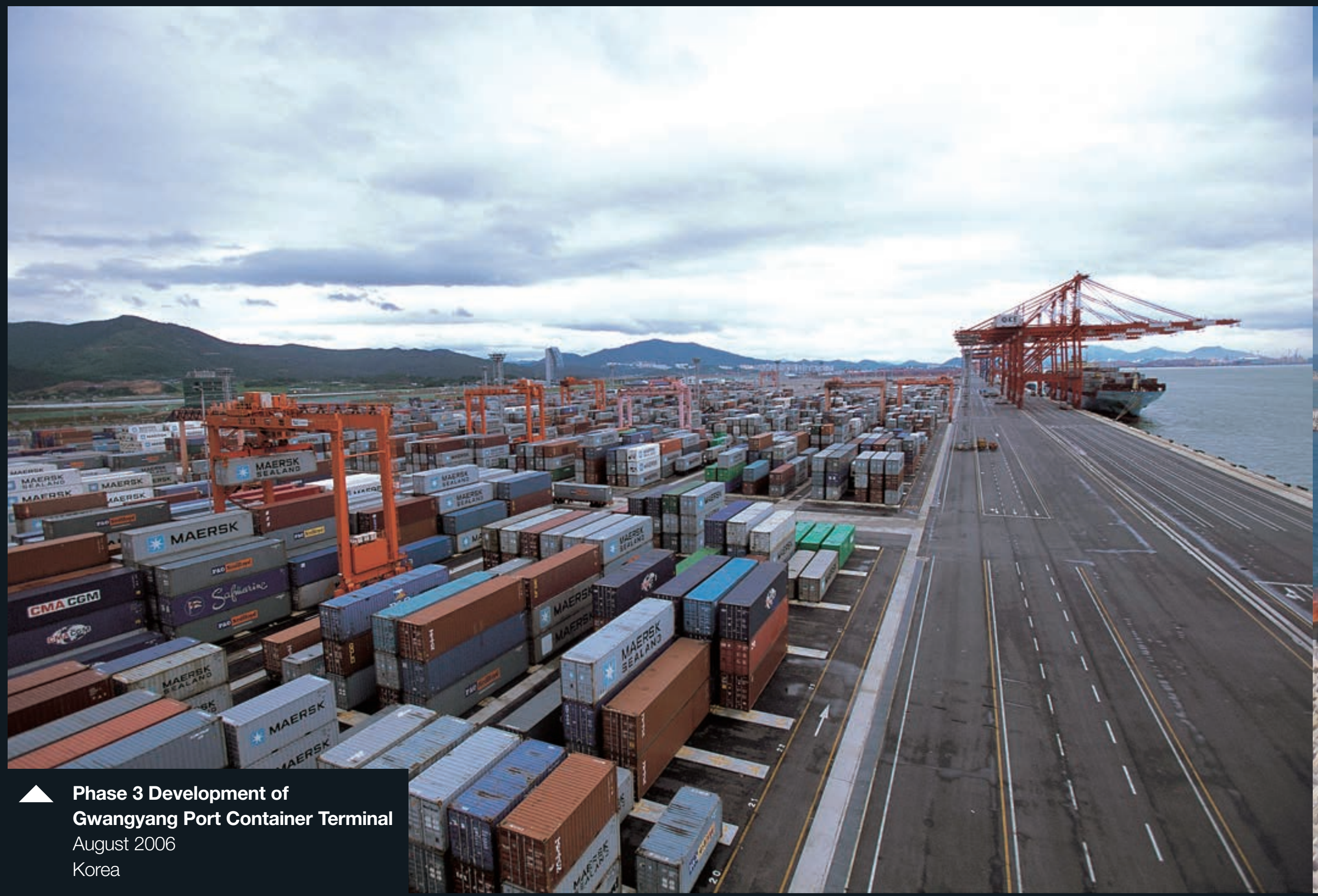
Dock and Port Facilities for Samchuck LNG Prouction Plant
June 2013
Korea

Port of Ras al Ghar
October 1978
Saudi Arabia

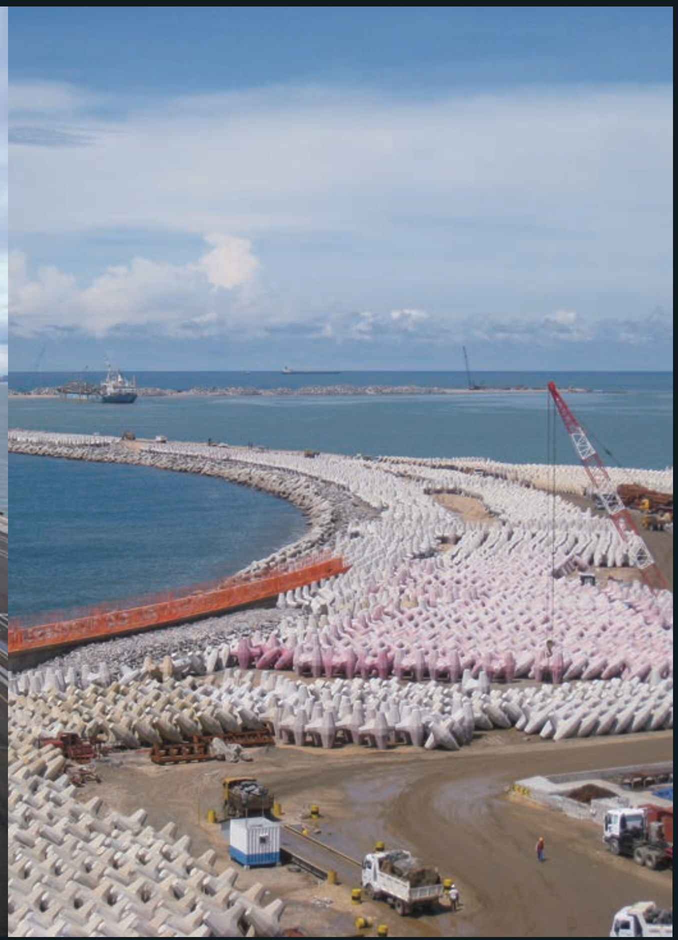
Songdo New City Dredging Reclamation Project
December 2007
Korea



GALLERY
MARITIME INFRASTRUCTURE



Phase 3 Development of
Gwangyang Port Container Terminal
August 2006
Korea



Extension Works for Colombo Harbor
April 2012
Sri Lanka

Dredging Construction of Cam Ranh Bay
January 1969
Vietnam

Phases 1-2 Extension Works for Port of Shuaiba
December 1979
Kuwait

Container Terminal
July 2005
Hong Kong

LIST MARITIME INFRASTRUCTURE

* The list below consists of select projects out of 318 projects.

Country	Project Name	Time of Completion
Korea	Gachon Dam	Jan. 1958
Korea	Construction of the 1st Dock of Incheon Harbor	Nov. 1960
Korea	Seonam Dam	Jan. 1964
Korea	Chunchon Dam & Hydroelectric Power Plant	Feb. 1965
Korea	Construction of Jinhae Harbor	Nov. 1967
Vietnam	Dredging Construction of Cam Ranh Bay	Jan. 1969
Australia	Dredging Project Bunbury Harbor	Mar. 1975
Korea	Damyang Dam	Sep. 1976
Korea	New Construction of Busan Port 1st Dock	Nov. 1976
Korea	Deokdong Dam	Jan. 1977
Bahrain	Arab Shipbuilding & Repair Yard	Feb. 1978
Korea	International Passenger Terminal Construction & the 1st Dock Reconstruction	May. 1978
Korea	Over-all Development Project Busan Port the 5th dock	Sep. 1978
Korea	Construction of Onsan Port North Breakwater	Sep. 1978
Saudi Arabia	Port of Ras al Ghar	Oct. 1978
Saudi Arabia	Marine Works for the Saudi Arabian Naval Base	Dec. 1978
Korea	Jangchan Dam	Jan. 1979
Kuwait	Phases 1-2 Extension Works for Port of Shuaiba	Dec. 1979
UAE	Preparatory Works of Zirku Island	Jan. 1980
Korea	Constructing Fuel Oil Terminal for Pyeongtaek Thermal Power Plant	Jun. 1980
Korea	Daecheong Multipurpose Dam	Dec. 1980
Korea	Phase 1 Development of Busan Port	Dec. 1980
Saudi Arabia	Jubail Industrial Harbor	Dec. 1980
Saudi Arabia	Yanbu LNG Sea terminal	Jan. 1981
Korea	Dredging Project Ulsan Port	Aug. 1981
Malaysia	Deep Water Port of Bintulu	Aug. 1981
Korea	Agricultural Comprehensive Development Project Daeseong-dong	Jun. 1982
Korea	Development Project Mihocheon the 2nd Sub-site	Jun. 1982
Korea	Phase 2 Development of Busan Port the 6th Dock	Dec. 1982
Korea	Juam Dam	Jan. 1983
Saudi Arabia	Yanbu Oil Port	Jan. 1983
Libya	Port of Ras Lanuf	Sep. 1983
Korea	Gwangyang Steel Works Site Renovation	Dec. 1983
Korea	Miho (Chopyeong) Dam	Jan. 1984
Korea	Seosan Reclamation Project	Feb. 1984
Libya	Phase 2 Development Port of Derna	Aug. 1984
Korea	River Improvement Project (Sub-site 84-1) of Nakdonggang River Coastal Development	Dec. 1984
Korea	Phase 2 Development of Busan Port	Dec. 1984
Korea	Incheon Costal Facilities	Dec. 1984
Singapore	Pulau Tekong Land Reclamation Project	Dec. 1984
Korea	Chungju Multipurpose Dam, Hydroelectric Power Plant and Incidental Facilities	Dec. 1985
Myanmar	Nyaunggyat Multipurpose Dam	Jan. 1986
Korea	Gwangyang Port Dredging Project	Jul. 1986
Korea	Hoeya Dam System Waterworks Expansion – Drainage Facilities the 3rd Sub-site	Jul. 1986
Korea	Ulsan Multipurpose Entrepot Construction (the 1st Sub-site)	May. 1987
Korea	Tancheon Sewage Treatment Plant of Han River Development Project	Aug. 1987
Korea	Bonghwa Dam	Jan. 1988
Yemen	Al Hudaydah Extension Work Project	Mar. 1988
Korea	Embankment in Nakdong Estuary	Jun. 1988
Korea	Phase 3 Development of Busan Port	Jun. 1988
Korea	Development an Agricultural Industrial Complex of District Sangbuk	Jun. 1988
Korea	Construction of Ulsan-si Sewage Pipes (the 2nd Sub-site)	Jun. 1988
Saudi Arabia	Medina College Shore Protection Work	Sep. 1988
Saudi Arabia	Duba Open Sea Tanker Terminal	Sep. 1988
Iraq	Shipbuilding & Repair Yard	Oct. 1988
Singapore	Changi Car Ferry Terminal Reclamation Project	Jan. 1989
Singapore	Sungei Punggol Reclamation Works	Apr. 1989
Pakistan	Tarbela Dam Construction	Mar. 1990
India	Nhava Sheva Harbors	Jul. 1990
Korea	Sihwa Development Project	Mar. 1992
Korea	Gunja Dredging Reclamation Project	Oct. 1992
Korea	Grounwork for Gwangyang Slag Processing Facility (zone 5)	Nov. 1992
Iran	Bandar Abbas Mobilization Drill Shipyard	Nov. 1993
Singapore	Construction of the Brani Container Terminal	Sep. 1994
Korea	The 2nd Construction Docking Facilities Onsan Port of Onsan National Industrial Complex	Dec. 1994
Korea	Ganwol Seawall	Jan. 1995
Korea	Hyundai Oil Bank 200,000 BPSD Capacity Expnasion Work	Dec. 1995
Korea	Bunam Seawall	Jan. 1996
Korea	Miryang Multipurpose Dam	Jan. 1997
Korea	Construction of Gwangyang-si Waste Disposal Facilities	Dec. 1997
Korea	Port Construction of Daebul Industrial Base	Dec. 1997
Singapore	Phase 2 Reclamation of Changi Airport	Mar. 1998
Korea	Facilities for Daechung Dam Municipal Water System (zone 2-1)	Jun. 1998
Korea	Mokpo-si Namhae Sewage Treatment Facility	Jun. 1998
Thailand	Sattahip Naval Base Dock	Jun. 1998
Korea	Construction of Ulsan Port East Seawall	Dec. 1998
Korea	Construction of Sewage Treatment Facilities in Damyang	Oct. 1999
Korea	Gwanghwa 2nd District River Bank Repair and Readjustment of Fields	Nov. 1999
Korea	Gwangju Pungam Housing Site Development Works (zone 2)	Nov. 1999
Korea	Mokpo Sapjin District Industrial Park Development	Nov. 1999
Korea	Sihwa Development Project	Nov. 1999
Korea	Coast Passenger Terminal Renewal	Nov. 1999
Indonesia	Ancol Baru Reclamation	Nov. 1999
Korea	Seawall and Drainage Gate Construction for New Airport in the Metropolitan Area (zone 7)	Dec. 1999
Korea	Nakdong River Sewage Treatment Facility Purchase and Installation	Mar. 2000
Korea	Dock Facilities and Immigration Office for Kumgangsan Ferry	Jun. 2000
Korea	Civil Works for Field on the North Side of Incheon International Airport Runway #1 (zone A-1)	Nov. 2000
Korea	Hoengseong Sewage Treatment Plant	Dec. 2000
Jordan	Aqaba Harbor Project	Dec. 2000
Korea	Geumho Seawall	Jan. 2001
Korea	Construction of Busan New Port	Jun. 2001
Korea	Undersea Pipe Circulation System for Incheon Metropolitan Area	Oct. 2001
Korea	Yeongil Bay New Port Harbor Facility Construction Work	Oct. 2001
Korea	Gumi Gupyung District Housing Site Development	Nov. 2001
Korea	West Nakdong River Sewage Treatment Facility	Nov. 2001
Egypt	Reclamation for eastern part of Port Said & Marin Construction	Jan. 2002
Singapore	Phase 2 Construction of Pasir Panjang Container Terminal	Mar. 2002
Kuwait	Oil Port & Docking Facilities (New Oil Pier Project)	Jul. 2004
Korea	Sihwa Development Project (Seawall & Incidental Facilities)	Nov. 2004
Korea	Civil Works for Youngsan River 3-1 section (Masan 1 zone)	Dec. 2004
Vietnam	Ha Long Shipyard	Feb. 2005
Korea	Gunjang National Industrial Park (Gunsan area) Development (zone 6)	Jun. 2005
Hong Kong	Container Terminal	Jul. 2005
Korea	Hyundai Heavy Industries Shipyard dock #1 and #2 Construction	Jan. 2006
Korea	Constructing the Sinsi Sluice Gate of Saemangeum	Apr. 2006
Iraq	Water Resource Restoration Work	Jul. 2006
Korea	Phase 3 Development of Gwangyang Port Container Terminal	Aug. 2006
Korea	Saemangeum Reclamation Project	Dec. 2006
UAE	Phase 1 Development of Jebel Ali Container Terminal	Aug. 2007
Korea	Songdo New City Dredging Reclamation Project	Dec. 2007
Singapore	The 1st Phase of the Pulau Ayer Merbau Reclamation Project	Feb. 2009
Korea	South Seawall of Ulsan New Port	May. 2009
Korea	Gunsan Shipyard DOCK	Jan. 2010
Singapore	The 4th Phase Reclamation of the Jurong and Tuas View	Dec. 2010
Korea	2nd phase Gulpo Stream Drainage (zone 1)	Jul. 2011
Korea	Chungju Dam Upstream Sewage Facility Expansion Work (zone 1)	Sep. 2011
Korea	Gwanggyo Stream Restoration Work	Nov. 2011
Korea	The 1st Sub-site Construction of Gyeongin Ara Waterway Project	Dec. 2011
Korea	Han River Restoration Work section 6 (Yeoju zone 4)	Dec. 2011
Korea	Civil Works for Raising Road for Saemangeum 1st Seawall	Dec. 2011
Korea	Nakdong river Restoration Project section 15 (Milyang 4 and Gimhae 11 zones)	Feb. 2012
Korea	Seongdeok Multipurpose Dam	Feb. 2012
Sri Lanka	Extension Works for Colombo Harbor	Apr. 2012
UAE	Khalifa Port Hinterland	Jun. 2012
Korea	Substructure for Incheon New Port Container Terminal 1-1 (zone 1)	Oct. 2012
Korea	New Ulsan General Industrial Park Development	Nov. 2012
Korea	Magnetic Measuring / Processing Dock Facilities	Dec. 2012
Singapore	Phase 3-4 Constructions of Pasir Panjang Container Terminal	Apr. 2013
Korea	Dock and Port Facilities for Samchuck LNG Prouction Plant	Jun. 2013
Kuwait	Boubyan Seaport Project (Phase-1)	Feb. 2014
Korea	Myungji District Development Project for Busan Jinhae Free Economic Zone	Jun. 2014
Korea	The 2nd Sub-site Jeju Nnaval Base	Sep. 2014
Singapore	Tuas Mega Port Southern Reclamation Project	Jan. 2015
Singapore	Chahwan Melayu Reclamation Project	Jan. 2015
Korea	Saemangeum Dongjin zone 1 Water Repellant Application Works	Dec. 2015
Korea	The 1st Phase of Construction Work for the Breakwater of the 1st Sub-site, Saemangeum Project	Dec. 2015
Qatar	New Port Project	Feb. 2016
Singapore	The 4th Phase of the Jurong and Tuas View	Apr. 2017
Korea	Phase 2 fo Incheon Port Internatinal Passenger Terminal	Jul. 2017
Korea	Sihwa MTV the 1st Sub-site	Dec. 2018
Singapore	Tuas Finger One Reclamation Project	Jan. 2019
Korea	Anheung Outer Port Maintenance	May. 2019
Kuwait	Al-Zour LNG Import Terminal	Feb. 2021
Singapore	The 2nd Stage of the Pulau Tekong Reclamation Project	Mar. 2023

BRIDGES

The noun, bridge is a structure carrying a road, path, railroad, or canal across a river, ravine, road, railroad, or other obstacle. Bridge can also be used as a verb, meaning to connect or link. Indeed, each bridge can create a link and eventually create a network. Hyundai E&C is helping connect people to the world by building bridges

Connecting people and the world

02

The 3rd Bosphorus Bridge, Turkey (August 2016)

In civil engineering terms, a bridge is a physical structure built to carry a road, railroad, or canal across a river, ravine, sea, road, railroad, or other obstacle. In other words, a bridge creates a link between two locations separated by a natural or manmade obstacle. Building a bridge does not just create a physical link between two locations but also creates a link between people and culture as well.

A bridge to a new era: Goryeong Bridge and Han River Bridge

HDEC's first bridge

Since time began, people has been building bridges to link geologically disconnected lands which in turn lead to trade and the expansion of culture. There are also ecological bridges which are built to allow wild animals and plants to travel between habitats, leading to better protection of the environment. As these examples indicate, bridges not only link people and culture but so much more. Finally let us not forget the great historical significance of some bridge, which have quite literally have changed history.

HDEC entered the business of bridge building with a small restoration project. In 1951, HDEC repaired the Sanghyun bridge and subsequently reconstructed Wolcheon, Hongman, Hosan, Nonsan and Jukpo bridges during the Korean War.

The bridge restoration projects provided HDEC with the basic skills and experience necessary to take on the Goryeong Bridge Restoration Project which was commissioned in April 1953. Goryeong Bridge, which links Daegu and Geochang, was destroyed by the US Army at the beginning of the Korean War and many civilians were sacrificed during the process.

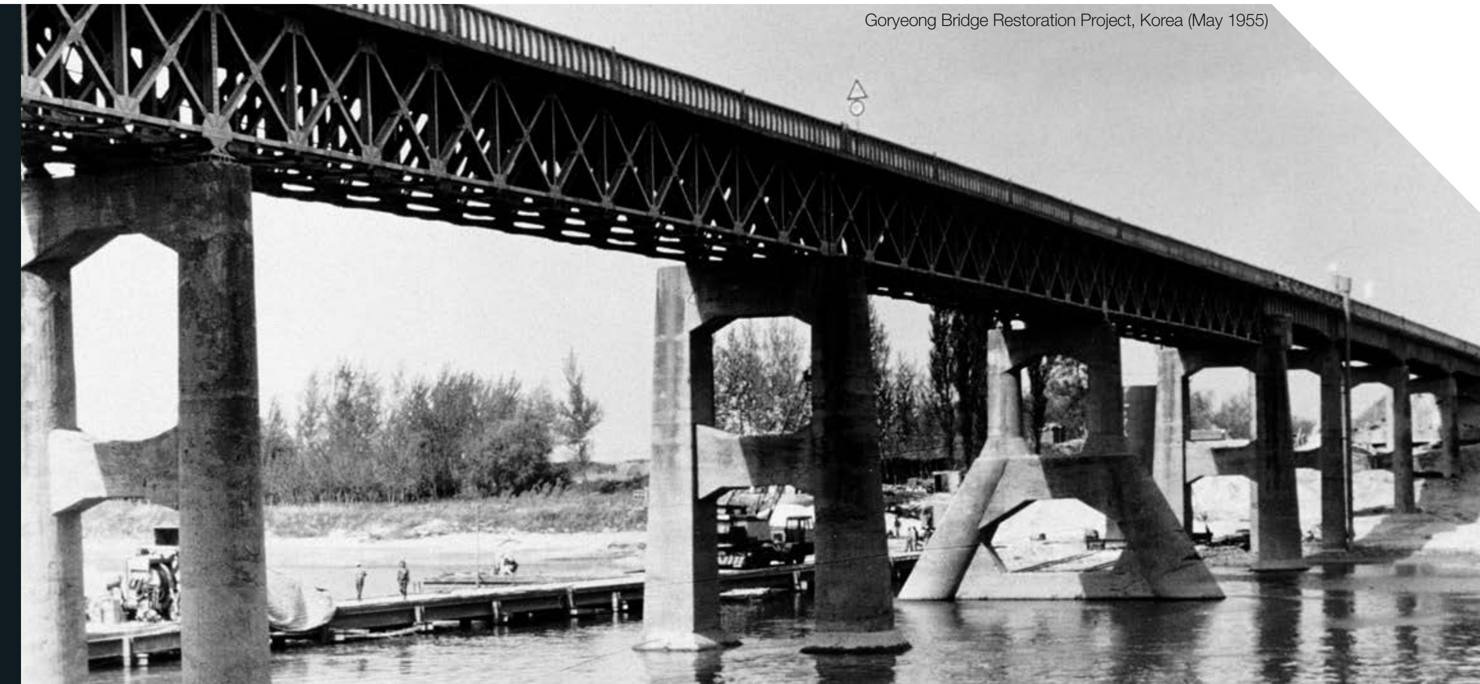
Spanning 195 meters, Goryeong Bridge was a pole bridge which was not very common. The restoration required construction of 13 piers and two 60 meter long trusses. The contract was for 54.78 million Hwan (Korean currency up to 1962), which at the time was the largest contract HDEC had won. There was much speculation that the project was too large for HDEC to handle so HDEC took on the project even more determined to succeed.

Successful restoration of the Goryeong Bridge was essential, as it would position HDEC to win subsequent civil engineering projects from the South Korean government. Yet, the restoration turned out to be incredibly difficult, particularly as the bridge was almost completely destroyed with the exception of the foundations.

The widely varying depth of the Nakdong River made the work even more difficult, as water levels rose greatly during the summer compared to winter. Equipment was lacking as well; all HDEC had was an old crane, a mixer and a stationary compressor. As a result, almost everything had to be done manually with human labor.

To make things worse, HDEC's financial situation wasn't good. The project was indeed too large in scale for HDEC to deliver and resources were tight from the very beginning of the project. Soaring material and labor costs due to high inflation made the situation even worse. At one point, executives sold their houses and even sold the automobile repair center which had been a cash cow for HDEC, yet these measures only provided temporary relief.

Over the 26 months that the project lasted, HDEC had to perform every financial maneuver known to complete the project. By the time it was finally completed in May 1955, HDEC was on the brink of bankruptcy.



Goryeong Bridge Restoration Project, Korea (May 1955)

Goryeong Bridge Restoration Project, Korea (May 1955)

THE HIDDEN STORY

Goryeong Bridge
Although the Goryeong Bridge resulted in significant financial loss, this was offset by the many intangible benefits it provided HDEC with. The first was credibility which was the biggest reason why HDEC did not give up on the project despite the overwhelming financial pressure. HDEC's commitment to completion regardless of financial loss greatly impressed the government and HDEC earned the well deserved reputation of being a 'trustworthy company'. The second reward was the technology and experience gained through being involved in the first major postwar reconstruction project. HDEC earned many new bridge construction techniques such as using scrap metal rails in bridge restoration.

Making it into the big six: Successful restoration of the Han River Bridge

The Goryeong Bridge Project may have almost bankrupted HDEC but it gave HDEC the capacity to take on the Han River bridge project which was commissioned in 1957. The Han River Bridge was originally built by the Japanese in 1917 and was rebuilt in 1930 after it was washed away during a flood in 1926. The bridge was once again destroyed on 27th June 1950, in order to slow down the North Korean army. Over 500 civilians were killed when the bridge was destroyed under the order of President Syng-man Rhee.

The contract for the Han River Bridge

restoration was 230 million Hwan which was approximately five times larger than the Goryeong Bridge Project. It was the largest restoration project commissioned by the Korean government after the end of the Korean War.

Unfortunately, HDEC did not have a great chance of winning the contract as at the time bribery and political connections were essential in order to win any sizeable government contracts. HDEC was still a relatively small company and winning the Goryeong contract was regarded as an abnormality.

However, overheated competition for the contract between two leading companies, lasting more than a year, forced the Korean government to open up the bidding, creating an unexpected opportunity for HDEC.

The outcome of the competitive bidding dismayed government officials as a leading company put in a bid for a mere 1,000 Hwan which was one quarter of a basic fare for a taxi ride in Seoul at the time. Their strategy was to win the bid with the lowest price and renegotiate later on. However, the government decided it was disrespectful and disqualified them.

With the lowest bid disqualified, the contract was given to the second lowest bidder which was HDEC.

It was a great victory yet the restoration work was not going to be easy. Unlike Goryeong Bridge which was a truss bridge, the Han River bridge was a tied arch bridge which was made with over 120,000 rivets. Although HDEC had some experience with bridge restoration this project presented many new challenges.

The restoration began by lifting up the old bridge structure by 2 meters and lowering it to the water surface level. This was a crucial step and HDEC carefully calculated the structural mechanics of the operation and successfully completed the operation without dismantling the old bridge, which was then able to serve as the work platform for workers. Thanks to its highly efficient operations, HDEC was able to successfully complete the restoration in eight months as planned. The profit margin for the Han River Bridge Project was over 40 percent which made up for some of the losses incurred during the Goryeong Bridge Project.

The Han River Bridge reopening ceremony was held at 11 AM, on 15th May 1958 with tens of thousands of Seoul citizens attending as well as President Syng-man Rhee. The Citizens' Committee for the bridge restoration organized a march over the bridge which created quite a spectacle.

A series of events were held to celebrate the restoration, covered by all major media including radio stations, making HDEC a household name. The success of the project also positioned HDEC as a leader in bridge restoration and from then HDEC was regarded as a member of the big six construction companies in South Korea.

Han River Bridge Restoration Project, Korea (May 1958)

TECH POINT

Bridge restoration with scrap steel rails

Restoring Goryeong Bridge was a huge challenge for HDEC especially because good construction materials were hard to secure at the time. The Korean government suggested using scrap metal for the restoration work, a method that had never been attempted before. HDEC hired all the civil engineers they could find including some from the Ministry of Home Affairs and Engineering, which had a patent in this area.

Preparing for a tiger hunt

During the Goryeong bridge restoration, HDEC chairman Ju-young Chung is known to have often repeated the Chinese proverb "One cannot hunt a tiger with bare hands likewise one can't cross the great Yellow River on foot" which reminded him to invest in the necessary construction equipment, which was vital for the successful completion of the project.

At that time, US military bases were the only source of construction equipment, each week selling pieces of their old equipment. Mr. Chung visited the base and bought anything that looked like it could have some value. He would then gather the engineers to study the equipment he has bought and repair it where necessary. Later, he opened a heavy machinery repair shop at the car repair factory he owned; refurbishing the equipment and even making some new construction equipment.

The construction equipment HDEC secured began to shine as the post-war reconstruction work funded by US aid funds, began to take off. Many of the construction projects required a lot of equipment, which could not be met by most of the domestic construction companies at the time. As a result, HDEC was able to win construction work at a fair price without much competition.

The vast majority of cities are positioned alongside a river. Yet, there are only a handful of cities which have as large a river as the Han. Guillaume Apollinaire, a famous French poet, wrote a number of romantic poems about the Seine in Paris. As charming as the Seine might be, its maximum width is only 120 meters, whilst the Han River is more than 1,100 meters, placing the Han River in a league of its own.

Bridges to the miracle of the Han River

A bridge of expansion

The Han River Railway Bridge, the first bridge across the Han River was 1,013 meters long. The bridge was completed in 1900, more than 500 years after Seoul was chosen as the capital of the Chosun Kingdom. Yet, most of Seoul remained on the north side of the Han River until many more bridges were built, starting in the 1960s. The Gangnam district which is now regarded as a central part of Seoul only started being developed in the early 1970s.

In this regard, bridges over the Han River and other parts of South Korea were one of the many driving forces of South Korea's economic development. The Miracle of the Han River, a term which symbolizes South Korea's rapid economic development could also be the Miracle of the Han River Bridges.

As of 2017, the Han River has 30 bridges and 13 of them were built by HDEC. In fact, HDEC built the 2nd and 3rd Han River Bridges, after the restoration of the Han River bridge which was briefly called the 1st Han River Bridge. The foundations for the Miracle of the Han River were the Han River Bridges and HDEC is proud to have been the driving force behind them.

The construction of the 2nd Han River bridge, Yanghwa Bridge, began on 20th May 1962 and was completed on 25th January 1965. Yanghwa Bridge carried special significance as it was

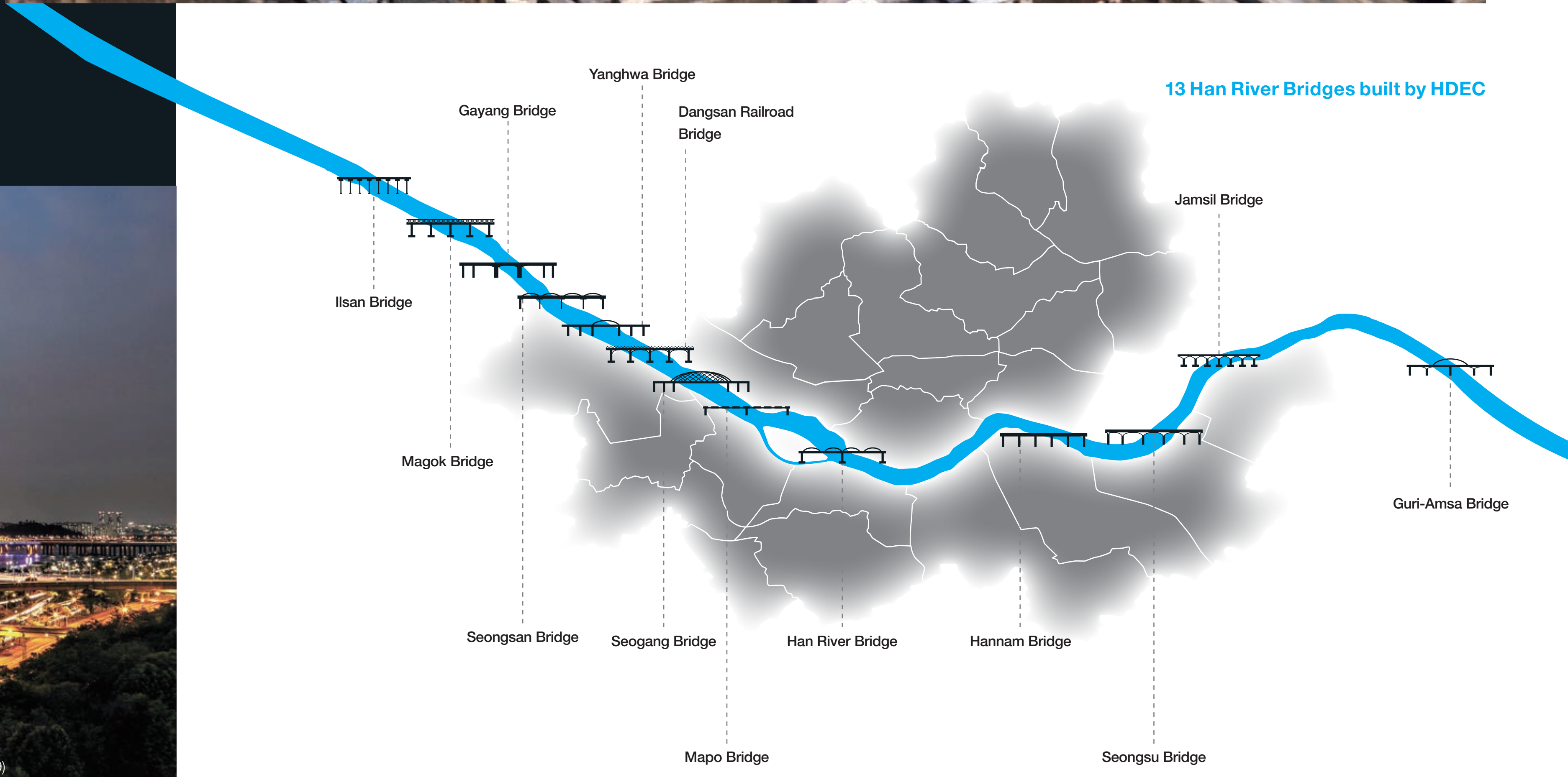

Hannam Bridge, Korea (December 1969)

THE HIDDEN STORY

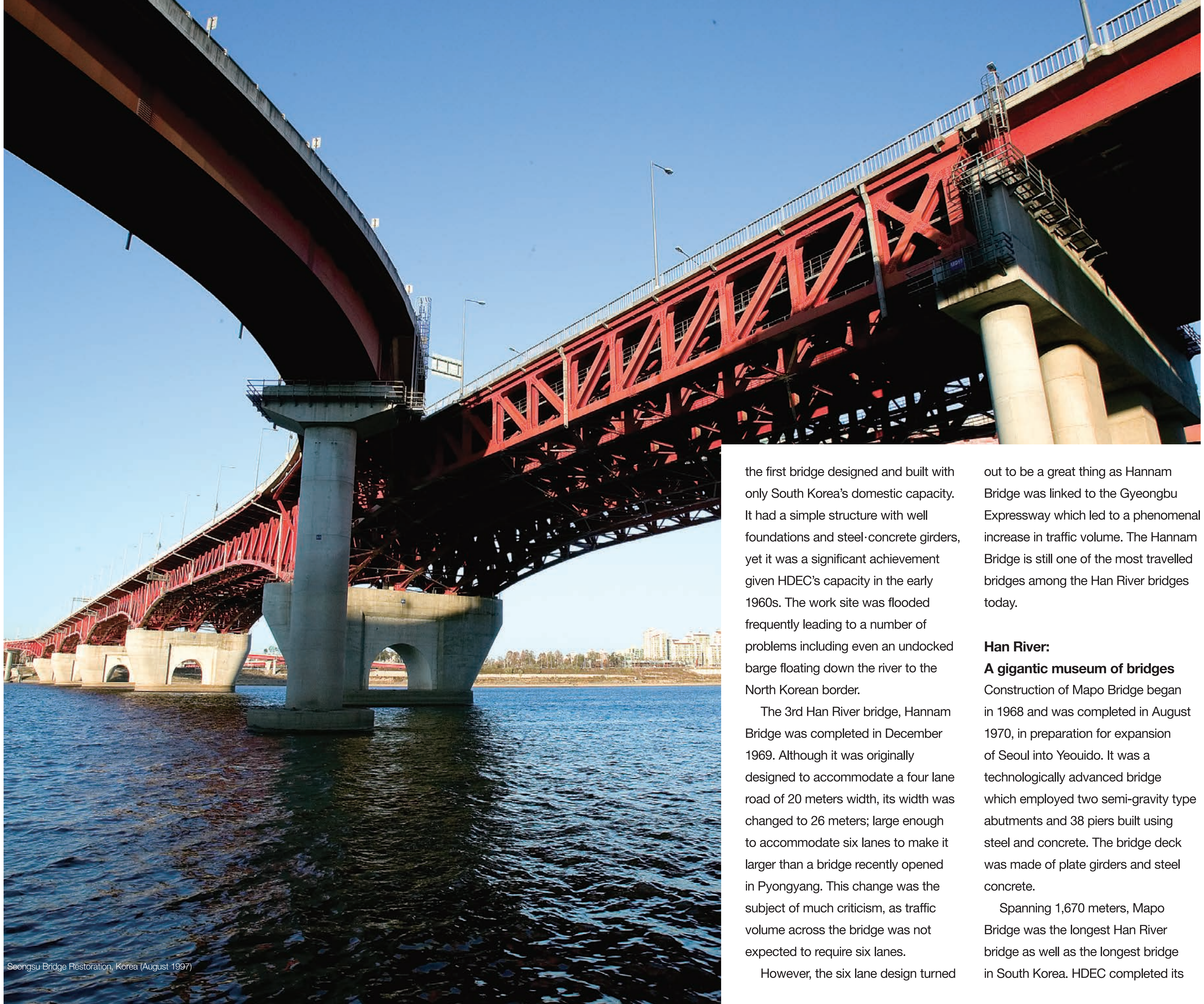
13 Han River Bridges built by HDEC

Following completion of the Gayang Bridge, HDEC built three more bridges including the Ilsan Bridge (completed in Jan. 2008), the Magok Bridge (completed in Oct. 2010), and the Guri-Amsa Bridge (completed in Nov. 2014), bringing the number of Han River bridges built by HDEC to thirteen. The latest, Guri-Amsa Bridge, is a three-span continuous arch bridge which has the longest span of 180 meters. A steel caisson tube cofferdam method was employed which allows for underwater construction without causing water pollution.


Yangwha Bridge, Korea (January 1965)



Mapo Bridge, Korea (August 1970)



Seongsu Bridge Restoration, Korea (August 1997)

the first bridge designed and built with only South Korea's domestic capacity. It had a simple structure with well foundations and steel·concrete girders, yet it was a significant achievement given HDEC's capacity in the early 1960s. The work site was flooded frequently leading to a number of problems including even an undocked barge floating down the river to the North Korean border.

The 3rd Han River bridge, Hannam Bridge was completed in December 1969. Although it was originally designed to accommodate a four lane road of 20 meters width, its width was changed to 26 meters; large enough to accommodate six lanes to make it larger than a bridge recently opened in Pyongyang. This change was the subject of much criticism, as traffic volume across the bridge was not expected to require six lanes.

However, the six lane design turned out to be a great thing as Hannam Bridge was linked to the Gyeongbu Expressway which led to a phenomenal increase in traffic volume. The Hannam Bridge is still one of the most travelled bridges among the Han River bridges today.

Han River:
A gigantic museum of bridges

Construction of Mapo Bridge began in 1968 and was completed in August 1970, in preparation for expansion of Seoul into Yeouido. It was a technologically advanced bridge which employed two semi-gravity type abutments and 38 piers built using steel and concrete. The bridge deck was made of plate girders and steel concrete.

Spanning 1,670 meters, Mapo Bridge was the longest Han River bridge as well as the longest bridge in South Korea. HDEC completed its

Seogang Bridge, Korea (December 1996)

construction in only two years. The twelfth Han River bridge, and fifth Han River bridge built by HDEC, was Seongsan Bridge which was completed in 1980. It was the first Han River bridge designed with an emphasis on aesthetic value. It was the first Gerber Truss bridge with half-moon shaped plates which created an aesthetically pleasing contrast against the straight lines of the bridge.

HDEC has also rebuilt existing Han River bridges. On 21st October 1994, a large part of Seongsu Bridge's deck fell into the river, leading to the death of 32 people. Built by the Donga Construction company, it was a Gerber Truss Bridge which was the eleventh Han River bridge built. HDEC began reconstruction work in April 1995 with significant attention from the media and the public. HDEC successfully addressed the flaws in the original design, making it anew.

HDEC's attention to aesthetic values continued with the Seogang Bridge completed in 1996. The project originally began in 1984 as the 18th bridge over the Han River yet it was stopped after the completion of 17 piers. The work resumed in 1992 and was completed three years later.

The Seogang Bridge was the first Nielsen Arch bridge built in South Korea and it worked well with its surrounding environment. The impact on the wild birds of Bamseom island was also considered during the project.

HDEC's work on Han River bridge construction has continued into the 21st century with Gayang Bridge which has the longest span of 180 meters among the Han River bridges.
It opened in January 2002 in preparation for the 2002 FIFA World Cup co-hosted by South Korea and Japan.

The evolution of bridges in South Korea

Completed by HDEC in 1973, Namhae Bridge was the first suspension bridge built in South Korea. A suspension bridge supports the weight of the deck using steel cables and is desirable when the maximum span of a bridge is too long for an arch bridge or cable-stayed bridge. At the time, many thought construction of Namhae Bridge would be impossible because of the fast currents and deep water. However, HDEC utilized suspension bridge technology and successfully linked Namhae island with the mainland.

In 1984, HDEC completed construction of Jindo Bridge which was the first cable-stayed bridge in South Korea. Employing steel box girders, it has two piers built far apart and employs cables to support the deck weight. The distance between the piers of Jindo Bridge is 344 meters. In 2005, HDEC built the 2nd Jindo Bridge which is largely identical to the first bridge.

Daedong-Hwamyeong Bridge, Korea (July 2012)

Applying advanced technologies, the 2nd Jindo Bridge can support more weight despite having eight strands of cables less than the first bridge.

Machang Bridge is one of most technologically advanced bridges built by HDEC in the 21st century, along with the 2nd Jindo Bridge. Spanning over 1,700 meters, it is a pole bridge with a deck height of 68 meters above sea level to allow ships to pass under the bridge to Masan seaport. Given its exposure to possible hurricanes, it is also designed to sustain wind speeds of up to 78 meters per second.

Completed in July 2012, Daedong Hwamyung Bridge is one of the finest examples to demonstrate HDEC's capacity in concrete cable-stayed bridges. Although most cable-stayed bridges use steel decks, the Daedong Hwamyung Bridge has as concrete deck which cost much less. For almost 20 years concrete cable-stayed bridges were not built after the Paldang Bridge and Olympic Bridge suffered from accidents. Successful completion of the Daedong Hwamyung Bridge helped set a new precedent for re-emergence of this technology.

To date Ulsan Bridge, which was completed in May 2015, stands as the most recent example of HDEC's mastery of suspension bridge construction which began with Namehae Bridge. The length of the structure, a single span suspension bridge, is over 8,380 meters including the connecting roads. The distance between the two main piers is 1,150 meters, which is the third longest span for a suspension bridge in the world.

New technologies such as Prefabricated Parallel Wire Strand (PPWS) cables and installation equipment played an essential role in making the Ulsan Bridge a success. Developed by HDEC, PPWS cables are made using 127 5mm-thick steel cables in a hexagonal formation, which makes it strong enough to sustain 600 tons of weight. The custom-made cable installation equipment can lay cable over a maximum span of 2,000 meters. The equipment also has a Driving Winch which can freely move and tighten or loosen the cables as needed.


Ulsan Bridge, Korea (May 2015)

The Han River Bridges that HDEC has built provide an excellent overview of how HDEC's bridge building capacity has evolved. However, there are many other great bridges that HDEC has built outside of Korea. HDEC has continually improved its technologies as it has built bridges around the world, linking people and cultures.

Bridging the world with advanced technologies

HDEC's first bridge outside of Korea and the Penang Bridge
The first bridge HDEC built outside of South Korea was the Hurricane Gulch Bridge in Alaska, which was completed in October 1971. The Hurricane Gulch Bridge is a 171 meter-long arch railroad bridge that crosses the Hurricane Gulch of Mount McKinley. The project presented many challenges which put off many other companies. HDEC established a local office, won the contract and completed the project after 34 intense months.

The Penang Bridge was HDEC's second bridge built outside of South Korea. The 13.5 kilometer-long bridge links the mainland and Penang island, nicknamed the Pearl of Asia. Approximately 8.5 kilometers of the bridge is over seawater and when it was completed in 1985 it was the longest bridge in Asia and third longest bridge in the world.

Taking place at the end of 1981, the competition for the Penang Bridge contract was fierce. Although HDEC was initially placed 2nd, HDEC made a bold offer to shorten the construction period to 30 months which strongly appealed to the Malaysian government and tipped the scale in HDEC's favor. Penang Bridge was built as a concrete girder bridge except for a 440 meter-long section in the middle which is cable-stayed.

Building piers on soft soil under seawater presented the biggest challenge of the project and over

Penang Bridge, Malaysia (August 1985)

Malaysian PM Mahathir Mohamad and his Pony

Mr Mahathir Mohamad was the Malaysian Prime Minister (PM) when Penang Bridge was under construction. Particularly impressed with the success of Hyundai Motor, he sent Malaysian engineers to Hyundai Motor's Ulsan factory for technical training. He also personally visited South Korea multiple times and toured the factory. He later implemented the 'Look East' policy to reproduce Korea's economic development.
HDEC chairman Chung greatly welcomed the PM when he visited Korea. Through this process, the relationship between HDEC and the Malaysian government became stronger, which helped HDEC win the Penang Bridge project. At the time of Mahathir's visit in 1983, chairman Chung presented Hyundai's first sedan, the Pony. The Pony car, presented by Ju-young Chung, is now displayed at the Tun Dr. Mahathir Mohamad Memorials.

Penang Bridge, Malaysia

Vancouver Skybridge Project, Canada (December 1988)

Hurricane Gulch Bridge in Alaska, USA (October 1971)

15,000 concrete piles had to be installed to strengthen the foundations. A pile manufacturing plant, the biggest in Asia, was built to supply the piles which measured 1 meter in diameter and 60 meters in length. To be installed, each pile had to be hammered over 5,000 times using a remote controlled steam hammer.

Leading in global bridge construction

Winning the Vancouver Skybridge Project put HDEC back in the North American market, giving it a second chance, 15 years after completion of the Hurricane Gulch Bridge in Alaska. Built to carry a high-speed train service, the Skybridge is a cable-stayed bridge which spans the Fraser River. Completed at the end of 1998, the bridge is an impressive 12.56 meters wide.

Penang Bridge in Malaysia and Skybridge in Canada are two of the most notable bridges HDEC's built in the 1980s. In the 1990s, HDEC's outstanding achievement was Jamuna Bridge in Bangladesh, which crosses the Jamuna River. The river is often swollen by heavy rain from the Assam region and melted glaciers from the Himalayan Mountains.

Building a bridge over a river spanning over 12 kilometers was a challenge in itself and the challenge was compounded as the bridge had to serve multiple facilities including a road, narrow-gauge railway, transmission

Yamuna Bridge, India (January 2004)

Jamuna Bridge, Bangladesh (June 1998)

lines, natural gas pipelines and telephone lines.

The work began in April 1994 and the bridge was completed in June 1998. The Jamuna Multi-purpose Bridge was the longest in-land bridge in Asia when constructed in 1998 and served as proof of HDEC's world-leading capacity in bridges.

HDEC has successfully constructed many other bridges including Jurong Island Road Link (completed in 1999), Yamuna Bridge (completed in 2004), Western Marine Bridges (completed in 2014), and Chambal River cable-stayed bridge (completed in 2017). Since 2013, HDEC has won a number of high-profile contracts including the third Bosphorus bridge in Turkey, Sheikh Jaber Causeway Marine Bridge in Kuwait and the Chacao Bridge in Chile.

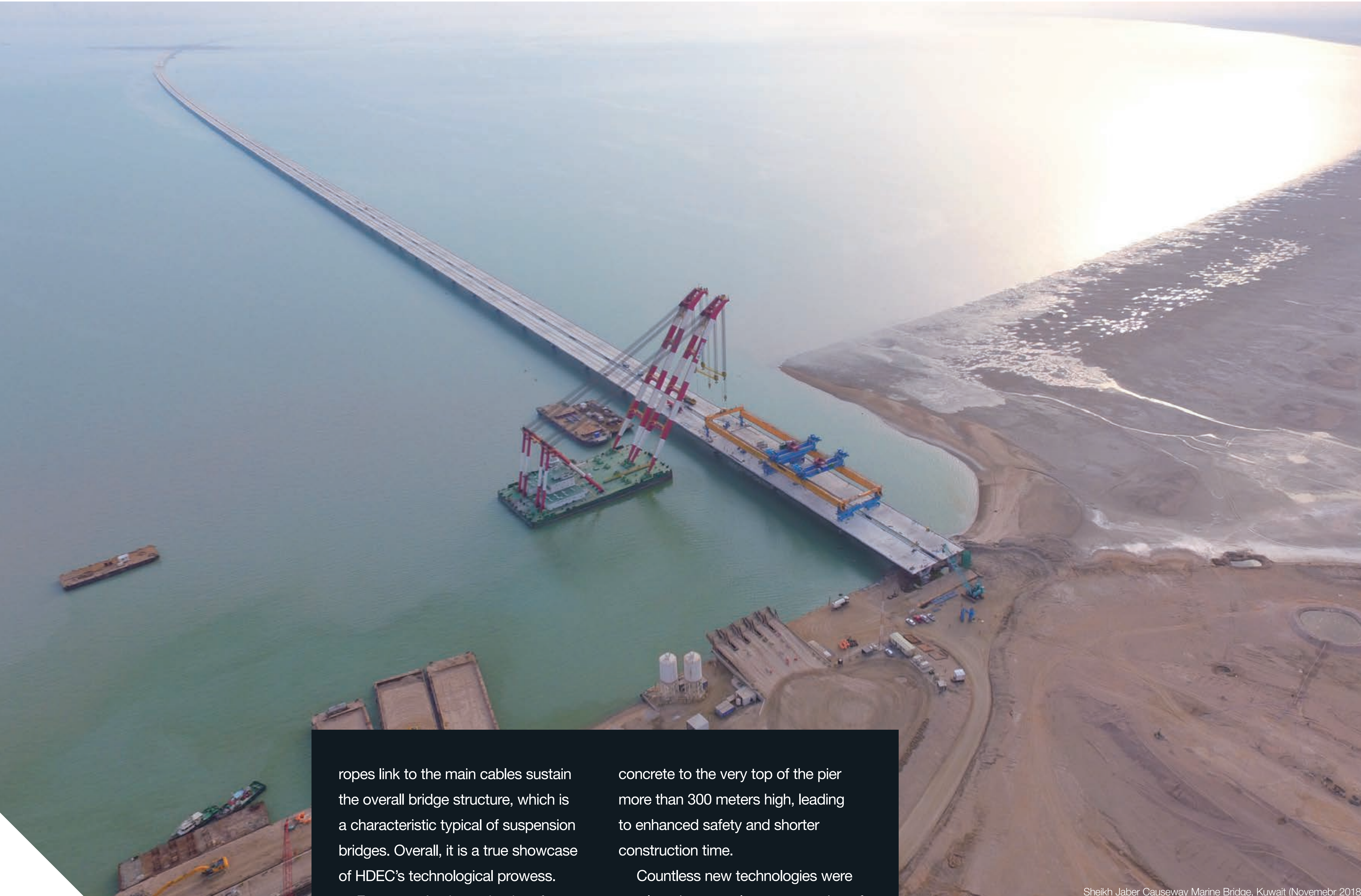
Regarded as the gateway to Eurasia, Istanbul is the largest city in Turkey which is partly in Europe and partly in Asia. It is a unique city straddling two continents. Istanbul's European part is separated from its Asian part by the Bosphorus strait, a 30km-long waterway that connects the Black Sea with the Sea of Marmara. Two suspension bridges cross the Bosporus, built in 1973 and 1988. In addition, an undersea railway tunnel was completed in 2013. In 2016, the third Bosphorus bridge was completed; the fourth connection across the Bosphorus strait.


Chambal River Cable-stayed Bridge, India (May 2017)


The third Bosphorus Bridge, Turkey (August 2016)

The third Bosphorus bridge which spans over 2,164 meters, opened on 26th August 2016, and stands out among the three bridges over the Bosphorus strait. The two main piers are 322 meters high which is higher than the Eiffel Tower and the main span is 1,408 meters. The bridge deck is suspended 58 meters above the sea, allowing large containerships to pass below the bridge.

One of the most remarkable characteristics of the third Bosphorus Bridge is that it is the first hybrid bridge of its kind. It has two main piers, and cables linked to the piers directly support the deck, a characteristic typical of cable-stayed bridges, while



Sheikh Jaber Causeway Marine Bridge, Kuwait (Novemebr 2018)

ropes link to the main cables sustain the overall bridge structure, which is a characteristic typical of suspension bridges. Overall, it is a true showcase of HDEC's technological prowess.

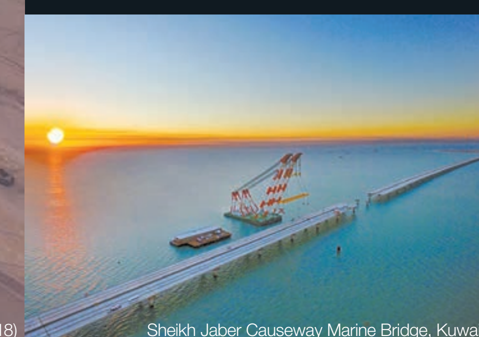
For example, the main pier of the 3rd Bosphorus bridge was built using advanced long-range concrete pumping technology developed by HDEC, which directly transported concrete to the very top of the pier more than 300 meters high, leading to enhanced safety and shorter construction time.

Countless new technologies were employed to complete construction of the 3rd Bosphorus bridge in a record 38 months. HDEC employed fast track methods which enabled design and construction work to happen

Sheikh Jaber Causeway Marine Bridge, Kuwait

simultaneously and worked around the clock to finish construction in record time.

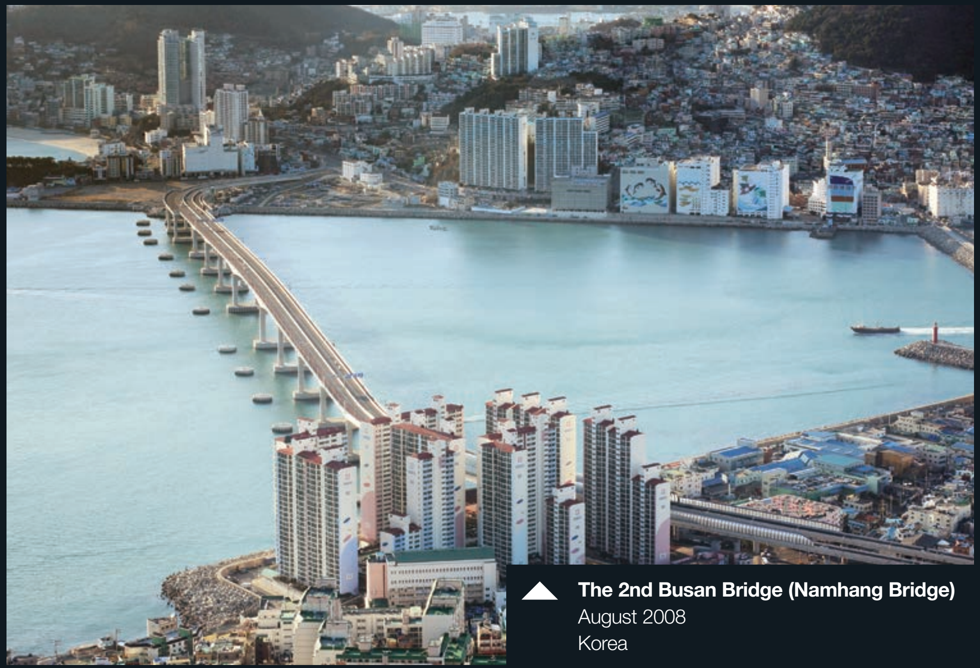
On struction of the Sheikh Jaber Causeway Marine Bridge, which is far larger than the 3rd Bosphorus bridge, commenced in November 2013. The 36.14km bridge and road spans the Kuwait Bay between Kuwait City and the Subiyah area. It is one of the largest and most challenging transport infrastructure projects to date in Kuwait and HDEC is responsible for 27.5km of the overall structure.



Sheikh Jaber Causeway Marine Bridge, Kuwait

HDEC formed a consortium with a local company and won the project with a bid of 2.6 billion USD. HDEC is responsible for 80% of the work which accounts for 2.06 billion USD, which makes it the largest contract won by a South Korean company since the Great Man-Made River contract in Libya in 1984. The scale of that project was comparable to the Jubail Industrial Harbor Project which was nicknamed the largest civil engineering project of the 20th century.

GALLERY
BRIDGES



The 2nd Busan Bridge (Namhang Bridge)
August 2008
Korea

Guri-Amsa Bridge
Novemeber 2014
Korea

Seongsan Bridge
June 1980
Korea

Machang Bridge
June 2008
Korea

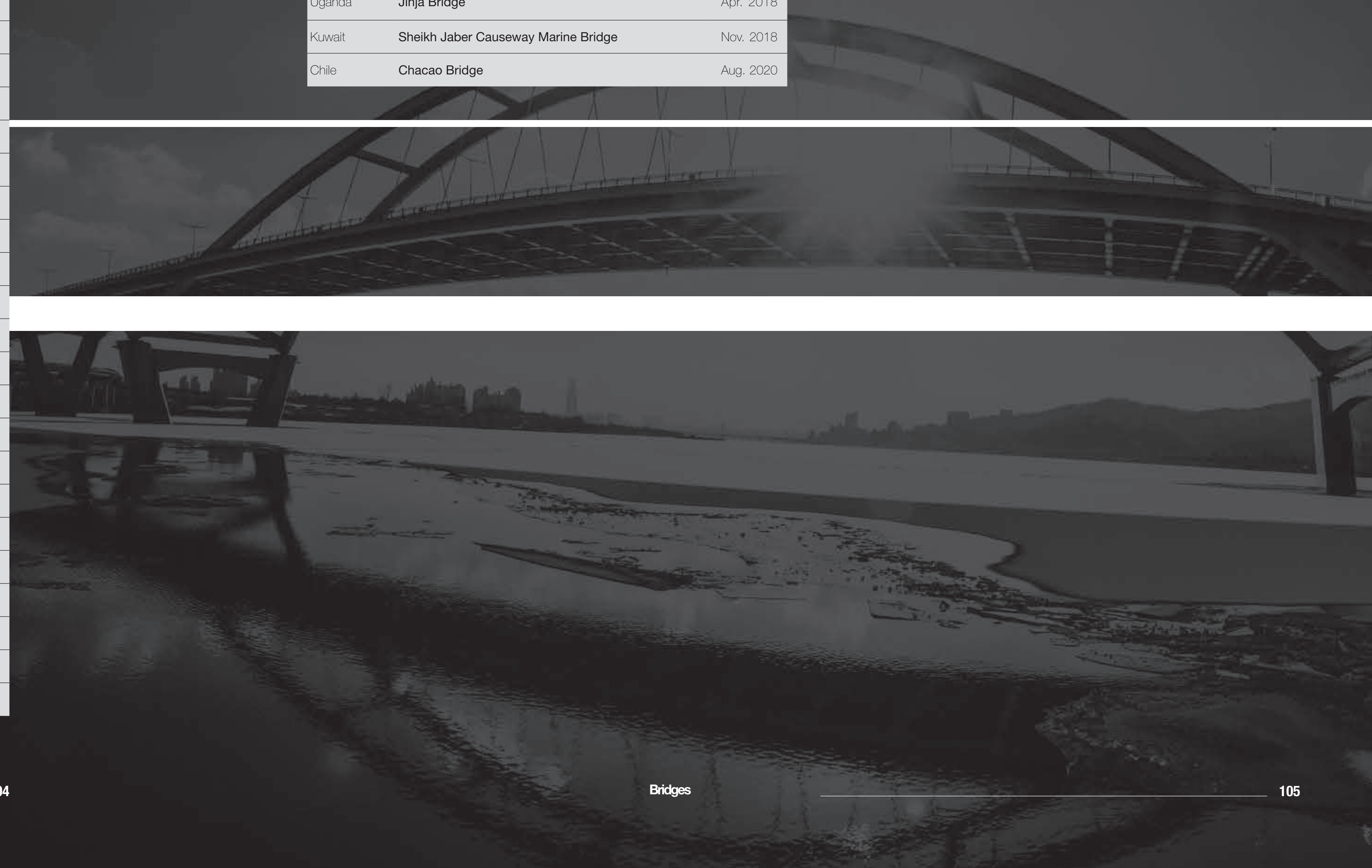
The 2nd Jundo Bridge
January 2005
Korea

Chacao Bridge
August 2020
Chile

Jamsil Bridge
December 1971
Korea

LIST BRIDGES

Country	Project Name	Time of Completion
Korea	Sanghyun Bridge Restoration Project	Oct. 1951
Korea	Goryeong Bridge Restoration Project	May. 1955
Korea	Sangryul Bridge (phases 2 to 3)	Jan. 1958
Korea	Ansung Bridge (phases 1 to 3)	May. 1958
Korea	Han River Bridge Restoration Project	May. 1958
Korea	Sangjin Bridge (phases 1 to 3)	Nov. 1959
Korea	The 2nd Cheonggye Bridge	Dec. 1960
Korea	Anyang Bridge Restoration Project	Apr. 1961
Korea	Temporary Works of Wonhyo Bridge & Pavement Works Neighboring Road	Dec. 1963
Korea	Yangwha bridge	Jan. 1965
Korea	Ganghwa Bridge (phases 1 to 5)	Dec. 1969
Korea	Hannam Bridge	Dec. 1969
Korea	Mapo Bridge	Aug. 1970
Korea	Seoul Bridge (phases 1 to 3)	Dec. 1970
Korea	Geoje Bridge (phases 1 to 8)	Jul. 1971
USA	Hurricane Gulch Bridge in Alaska	Oct. 1971
Korea	Jamsil Bridge	Dec. 1971
Korea	Namhae Bridge	Jan. 1973
Korea	Gumi Bridge	Dec. 1974
Saudi Arabia	Port of Ras al Ghar wharf Bridge	Nov. 1977
Korea	Seongsan Bridge	Jun. 1980
Korea	Temporary Works of Gangchon Bridge (phases 1 to 5)	Jul. 1980
Korea	Temporary Installation of Siheung Bridge (phases 1 to 3)	Dec. 1980
Korea	Nakdong Bridge	Dec. 1981
Korea	The 1st Han River Bridge Expansion Works	Feb. 1982
Korea	Jindo Bridge	Dec. 1984
Malaysia	Penang Bridge	Aug. 1985
Korea	Gongju Bridge	Dec. 1986
Canada	Vancouver Skybridge Project	Dec. 1988
Korea	Muhan Bridge	Dec. 1989
Korea	Daejeon EXPO Suspension Bridge	May. 1993
Korea	Chungmu-Sadeung Steel Bridge	Jun. 1995
Korea	Jujin Bridge	Aug. 1995
Korea	Rework of Gyoha Bridge	Jul. 1996
Korea	Pyeongchon Elevated Bridge	Aug. 1996
Korea	Seogang Bridge	Dec. 1996
Korea	Daejeon South Expressway Steel Bridge	Dec. 1996
Korea	Seongsu Bridge Restoration	Aug. 1997
Korea	Jayu Steel Bridge (Linked to Panmunjeom)	Aug. 1997
Korea	Expansion Works of Gumi Bridge	Jan. 1998
Korea	Incheon International Airport Suspension Bridge	Feb. 1998
Korea	Improvement of Namhan River Bridge	Jun. 1998
Bangladesh	Jamuna Bridge	Jun. 1998
Singapore	Jurong-Mulimau Bridge	Jul. 1999
Korea	Incheon International Airport Expressway Bridge	Oct. 1999
Korea	Banhak Bridge	Nov. 1999
Korea	Repairing Construction of Dangin Bridge	Jul. 2000
Korea	Improvement of Yanghwa Bridge	Jul. 2000
Korea	Temporary Installation of Jangan Bridge	Dec. 2000
Pakistan	Bridge of Chasma Right Bank Canal ; CRBC	May. 2001
Korea	Naeseo-Naengjung 2nd Sub-site Steel Bridge	Jun. 2001
Korea	Daecheon-Gwangcheon Steel Bridge	Nov. 2001
Korea	Bonpo Bridge Temporary Works	Dec. 2001
Korea	Gayang Bridge	Jan. 2002
Korea	Temporary Works of Wangjin Bridge	Jun. 2002
Korea	Temporary Works of Namsan Bridge	Dec. 2002
Korea	Temporary Works of Jeonju Bridge	Dec. 2002
Korea	Reworks of Naju Bridge	Jul. 2003
Korea	Reworks of Nakdan Bridge	Dec. 2003
India	Yamuna Bridge	Jan. 2004
Korea	Jamsil Bridge Expansion Works & Improvement Project	Feb. 2004
Korea	Mokpo Bridge	Jun. 2004
Hong Kong	Stone Cutter Bridge Construction Geological Survey Works	Jul. 2004
Korea	Seongsu Bridge Expansion Works	Dec. 2004
Korea	The 2nd Jindo Bridge	Jan. 2005
Korea	Construction of Seoul Bridge & Southern Underpass Expansion	Apr. 2005
Korea	Sanho Bridge	Jun. 2005
Korea	Hannam Bridge Expansion Works & Improvement Project	Nov. 2005
Korea	Mapo Bridge Expansion Works	Dec. 2005
Korea	Ilsan Bridge	Jan. 2008
Korea	Machang Bridge	Jun. 2008
Korea	Jungdong Bridge Expansion Works	Jun. 2008
Korea	The 2nd Busan Bridge (Namhang Bridge)	Aug. 2008
Korea	Yeongga Bridge Temporary Works	Dec. 2008
Korea	Inje 38 Bridge Temporary Works	Sep. 2009
Korea	Magok Bridge	Oct. 2010
Korea	Geogeum Bridge Temporary Works (phase-2)	Dec. 2011
Korea	Goha Bridge (Mokpo Bridge)	Dec. 2011
Korea	Singeum Bridge Temporary Works	Dec. 2011
Korea	Daedong-Hwamyeong Bridge	Jul. 2012
Korea	Muyung Bridge	Dec. 2012
India	Western Marine Bridge	May. 2014
Korea	Guri-Amsa Bridge	Nov. 2014
Korea	Ulsan Bridge	May. 2015
Turkey	The third Bosphorus Bridge	Aug. 2016
India	Chambal River Cable-stayed Bridge	May. 2017
Uganda	Jinja Bridge	Apr. 2018
Kuwait	Sheikh Jaber Causeway Marine Bridge	Nov. 2018
Chile	Chacao Bridge	Aug. 2020



ROADS

The famous saying 'all roads lead to Rome' is not merely a reminder of how prosperous Rome was but of how its roads were an essential part in creating this prosperity. Between 300 BC 3rd and 200 AD, the Romans built a road system which had a total length of 230,000km and extended throughout their empire. The roads had clearly separated pedestrian and chariot paths and incorporated a drainage system. The road system served as the backbone for the prosperity and peaceful reign of the Roman Empire.

Building the pathways for expansion of human civilization

03

Gyeongbu Expressway Seoul Tollgate

The human body requires a constant flow of blood throughout its body and the neural network is also essential, collecting information from all parts of the body and sending it to the brain so that appropriate responses can be made. In a similar way, the road system of a city or a nation works much like the blood vessels and neural networks; resources and information flows through the roads, allowing them to maintain themselves.

Building the arteries of industrial civilization

Building the first highway overseas

Civil engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including of course roads. Roads are essential to human civilization and often serve as an indicator of development and sustainability.

When Korea was liberated from the Japanese colonial government, the US military served as a transitional government and during this time made some improvements to Korea's road system. There had been a road system development plan in place but the South Korean government was unable to implement it as the Korean War broke out. The war ravaged South Korea's road system; halving the total paved road length from 1,070km down to less than half of this, only one year into the war.

HDEC first began its road works by taking on military road construction and repair works commissioned by the US military during the Korean War (1950-1953) after it acquired road pavement works in Busan. After the war, HDEC focused on bridge restoration projects and then later began to take on road pavement work between 1957 and 1962.

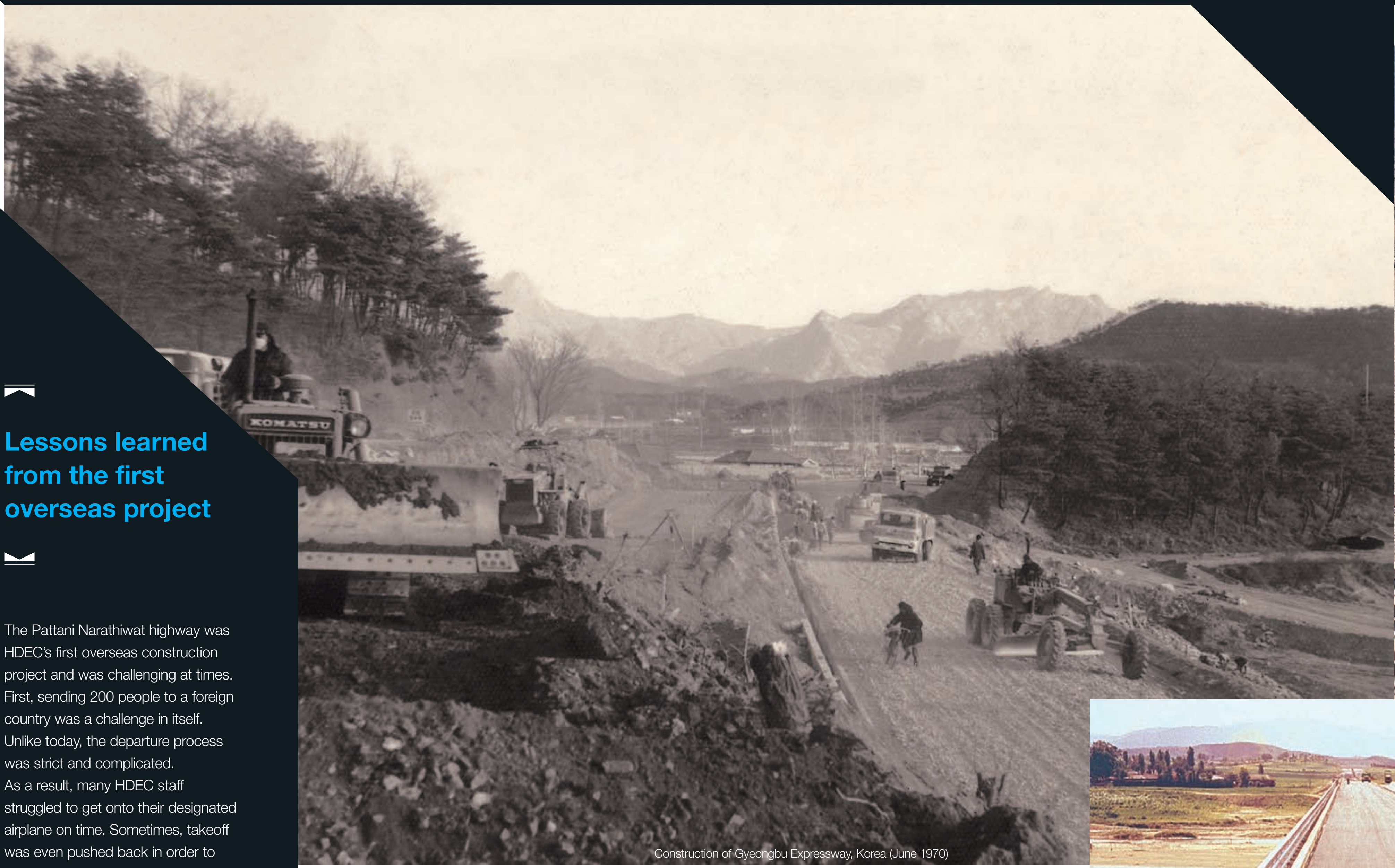
Initially, HDEC relied on basic methods; laying large pebbles and manually applying pavement materials. By the late 1950s, more advanced methods using gravel and basic machinery was adapted from the US military. Nevertheless, much of the work with the exception of the asphalt layer application and compaction was done manually.

HDEC had to rely on the intuition of the machine operator when it came to ensuring the evenness of the asphalt spray. HDEC continued to purchase machinery and equipment from the US military. In turn, this allowed HDEC to take on more sophisticated road projects such as the construction of air strips for the US Air Force base.

In 1965, HDEC won the contract for the Pattani Narathiwat Highway Project in Thailand, which was a

Late chairman Ju-young Chung supervising at highway project in Thailand

Pattani Narathiwat Highway Project, Thailand (February 1968)



Construction of Gyeongbu Expressway, Korea (June 1970)

Lessons learned from the first overseas project

The Pattani Narathiwat highway was HDEC's first overseas construction project and was challenging at times. First, sending 200 people to a foreign country was a challenge in itself. Unlike today, the departure process was strict and complicated. As a result, many HDEC staff struggled to get onto their designated airplane on time. Sometimes, takeoff was even pushed back in order to allow the HDEC staff to get on the plane. It is hard to imagine now, but it happened because the success of the project was regarded as crucial for the whole country.

great opportunity for HDEC to further develop its capacity.

The Pattani Narathiwat Highway Project was the first overseas project a South Korean company had won. It was also the first project which had to be done to international specifications. Ironically, South Korea did not even have any of its own highways and HDEC therefore lacked experience.

The HDEC team faced a wide variety of challenges as soon as work began in January 1967. The team was ill-equipped and the engineering specifications from the US-based engineering company were difficult to understand. Differences in climate, culture and the language barrier added yet more challenges, slowing down the work. In the end, HDEC completed the project despite all of these challenges. However, in the process significant financial losses totaling 288 million KRW were incurred.


Construction of Gyeongbu Expressway

Chairman Chung emphasized that this was a small loss considering the valuable lessons learned. Indeed, the Thai government proceeded to commission HDEC for five more expressway projects, recognizing that HDEC was able to deliver on its promises.

The lessons learned from the Thai project also proved to be highly valuable back home in South Korea when HDEC took on the challenge of the Gyeongbu Expressway Project. This was the first expressway built in South Korea and HDEC was able to successfully complete the project, applying the hard-earned lessons from the Thailand project. At the time, HDEC was the only company in South Korea with any expressway construction experience and therefore won a large share of similar projects.


Construction of Gyeongbu Expressway

Gyeongbu Expressway, Korea (June 1970)

Taking the lead on construction of Gyeongbu Expressway

Gyeongbu Expressway construction project faced heavy resistance from a full range of stakeholders in all sectors, particularly because of its large scale and high costs, when the government budget was struggling. The government was keen to ensure the project went ahead but was similarly uncertain about whether the project could be funded.

At the lowest point, even the government was losing faith in the project. HDEC declared that it would build the expressway at 100 million KRW per 1 kilometer, inspiring even the government.

Encouraged by HDEC's proposal to cut the costs, the South Korean government approved the Gyeongbu Expressway project and allocated a total of 33 billion KRW. It was a truly enormous amount of money at the time and accounted for 23.6 percent of the government budget. A total of 16 domestic construction companies and three army engineering corps were involved in the project. The expressway was divided into eight subsections and HDEC were put in charge of three subsections; Seoul-Suwon, Suwon-Cheonan and Cheonan-Daejeon, a total of 128 kilometers.

Since HDEC was the only company with experience in expressways, not only was the company put in charge of the longest subsections but also played a leadership role. Everyone involved in the project was reliant on HDEC's expertise to some degree. As a result, HDEC engineers and staff were as busy helping out other companies as they were doing actual construction work. HDEC alone was responsible for 37% of the construction which was vastly larger than what any other company was responsible for.

Making own high-early strength portland cement

The Cheonan-Deajon section was the most challenging section of the Gyeongbu Expressway. The difficulty arose due to five obstacles, which included the construction of three bridges over the Geum River, Dangjae overpass and Dangjae tunnel, all within an eight kilometer-long subsection of the expressway. Furthermore, the terrain was not ideal for the expressway and the soil quality was subpar as well. The five structures which were constructed were also quite long which required 20% of the road to be built using concrete and steel.

Among the five structures constructed for the subsection, the Dangjae tunnel presented the biggest challenge. At the time, HDEC did not have the technology to make a long tunnel and had a very tight budget, so the tunnel location was chosen to make its length as short as possible. Unfortunately, the location was not ideal; the rocks crumbled easily, on occasion even taking the lives of some workers. There were thirteen accidents within five months yet only one of the tunnels had been completed and only two months remained before the opening of the expressway.

Even with the deadline approached, the tunnel boring did not make much progress. Rumors began to spread that the Gyeongbu Expressway project would fail because HDEC could not even complete a single tunnel. HDEC tried to buy more time from the government but the request for an extension was rejected. Tunnel boring is a slow process, requiring reinforcement after the openings are created with explosives. Cement reinforcement takes one week, the time required for hardening, slowing down the whole process significantly. Something had to be done to speed things up.

The only method available was to use high early-strength portland cement which hardens within 12 hours of application thanks to its smaller particle size compared to regular cements, allowing boring to take place at much faster pace. However, this cement were not produced anywhere in South Korea at the time. Ultimately, HDEC retrofitted a cement production plant in Danyang for production of portland cement.

On 27th June 1970, the roaring cheers of the workers and engineers filled the Dangjae tunnel as the rock blasting teams from both sides of the tunnel finally met each other at 11 PM.

Construction of Dangjae Tunnel

Construction of Dangjae Tunnel

I have given up making a profit on this project anyway

"Can you finish the tunnel if I provide you with the high early-strength portland cement you need?"
"If you do, I will make it happen."
The supervisor of the tunnel construction later said he regretted asking for the special cement because it is at least three times more expensive than regular cement. The supervisor already knew that HDEC was losing money on the project. He was also concerned that transporting cement from the Danyang cement production plant could be expensive even though it would enable the tunnel construction to be sped up significantly. Despite all this, Chairman Chung gave permission for trucks to be hired to deliver the portland cement.
From the very beginning of the Gyeongbu Expressway project, Chung was heard to say often "I have given up making a profit on this project anyway." He knew that the future benefits the project would bring would be worth it.

As South Korea began construction of its national expressway network, HDEC firmly positioned itself as the industry leader in expressways. HDEC led construction of not only the Gyeongbu Expressway but many subsequent projects.

Pioneering in the era of expressways

Gyeongin Project, Korea (December 1968)

HDEC: The era of the expressway

HDEC was involved in an unusually large number of projects overseas between 1966 and 1967. In Thailand, successful completion of the Pattani Narathiwat Highway led to many new projects and many projects were won in Vietnam due to the Vietnam war. However, the overseas project boom was largely over by 1968 and lots of new opportunities began to arise in South Korea thanks to the many large scale projects announced by the South Korean government.

As the only South Korean company with expressway experience, through the Pattani Narathiwat Highway, HDEC was in an enviable position. The experience allowed HDEC to win a large part of the Gyeongbu Expressway project and many other similar projects.

What happened during the Gyeongin Seoul-Incheon Expressway project shows how big a role HDEC played in South Korea's expressway project. Although people regard the Gyeongbu Expressway as the first highway in Korea, the Gyeongin Expressway is actually the first highway.

The project was commissioned to a newly established construction company, Saman Industry. The project made sluggish progress as the inexperienced Saman Industry struggled.

To make things worse, government officials exerted pressure on the company, hoping to see the expressway open by the end of 1968. After some monitoring, Chairman

Construction of Gyeongin Expressway

88 Olympic Expressway Daegu between Gwangju, Korea (September 1984)

Ju-young Chung suggested to the government that the project could be completed by the of 1968 if a consortium of three top companies including HDEC took over. HDEC had the capacity to do it by itself but Chung did not want to risk the smooth progress of the Gyeongbu Expressway by spreading HDEC's capacity too thinly.

The Korean government accepted Chung's proposal and canceled the contract with Saman Industry on 5th March 1968. The Gyeongin Expressway

Namhae Expressway, Korea (December 1973)

Yeongdong Expressway, Korea (December 1971)

Jungbu Naeryuk Expressway Chungju-Sangju (section 6), Korea (December 2004)

Company was launched on the 12th of March, with various investors including the Ministry of Construction. The overall plan was redrawn and the work was swiftly completed, allowing the expressway to be opened by 21st December 1968.

Successful completion of the Gyeongbu and Gyeongin Expressways led to an explosive increase in highway construction projects in South Korea. In the 1970s, the Yeongdong Expressway (Singal-Saemal) in 1971, the Honam and Namhae Expressway (Daejeon-Suncheon-Busan) in 1973, extension of the Yeongdong Expressway to Gangneung in 1975, the Donghae Expressway (Donghae-Gangneung) and Guma Expressway (Daegu-Masan) both in 1977, in addition to many other smaller road projects. In the 1980s, more technologically advanced expressways were built, including the 88 Olympic Expressway (Damyang-Okpo) in 1985, Jungbu Expressway (Seoul-Nami) in 1987 and Jungang Expressway (Daegu-Chuncheon) in 1989.

Thanks to many expressways built, South Korea was able to establish a highly functional road network before the 1990s and as a result many companies gained valuable experience. The total length of expressways in South Korea had surpassed 3,000km by 2007 and 4,000km by 2012.

The alternatives subway and high-speed railroads

HDEC played a leading role in the construction of subway and railroad. In 1971, Seoul's population was increasing at annual rate of 5.7 percent, while the number of people using public transport was increasing by 10.7 percent per annum. The estimated number of people using public transport was 6.27 million.

The Seoul metropolitan government commissioned the construction of a subway system, recognizing that adequate transport could not be provided solely by a public bus system. In 1971, project bidding opened for the 9.54km long subway line number one from Seoul train station to Cheongyangni. The project was divided into 12 subsections and HDEC won the contract for the 7th subsection between Jongno 3-ga and Jongno 4-ga.

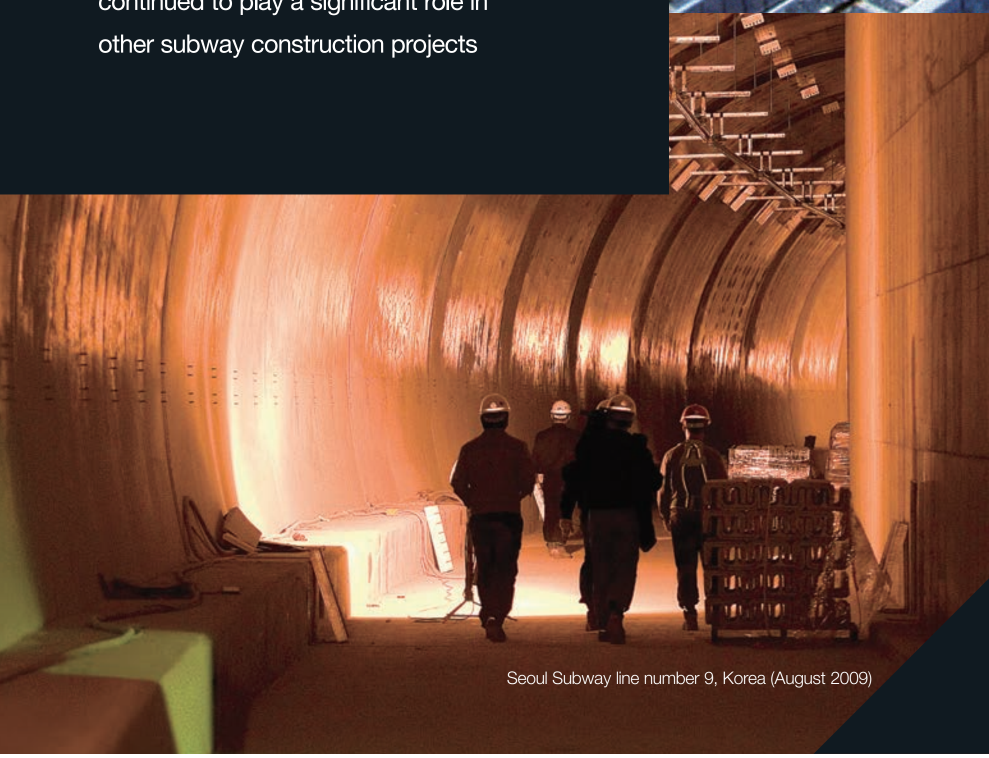
The work included construction of a 896.2 meter long track, Jongno 5-ga subway station, a substation, electrical engineering work, a ventilation system, a sewage treatment facility and various other tertiary facilities. Seoul government commissioned five more subway line projects and rewarded them as private contracts. HDEC won the contract for 1-A section which included a 220 meter rail track near Seoul train station in September 1972.

Located in downtown Seoul, Jongno 5-ga subway station was larger than other stations that had been built and more complicated in its structure. One of the biggest challenges was sourcing of the necessary materials. Construction of subway stations requires a significant amount of steel, yet at this time most steel materials had to be sourced from Japan. Thanks to the construction boom, there was a constant shortage of steel materials. There was also a scrap metal crisis in 1972 which further aggravated the situation.

Subway line number one launched its service on 15th August 1974. Prior to this many challenges had to be overcome including the excavation of 470,000 metric tons of soil. The 30 billion KRW budget for the project was the largest Seoul city had commissioned at that time. HDEC continued to play a significant role in other subway construction projects including line number 1 through to line 9 projects crisscrossing Seoul, the Airport rail service and subway projects in six other major cities (Busan, Daegu, Gwangju, Daejeon and Incheon), employing increasingly advanced methods over time. These experiences allowed HDEC to win a number of overseas projects including the Mass Rapid Transit project in Singapore and a subway project in Hong Kong.


Busan Subway Dongnae Station, Korea (July 1985)


Expansion Works of High-speed Train, Singapore (August 1995)

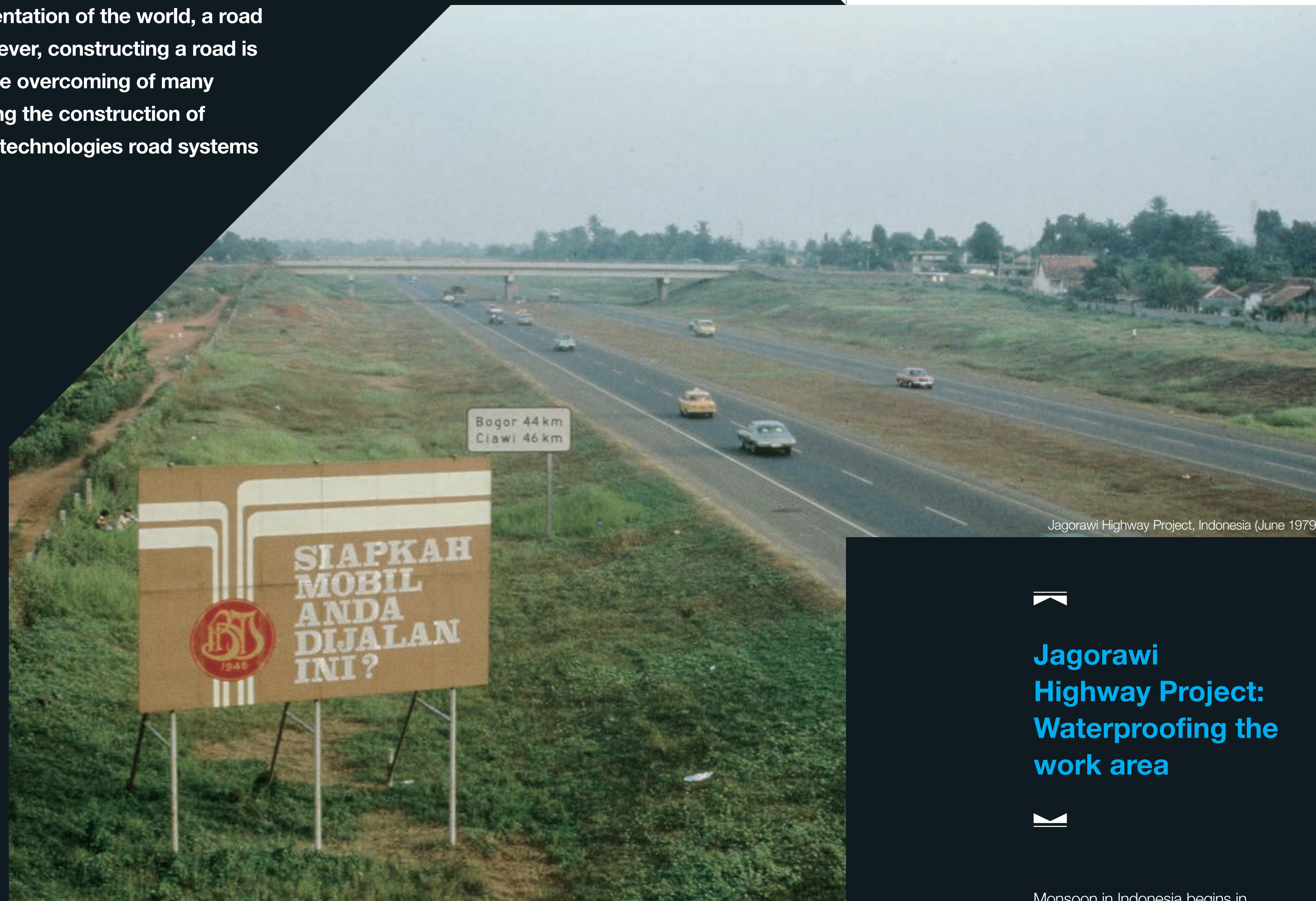

Seoul Subway line number 9, Korea (August 2009)

HDEC also participated in the high-speed railroad projects launched in early 1990s. HDEC was responsible for the sub-base course construction of section 2-2, 13-4 and 6-3 of the Gyeongbu high-speed railroad and section 2-3 of the Honam high-speed railroad.


Seoul Subway line number 3 Oksu Station, Korea (September 1982)

On maps, a two dimensional representation of the world, a road is represented as a simple line. However, constructing a road is a complicated business, requiring the overcoming of many three-dimensional obstacles including the construction of tunnels and bridges. Thanks to new technologies road systems are constantly evolving.

Building the roads of the future



Jagorawi Highway Project, Indonesia (June 1979)

Beginning with overseas road projects

HDEC made a major contribution constructing the expressway network in South Korea in the 1960s and 1970s thanks to the experience gained from the Pattani Narathiwat Highway in Thailand. HDEC successfully completed five other highway projects including the Tak–Khon Kaen Highway and Thonburi-Pak Tho Highway and a reclamation project.

The Jagorawi Highway project, constructed between Oct. 1973 and June 1979 was an important commission for HDEC. The 52 kilometer-long highway links Jakarta, Bogor - a famous botanical garden and Tjiwawi. In fact, the name Jagorawi comes from the three key destinations which are linked by the highway.

Competition for the Jagorawi Highway project was intense. When HDEC finally won the contract, it had high expectations that the project would provide a strong foundation for even greater works. Unfortunately, the project was scaled down significantly with the number of lanes reduced to four from eight, due to the first oil shock. The contract size was therefore reduced from 43 million USD to 33.8 million USD.

When the work began, the rainy weather presented a huge challenge. For example, the rainy season lasts for seven months, limiting the number of days suitable for construction to less than six months of the year. In addition, a network of irrigation waterways had to be overcome, requiring the construction of 42 bridges of various sizes, adding to the challenges already in place. Ultimately, the Jagorawi Project was completed 18 months late at a significant loss to HDEC.

HDEC was paid 6.6 million USD extra after two years of negotiation, however it was not enough to make up for the loss. Nevertheless, HDEC built a positive relationship with the Indonesian government due in large part to the high quality work and the project enabled HDEC to successfully reenter the Southeast Asian market in the 1980s.

Working beyond borderlines

The first expressway project commissioned to HDEC in the Middle East was the freeway 1 expressway project in Iraq. It was the third Middle East road project that HDEC won following Al Uraija–Yamiya Road in Saudi Arabia and the 6th Ring Road in Kuwait. Commissioned as part of Iraq's national economic development plan, the expressway was intended to serve as the backbone of the expressway system which would extend from Basra City in Southern Iraq to the border of Jordan and Syria in the western Iraq.

HDEC was responsible for the sections of the road linking Rutbah and Jordan border and Rutbah and Syrian border, with a combined length of 235 kilometers. Although the combined length of the highway was little more than half of the Gyeongbu Expressway, it was much wider, making it 2.5 times larger than the Gyeongbu project, covering 20 million m^2.

One of the biggest challenges was

Jagorawi Highway Project: Waterproofing the work area

Monsoon in Indonesia begins in October and lasts for seven months ending in April. The constant rain slowed down the construction so HDEC began to cover up the work site with waterproof clothes when the rain clouds began to form. The total length of area covered up was between 1 and 1.5 kilometers, which required an extremely labor-intensive process, taking two hours each time. Not a single day passed without the cover-up operation taking place and the clothes were then worn after each operation. Over 4,000 sheets were used during the project, and the clothes alone cost HDEC half a million USD which was a lot of money back then.


Jagorawi Highway Project, Indonesia

the sourcing of 13,000 tons of water that was required daily. HDEC dug over 30 water wells every 20 to 30 kilometers along the expressway route, each 200 to 300 meters deep. When the water wells failed to produce water, water was then transported over 100 kilometers. The on-going Iran-Iraq war reduced the financial resources available for construction projects and work was temporarily discontinued in 1983.

For the reasons described above and many others, the freeway 1 expressway project was full of challenges throughout the six years that it lasted. The work continued literally day and night for the first five years, which led to a 90 percent completion rate. At the peak of the project, up to 5,500 workers and 2,500 pieces of heavy machinery were employed.

The Fahaheel Highway Project in Kuwait, constructed between August 1984 and March 1988, provided some unusual obstacles rather than the usual technical difficulties.
The project involved the expansion of a 21 kilometer long road into six lanes and included nine bridges, five overpasses and various other small structures. The unexpected challenge of the project was drivers with fake licenses who were often arrested.

The frequent arrests slowed down the work and led to HDEC being liable for some heavy fines. Although the Kuwaiti government was not very sympathetic, HDEC handled all incidents reasonably and was able to complete the project on time, earning the trust of the Kuwaiti government.

After this project, HDEC was appointed to carry out a number of road construction projects in Kuwait including the Mirqab intersection. However, all work was halted due to the Gulf War which broke out in August 1990. The work, renamed 'Kuwait Inner City Road Works' resumed in November 1992.

The construction of the Mirqab intersection was first awarded to a Yugoslavian company in 1986 but work was discontinued in 1988 due to many challenges. HDEC won the contract through a bidding process and construction resumed. All work including the three first ring road interchanges, six bridges, and six footbridges over the 30 kilometer-long road were successfully completed.

As the great construction boom in the Middle East subsided HDEC began to more actively participate in road projects in Southeast Asia in the 1990s, such as the North-South Expressway in Malaysia which was completed in October 1992.

The 40.3 kilometer long expressway has four lanes and links Pagoh and Yong Peng. The project was divided into four sections and section two was notorious for the challenges presented by the high mountains and jungles in the area. The hot and humid climate of

Freeway 1 Expressway Project, Iraq (December 1989)

Fahaheel Highway Project, Kuwait (March 1988)

Malaysia presented extra challenges to the workers who were already struggling with mosquitoes, leeches and various other creatures. Despite all the challenges, HDEC impressed the client by completing the project two months prior to the deadline.

Road of the future enabled with HDEC's Intelligent Transportation System

HDEC has constructed numerous roads in the Middle East and South East Asia during the last 70 years. Amongst all of these roads, the Lusail Expressway in Qatar presents some exciting new possibilities for the future of our roads.

Expected to be completed by December 2017, the 16 kilometer long 16 lane Lusail Expressway links Doha, the capital of Qatar and the host city for the 2022 World Cup, and Lusail City. HDEC is responsible for a 6 kilometer long section which extends from Lusail city to the Al Wahda Interchange.

It is a technologically sophisticated project involving the installation of Art Scape, a landmark structure which symbolizes the future of Qatar, overpasses, intersections, bridges, box-type tunnels, micro tunnels, a drainage pumping station, a substation and various public infrastructures.

The Lusail Expressway has a three-layer structure. The lowest layer is for the Light Rail Transit system. The main tunnel which links Doha and Lusail takes the second layer from the base. Another tunnel which leads to Pearl city sits on the top layer. There is also an underground structure where the high voltage electrical lines pass through. Overall, the road work is comparable to building a three story building which is also six kilometers long.

HDEC's application of the proprietary Intelligence Transport System (ITS) ensures that the Lusail Expressway is a good indication of what we can expect in the future. ITS is created to improve road safety, traffic flow and road management using advanced information technologies. Other examples of ITS include a traffic flow information

Lusail Expressway, Qatar (December 2017)

Changwon-Busan Expressway Project, Korea (December 2015)

The 2nd Yeongdong Expressway Project, Korea (November 2016)

billboard and the Road Weather Information System which provides detailed weather information obtained from national weather forecasting services to drivers.

In late 2015, HDEC introduced its Tunnel Evacuation Information System to the Changwon-Busan Expressway. Since GPS does not work in tunnels, it is difficult for drivers to identify the exact location of their cars. As a result, auto accidents in tunnels can be particularly dangerous as even a minor accident can escalate into a highly risky situation.

Some technologies such as CCTV coupled with monitoring agents and automated fire detection systems already exist, but they have limitations. The Tunnel Evacuation Information System developed by HDEC helps overcome the limitations of the conventional systems. For example it can find out whether congestion within a tunnel is due to heavy traffic or a breakdown.

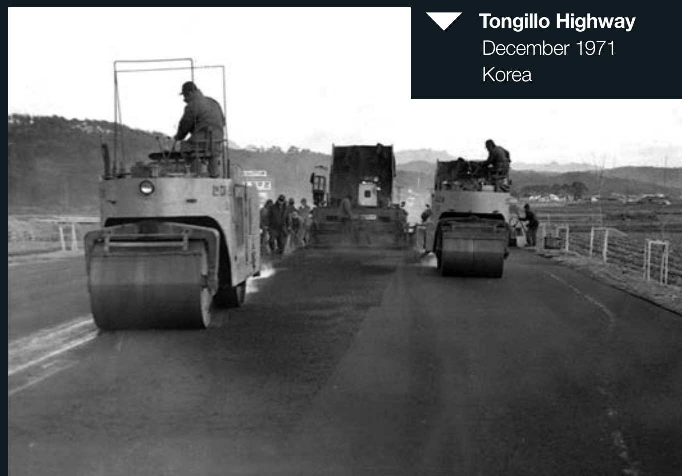
HDEC introduced even more advanced ITS systems for the 2nd Youngdong Expressway which opened in November 2016, including a Road Surface Temperature Forecast System and a One Tolling System (OTS). The OTS uses cameras to read the license plates of a car, identify the path of travel and collect the toll.

The Road Surface Temperature Forecast System is designed to accurately predict road conditions on the 2nd Youngdong Expressway, which passes through a high altitude area prone to heavy snow. The information is transmitted to the car's GPS navigation system and electronic billboards for safer driving.

The 2nd Yeongdong Expressway Project, Korea (November 2016)

GALLERY ROADS

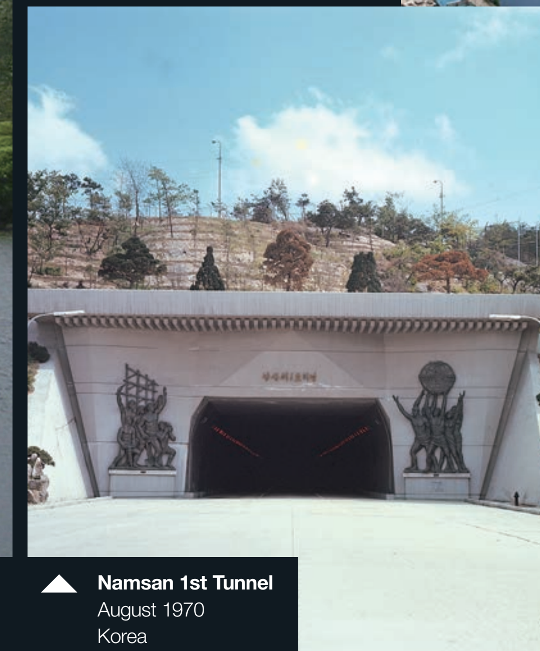
Namsan 3rd Tunnel
February 1978
Korea



Tongillo Highway
December 1971
Korea

Gyeongbu High-Speed Railroads Section 13-4
December 2008
Korea

Busan the 2nd Urban Expressway
February 1995
Korea



Namsan 1st Tunnel
August 1970
Korea

Construction of Expressway Busan between Masan
December 1981
Korea

High-Speed Railroads Project
August 2004
Taiwan

GALLERY ROADS

Machang Bridge Accident Road Construction (Guisan–Yanggok)
May 2008
Korea

Daegu Subway Section 2-12
December 2004
Korea

North-South Expressway
October 1992
Malaysia

Construction Section 1 of Highway Boryeong–Taean
April 2021
Korea

Highway Sungnam-Janghowon
March 2012
Korea

Section 4 Works of Seohaean (Dangjin-Seochun) Expressway
November 2001
Korea

Expansion Works of Expressway Aphae-Unnam
December 2013
Korea

LIST ROADS

* The list below consists of select projects out of 404 projects.

Country	Project Name	Time of Completion
Korea	Road Pavement Works for Seoul - Mokpo & Anyang - Osan	Jan. 1959
Korea	Gyeongbu Road Pavement Works (phases 1 to 6)	Jun. 1962
Thailand	Pattani Narathiwat Highway Project	Feb. 1968
Korea	Gyeongin Expressway Project	Dec. 1968
Thailand	Tak – Khon Kaen Highway Project	May. 1970
Korea	Construction of Gyeongbu Expressway	Jun. 1970
Korea	Namsan 1st Tunnel	Aug. 1970
Korea	Expressway Seoul - Suwon the 1st phase Construction	Dec. 1970
Korea	Honam Expressway (Daejeon – Jeonju)	Dec. 1970
Korea	Yeongdong Expressway	Dec. 1971
Korea	Tongillo Highway	Dec. 1971
Korea	Honam – Namhae Expressway (Daejeon – Suncheon – Busan)	Jan. 1973
Korea	Construction phase 1 of Gyomun - Walker Hill Highway	Jan. 1973
Korea	Namhae Expressway	Dec. 1973
Korea	Expressway Suncheon between Busan (Masan – Gimhae)	Dec. 1973
Korea	Launching Seoul Subway Line Number One	Aug. 1974
Korea	Donghae Expressway (Donghae – Gangneung)	Jan. 1975
Korea	Expansion of Yeongdong Expressway (Saemal – Gangneung)	Jan. 1975
Korea	Guma Expressway (Daegu – Masan)	Jan. 1977
Korea	Chungmu - Jangseunpo Pavement & Expansion Works	Oct. 1977
Korea	Namsan 3rd Tunnel	Feb. 1978
Indonesia	Jagorawi Highway Project	Jun. 1979
Korea	Seongsan Highway (the 3rd section)	Sep. 1980
Korea	Construction Section 6-12 of Seoul Subway Line Number Two (phases 1 to 5)	Dec. 1980
Saudi Arabia	Al Uraija - Yamiya Expressway	Jul. 1981
Korea	Construction of Expressway Busan between Masan	Dec. 1981
Korea	Construction of Seoul Subway Line Number Three Oksu Station	Sep. 1982
Libya	Al Qubbah (Gubba) Highway	Dec. 1982
Kuwait	The 6th Ring Road	Jan. 1983
Korea	88 Olympic Expressway Daegu between Gwangju	Sep. 1984
Korea	Highway Seosan - Changri	Nov. 1984
Korea	88 Olympic Expressway Damyang - Okpo	Jan. 1985
Korea	Construction of Busan Subway Dongnae Station	Jul. 1985
Korea	Construction of Seoul Subway Line Number Three (zone 327)	Dec. 1985
Korea	Joongbu Expressway (Seoul – Nami)	Jan. 1987
Kuwait	Fahaheel Highway project	Mar. 1988

Country	Project Name	Time of Completion
Korea	Jungang Expressway (Daegu – Chuncheon)	Jan. 1989
Iraq	Freeway 1 Project	Dec. 1989
Malaysia	North-South Expressway	Oct. 1992
Korea	Expansion Works Section 3 of Gyeongbu Expressway Suwon – Cheungwon	Jul. 1993
Korea	Expansion Works of Sungsan – Haengju Bridge	Dec. 1993
Korea	Namsan 1st Tunnel (Twin Tunnel)	Feb. 1994
Korea	Yeongdong (Singal – Wonju) Expressway Expansion	Jan. 1995
Korea	Busan the 2nd Urban Expressway	Feb. 1995
Singapore	Expansion Works of High-Speed Train	Aug. 1995
Korea	Riverside City Highway the 4th Sub-site	Dec. 1997
Korea	Expressway Daejeon between Jinju (section 6)	Oct. 1998
Korea	Gyeongbu Expressway (section 2-2)	Jan. 1999
Korea	Expansion Works of Gyeongbu Expressway Chungwon - Jeungyak (section 2)	Nov. 1999
Korea	Expansion Works of Yeongdong Expressway Wonju – Gangneung (section 6)	Dec. 1999
Korea	Construction of Incheon International Airport the 1st Runway Area	Jan. 2000
Korea	Construction of Urban Railway Line Number One	Jul. 2000
Korea	Construction of Incheon International Airport North Side Entry Road	Oct. 2000
Korea	Construction of 2nd Railtrack between Cheonan and Pyeongtaek	Dec. 2000
Korea	Expressway Gwangyang – Golyak Pavement & Expansion Works	Dec. 2000
Korea	Route 17 Geumsan Road Expansion Work (zone 1)	Dec. 2000
Korea	Construction Section 2 of Expressway Daejeon – Hamyang	Dec. 2000
Korea	Expressway Hoengseong – Gonggeun Pavement & Expansion Works	Dec. 2000
Korea	Construction Section 6-12 of Subway Line Number Six	Mar. 2001
Korea	Busan 18th Gwangjang Underground Passage Works	Apr. 2001
Korea	Expansion Works of Donghae Expressway Donghae – Jumunjin	Jun. 2001
Korea	Construction of Ulsan Port Road Transport	Jun. 2001
Korea	Improvement of Honam Expressway Mangyeong River Bridge	Jun. 2001
Korea	High-Speed Railroads (section 2-2)	Sep. 2001
Korea	Construction Section 1-7 of Urban Railway Line Number One	Sep. 2001
Korea	Expressway Guryongpo – Pohang Pavement & Expansion Works	Sep. 2001
Korea	Yeocheon National Industrial Park Expansion Work (zone 3)	Sep. 2001
Korea	Bypass Construction of Expressway Line Number One	Oct. 2001
Korea	Expansion Works of Expressway (Naeseo - Naengjeong)	Oct. 2001
Korea	Myongji IC Project	Nov. 2001
Korea	Section 4 Works of Seohaean (Dangjin - Seochun) Expressway	Nov. 2001
Korea	Expansion Works of Youngdong (Wonju - Gangneung) Expressway (section 12)	Nov. 2001

Country	Project Name	Time of Completion
Korea	High-Speed Railroads (section 9-2)	Sep. 2002
Korea	Expansion Works of Gyeongbu (Cheonan IC – JCT) Expressway	Dec. 2002
Korea	Jungbu Expressway Yeoju - Gumi (section 4 & 5)	Dec. 2002
Korea	Construction of Expressway Cheonan between Nonsan	Dec. 2002
Korea	Expansion Works of Gangbyeon Highway Hannam - Dongho Bridge	Jul. 2003
Korea	Expansion Works of Gyeongbu (Gumi – East Daegu) Expressway	Dec. 2003
Korea	Roadbed Construction of Gyeongui Line (Moondan – Jangdan)	Dec. 2003
Korea	Expressway Daejeon – Tongyeong (section 22)	Dec. 2003
Korea	Construction of 2nd Honam metro line between Songjungri and Mokpo	Dec. 2003
Korea	Expressway Hoengseong – Chudong Pavement & Expansion Works	Dec. 2003
Taiwan	High-Speed Railroads Project	Aug. 2004
Korea	Daegu Subway (section 2-12)	Dec. 2004
Korea	Expressway Daegu - Pohang (section 7)	Dec. 2004
Korea	Jungbu Naeryuk Expressway Chungju - Sangju (section 6)	Dec. 2004
Korea	Jungbu Naeryuk Expressway Yeoju - Gumi (section 6)	Sep. 2005
Korea	Roadbed Construction of Central line Double Track Railway Cheongnyangni – Deokso (section 2)	Jun. 2006
Korea	Jangseong - Damyang (section 1) of Expressway Gochang – Damyang	Dec. 2006
Korea	AREX Project	Mar. 2007
Korea	Machang Bridge Accident Road Construction (Guisan – Yanggok)	May. 2008
Korea	Gyeongbu High-Speed Railroads (section 13-4)	Dec. 2008
Korea	Construction of Seoul Subway Line Number Nine	Aug. 2009
Korea	Expressway Seoul - Chuncheon (section 2, 3 & 5)	Aug. 2009
Korea	Subbase Course Construction for Railway Track Inland Freight Base in Yeongnam Area	Oct. 2009
Korea	Highway Hapcheonho – Sancheong Construction	Oct. 2009
Korea	Gyeongbu High-Speed Railroads (section 14-2)	Dec. 2009
Korea	Third Gyeongin Expressway Construction	Jul. 2010
Korea	AREX section 2-1 Construction	Dec. 2010
Korea	New Construction section 1 of Double Track Railway Mangu - Geumgok	Dec. 2011
Korea	Construction section 2 of Double Track Railway Wangsimni - Seolleung	Dec. 2011
Korea	Goyang Samsong District Housing Site Development (zone 4)	Jan. 2012
Korea	Highway Sungnam - Janghowon	Mar. 2012
Korea	Development Project section 4 of Free Economic Zone in Incheon Cheongna District	Mar. 2012
Korea	Expansion of the No. 50 Expressway between Shingal and Hobup	May. 2012
Korea	Construction section 7-2 of Gangnam Ring Road	Mar. 2013
Korea	Construction section 2-3 of Honam High-speed Railroads	Aug. 2013
Korea	Expansion Works of Expressway Aphae - Unnam	Dec. 2013

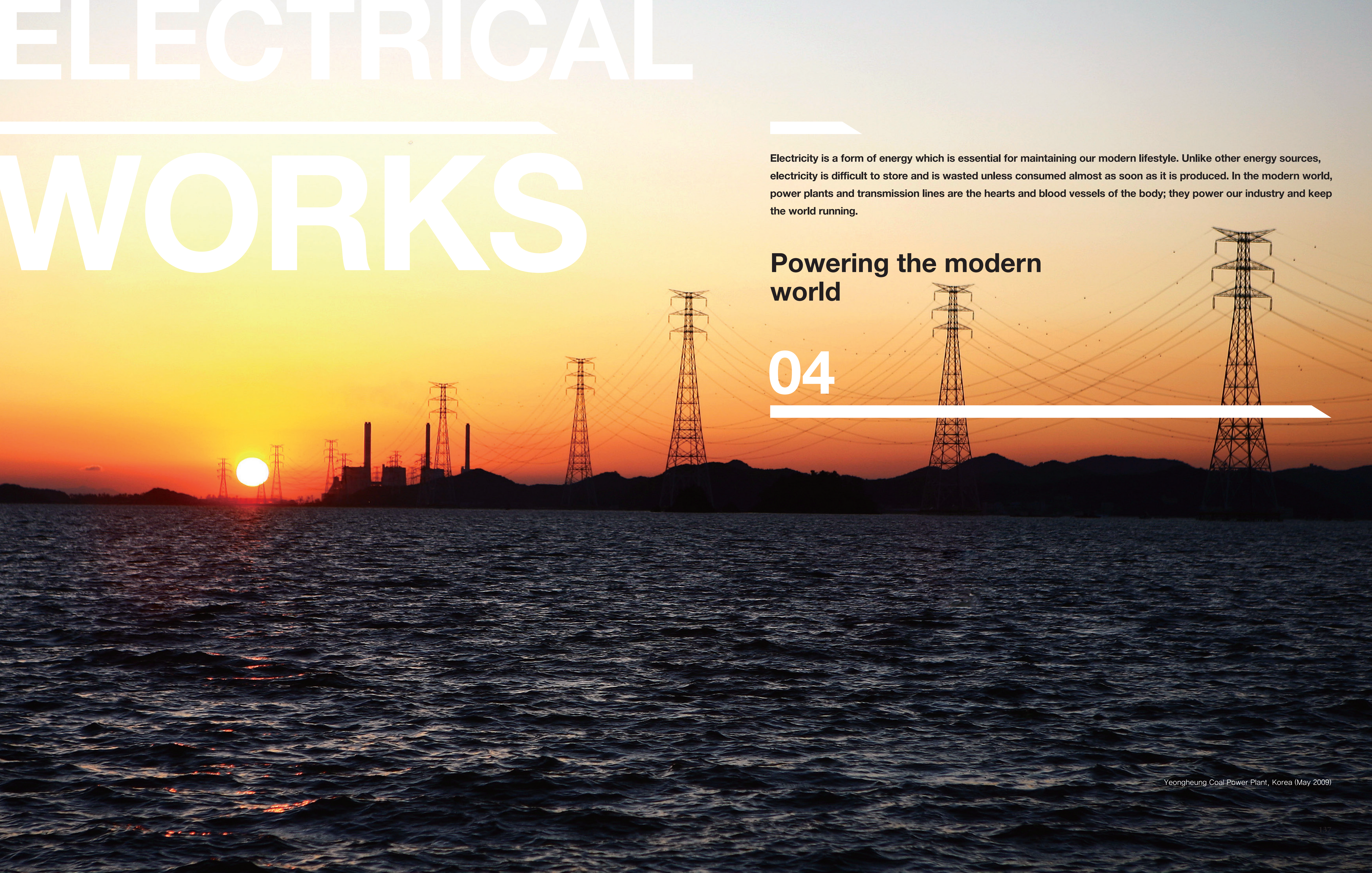
Country	Project Name	Time of Completion
Korea	Construction section 5 of Double Track Railway Ori - Suwon	Dec. 2013
Korea	Construction of Double Track Railway Haman - Jinju	Jan. 2014
Korea	Construction section 7 of Double Track Railway Ulsan - Pohang	Apr. 2014
Korea	Construction section 4 of Urban Railway Line Number Three	Jun. 2014
Korea	Construction section 6-3 of Gyeongbu High-Speed Railroads	May. 2015
Korea	Construction section 6-4B of Gyeongbu High-Speed Railroads	May. 2015
Korea	Infrastructure and access road construction in Seosan City Research Zone	Nov. 2015
Korea	Expansion of Expressway Line Number 12 Damyang– Sungsan	Dec. 2015
Korea	Changwon - Busan Expressway Project	Dec. 2015
Korea	Gangnam Ring Road Project	May. 2016
Korea	Expressway Bono – Okcheon Pavement & Expansion Works	Aug. 2016
Korea	The 2nd Yeongdong Expressway Project	Nov. 2016
Korea	Construction section 1 of Donghae Nambu Line	Dec. 2016
Korea	Double Track Railway Construction of Donghae Nambu Line	Dec. 2016
Korea	Anyang – Sungnam Expressway Project	May. 2017
Korea	Okdong - Nongso Road Construction	Jun. 2017
Korea	Private Investment Business Project of Sangju - Youngcheon Expressway	Jun. 2017
Korea	Seungju Bypass Project	Nov. 2017
Korea	Singal Bypass Project	Dec. 2017
Korea	Roadbed Construction section 3-1 of Railway Wonju - Gangneung	Dec. 2017
Qatar	Lusail Expressway	Dec. 2017
Korea	Expressway Jori – Beobwon Pavement & Expansion Works	Dec. 2017
Korea	Construction of Expressway Inhwa – Ganghwa	Jan. 2018
Korea	Construction (section 1) of Expressway Jincheon - Jeuongpyeong	Feb. 2018
Korea	Double Track Railway Sosa – Wonsi Construction (section 1 & 2)	Feb. 2018
Korea	Construction (section 1) of Expressway Jeokseong - Jeongok	Jun. 2018
Korea	Subbase Course Construction of Double Rail Track between Dodam and Youngcheon for Chungang Line (zone 1)	Dec. 2018
Korea	Expansion section 1 of Expressway Line Number One Eonyang – Yeongcheon	Dec. 2018
Korea	Subbase Course Construction of Donghae Rail Track between Pohang and Samchuck (zone 12)	Jan. 2019
Korea	Construction of Expressway Socheon - Dogye 2	Sep. 2019
Korea	Construction section 2 of Expressway Hwayang - Jeokgeum	Nov. 2019
Korea	Highway Sunjang–Yeomchi Pavement & Expansion Works	Dec. 2019
Korea	Construction section 2 of Highway Seomyeon – Gyunnam	Dec. 2019
Korea	Subbase Course Construction of Janghang Rail Track (2nd phase zone 4)	May. 2020
Korea	Construction of Bypass road between Gupo and Sanggok of Gumi City	Jan. 2021
Korea	Construction Section 1 of Highway Boryeong – Taean	Apr. 2021

ELECTRICAL WORKS

Electricity is a form of energy which is essential for maintaining our modern lifestyle. Unlike other energy sources, electricity is difficult to store and is wasted unless consumed almost as soon as it is produced. In the modern world, power plants and transmission lines are the hearts and blood vessels of the body; they power our industry and keep the world running.

Powering the modern world

04



Yeongheung Coal Power Plant, Korea (May 2009)

When Korea was liberated from colonial government, Korea had an electricity production capacity of 1,723MW. Only 199MW of this capacity was located in South Korea of which only 40.3MW was reliable. As a result, South Korea was heavily reliant on the power generation capacity located in North Korea.

Building the power infrastructures of South Korea

Incheon Coal Power Plant, Korea (December 1978)

Building a power industry to fuel industrialization

Even before the Korean War broke out, South Korea was unable to rely on the power supply from the North. For example on 14th May 1948, North Korea temporarily shut down electricity transmission to South Korea causing a blackout. The Korean War which broke out on 25th June 1950 immediately led to 40, 20 and 60 percent of power generation, transmission and distribution capacity in South Korea.

After the cease-fire agreement in July 1953, building an electricity grid became the top priority and a three year electricity development plan was announced.

Construction of Dangin-ri, Masan and others increased the generation capacity to 215MW by 1956. In 1962, the first five-year national electricity infrastructure plan was announced alongside the first five-year national economic development plan. The simultaneous announcement of the two plans was no coincidence, there could be no economic plan without a reliable electricity supply.

HDEC began to play an active role in power plant construction at the same time. Between 1962 and 1977, three five year national electricity infrastructure development plans were announced and HDEC completed the Busan, Samcheok, Yeongwol and Gunsan coal power plants as well as the Ulsan natural gas power plant. Although HDEC was capable of building other industrial plants, power plant projects alone kept the company busy.

Up until 1977, Korean construction companies including HDEC were almost entirely reliant on overseas technologies. It was a time of learning and technology transfer for all companies involved in projects. Core generation technologies and engineering roles were almost entirely carried out by engineers from overseas.

Pyeongtaek Coal Power Plant, Korea (August 1983)

The Incheon coal power plant, which was completed in 1978 after 9 years of work, marked a turning point for HDEC. Consisting of two 250MW and two 320MW boilers, the Incheon plant had a combined capacity of 1,150MW. Although the engineering design was created by an overseas partner, HDEC was able to independently carry out procurement, construction and pilot operation of the plant.

Construction of the 1st and 2nd Pyeongtaek coal power plants began in December 1978. HDEC demonstrated its own capacity to build a power plant by carrying out the whole process including the engineering design. It marked yet another landmark moment for HDEC as an independent power plant engineer and construction company. Successful completion of the 1st and 2nd units led to commissioning of the 3rd and 4th units. The Pyeongtaek power plant was completed in August 1983 with a combined generation capacity of 1,400MW.

Leading the way in diverse power plant technologies

HDEC won the contract for electrification of Asir, Saudi Arabia, which was one of the largest power grid projects in the world. The project consisted of construction of nine 10MW diesel generators, 88 kilometers of 132kV transmission line and 12 substations. Successful completion of the Asir project led to a number of other power plant projects overseas including the Al-mussaib (730 million USD) project in Iraq and the Makkah Taif (275 million USD) project in Saudi Arabia, which were completed in February 1988 and November 1990 respectively.

In the 1980s, many small hydro power plant projects were commissioned. Small hydro power plants utilize the energy embedded in fast flowing water in small rivers and creeks, contributing to a reduction in fuel consumption and the need for long-distance transmission lines by supplying power locally. In 1985, HDEC built a 6MW small hydro power plant at the junction of the Hantan River and Yeonpyeong Stream. Many more small hydro power plant projects including the Geum River and Bonghwa were successfully completed by HDEC in the 1980s.

Construction of Samnangjin pumped hydro storage was yet another important achievement for HDEC. Pumped hydro storage utilizes the electricity created during the off-peak period to pump water to a reservoir on higher ground and uses the stored water to generate electricity when needed. In short, it works as a battery. The Samnaggjin pumped hydro storage began operating in December 1985, significantly increasing the operation efficiency of Kori and Wolseong nuclear power plants, and helping create a stable electricity supply to Ulsan and Busan.

Leading the 2nd wave of the power infrastructure boom in South Korea

Successful construction of the electricity infrastructure in the 1960s and 1970s set a solid foundation in South Korea. However, the demand for electricity continued to increase with the country's economic development and the reserve capacity was as low as 5 percent in the early 1990s. This led to the commissioning of more large power plants including four coal power generators in Taean and two coal power generators in Yeongheung.

Unlike the existing coal power plants which used hard coal as fuel, the newly commissioned Taean and Yeongjeung plants used bituminous coal. Each generator was significantly larger at 500MW and 800MW capacity.

Yeongheung Coal Power Plant, Korea (May 2009)

The Yeongheung project also included construction of a 76 kilometer long 354,000 Volt transmission line over the sea which was the first in the world. HDEC also participated in construction of the 3rd and 4th generators which each had a capacity of 870MW capacity, at the Yeongheung power plant completed in May 2009.

The Bundang combined cycle power plant, constructed by HDEC, was the first of its kind. This highly efficient plant burns LNG and uses high-temperature exhaust gas to turn a turbine, creating electricity and then uses the heat from the exhaust gas to generate steam, which turns another turbine to generate additional electricity. HDEC built five 80MW gas turbines and 200MW steam turbines with a total capacity of 600MW.

The Bundang combined cycle power plant was constructed in the 1990s in order to provide power to Bundang, a newly built city on the outskirts of Seoul. Since LNG generates far less pollution than coal, the power plant was built close to Bundang and easily supplies the city with electricity. The waste heat is also used to provide regional heating, further boosting efficiency.

Bundang Combined Cycle Power Plant, Korea (March 1997)

Taean Coal Power Plant, Korea (May 2002)

After successful completion of the 380kV transmission line in Saudi Arabia, HDEC's technologies were referred to as the 'Hyundai Standard' and began spreading throughout the Middle East including Saudi Arabia, Qatar, UAE, Bahrain and other Gulf Cooperation Council member countries with the expansion of transmission lines in the region.

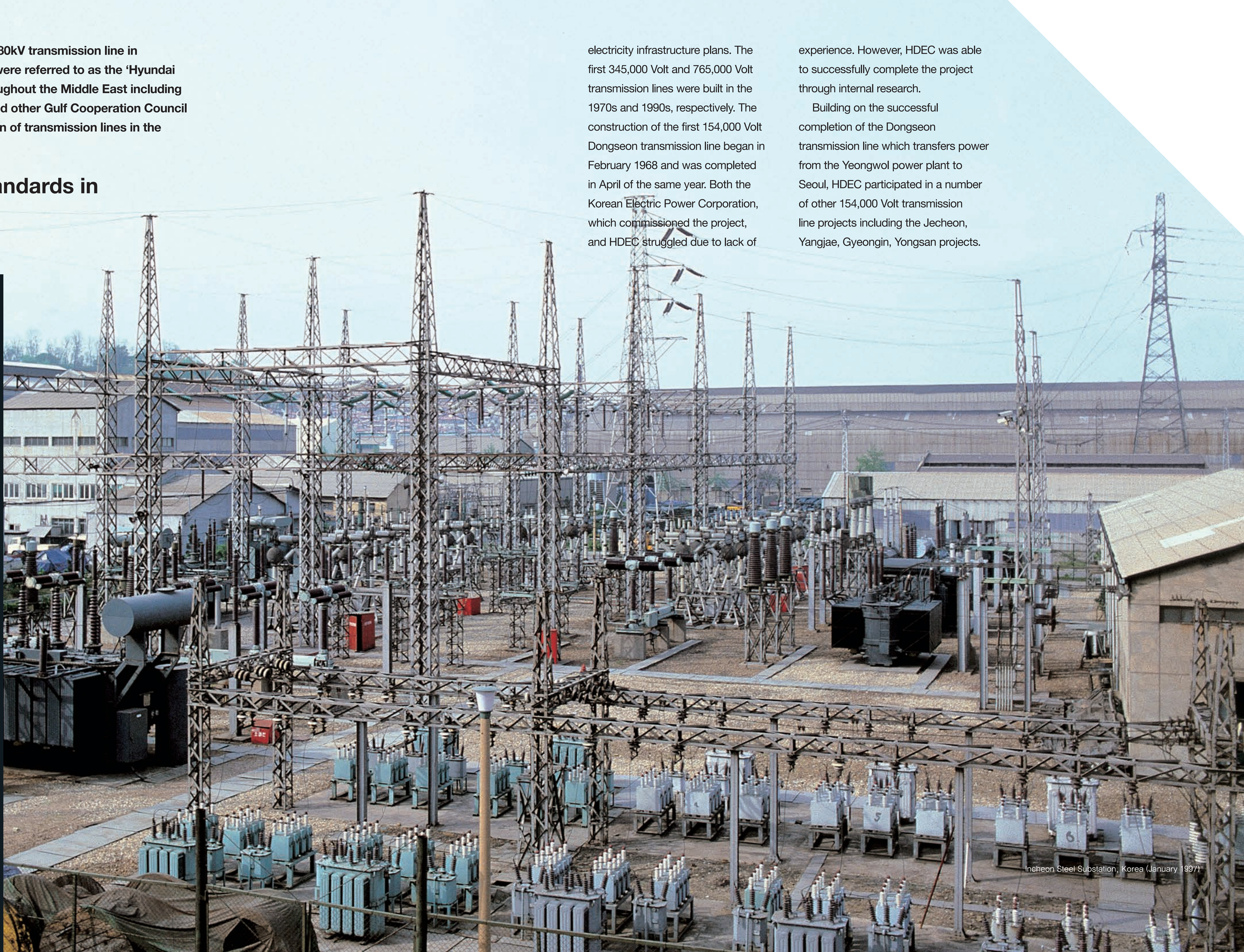
Spreading HDEC standards in power transmission

Building high voltage transmission lines for efficient transmission of power

With electricity transmission, higher voltage lines are equivalent to a highway with more lanes as the transmission efficiency increases with the voltage of the transmission line. As a result, the voltage in the transmission line needs to be increased to ensure the efficient transmission of electricity from large power plants. Although it may sound simple, increasing the voltage requires numerous changes to the hardware specifications such as the thickness of wires, strength of pylons and specifications of the concrete base structure. As a result, advanced civil engineering and construction capacity is required in order to increase the transmission voltage.

In South Korea, maximum transmission voltage has been increased three times so far. In the 1960s, the first 154,000 Volt transmission lines were built as part of the first and second national electricity infrastructure plans. The first 345,000 Volt and 765,000 Volt transmission lines were built in the 1970s and 1990s, respectively. The construction of the first 154,000 Volt Dongseon transmission line began in February 1968 and was completed in April of the same year. Both the Korean Electric Power Corporation, which commissioned the project, and HDEC struggled due to lack of experience. However, HDEC was able to successfully complete the project through internal research.

Building on the successful completion of the Dongseon transmission line which transfers power from the Yeongwol power plant to Seoul, HDEC participated in a number of other 154,000 Volt transmission line projects including the Jecheon, Yangjae, Gyeongin, Yongsan projects.



Incheon Steel Substation, Korea (January 1997)

Gulf States 400kV Transmission Line, Saudi Arabia (January 2009)

The Yongsan project was the first high voltage underground transmission.

In the mid 1970s, the need for long-distance transmission lines arose with the vast expansion of the electricity generation capacity including the launch of the Kori 1 nuclear reactor. HDEC once again led the market by taking the Shinulsan transmission line, which transmitted electricity from the Kori 1 reactor and Seoseoul transmission line project. Completed in 1977, the two projects marked the beginning of the era of the 345,000 Volt transmission line.

HDEC continued to participate in a number of 345,000 Volt transmission line projects including the Shinyeosu, Asan and Shinincheon projects. Among them, the Ildo-Yangju transmission line project, built between March 1991 and May 1992, was the first long-range transmission line built without support from an overseas partners. HDEC constructed two 195 meter tall pylons to cross the Han River between Gimpo and Paju, which at the time were the tallest pylons in Asia.

South Korea began development of 765,000 Volt transmission technology in 1984. HDEC built the first technology demonstration in Gochang, Jeollabuk-do. It also carried out development research on pylon foundation construction technology for 765,000 Volt lines, ideal for South Korea. The new technology was first tested in construction of the foundations for the Shintaebaek and Seoan-Dangjin transmission lines. It was later adopted widely in other 765,000 Volt transmission line projects in South Korea.

The 345,000 Volt transmission line which transfers electricity from the Yeongheung coal power plant is one of the most remarkable projects completed by HDEC. Completed in June 2004, the project involved the construction of 137 pylons over a 76 kilometer long route. Eighty one pylons had to be built on the sea or reclaimed wetlands. A vast amount of materials including 35,000 ton of steel piles, 20,613 tons of steel pylon structures and 1,837 kilometers of wires were used to complete the project. It was an expensive project with each pylon costing 3.2 billion KRW.

The first large-scale electrification project overseas

Although HDEC was involved in small scale transmission line projects in the Middle East, the turning point was the Asir electrification project in Saudi Arabia, which HDEC was awarded in 1976. It was a turnkey project which included construction, operation and maintenance of power plants, transmission lines, substations and even electricity meters for individual houses. Included in the project was transmission line work totaling 88 kilometers of 132,000 Volt lines and 179 kilometer of 33,000 Volt lines.

The majority of the construction sites were at an altitude of over 2,500 meters which created many unexpected challenges. However, the first phase of the work was completed in June 1979 which led to the winning of the 2nd phase contract. Successfully completed in June 1980, the combined value of the project was 181 million KRW.

In July 1983, HDEC began work on the Tihama electrification project which included construction of 132,000 Volt transmission lines. The project was the second large-sale project commissioned by the Southern Electric Power Bureau.

The works sites were scattered over an area approximately 70 kilometer in width and 400 kilometers in length with some of the sites over 100 kilometers apart from one another. A total of 1,975 pylons were constructed for the 946 kilometer-long high-voltage transmission lines and 2,800 kilometers of wires were utilized for the project which included 1,400 kilometers of low voltage transmission lines for households.

Establishing the Hyundai Standard with a 380kV transmission line

With a 172 million USD budget, the 380,000 Volt transmission line project commissioned by the Southern Electric Power Bureau of Saudi Arabia led to the establishment of what later became known as the Hyundai Standard. After its involvement in the Asir and Tihama electrification projects, HDEC prepared for a boom in electrification projects in

Saudi Arabia. For example, a dedicated team was created for pylon engineering and a local office was setup as a joint-venture for more efficient procurement.

The 380,000 Volt transmission line was commissioned to transfer the electricity generated in the east of Saudi Arabia, which is rich with oil and gas resources, and supply the electricity to Riyadh and Al Kharj at a reasonable price. HDEC won the bidding against SAE, an Italian company with a strong reputation as a leader in transmission line construction.

The project consisted of a 311 kilometer-long line in the north linking Shedgum and Riyadh and a 254 kilometer-long line in the south linking Faras and Al Kharj. HDEC constructed a total of 1,448 pylons for the project. All engineering work related to the pylons was done in-house with an agreement to transfer the technology to HIDADA, a joint venture created for pylon construction.

New technologies such as the Supervisory Control & Data Acquisition system which protects the transmission lines from lightning and allows for remote operation of the substations was introduced. The Auger method and the Rock Anchor method which had been tested during the Yemen and Iraq projects were employed in the foundation work. Furthermore, the introduction of mobile batch plants by the US-based Johnson company allowed HDEC to significantly reduce manual labor, allowing for completion of the project in August 1987, 34 months after it began.

Known as the 'Hyundai Standard', the technologies developed for the project including pylon design became the national standard in Saudi Arabia.

HDEC continued to participate in a number of transmission line projects in the Middle East including 66,000 and 33,000 Volt transmission lines and substation project in Jamahiriya, Libya (completed in Dec. 1997), and the Riyadh-Qasim 380,000 Volt transmission line in Saudi Arabia (completed in Feb. 2002).


Manifa 115kV Transmission Line and Substation, Saudi Arabia (December 2012)

Substation: A vital component of the global electricity network

Substations are a vital part of an electricity network. HDEC built the first large-scale substation equipped with a 345kV Gas Insulated Switchgear (GIS) for the 3rd and 4th Kori nuclear reactors in 1979. HDEC also built a 345kV Air Insulated Switchyard (AIS) substation for the 3rd and 4th Pyeongtaek power plants and a 345kV GIS substation, ensuring its position as market leader.

Successful completion of the GIS substation for the 3rd and 4th Kori reactor served as proof of HDEC's capacity. The 33kV AIS substation in Iraq was HDEC's first overseas substation project. HDEC won a number of substation projects in the Middle East including Libya, Saudi Arabia and Yemen. In the 1990s, HDEC built substations in a number of Southeast Asian countries including the Philippines, Malaysia, India, Thailand and Sri Lanka.

Thanks to HDEC's strong reputation and technological capacity, it won many projects in Saudi Arabia, Kuwait, Qatar and the United Arab Emirates and also began to build a 400kV GIS substation equipped with a substation automation system. Winning the highly profitable 400kV GIS substation bid was a great achievement in itself because such projects were normally awarded to more experienced companies.

HDEC is currently concentrating its efforts on winning contracts for 500kV ultra high voltage GIS substation projects and high voltage direct current transmission line projects which are expected to be the future of electricity networks.

The electricity industry is constantly evolving, especially as we pursue higher efficiency and lower pollution. Achieving higher efficiency is important since it allows more electricity to be generated with less pollution. HDEC is building various electricity generation plants with advanced technologies to create a greener future for electricity.

Setting a new benchmark in efficient green electricity network

Mong Duong 1 Power Plant, Vietnam (December 2015)

On the cutting-edge of the next-generation coal power plant

The international community is increasingly emphasizing the importance of Energy Security, Economic Efficiency and Environmental Performance. Achieving all three characteristics has become an important requirement of electricity generation.

The coal power plant is one of the oldest electricity generation technologies still in use and is usually regarded as a prime source of greenhouse gases and air pollutants. The 1,080MW Mong Duong 1 power plant completed in December 2015 is located in Mong Duong, Quang Ninh province in Vietnam. It uses hard coal as fuel and alleviated the power shortages in Mong Duong as soon it began operating.

Coal mined in Vietnam is hard coal and has less heat content per weight, which makes it unsuitable to convert into pulverized coal. Despite this, the Mong Duong 1 power plant is one of the most efficient and least polluting coal power plants. For example, it has a dedicated sulfur removal facility which significantly reduce SOx emissions.

It also has very low NOx emissions compared to other coal power plants.

The thermal efficiency of the Mong Duong 1 plant is also comparatively high thanks to the Circulating Fluidized-Bed Combustion (CFBC) technology. CFBC technology helps reduce air pollutants dramatically by simultaneously supplying air and limestone.

The Samcheok Green power plant, which began operating in July 2017, has four advanced supercritical pressure CFBC boilers. The supercritical steam generator operates at pressures above the critical pressure (225.65kg/cm^2) which turns liquid water immediately into steam leading to less fuel use.

When the conditions for the fluidized-bed phenomenon is created, solid particulate substance behaves like a fluid. The fluidized-bed combustion boiler inserts sand particles which has a higher heat conductivity than air, leading to more efficient combustion of the coal. The sand also absorbs heat and accelerates the heating of the pipeline. The sand is separated from the coal ash and recycled into the boiler. Exhaust gas is also sent through a convection pass and helps heat the pipes. Employing two 550MW super critical pressure fluidized-bed combustion boilers and one gas turbine unit, the Smacheok Green power plant is one of the most efficient in the industry.

The Cirebon Ⅱ coal power plant project in Indonesia, which HDEC won in November 2015, has 1,000MW of generation capacity, and employs ultra supercritical pressure technology. By operating in ultra supercritical pressure conditions, above 279kg/cm^2 , steam temperatures above 606°C can be achieved making the boiler smaller and more efficient. Due to be completed by July 2021, Cirebon Ⅱ is expected to be the first commercial ultra super critical coal power plant.

Comparing Pulverized Coal Boiler and Circulating Fluidized Bed Boiler

	Comparing Pulverized Coal Boiler	Circulating Fluidized Bed Boiler
Fuel	100um coal	Wide range of fuel under 10mm in radius including low grade coal and biomass
Combustion type	Mixed with air and burned in the flue gas flow	Combustion assisted by fluidized medium
Operating temperature	1,200~1,500℃	750~950℃
Emission control	Require separate sulfur removal facility	Sulfur and other pollutants are removed within the boiler
Maximum capacity	1,300MW	600MW

Ras Laffan C combined Cycle Power Plant, Qatar (April 2011)

Creating new opportunities in combined cycle power plant and geothermal power plant

In the Middle East, water is often more precious than oil and there are an increasing number of projects

Samcheok Green Power Plant, Korea (July 2017)

Yulchon Ⅱ Power Plant, Korea (June 2014)

which involve the construction of desalinization and power generation plants. The Ras Laffan C combined cycle power plant in Qatar, which HDEC completed in April 2011 is a great example.

The Ras Laffan C project contract totaled 2.07 billion USD, which made it the largest plant project a South Korean company has won to date. It has a combined power generation capacity of 2,730MW and accounts for an impressive 30 percent of the power generation capacity of Qatar. The desalinization plant is capable of producing 286,000 tons of fresh water per day which is enough drinking water for 800,000 people.

The water and electricity produced from the Ras Laffan C plant is supplied to three cities in Qatar including Doha and Saudi Arabia, providing two of the basic necessities for the Persian Gulf region.

HDEC's latest combined-cycle power plant built in South Korea is the Yulchon Ⅱ power plant which was completed in June 2014. The Yulchon Ⅱ power plant uses LNG as fuel and generates high-temperature exhaust gas to turn the turbine to generate electricity and then uses the heat from the exhaust gas to generate steam, which turns another turbine to generate additional electricity. Its double cycle operation and use of LNG makes the Yulchon Ⅱ power plant more efficient and cleaner.

Yulchon Ⅱ is also an important showcase of HDEC's R&D achievements. An automated mass concrete curing method was developed by HDEC's advanced technology research team in order to improve the concrete quality.

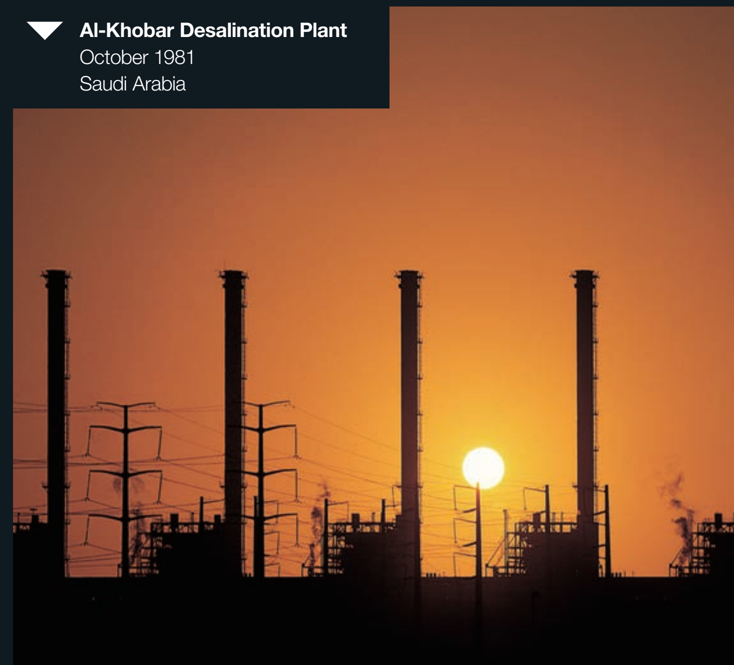
The new curing method prevents cracks forming during curing, due to temperature differences between different parts of the concrete, by applying water at a temperature calculated using temperature measurement data. The new method can also prevent contraction cracks, significantly enhance durability and strength and shorten curing period.

The Sarulla power plant project is HDEC's first geothermal power plant and is currently being constructed on Sarulla Island in Indonesia's Noth Sumatra. Located within the seismically-active Pacific Ring of Fire, Indonesia has 40% of the world's geothermal energy resources. Geothermal plants generate electricity using the produced from heat deep within the Earth's crust.

Made up of three 110MW units, the 330MW Sarulla geothermal power plant is the largest geothermal plant in the world. Previously, geothermal power plants had generators with a maximum of 40 to 60MW per unit. HDEC incorporated a wide range of new technologies to double the generation capacity per unit.

GALLERY
ELECTRICAL WORKS

Ildo-Yangju Transmission Line
May 1992
Korea



Al-Khobar Desalination Plant
October 1981
Saudi Arabia

Portobello Combined Cycle Power Plant
June 2003
Brazil

Talimarjan 900MW Combined Cycle Power Plant
December 2016
Uzbekistan

Riyadh-Qasim Transmission Line
August 1990
Saudi Arabia

Tanjung Bin 500,000/275,000 Volt Substation
February 2006
Malaysia

Jebel Ali Combined Cycle Power Plant
October 2008
UAE

Sarir 3×250MW Plant
July 2013
Libya

Zawiya Combined Cycle Power Plant Extension
February 2008
Libya

LIST ELECTRICAL WORKS

* The list below consists of select projects out of 329 projects.

Country	Project Name	Time of Completion
Korea	Masan Coal Power Plant	Apr. 1956
Korea	Samcheok Coal Power Plant	Dec. 1963
Korea	Busan Coal Power Plant #1, 2	Aug. 1964
Korea	Yeongwol Coal Power Plant #1, 2	Feb. 1965
Korea	Gunsan Coal Power Plant	May. 1968
Korea	Ulsan Natural Gas Power Plant	Sep. 1968
Korea	154,000 Volt Dongseon Transmission Line	Apr. 1969
Guam (USA)	Diesel Power Plant	Mar. 1970
Korea	Gyeongin Coal Power Plant	Apr. 1972
Korea	Incheon Coal Power Plant	Dec. 1978
Saudi Arabia	Riyadh Substation	Dec. 1978
Bahrain	66,000 Volt Substation	Apr. 1979
Saudi Arabia	Abha Power Plant Retrofit, Operation and Management	Aug. 1979
Saudi Arabia	Asir Electrification Project	Jun. 1980
Saudi Arabia	Jizan Distribution Network Extension	Jul. 1980
Saudi Arabia	Al-Khobar Desalination Plant	Oct. 1981
Saudi Arabia	Al-khobar Natural Gas Transmission Line Project	Oct. 1981
Yemen	132,000 Volt Transmission Line	Mar. 1983
Korea	Pyeongtaek Coal Power Plant	Aug. 1983
Qatar	Doha Coal Power Plant	Nov. 1983
Iraq	132,000 Volt Transmission Line	Dec. 1983
Saudi Arabia	Asir Power Plant Additional Construction	Jun. 1984
Iraq	33,000/11,000 Volt Substation	Jul. 1984
Korea	Yeoncheon Small Hydro Power Plant	Jan. 1985
Saudi Arabia	33,000 Volt Transmission and Distribution Line	Oct. 1985
Kuwait	300,000/132,000/33,000/11,000 Volt Transmission Line	Jun. 1986
Saudi Arabia	80,000 Volt Transmission Line	Aug. 1987
Iraq	Al-mussaib Power Plant	Feb. 1988
Korea	Kumkang Small Hydro Power Plant	Mar. 1988
Saudi Arabia	Electrical, Communication Systems and Subsidiary Facilities of Technology division of the Ministry of the Interior Building	May. 1988
Saudi Arabia	Haql Transmission and Distribution Line	Jun. 1988
Yemen	Third phase Rural Area Electrification Project	Jul. 1988
Iraq	High-voltage 400,000/132,000 Volt Substation	Aug. 1988
Korea	Bonghwa Small Hydro Power Plant	Sep. 1988
UAE	Jebel Ali-Dubai 132,000 Volt Transmission Line	Nov. 1988
Yemen	Underground 11,000 Volt Transmission Line and Switch Gear	Jan. 1989
Saudi Arabia	Southern Electric Power Bureau Substation	Mar. 1989

Country	Project Name	Time of Completion
Sri Lanka	Samanala Wewa Hydropower plant Lot 2 Civil Works	Apr. 1989
Saudi Arabia	Ash-Sharqiyyah-Jizan Transmission Line	Jun. 1989
Kuwait	Umm Qudair 33,000/11,000 Volt Transmission Line	Aug. 1989
Saudi Arabia	North of Asir 132,000/33,000 Volt Substation	Oct. 1989
Korea	Hyundai Petrochemical Complex Transmission Line	Jul. 1990
Saudi Arabia	Riyadh-Qasim 380,000 Volt Transmission Line	Aug. 1990
Saudi Arabia	Makkah Taif Power Plant	Nov. 1990
Kuwait	Subiya 300,000/132,000 Volt Transmission Line	Jan. 1991
Saudi Arabia	Middle Electric Power Bureau 132,000 Volt Transmission Line	Jul. 1991
Saudi Arabia	Muhayel-Medjerda substation #2	Nov. 1991
Korea	Bundang Combined Cycle Power Plant	Apr. 1992
Korea	Ildo-Yangju Transmission Line	May. 1992
Korea	Shingwangju-ShinGangjin Transmission Line	Aug. 1992
Korea	Namjeju Transmission Line	Jan. 1993
Saudi Arabia	Asus Bay 230,000/115,000 Volt Transmission Line	Dec. 1993
Indonesia	Phaeton Coal Power Plant Mechanical & Electrical works	Jul. 1994
Saudi Arabia	Ras Tanura 69,000 Volt Transmission Line and Substation Replacement Works	Jul. 1994
Saudi Arabia	Aramco 69,000 Volt Substation	Aug. 1994
Saudi Arabia	3 Substations in the Riyadh	Jun. 1995
Malaysia	275,000/132,000/22,000 Volt Substation	Dec. 1995
Lebanon	Transmission Line & Substations New Maintenance	Dec. 1995
Saudi Arabia	Mahasen 230,000/115,000 Volt Substation	Dec. 1995
Korea	Yeonggwang-Shinnamwon Transmission Line	Jan. 1996
Korea	Incheon Steel Substation	Jan. 1997
Korea	Bundang Combined Cycle Power Plant	Mar. 1997
Malaysia	275,000/132,000 Volt High-pressure Gas Insulated Transmission Line	Apr. 1997
Korea	154,000 Volt Transmission Line for Daesan Combined Cycle Power Plant	Aug. 1997
India	Anpara-Unnao 800,000 Volt Transmission Line	Sep. 1997
Kuwait	132,000/33,000 Volt Transmission Line	Sep. 1997
Korea	154,000 Volt Transmission Leading-wire Undergrounding for Hyundai Motor Asan Plant	Dec. 1997
Libya	Jamahiriya System 66,000/33,000 Volt Transmission Line and Substation	Dec. 1997
Korea	Namyang Technology Reserch Center 154,000 Volt Substation	Jan. 1998
Saudi Arabia	Shuaibah-Makkah 380,000 Volt Transmission Line	Jul. 1998
Korea	Hyundai Electronics 2nd phase Combined Cycle Plant Works	Aug. 1998
India	Nathpa Jhakri Hydroelectric Dam	Sep. 1998
Malaysia	Kuala Lumpur 135,000/275,000 Volt Substation	Dec. 1998
Thailand	115,000/22,000 Volt Substation	Jan. 1999

Country	Project Name	Time of Completion
UAE	132,000/33,000 Volt GIS Substation	Jan. 1999
Libya	Misrata Power Plant and Desalting Plant	Sep. 1999
Saudi Arabia	132,000 Volt Substation #4 Foundation & #2 Extension	Jan. 2000
Philippines	Mindanao 138,000/69,000 Volt Substation	Mar. 2000
UAE	Abu Dhabi & Al-Ayn Transmission Line Extension	Aug. 2000
Nepal	Modi River Hydroelectric Plant	Sep. 2000
UAE	132,000/33,000 Volt Transmission Line for Central Region	Sep. 2000
Philippines	Leyte-Bohol Transmission Line and Substation	Nov. 2000
Philippines	Mindanao 132,000 Volt Substation Extension	Dec. 2000
India	Veraval 20MW Diesel Plant	Dec. 2000
Kuwait	Sabiya Power Plant	Jan. 2001
Saudi Arabia	132,000 Volt GIS Substation #3 Foundation & #2 Extension	Sep. 2001
Vietnam	Vung Tau-Ba Ria Combined Cycle Power Plant	Sep. 2001
Bangladesh	Haripur-Megnaghat Combined Cycle Power Plant	Nov. 2001
Kuwait	33,000 Volt Transmission Line and 5MVA Transformer Installation	Dec. 2001
Saudi Arabia	Riyadh-Qasim Transmission Line	Feb. 2002
Korea	Taean Coal Power Plant	May. 2002
Kuwait	Jleeb 5 Substations in Western Region	Dec. 2002
Malaysia	Prai 132,000 Volt GIS Substation Extension	Jan. 2003
Macao	Coloane B Combined Cycle Power Plant	Mar. 2003
Brazil	Portobello Combined Cycle Power Plant	Jun. 2003
Korea	Busan Combined Cycle Power Plant #1, 2	Jul. 2003
Vietnam	Ham Thuan-Dami 220,000 Volt Substation	Dec. 2003
UAE	Abu Dhabi & Al-Ayn 33,000/11,000 Volt Substation	Dec. 2003
Kuwait	Jahra 131,000/11,000 Volt Substation	Apr. 2004
Korea	Yeongheung Coal Power Plant 345,000 Volt Transmission Line	Jun. 2004
Korea	Busan Combined Cycle Power Plant #3, 4	Aug. 2004
Korea	Yeongheung Coal Power Plant #1, 2	Dec. 2004
Korea	Yulchon Combined Cycle Power Plant	Jun. 2005
Malaysia	Tanjung Bin 500,000/275,000 Volt Substation	Feb. 2006
Saudi Arabia	Jubail Industrial Park Substation Replacement	May. 2006
Iraq	New Transmission Lines and Substations and Upgrade of Existing System in Northern Region	Jul. 2006
Kuwait	Sabiya-Jahra 300,000 Volt Transmission Line	Aug. 2006
Malaysia	Ulu Tiram Substation Extension	Dec. 2007
Libya	Zawiya Combined Cycle Power Plant Extension	Feb. 2008
UAE	Jebel Ali Combined Cycle Power Plant	Oct. 2008

Country	Project Name	Time of Completion
Saudi Arabia	Khurais 380,000/115,000 Volt Substation	Oct. 2008
UAE	Abu Dhabi 132,000 Volt Substation	Nov. 2008
Saudi Arabia	Gulf States 400,000 Volt Transmission Line	Jan. 2009
Korea	Yeongheung Coal Power Plant #3, 4	May. 2009
Saudi Arabia	Rabigh 380,000 Volt Transmission Line	Jul. 2009
Libya	Benghazi-Tobruk 400,000 Volt Transmission Line	Aug. 2009
Qatar	220,000 Volt Substation	Jul. 2010
Saudi Arabia	Qasim-Madinah 380,000 Volt Transmission Line	Sep. 2010
Korea	Paju Gyoha Combined Cycle Power Plant	Feb. 2011
Qatar	Ras Laffan C combined Cycle Power Plant	Apr. 2011
Korea	Shin Wolsong-Buk Kori 345,000 Volt Transmission Line	Jun. 2011
Saudi Arabia	Manifa 115,000 Volt Transmission Line and Substation	Dec. 2012
Saudi Arabia	Hail-Jouf 380,000 Volt Transmission Line	Mar. 2013
Libya	Sarir 3×250MW Plant	Jul. 2013
UAE	Ruwais 400,000/220,000 Volt Substation	Mar. 2014
Korea	Hyundai Green Power Coal Power Plant	May. 2014
Korea	Yulchon Ⅱ Power Plant	Jun. 2014
Saudi Arabia	Qurayyah Power Plant phase 1 380,000 Volt Transmission Line	Jul. 2014
Ivory Coast	Azito Plant Extension	May. 2015
Vietnam	Mong Duong 1 Power Plant	Dec. 2015
Korea	Dangjin Coal Powerplant	Jun. 2016
Iraq	Al-mussaib Powerplant Repair Works	Jul. 2016
Indonesia	Sumatra 275,000 Volt Transmission Line	Sep. 2016
Philippines	Subic 2×300MW Coal Power Plant	Sep. 2016
Saudi Arabia	Al-Samir 380,000/110,000/13,800 Volt Substation	Dec. 2016
Uzbekistan	Talimarjan 900MW Combined Cycle Power Plant	Dec. 2016
UAE	Al Mirfa Power and Desalination Plant	Apr. 2017
Saudi Arabia	Yanbucity 380,000/110,000/13800 Volt Substation	May. 2017
Saudi Arabia	Duba-Tabuk-Madain 380,000 Volt Transmission Line	May. 2017
Korea	Samcheok Green Power Plant	Jul. 2017
Saudi Arabia	New Jubail Substation	Oct. 2017
Saudi Arabia	Hail-Qasim 380,000 Volt Transmission Line	Dec. 2017
Saudi Arabia	Riyadh 380,000 Volt Transmission Line	Feb. 2018
Indonesia	Sarulla Geothermal Power Plant	Mar. 2018
Uruguay	Punta del Tigre Combined Cycle Power Plant	Aug. 2018
Indonesia	Cirebon Ⅱ Coal Power Plant	Jul. 2021

BUILDING WORKS

Beautiful buildings make cities pleasant to live in and sometimes even become a national symbol. Good architecture requires knowledge of technology, aesthetics and even an understanding of human psyche, and is regarded as a form of art. HDEC has built some of the finest buildings in the world.

Building the world's landmarks

05

Yeosu International Expo (Big-O), Korea (April 2012)

The devastation of the Korean War led to a decade of restoration work. During the war, over 5,000 government buildings were destroyed in Seoul alone. Countless banks, hospitals, office buildings and houses were destroyed as well. Thanks to generous overseas aid restoration work was quickly undertaken and Seoul began to recover, with modern buildings erected in the old city center of Seoul. By the early 1960s, Seoul had been restored adequately to function as a modern city complete with a basic road system.

HDEC: A living history of South Korea's Architecture

Setting the foundations: The public buildings of Seoul

Although basic restoration work had been completed, Seoul still lacked a number of important elements to make it a fully-functioning capital city for South Korea. One of the missing elements was public buildings.

Plans for construction of a National Assembly building were first made in 1951, and it has since become one of the most important buildings in the history of South Korea's architecture. Initially, Jongno 3-ga, in the center of Seoul was chosen as the site but this was later changed to the Nam Mountain area and then ultimately to Yeouido by the Han River. It took 20 years before the construction work even began.

The National Assembly was designed to incorporate various elements of traditional Korean architecture, such as the stone pillars of the Gyeonghoeru Pavilion, and western architecture, such as the round dome. First designed as a 5-story building, it was later made a 6-story building in order to make it taller than the Japanese colonial government building.

The large-scale stone works and construction of a large dome gained HDEC valuable experience in new techniques. During the construction, many lessons were learned and new skills mastered including analysis of different stones, how to bond them, and various surface treatment methods including the application of mortar to prevent surface contamination.

HDEC was awarded the prestigious contract to build a new reception hall for the presidential Blue House, yet another high-profile public building. The work began in September 1977 and was completed just over a year later in December 1978. It is widely regarded as one of the finest buildings in terms of design and quality of construction. HDEC visited many reception halls in western Europe and Japan and incorporated elements from them in the design of the Blue House reception hall.

The 21 stone pillars on the exterior of the reception hall help create an imposing first impression. The eight pillars on the front are each made of a single stone piece, weighing over 60 metric tons each. HDEC also built the new main presidential Blue House building which was constructed between December 1989 and August 1991. It has a traditional octagonal roof covered with over 150,000 blue shingles and has become a landmark building that represents the South Korean government.

HDEC also led on construction of the second government complex in Gwacheon. The complex hosts the majority of the government ministries, making it one of the most important places for administration and policy-making in South Korea. It was a long-term projects completed over a 15 year period.

Constructed in June 1995, which is much later than the aforementioned public buildings, the supreme court was also built by HDEC. The supreme court was designed around the theme of symmetry, with a 16-story high central section, symbolizing its independence and legal authority. By completing the supreme court building HDEC became the company which had built the main buildings for the top three branches of the government.

Built between the 1960s and 1970s, the Nam Mountain Seoul Tower is yet another great landmark in Seoul. The 237m tower, which was the tallest in Asia at the time of its completion, is built on top of Nam Mountain which

National Assembly Building, Korea (September 1975) is 262m tall. Visitors to the tower are therefore able to enjoy a bird's eye view of Seoul. In the 2000s, the tower went through major renovation work including the installation of a rotating observatory and it continues to serve as a landmark and popular tourist destination.

HDEC also participated in 27 Gimpo airport expansion projects, between 1969 and 1980. The biggest project was the construction of the passenger terminal between December 1977 and July 1980. The passenger terminal of Gimpo International Airport employed a highly sophisticated Waffle Pan Slab method which allowed for construction of the roof without steel beams. The Waffle Pan Slab method, enabled the construction of a wavy roof, which has become a key characteristic of Gimpo International Airport.

HDEC was also involved in a number of school construction projects. One of the most well-known is the Gwanak campus of Seoul National University. HDEC was responsible for construction of large proportion of the campus including a number of buildings such as the library and sports complex, in addition to infrastructure such as the roads and pavements.

In the 1980s, HDEC built the science department building of Ewha Womans University and the Ewha Girls High School. In the 1990s, HDEC was chosen to build a range of buildings for Ewha Womans University, Sogang University and Korea University. In the 2000s, HDEC was involved in a number of university projects including the life science department building of Korea University, Songdo Campus of Yonsei University and the Military Administration Academy building. The Ulsan National Institute of Science and Technology project was unique as it was commissioned as the first Build Transfer Lease contract.

The Pungmoon High School, completed in February 2017, was one of the most recently completed school project by HDEC. The high school relocated from Jongno-gu to Jagok-dong, Gangnam-gu and the new campus had to be completed on tight schedule. The groundbreaking took place in February 2016 and five buildings including an administration, two classrooms, a sports center and a dormitory, with total floor area of $30,516m^2$ were all completed in time for new school year in March 2017.

Main Presidential Blue House Building, Korea (August 1991)
Official Residence of Presidential Blue House, Korea (October 1990)

Nam Mountain Seoul Tower, Korea (October 1971)

Built with cutting-edge technologies: Private sector buildings

Construction and expansion of the Korean Exhibition Center was at the time one of the most high-profile projects in Seoul, which was on the verge of becoming an international city. The exhibition hall was constructed in 1979 and the 56-story Korea World Trade Center was constructed adjacent to the exhibition hall in 1989. Korea City Air Terminal, hotel and department store were also constructed, turning the area into a bustling business center.

Plans for expansion of the Korea Exhibition Center were announced in mid 1990s in preparation for the 3rd Asia-Europe Meeting (ASEM) scheduled for 2000. HDEC formed a consortium with other leading construction companies and took on the expansion project which consisted of the 41-story ASEM tower, a four story convention center and a larger exhibition hall. When it reopened, the Korea Exhibition Center was renamed the Convention & Exhibition Center.

The 174 meter-tall ASEM tower was built to support the new convention center and its exterior was shaped to resemble a container ship carrying export goods. Fast track method

Pungmoon High School, Korea (February 2017)

Federation of Korean Industries Building, Korea (September 2013) allowed construction to be completed by January 2000, opening the center in time to host the 3rd ASEM in May 2000. The 3rd ASEM meeting was the biggest diplomatic event to be hosted in South Korea at that time, with leaders from 25 Asian and European countries.

In May 2000, a large underground shopping mall linking the ASEM tower, convention center and exhibition hall was created. The 663 meter-long shopping mall was named the COEX mall and became a popular center for cultural activities. HDEC also led on the COEX mall renewal project which was carried out between October 2013 and December 2014.

Following successful completion of the ASEM Tower, HDEC demonstrated its capacity to build a skyscraper once again by successfully completing the Federation of Korea Industry (FKI) building in September 2013. Built on the old FKI building site, the new FKI building is 245 meters tall (50-story) with an additional 6 floors underground. It is the third tallest building in Yeouido.

Busan International Finance Center, Korea (June 2014)


LH Corporation Headquarters, Korea (March 2015)


Amore Pacific New Headquarters, Korea (August 2017)

The new FKI building was designed as a green building to have minimum environmental impact. By angling the spandrel panels 30 degrees toward the sun, the solar panels produce up to 730kW of power per hour. The spandrel panels, minimize the amount of direct sun radiation and glare, further contributing to a reduction in energy use.

Busan International Finance Center (BIFC) is yet another building constructed by HDEC. It is regarded as one of the most remarkable skyscrapers among the many high-rise buildings to be found in Busan. The 63-story, 289m BIFC has a total floor area of 197,169m^2. HDEC used a 'sailboat ready to travel six oceans' as a design motif for the BIFC, considering BIFC was built as a hub for the financial market of the Northeast Asia. HDEC employed a GPS-based building monitoring system for construction of BIFC, which uses high-precision location data from five GPS receivers to correct the position in real-time, allowing for truly high-precision works with only a few millimeters of an error margin.

Completed in March 2015, the Korea Land & Housing (LH) corporation headquarters boasts one of the most advanced building energy management systems in South Korea. The energy consumption per floor area is 131kWh/m^2 which is 57% lower than 300kWh/m^2, the threshold for the top energy efficiency rating.

The LH corporation HQ is the first building in South Korea designed and constructed using the Building Information Modeling (BIM) method. BIM experts stayed throughout the whole construction process, ensuring high quality construction. A digital mock-up model was also created in order to virtually eliminate any construction errors, minimizing the need for resources and time required for construction.

HDEC also constructed a number of high profile and unique buildings including the National Digital Library of Korea (completed in Jan. 2009), the NHN Green Factory (completed in Apr. 2010), the International Passenger Terminal of Busan Port (completed in Jan. 2015), and the NH Integrated IT center (Jan. 2016).

The National Digital Library of

International Passenger Terminal of Busan Port, Korea (January 2015)

NH Integrated IT center, Korea (January 2016)

Korea won multiple environmental awards including from the Korean Institute of Ecological Architecture and Environment. NHN Green Factory also won praise for the use of natural lights, energy saving and refreshing green images.

The exterior design of the International Passenger Terminal of Busan Port was created to resemble the shape of a whale and earned high praise for successfully expressing the sense of dynamism of Busan city. The NH Integrated IT center was praised for setting a new standard for data centers with its high-security, dustproof-design, emergency power generation capacity and highly efficient energy management.

Expected to be completed in August 2017, the new Amore Pacific headquarters will set a new trend in office building design in Seoul. The 22-story HQ building was designed by David Chipperfield, and is significantly smaller than other recently built office buildings in the area. This unconventional design decision was made to ensure the building stands out, by staying lower than most other buildings in the surrounding area. Instead of going higher, the building is designed to blend in with Yongsan Park in the East and Nam Mountain in the North.

The box-shaped building has an open space in the middle which presented some tough challenges. Amore Pacific created empty space in the lower, middle and high part of the building, allowing air circulation and natural light penetration.

Amore Pacific HQ was designed to function both as an advanced green office building and as a public space with walkways, parks, art galleries and a large atrium. Designed to be easily accessible to the public with lots to enjoy and appreciate. The design reflects the philosophy of Amore Pacific, one of the largest beauty companies in the world, committed to creating a more beautiful world by achieving both inner and outer beauty.

Exhibition center built with technology and care

Located in Goyang city, which is known as the city of flowers, the 2nd Kintex exhibition hall is shaped like a butterfly and has a floor area of 212,442m^2. The construction work for the exhibition hall began in January 2009 and ended in September 2011. Located by a beautiful lake and the great Han River, the exhibition hall is designed to exist in harmony with its surroundings.

HDEC showed off its technological prowess, accumulated through a range of projects including the COEX convention center, the Kintex 2nd exhibition hall, and the Suntec Convention Centre in Singapore, at the Yeosu Expo. The Yeosu Expo is widely

Hyundai Motorstudio Goyang, Korea (March 2017)

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National Museum of Korea, Korea (October 2005)

The 2nd Kintex Exhibition Hall, Korea (September 2011)

regarded as one of the three biggest international conventions in the world and HDEC worked hard to ensure it was a success.

The Korean pavilion at the Yeosu Expo is equipped with the largest dome screen in the world, which is 15 meters tall and 30 meters wide. Certified with the highest energy efficiency, everything in the Korean pavilion is powered using zero carbon energy such as solar PV, solar thermal, wind and heat from sea water. Hyundai Motor incorporated a zero emission hydrogen fuel cell system, developed for cars, as a generator for the building.

The Big-O show on a gigantic water screen quickly became the must-watch performances of the Yeosu Expo 2012. HDEC's offshore engineering technology was used to install a gigantic ring-shaped machine. The base podium, equipped with pumps and machinery to operate the water screen, was constructed on the ground and later installed on the seafloor using hydraulic jacks. This method allowed for reduced construction time and minimization of equipment needs.

HDEC has also built Hyundai Motor's brand experience centers including the Hyundai Motorstudio Seoul in 2014 and the Hyundai Motorstudio Hanam in 2016. In March 2017, HDEC completed the Hyundai Motorstudio Goyang which is designed to look like a floating spaceship. Created around the design concept of 'heaven, earth and forest' the building has a sense of tension with use of diagonal lines. An extra-long cantilever was employed to make it look as though the building is about to soar into the sky.

HDEC has also been the primary contractor responsible for the construction of a number of museums including Gyeongju National Museum (completed in Jul. 1975), Seoul History Museum (completed in Jan. 1998), Gongju National Museum (completed in Oct. 2003), Nam-jun Paik Art Center (completed in Feb. 2008), Busan National Gugak Center (completed in Aug. 2008), Korea Manhwa Contents Agency (completed in Aug. 2009) and Jeongok Prehistory Museum (completed in Jan. 2011).

The most exemplary museum building constructed by HDEC is the National Museum of Korea which opened in October 2005. The museum has received high praise for continuing South Korea's unique tradition of achieving harmony between nature and man's creations. The museum consists of two main buildings with a carefully designed space between them, all of which has been designed to allow the penetration of natural light.

Buildings to cities are like DNAs to organisms as each unit determines characteristics of the whole. Just as an organism with superior DNA become more competitive in survival, cities and countries with great buildings become more competitive than others. Sometimes, one single landmark or DNA can make a transformative impact for the whole.

Built by HDEC: Landmark buildings of the world

Art made with steel: Ministry of the Interior Building, Saudi Arabia

Completed in February 1992, the Ministry of the Interior Building in Saudi Arabia is one of the best examples of HDEC's mastery of architecture.

The ministry building is located in Riyadh and looks like an upside down pyramid. Some says it looks like a flower in full bloom facing sky. It is easily spotted for people travelling from Riyadh King Khalid Airport. A round dome - found in masjid - is built on top of the building resembling pistil of a flower.

In order to build the ministry building with reverse sloping exterior wall, HDEC employed 3D structural analysis method. Since it was early 1990s, it required a super computer from UCLA to conduct simulation over and over, testing different steel structure designs. The biggest challenge of the project was installation of cantilever truss on top of the building which accounts for possible sagging due to weight of finished building.

Due to large daily temperature fluctuation which makes the structure expand and contract, which made it challenging to find the right design. The impending Gulf War in Kuwait unnerved the people involved in the project as SCUD missiles were reportedly pointing at the central Riyadh. Despite, HDEC staffs continued their work as completion was in sight. Thanks to dedicated workers, the Ministry of the Interior Building, landmark in Riyadh and one of HDEC's finest achievement was completed in February 1992.

Building a portfolio of landmarks in Singapore

Singapore is a living portfolio of HDEC's work and so much of its infrastructure and buildings were constructed by HDEC. For example Suntec City, which won a staggering number of major awards when it was completed in 1997, is one of the best known landmark built by HDEC.

Suntec City consists of four 45-story office towers, one 18-story building and one 8-story Singapore International Convention & Exhibition Center. This mega complex is designed by Ieoh Ming Pei, a renowned Chinese-American architect who adopted Feng Shui, a philosophical system of harmonizing everyone with the surrounding environment. Viewed from distance, the five buildings and convention center looks like five finger and palm of a human hand.

Suntec City is located in the eastern part of Marina Bay, which is Singapore's biggest business and entertainment center. It is still regarded as one of the best landmarks in Singapore although it was built two decades ago. The Suntec City mall is still the biggest shopping mall in Singapore and it is home to a large number of Michelin-starred restaurants.

Ministry of the Interior Building, Saudi Arabia (February 1992)


Suntec City, Singapore (July 1997)

Suntec City is also famous tourist destination as starting point of the Hippo Tour Bus and laser shows at night. The Fountain of Wealth located at the 'palm' of Suntec City's human hand like structure, is also popular among tourists.

The Asia Square Tower was the second mega complex project built by HDEC, following the Suntec City. The Asia Square Tower is located in the western financial district of Marina Bay and consists of 43-story Tower Ⅰ and 46-story Tower Ⅱ. The towers have top-rated offices, various commercial establishments as well as a luxury hotel operated by Westin Hotel.

The Asia Square Tower Ⅰ, which was completed in June 2011, was built without interior pillars to maximize interior space. Many innovative measures were introduced in underground structure construction, reducing construction time by 45 days while setting right foundation for frame construction. Successful completion of the Tower Ⅰ has made it possible for HDEC to win the Asia Square Tower Ⅱ Project.

In 2017, HDEC completed yet another landmark, named the South Beach located by the Beach Road across the Suntec City. Built on 34,959m² site, the complex has 10 buildings including 34-story office towers and 45-story hotel. It was designed by a UK-based design firm, Foster & Partners.

Created with design concept of 'Huge Wave' and the South Beach has a gigantic gold-colored canopy covering 70 percent of the lower structure. The 280 meter-long canopy blocks sunlight·rain and help facilitate airflow acting like a filter. The rainwater fell on the canopy is collected in underground tank and used in the building. The canopy also has solar panels which generate electricity for the building.

In June 2013, HDEC and GS E&C won contract for the Marina South development project. Funded by Singapore sovereign fund Temasek and Malaysia sovereign fund Khazanah, it is the largest resort-resident development plan in Asia. The resort has heart-shaped Louber, which connects four residential towers, and help create floors with varying shapes. Due to complex design, construction work is full of challenges without a single straight pillar. HDEC employed steel beam deck instead of steel concrete structure in order to improve build quality and reduce construction time.

The project was completed in June 2017 and quickly became a new landmark as famous as Suntec City and Asia Square Towers. Moreover, the new landmark is expected to make South Beach area as famous as Marina Bay.

The 338m Macau Tower Convention and Entertainment Centre, 10th tallest building in time of completion, opened in April 2000 in commemoration of 2nd anniversary of Macau's return to Chinese sovereignty. The center is most famous for rotating restaurant on the 60th floor and observatory with glass floor. It also has world's tallest bungee jump platform and Sky Walker attraction where visitors can walk around the exterior of top floor.

The 262m, 68-story Bitexco Financial Tower is located in Ho Chi Minh city, Vietnam. Completed in May 2011, it is well-known for design


Asia Square Tower Ⅰ, Singapore (June 2011)
Asia Square Tower Ⅱ, Singapore (June 2015)

South Beach, Singapore (February 2017)

Bitexco Financial Tower, Vietnam (May 2011)

National Museum, Qatar (June 2017)

resembling a blossoming lotus bud, the national flower of Vietnam.

Roses of desert: National Museum of Qatar

HDEC completed the first phase Msheireb Downtown Doha development project in July 2015. It was an important project which allowed HDEC to reenter Qatar market after a 30 year gap since Doha hotel project which was completed in February 1982.

The Master Plan comprises six distinct phases with a goal of turning Msheireb Downtown of Doha as an advanced green city. The first phase, features a combination of three major government buildings including the National Archive, an office building and a guard house behind the existing palace. There is also a plan to build a new museum with floor area of 46,596㎡ on an Old Palace heritage site spanning over 135,000㎡.

Jean Nouvel, one of the most recognized architect based in France lead design part of the project. He created an innovative design which was created using sand rose as a motif. Also referred as desert rose, it is a rose-like formations of crystal clusters of gypsum or baryte which include abundant sand grains. HDEC created 316 round disk shaped panels which were made using 74,000 glass fiber panels and reinforced concretes.

Currently under construction as of mid 2017, the museum is expected to go down in history as one of the most uniquely designed built structure found in the world. HDEC employed 3D Building Information Modeling method in all process of the project in order to ensure successful completion of the museum.

Although they could be exceptions, people are born, live and die in a building. This is why some people say buildings are integral part of people's lives. Among them, hospitals, sports complexes and hotels are most significant to human lives.


Al Iman General Hospital, Saudi Arabia (September 1993)

Buildings for everyday life


Medical City Complex, Iraq (August 1986)

Built for more than recovery

HDEC's history of hospital construction dates back to the 121st. Evacuation Hospital of the US Army which was completed in January 1971.

Building the 121st Evacuation Hospital, which was equipped with latest medical equipment, provided HDEC with an invaluable experience for its future works in hospital construction. The project required HDEC to strictly follow specification by the US federal government and was subjected to safety inspection. HDEC learned how to properly install special equipment and related electric and mechanical facilities at requested specification.

In July 1979, HDEC created the Asan Social Welfare Foundation (Asan Foundation) in commemoration of its 30 years anniversary. As a first project, the foundation launched hospital building projects for rural towns in order to provide rural communities adequate access for advanced medical services.

Over first two years, the foundation spent 10 billion KRW to build JeongEup Asan Hospital, InJe Asan Hospital, BoSeong Asan Hospital, BoRyeong Asan Hospital and YeongDeok Asan Hospital which were completed between 1978 and 1979. All project works were handled by HDEC which further led to improvement in HDEC's capacity to carry out hospital projects.


Riyadh King Fahd Medical City, Saudi Arabia (June 1994)

The Medical City Complex project in Iraq was HDEC's first hospital project in overseas. It was also significant that the project involved construction of a group of facilities not just a single hospital building.

The medical complex project was announced as a part of the 2005 Project which aimed to create cutting-edge medical complex in Baghdad by 2005. HDEC was commissioned with 2nd phase work for the project and contract was 327 million USD in total value, making it one of the 10 largest projects in the Middle East. HDEC built nine hospital buildings including 20-story surgical ward with 1200 hospital beds, a pediatric ward, a general ward and so on.

The hospitals in the Medical City Complex were equipped with cutting-edge facilities and instantly earned strong reputation among public. Its reputation became stronger as it was used as key hospital during the Iraq war.

In December 1983, HDEC won contract to build King Fahd Medical City in Riyadh, Saudi Arabia. The 613 million USD project is the largest project of its kind even compared to the Medical City Complex in Iraq, with 1,905 hospital beds in its capacity. HDEC began construction work in June 1994 and built various facilities including highly advanced hospital and residential apartments for 2,600 staffs.

Later on, HDEC won the Group A project which consists of constructing two hospital buildings with 300 hospital beds each in Riyadh, for Al Iman General Hospital. Completed in September 1993, Al Iman General Hospital has become one of the most reputable hospital in Riyadh as well as Saudi Arabia as a whole.

HDEC continued to lead on hospital

projects for universities in South Korea including Korea University Medical Center, Ewha Womans University Mokdong Hospital, Seoul National University Hospital, Seoul National University Bundang Hospital and the Catholic University of Korea Seoul St. Mary's Hospital, between 1991 and 2009. HDEC also completed the Asan Medical Center in 1989 and GangNeung Asan Hospital in 1997 which were commissioned by the Asan Foundation.

Seoul National University Bundang Hospital is national hospital with 900 hospital beds and is designed to accommodate approximately 3,000 inpatients a day. Designed for large number of inpatients, the hospital has ample waiting areas. The waiting area is divided into outer area and inner area by central atrium, and are designed to effectively separate inpatients to avoid inconvenience and congestion. Designed for maximum light penetration, the top light atrium is designed for maximum light penetration and gives the building a unique look.

Built on a site originally reserved for a sports complex for Catholic University, the 22-story Catholic University of Korea Seoul St. Mary's Hospital with 1,805 hospital beds and floor area of 219,813m^2 was the biggest single building built in South Korea at the time of completion. The building serves as both College of Medicine, The Catholic University of Korea and is linked with existing hospital providing excellent service to patients and while serving as a center of excellent learning

Seoul National University Bundang Hospital, Korea (August 2003)

and research.

The Asan Medical Center opened in March 1989, three months after completion of the west wing. It is has total floor area of 1.39 million m^2 and 554 hospital beds. Its east wing was completed in June 1995 with additional 1,125 hospital beds. A separate new building with 727 hospital beds was completed in May 2008, further increasing capacity to 2,406 hospital beds.

Asan Medical Center is built to provide best care service for people and to minimize environmental impact. Equipments and staffs are arranged for maximum convenience of patients. Optimization of service system including streamlining of administration process were constantly made in order to minimize wait time and provide better service.

In 1979, Asan Foundation began its medical service through operation of five hospitals in South Korea. In 1989, the foundation acquired GeumGang Asan Hospital and later it launched GangNeung Asan Hospital in November 1996. As of 2017, the foundation has a network of eight hospital and Asan Medical Center in Seoul serving as central facility.

In overseas, HDEC built the Changi General Hospital in Singapore which was completed in April 1994. The Singapore government created plan for the hospital in 1980 in order to provide high quality medical service to fast growing population in the Eastern region.

The Changi General hospital has a 4-story podium block with two underground floors and a 9-story tower block. It was created to be the central medical hub for the East Singapore and a series of improvements were made to complete its mission. The hospital has a luxury hotel-like interior and the tower block with wards is stretched to north and south to minimize direct light penetration while allowing maximum flow of northeast and southeast winds.

Completed in 2010, the Khoo Teck Puat Hospital is the second hospital HDEC built in Singapore. It was designed to provide high quality

Catholic University of Korea Seoul St. Mary's Hospital, Korea (April 2009)


Hamad Medical City, Qatar (April 2016)

medical service for the resident of Northern region of Singapore. It also boasts luxury-hotel like interior and is a proud symbol of Singapore medical community.

Unlike most large buildings located in city center, the Khoo Teck Puat Hospital is located by scenic Yishun lake on the outskirt of city center. It is highly regarded for its peaceful environment ideal for recovery.

The Hamad Medical City project in Qatar was the third large-scale hospital project implemented by HDEC, following the Medical City Complex in Iraq and King Fahd Medical City in Saudi Arabia. The project goal was to remodel athlete's quarter and press enter built for the 2006 Doha Asian Game into four hospital ward buildings. Major renovation was necessary except the core frame.

HDEC was responsible for creation of three wards (women's ward, inpatient ward and rehabilitation ward) out of four wards. Combined capacity of three wards is 176,167m^2 floor area with 532 beds. Employing Design Build method, HDEC carried out all process of the project and applied all lessons it learned from its long experience.

Sports complexes: The home of dreams

Sports complexes are a by-product of prosperity, which is why only a small number were built during South Korea's construction boom between the 1960s and 1970s. Until the 1970s, there were only a handful of large sports stadiums in Seoul; Dongdaemun Stadium, Hyochang Stadium and Jangchung Arena which were built in 1925, 1960

Changi General Hospital, Singapore (August 1996)

and 1963 respectively.

Construction of large sports complexes outside of Seoul, began in the mid 1970s for the annual Korean National Sports Festival which was hosted in different parts of South Korea each year. Between 1974 and 1979, HDEC built a number of sports facilities including the Chungbuk Gymnasium, Kimil Gymnasium, Hyundai Sports Complex and Chungbuk Sports Complex, Baseball Stadium and Judo arena.

A boom in construction of large sports facilities in South Korea began


Khoo Teck Puat Hospital, Singapore (June 2010)

in earnest in the 1980s as South Korea began to host major international sports events. HDEC completed the Jamsil Baseball Stadium in Seoul in July 1982 which was the first large outdoor sports facility built within the Seoul Sports Complex. The stadium was built to host the 1982 Amateur World Series, which it did very successfully.

Jamsil Baseball Stadium received a lot of media attention as it was the first stadium built to meet international specifications, having such things as 100 meter-long foul lines and a natural lawn cover. Before the Jamsil stadium was completed, Dongdaemun stadium was the closest to the international specifications with its 98 meter-long foul lines. Although it was built 35 years ago, Jamsil Stadium remains the best baseball stadium in South Korea and where the biggest baseball games are hosted.

Completed in July 2001, the Busan Sports Complex was built for the 2002 Korea-Japan FIFA World Cup and the 2002 Asian Games. The Busan Asiad Main Stadium is the main stadium in the complex; it has 48 curved external pillars and delicate curved lines which symbolize the harmony of heaven and earth. The stadium has a walkway deck built along the round external wall, resembling the rings of Saturn, and allowing visitors to easily access different parts of the stadium.

Completed in June 2001, Ulsan Munsu Football Stadium is a dedicated football stadium with 43,512 seats. It is the second largest football stadium in South Korea, second only to the Seoul World Cup Stadium which can accommodate 67,000 people at once. The roof, which covers 87% of the spectator seats, is in the shape of a crown from the Silla kingdom and has a truss resembling a whale bone found on ancient wall painting. It is from the shape of the roof that the stadium got its nickname, the Big Crown.

The 2014 Asian Games were hosted in Incheon and HDEC, who had constructed the main stadium for the Busan Asian Games, was once again chosen and on this occasion to build the Incheon Asiad Main Stadium. Work began in June 2011 and was completed in August 2014. HDEC also constructed the Wangsan Yachting Center for the event.

The Incheon Asiad Main Stadium is equipped with a geothermal energy facility and a solar generation facility for heating·cooling and lighting. It was also designed to be fully accessible for all and earned the top rating in the Universal Design and Barrier Free. It has a maximum seating capacity of 100,000 with 62,000 standard seats and 32,000 removable seats.

The Gwangju-Kia Champions Field is home to the Kia Tigers baseball team and was built to provide the best possible baseball experience for spectators. Compared to traditional stadiums, the seating area has been pushed inwards by two to seven meters to bring the game closer to the fans.

HDEC invited baseball fans in Gwangju city in order to ensure the new stadium was appealing and accessible for a wide range of people. As a result, the stadium has more than ten special booths including terrace seats, skyboxes, family seats, party floors and club lounges. Equipped with automatic doors and access ramps, the stadium earned Barrier Free certification for the physically-disabled.


Busan Sport Complex, Korea (July 2001)


Jamsil Baseball Stadium, Korea (July 1982)

The stadium is equipped with high energy-efficiency devices including an air ventilation system coupled with a heat exchanger. It also has a geothermal energy system ensuring maximum heating and cooling efficiency.

The Gwangju-KIA Champions Field opened in March 2014 and is the home of the KIA Tigers. It has been remodeled several times with the aim of achieving the best 'Look and Feel' for baseball fans. In 2015, the bullpen and dugout was renovated to provide enhanced openness. In 2016, before the season began the ground soil was replaced.

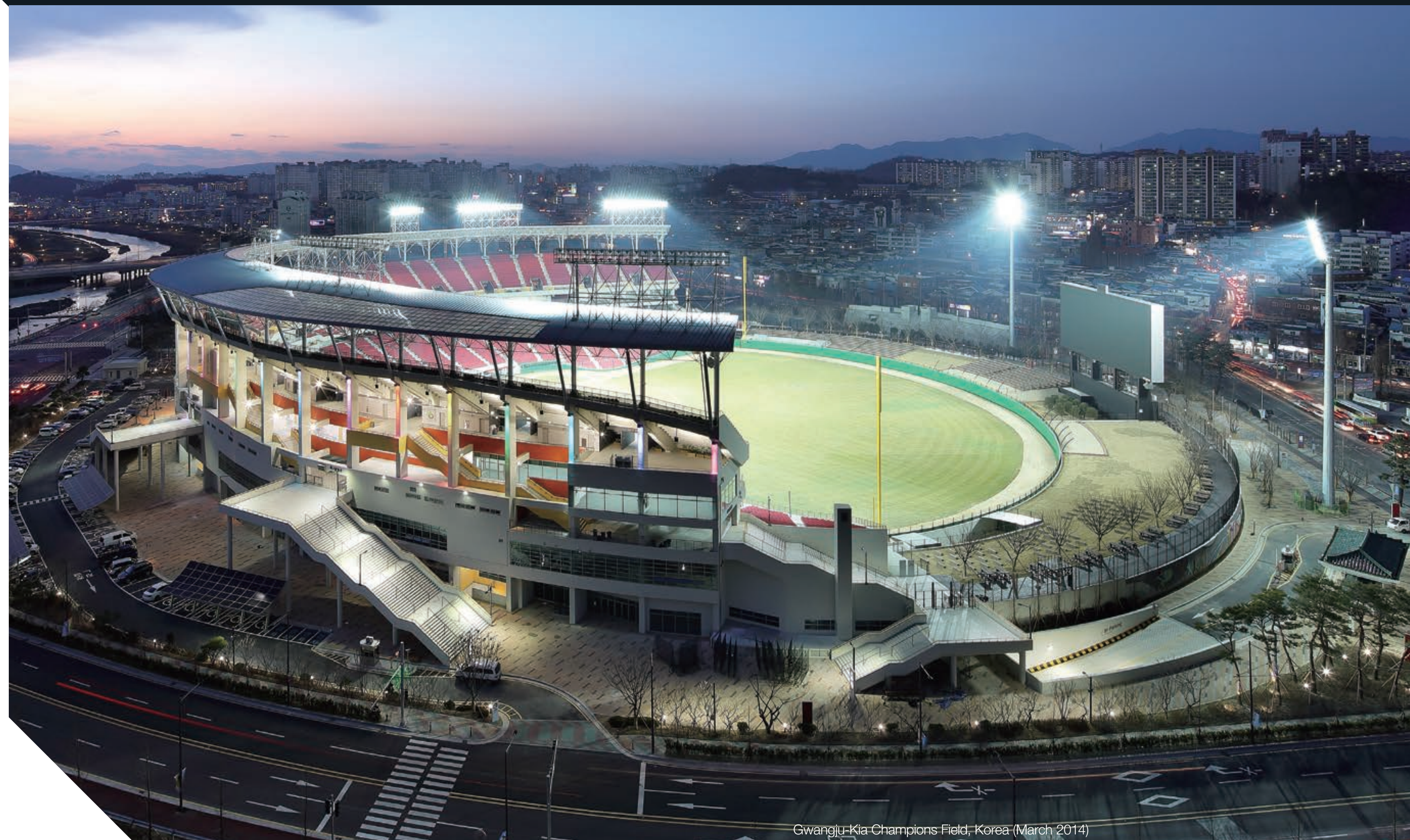
HDEC continued to build sports facilities in South Korea including; Geumjeong Gymnasium (completed in Sept. 2002), Pyongyang Hyundai Asan Sports Complex (Feb. 2004), Public Stadium in Asan (Apr. 2008), Samsan World Gymnasium (Sept. 2008), Jinju Stadium (Jun. 2010), Hwaseong Stadium (May. 2011), Goyang Gymnasium (Jun. 2011), Incheon Football Stadium (Mar. 2012), and Cheongshim Gymnasium (Dec. 2012).

Cheongshim Gymnasium is the second biggest indoor sports facility in Asia which is built using a pillar-less construction design method. The gymnasium was built to be both a sports facility and a performance arena, with a retractable 9 meter-tall arena seating platform, making it one of the most versatile facilities in South Korea.

The Hwaseong Sports Complex consists of a main stadium and a gymnasium, connected by a curved roof. The complex was designed to resemble two water drops about to merge with each other, symbolizing the dynamism of sports. It earned the prestigious 2011 Korea Civil Engineering and Construction Grand Award.

The Yokohamashi Tsurumi Sports Center, completed in August 1991, was HDEC's first sports complex project. It was not a full-size stadium with spectator seats nevertheless it was an important project as it was a double first; HDEC's first in Japan and first sport facility employing a truss construction method.

Completed in June 2001, the Tunis


Gwangju-Kia Champions Field, Korea (March 2014)

Rades Sports Center is located 20 kilometers south of Tunis, the capital of Tunisia. In 1992, the Tunisian government gave final approval for the Olympic City project, a large sports complex including a main stadium and athlete's quarters, for the 2001 Mediterranean Games. The project was an important part of the 9th national economic development plan of Tunisia.

The contract for the Olympic City project was won by a consortium of HDEC and Ferrovial, a Spaini construction company. The 138 million USD project consisted of a main stadium with 60,000 capacity, three football practice grounds, a heliport, parking lots and entrance roads. The Export-Import Bank of Korea provided a 30 million USD loan to the Economic Development Cooperation Fund. The project was completed successfully, allowing for the successful hosting of the 2001 Mediterranean Games. Furthermore, in 2004, the African Cup of Nations was hosted at the main stadium.

Construction of the Sports Hall and Athletic Stadium in Jeddah began in December 2012 and was completed in October 2015. It was the first construction project that HDEC had won in Saudi Arabia since 1992. Commissioned by Saudi Aramco, the 125.16 million USD project was for an international event standards indoor sports hall with a capacity of 10,000 and a 1,000 capacity athletic stadium.

The Jeddah Sports Hall and Athletic Stadium is located within the King Abdullah Sports City, 60 kilometers north of Jeddah city center. The King Abdullah Stadium, home s of the renowned Al-Ittihad Football Club, is also located within the King Abdullah Sports City, making it the center of sports in Saudi Arabia.


Ulsan World Cup Stadium, Korea (June 2001)

Hotels of best conveniences and elegance

As the Korea's economy began to grow rapidly in the late 1960s, service industries such as commercial, financial, education and tourism also grew rapidly increasing building projects, especially hotel construction.

At the time, HDEC had already established itself as the top construction company in Korea and was able to simultaneously construct three luxurious hotels, the Chosun Hotel, Koreana Hotel and Tokyu Hotel, in central Seoul.

The construction of the Chosun Hotel began first in October 1967. This 18-story hotel has a floor area of 42,195m^2. The Bechtel, a US-based company, was responsible for the design and construction inspection. Created to be a truly international hotel, it was built with the most advanced technologies of the time. For example, high-strength concrete was used to reduce the pillar volume to one eighth of a conventional pillar. A flat slab method, which support pillars with slabs, was employed to reduce the total height for floor.

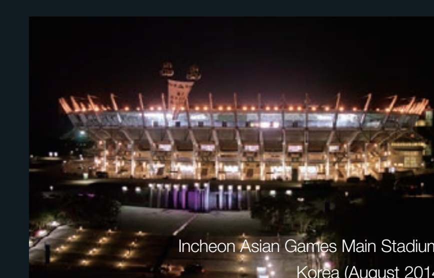
Construction of the Chosun Hotel was special as it was the first project by HDEC to use a tower crane. Even assembling the tower crane was difficult, but as staff became familiar with it construction was greatly accelerated. HDEC completed the framework of each floor within 5 to 7 days which would have been unimaginable without the tower crane. Thanks to the tower crane, construction took only 17 months in March 1970. Furthermore, the use of the tower crane made construction of the Tokyu Hotel and Koreana Hotel much faster as well.

The Tokyu Hotel was built in Seoul by Tokyu Hotels of Japan. The 100m 24-story hotel was the tallest building in Korea at the time of its completion. HDEC was commissioned to construct the framework of the hotel because the client felt that Tokyu Hotels lacked the capability to build the framework. Construction of the Tokyu Hotel was carried out between October 1968 until December 1969.

Construction of the 24-story Koreana Hotel began in November 1969 and was completed in December 1971. At the time it was one of the most modern high-rise buildings in Seoul, and had a floor area of 31,894m^2. To reduce the load a steel-concrete frame and lightweight vermiculite blocks were combined.

The size of these three hotels ranging from 18 to 24-story is common nowadays, but in the 1960s, they were considered high. Back then, these three magnificent skyscrapers representing Seoul were all constructed by HDEC. Even today, more than half a century later, the Chosun Hotel and Koreana Hotel are still thriving in downtown Seoul, and although the Tokyu Hotel sold the hotel in the 1980s, the building still stands.

Thanks to South Korea's rapid economic growth, hotel constructions


Incheon Asian Games Main Stadium, Korea (August 2014)


Chosun Hotel, Korea (March 1970)

have also continued to thrive.
The Walkerhill Hotel, renamed as the W Hotel, (completed in Jan. 1977), Intercontinental Hotel (Aug. 1988) and Gyeongju Hotel Hyundai (Jan. 1990) are some of HDEC's most outstanding achievements between the1970s and 1990s.

Hotel Hyundai Gyeongju has been a popular tourist hotel for many years, with its perfect location by scenic Bomun Lake, in historic Gyeongju city, the old capital from the Silla period. At the time this project presented lots of challenges. The curved external design was unique and not difficult to implement. However, the steel structure and floor plan of the guestrooms needed extra care in order to fit within the S shaped exterior design. Dry method was employed and high-precision construction methods were used to ensure each room was both waterproof and soundproof.

Completed in May 2015, the SEAMARQ Hotel was the next Hyundai hotel after the Hotel Hyundai Gyeongju. The SEAMARQ Hotel was created through renovation of the Hotel Hyundai Gyeonpodae which was one of the most popular hotels on the East Coast. In the period from when it opened in 1971, until the refurbishment began in May 2013 over 5.5 million people stayed at the hotel.

The SEAMARQ Hotel was designed by world-renowned architect Richard Meier; with four underground floors, 14 floors above ground, and a total floor area of 29,406 square meters. There is a convention center, open theater, exhibition hall and even a separate Hanok Hotel all within the complex. Richard Meier who is famous for his use of white, in simple and beautiful designs helped create the classic SEAMARQ Hotel in partnership with HDEC.

The SEAMARQ Hotel is the first building in Asia to use TX concrete panels and is fully equipped with renewable energy facilities such as solar & geothermal power, which has earned it the LEED green building certification for New Construction. It also received the Grand Prize at the 2016 Korean Architecture Awards.

In addition to the SEAMARQ Hotel, HDEC built the High One Resort (completed in Nov. 2010) and the Mega Star Youngjong (to be completed in Oct. 2017). The Megastar Yeongjong, located by the Unseo Station on Yeongjong Island near Incheon International Airport, is a landmark complex with various facilities including a business hotel and a residence hotel.

HDEC's first overseas Hotel construction project was the Diplomat Hotel in Bahrain. Construction began in April 1977 and was completed by October 1981. The budget for the 16-story Diplomat Hotel, with over 280 rooms, was 33.5 million USD. Although it was a reasonably small project, it was significant as it was HDEC's first hotel construction in the Middle East.

After completing the Diplomat Hotel in Bahrain in September 1978, HDEC took on construction of the much larger New Doha Hotel, later renamed the Sheraton Grand Doha Hotel, in Qatar in February 1979.

At the time of the commissioning, the New Doha Hotel's steel-frame work had already been completed by a Japanese contractor. The Qatar Public Works Authority presented two different methods for the interior construction and finishing works and requested submission of estimates for each method. The methods were for inner partition wall, one was the Block Wall method which was commonly used and the other was the Dry Wall method.

HDEC was the lowest bidder for the dry wall construction method, but was the second lowest bidder for the block wall construction method. Luckily HDEC won the project because Qatar Public Works Authority choose the drywall method.

The New Doha Hotel had a magnificent pyramid-shaped exterior with different shaped surfaces for each story. However, the exterior caused many difficulties during construction. Unlike other construction work, where the floor plans are nearly identical a lot of time and money had to be spent creating new blueprints for each floor. Moreover, obtaining construction permits for each blueprint was very time consuming, leading to significant delay.

Due to its complicated structure, changes in the design occurred frequently. More than 800 design modifications were made before completion of the project, and construction was often taking place whilst designs were still being finalized.

Despite numerous challenges during the construction process, the New Doha Hotel was a particularly successful project for HDEC. More than anything, successful construction of the sophisticated New Doha Hotel inspired confidence in HDEC's capacity for hotel construction.


SEAMARQ Hotel (Hotel Hyundai Gyeongpodae), Korea (May 2015)

Although the New Doha Hotel was constructed nearly 40 years ago, it is still regarded as one of the most outstanding landmarks in Qatar. In 2000, the hotel once again reaffirmed its reputation because it was the only high-rise building that did not suffer from flood damage while all other high-rise buildings did. In fact, the strong reputation of HDEC gained from the New Doha hotel project helped HDEC win many mega projects in the 2010s such as the Royal Palace, the National Museum, the new seaport and the Lusail Expressway project.

After the mid 1980s, HDEC's overseas hotel construction work shifted its focus from the Middle East to Southeast Asia. Complex buildings including Suntec City, Asia Square Tower and South Beach in Singapore are some of the most prominent overseas construction projects for HDEC between the 1990s and 2010s. HDEC was also involved in other hotel projects such as the Kuta Beach Resort Bali in Indonesia, which was completed in July 1997.

One of the most notable hotel project in the 1980s was the Hotel Hyundai Vladivostok in Russia. This notable achievement in the Northern region, was made possible due to many years of effort by HDEC.

In August 1994, HDEC signed a 57.95 million USD contract to build a hotel with the Vladivostok Business Co. Built in the center of Vladivostok, Russia's gateway city to the Pacific region, the hotel received a lot of public attention. The 11-story hotel was completed in June 1997 with a total floor area of 21,876 square meters, 219 rooms and two underground floors. Facilities in the hotel include offices, restaurants, a swimming pool and banquet halls.

The Four Seasons Hotel in Egypt was HDEC's first construction project in Africa. The work was carried out between May 1999 and January 2003. The project was commissioned by Nova Park Cairo, a real estate company that is 50 percent owned by Prince Alwaleed of Saudi Arabia. Located in the center of Cairo city by the banks of the Nile, the 30-story landmark hotel has a total floor area of 13,223 square meters.

The JW Marriot Hotel Hanoi is famous for its exterior, designed to resemble a dragon coiled up resting. The dragon is an important symbol for the Vietnamese, who believe they are descended dragons. Prior to the JW Marriott Hotel Hanoi project, HDEC had successfully completed the 68-story Bitexco Financial Tower which is well-known for its exterior design resembling a blossoming lotus bud, the national flower of Vietnam. As a result, HDEC became the company who had landmark buildings representing two important Vietnamese symbols.

In order to realize its unique Cantilever design which must sustain up to four times more deflection load, HDEC employed 9,500 tons of steel bars and 2,300 tons of structural steel parts to create the truss structure to sustain the load.

The JW Marriott Hanoi Hotel became famous when President Obama stayed during his visit to Vietnam in 2016. It received the 'Innovation New York' design award from ENR New York in 2011, the Gold Building Team Award from the Building Design and Construction in 2014, and the Excellence in Structural Engineering Award from the National Council of Structural Engineers Association.


Four Seasons Hotel, Egypt (March 2003)


Doha Sheraton Hotel, Qatar (February 1982)

GALLERY
BUILDING WORKS

Public Buildings the Supreme Court
June 1995
Korea

Royal Office Building and Guard House
July 2015
Qatar

Press Center
October 1984
Korea

Koreana Hotel
December 1971
Korea

Guui-dong Techno Mart
June 1998
Korea

Vladivostok
Hotel Hyundai
June 1997
Russia

BEXCO
May 2012
Korea

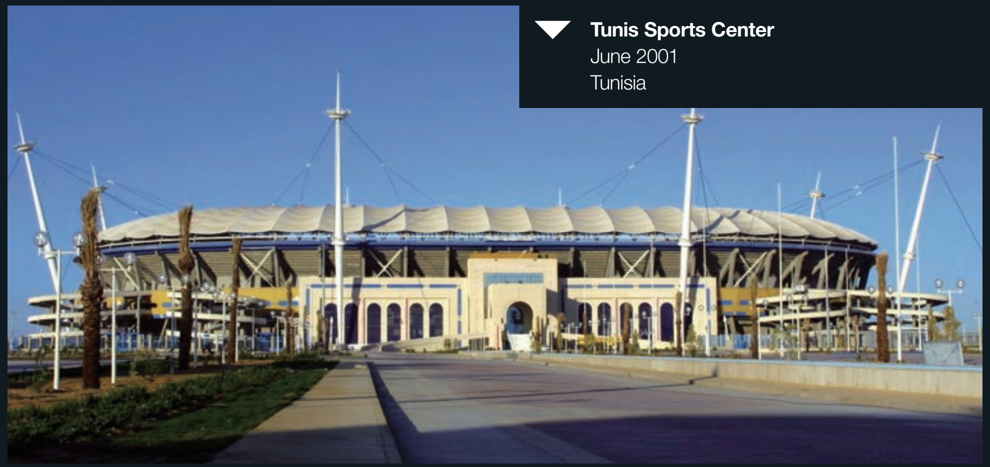
Nam-jun Paik Art Center
February 2008
Korea

JW Marriott Hanoi Hotel
September 2013
Vietnam

Hyundai Motorstudio Seoul
September 2014
Korea

Ulsan National Institute of Science and Technology
August 2016
Korea

Ryugyong Ju-young Chung Arena
February 2004
North Korea



Tunis Sports Center
June 2001
Tunisia

Dalian Hope Building
December 1998
China

LIST BUILDING WORKS

* The list below consists of select projects out of 903 projects.

Country	Project Name	Time of Completion
Korea	Tokyu Hotel	Dec. 1969
Korea	Chosun Hotel	Mar. 1970
Korea	121st. Evacuation Hospital of the US Army	Jan. 1971
Korea	Nam Mountain Seoul Tower	Oct. 1971
Korea	Koreana Hotel	Dec. 1971
Korea	Chungbuk Gymnasium	Nov. 1974
Korea	Kim Il Sports Center	Dec. 1974
Korea	Gwanak Campus of Seoul National University	May. 1975
Korea	Gyeongju National Museum	Jul. 1975
Korea	National Assembly Building	Sep. 1975
Korea	Walker Hill Hotel	Jan. 1977
Bahrain	National Bank Building	Oct. 1977
Korea	BoSeong Asan Hospital-Asan Social Welfare Foundation	Jan. 1978
Korea	Hyundai Sports Complex	Jul. 1978
Korea	InJe Asan Hospital-Asan Social Welfare Foundation	Jul. 1978
Korea	JeongEup Asan Hospital-Asan Social Welfare Foundation	Jul. 1978
Bahrain	Closing Construction of Hotel Diplomatic	Sep. 1978
Korea	Reception Hall for the Presidential Blue House	Dec. 1978
Korea	BoRyeong Asan Hospital-Asan Social Welfare Foundation	Jan. 1979
Korea	YeongDeok Asan Hospital-Asan Social Welfare Foundation	Jan. 1979
Korea	Chungbuk Sports Complex, Baseball Park, Judo Center	Nov. 1979
Korea	Ewha Girls High School	Jan. 1980
Korea	Science department building of Ewha Woman's University	Jan. 1980
Korea	Passenger Terminal Building of Gimpo International Airport	Jul. 1980
Korea	Korea Exchange Bank Head Office Building	Dec. 1980
Bahrain	Hotel Diplomatic	Oct. 1981
Qatar	Doha Sheraton Hotel	Feb. 1982
Korea	Jamsil Baseball Stadium	Jul. 1982
Korea	Press Center	Oct. 1984
Korea	Hyundai Department Store's Main Branch	Nov. 1985
Iraq	Medical City Complex	Aug. 1986
Korea	Inter-Continental Hotel	Aug. 1988
Korea	Asan Medical Center	Mar. 1989
Korea	Gyeongju Hotel Hyundai	Jan. 1990
Korea	Korea University	Jan. 1990
Korea	Sogang University	Jan. 1990

Country	Project Name	Time of Completion
Korea	Official Residence of Presidential Blue House	Oct. 1990
Singapore	The 2nd Passenger Terminal Building of Changi Airport	Dec. 1990
Singapore	Korea University Medical Center	Jul. 1991
Japan	Yokohama Tsurumi Gymnasium	Aug. 1991
Saudi Arabia	Ministry of the Interior Building	Feb. 1992
Korea	Main Presidential Blue House building	Aug. 1992
Korea	Ewha Womans University Mokdong Hospital	Jul. 1993
Saudi Arabia	Construction Group A Project (Riyadh Downtown, Al Iman General Hospital etc.)	Sep. 1993
Saudi Arabia	Riyadh King Fahd Medical City	Jun. 1994
Korea	Seoul National University Hospital	Dec. 1994
Korea	The 2nd Government Complex in Gwacheon	Jan. 1995
Korea	Public Buildings the Supreme Court	Jun. 1995
Singapore	Changi General Hospital	Aug. 1996
Korea	GangNeung Asan Hospital	Jan. 1997
Russia	Vladivostok Hotel Hyundai	Jun. 1997
Singapore	Suntec City	Jul. 1997
Indonesia	Kuta Beach Resort	Jul. 1997
Korea	Seoul History Museum	Jan. 1998
Korea	Korea Economic Daily Building	Mar. 1998
Korea	Guui-dong Techno Mart	Jun. 1998
Korea	Hyundai Motor Namyang R&D Center	Dec. 1998
Korea	Hyundai Securities' Daegu Office Building	Dec. 1998
China	Dalian Hope Building	Dec. 1998
Korea	Hyundai Heavy Industries New Office Building	Dec. 1999
China	Macau Entertainment Tower	Apr. 2000
Korea	Life Science Department Building of Korea University	Jun. 2000
Korea	ASEM Tower	Mar. 2001
Tunisia	Tunis Sports Center	Jun. 2001
Korea	Ulsan World Cup Stadium	Jun. 2001
Korea	Busan Sport Complex	Jul. 2001
Korea	Busan Geumjeong Gymnasium	Sep. 2002
Egypt	Four Seasons Hotel	Jan. 2003
Korea	Seoul National University Bundang Hospital	Aug. 2003
Korea	Gongju National Museum	Oct. 2003
Singapore	Construction of Golden Hill Park Condominium	Jan. 2004
North Korea	Pyongyang Hyundai Asan Sports Complex	Feb. 2004

Country	Project Name	Time of Completion
North Korea	Ryugyong Ju-young Chung Arena	Feb. 2004
Korea	National Museum of Korea	Oct. 2005
Korea	Daehan Paper Company Building	Jul. 2006
Korea	Pohang-si Government New Building	Dec. 2006
Korea	Korea Land Corporation's Gwangju Office Building	Dec. 2007
Korea	Hyundai Marine & Fire Insurance's Gwangju Office Building	Jan. 2008
Korea	Nam-jun Paik Art Center	Feb. 2008
Korea	Advanced Institute of Convergence Technology ; AICT	Feb. 2008
Korea	Asan-si Public Stadium	Apr. 2008
Korea	Busan National Gugak Center	Aug. 2008
Korea	Incheon Samsan Gymnasium	Sep. 2008
Korea	The National Digital Library of Korea	Jan. 2009
Korea	Institut Pasteur Korea	Mar. 2009
Korea	Catholic University of Korea Seoul St. Mary's Hospital	Apr. 2009
Korea	Gwangju-si Government New Building	Apr. 2009
Singapore	Park View Condominium	Jul. 2009
Korea	Korea Manhwa Contents Agency	Aug. 2009
Korea	NHN Green Factory	Apr. 2010
Korea	Jinju Sports Complex	Jun. 2010
Singapore	Khoo Teck Puat Hospital	Jun. 2010
Korea	National Youth Space Center	Jul. 2010
Korea	High One Resort Condominium	Nov. 2010
Korea	Jeongok Prehistory Museum	Jan. 2011
Singapore	One Shenton Way Condominium	Mar. 2011
Korea	Hwaseong Sports Complex	May. 2011
Vietnam	Bitexco Financial Tower	May. 2011
Korea	Goyang Indoor Sports Arena	Jun. 2011
Singapore	Asia Square Tower Ⅰ	Jun. 2011
Korea	The 2nd Kintex Exhibition Hall	Sep. 2011
Korea	Military Administration Academy	Dec. 2011
Korea	Incheon Football Stadium	Mar. 2012
Korea	Yeosu International Expo (Big-O)	Apr. 2012
Korea	BEXCO	May. 2012
Korea	Songdo Campus of Yonsei University	Aug. 2012
Korea	Cheongshim Indoor Sports Arena	Dec. 2012
Singapore	The 2nd Phase Construction for Pasir Ris Condominium	Jan. 2013

Country	Project Name	Time of Completion
Korea	Hallym University Medical Center Dongtan Hospital	Mar. 2013
Vietnam	JW Marriott Hanoi Hotel	Sep. 2013
Korea	Federation of Korean Industries Building	Sep. 2013
Korea	Ewha University-Industry Collaboration Foundation Building	Mar. 2014
Korea	Gwangju-Kia Champions Field	Mar. 2014
Korea	Busan International Finance Center ; BIFC	Jun. 2014
Korea	Hyundai Card Music Library	Jun. 2014
Korea	Incheon Asian Games Main Stadium	Aug. 2014
Singapore	Specialist Shopping Center	Sep. 2014
Korea	Hyundai Motorstudio Seoul	Sep. 2014
Korea	COEX mall renewal project	Dec. 2014
Korea	International Passenger Terminal of Busan Port	Jan. 2015
Singapore	Twin Peaks Condominium	Feb. 2015
Korea	Hyundai Premium Outlet Gimpo	Mar. 2015
Korea	Korea Land & Housing (LH) Corporation Headquarters	Mar. 2015
Korea	Dongnam Distribution Complex	Apr. 2015
Korea	SEAMARQ Hotel (Hotel Hyundai Gyeongpodae)	May. 2015
Singapore	Asia Square Tower Ⅱ	Jun. 2015
Vietnam	Hanoi Ha Đông Residential Complex	Jun. 2015
Singapore	The 4th Phase Construction for Pasir Ris Condominium	Jun. 2015
Qatar	Royal Office Building and Guard House	Jul. 2015
Saudi Arabia	Jeddah Stadium	Oct. 2015
Korea	NH Integrated IT Center	Jan. 2016
Qatar	Hamad Medical City	Apr. 2016
Singapore	Lucky Tower Condominium	May. 2016
Korea	Ulsan National Institute of Science and Technology ; UNIST	Aug. 2016
Korea	Hyundai Card Cooking Library	Oct. 2016
Singapore	South Beach	Feb. 2017
Korea	Pungmoon High School	Feb. 2017
Korea	Hyundai Motorstudio Goyang	Mar. 2017
Singapore	Marina South Development Project	Jun. 2017
Qatar	Qatar National Museum	Jun. 2017
Korea	Amore Pacific New Headquarters	Aug. 2017
Korea	Mega-star Yeongjong	Oct. 2017
Indonesia	Shangri-La Residence	Dec. 2017
Sri Lanka	Colombo Keells City	Apr. 2019

PLANTS

Abu Dhabi-Habshan-5 Support Facilities, UAE (September 2013)

By definition, an industrial plant is an industrial site, usually made up of buildings and machinery where goods are manufactured. However, industrial plants are not limited to manufacturing plants and the size and structure of modern industrial plants varies widely depending on what they produce.

Realizing the full potential of humanity and the planet

06

HDEC began its plant construction work with fertilizer and cement plants in the 1960s. In the 1970s, HDEC began to build many oil refineries and petrochemical plants which required high-precision construction. It then expanded its scope to steel mills, auto manufacturing plants and ship building plants, spearheading the heavy industry boom in South Korea.

Inspiring the nation's industrial age

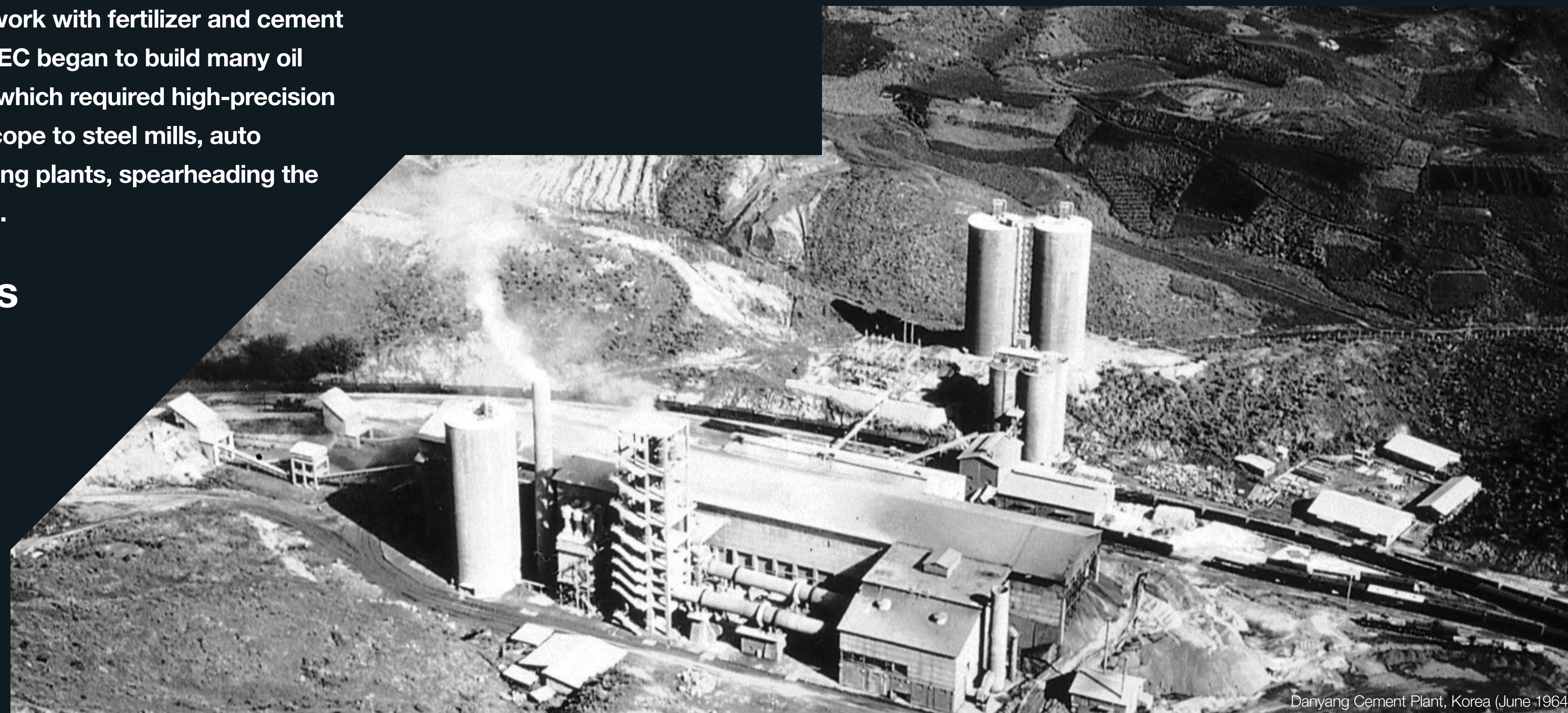
The first step: Fertilizer and cement plants

Most companies begin their plant construction work with simple plants and then move onto building oil refineries and petrochemical plants. Building oil and gas production plants is regarded as the pinnacle of plant construction. HDEC's plant work from the 1960s to today is a fine example of such evolution.

In the early days, HDEC took on a number of civil engineering projects until it was commissioned by Honam Fertilizer with the construction of a fertilizer plant in Naju in 1959. Completed in January 1963, it was the second fertilizer plant in South Korea and had an annual urea production capacity of 85,000 tons.

The project was also meaningful as it was one of the first projects financed with domestic capital although HDEC's role was relatively small. Although it was a simple plant, taking on all aspects of the project from engineering to procurement was too much for HDEC to handle at the time.

HDEC's participation in the Honam Fertilizer plant project enabled HDEC to participate in other fertilizer plants in Jinhae and Ulsan, building on their capacity to take an increasingly larger role.



Danyang Cement Plant, Korea (June 1964)

Honam Fertilizer Plant in Naju, Korea (January 1963)

Construction of the Ulsan fertilizer plant by the Hankook Fertilizer began in April 1966 and was completed in a record nine months. It was the largest fertilizer plant in the world at the time and HDEC carried out most of the work including construction of the ammonia and urea production facilities. However, HDEC still had to use an overseas company for the core engineering work.

The Danyang cement plant, which was commissioned in June 1964, is yet another project which demonstrated HDEC's growing capacity. HDEC completed the plant, with an annual production capacity of 200,000 tons, in 24 months, reducing the construction time by six months. The project enabled HDEC to rapidly improve their engineering capacity.

The Danyang cement plant was expanded twice, in 1968 and 1974, increasing the annual production capacity to 1.2 million tons in order to meet the skyrocketing cement demand in South Korea. HDEC participated in the expansion works, learning new technologies and methods each time.

Leading the heavy industry boom

After learning the basics of plant work in the 1960s through fertilizer and cement plant projects, HDEC began to take on much more sophisticated plant projects in the 1970s with South Korea's heavy industry boom. HDEC began to take on oil refinery and petrochemical plant projects which were not only larger but required high-precision construction capacity.

HDEC first gained experience in refinery works by participating in the expansion works and new refinery construction projects of the Korea Oil Corporation and Honam Jungyu, respectively. In the 1970s, the Ulsan Oil Refinery-Petrochemical Industrial Complex Project, which included 13 individual plants including a naphtha cracking plant, provided a big boost to HDEC.

HDEC made a major contribution to the successful completion of the Ulsan complex by taking on a variety of projects including refinery expansion and construction of new production plants for synthetic rubber, caprolactam and ethanol.

The Five-year National Economic Development Plan, first announced in the 1960s, focused on the building of oil refineries, petrochemical industry, Gyeongbu Expressway and integrated steelworks. The four-phase plan for establishment of integrated steel works was announced on 1st April 1970. Seven companies based in the US, UK and Japan participated in the construction and supply of the main facilities and 13 South Korean construction companies including HDEC were chosen for the construction.

The construction of the first steel works began on 1st April 1970 and was completed on 8th June 1973. HDEC was responsible for construction of the blast furnace plant, the oxygen plant and the raw material processing facility. The blast furnace is the heart of the steel works and has equipment weighing more than 7,320 tons and electric wires with an overall length of 138,913 meters.

HDEC completed the oxygen plant and material processing facility on 10th October 1972 and 31st January 1973 respectively. Lastly, the blast furnace plant was completed on 8th June 1973. The works were completed 54 days earlier than scheduled, contributing to the early success of what has become the Pohang Integrated Steelworks.

The completion of the first steel works dramatically increased the supply of steel in South Korea thanks to its annual production capacity of 1.03 million tons. However, with the country's rapid economic development the demand for steel was increasing at an incredibly fast rate. In response, the second steelwork project was commissioned with an additional 1.5 million tons of production capacity in December 1973. HDEC once again was commissioned for the core facilities including the blast furnace and raw material processing facilities.

Completion of the second steel works increased the annual steel production capacity of Pohang Integrated Steelworks to 2.53 million tons. There was still a shortage of steel

Pohang Integrated Steelworks Construction, Korea (May 1981)

HDEC's own Cement Plant: An important step towards independence

Planning for construction of HDEC's own cement factory in Danyang began in 1957, yet construction didn't begin until 1962 when the technical service contract was signed. The main equipment for the plant from Alis Chamers began to arrive at the construction site in 1963.

However, the industrial base for the construction sector was very weak. In fact, even the most basic materials had to be sourced from overseas suppliers. Even natural resources such as pine timber had to be sourced from the US and cement was very hard to come by as well. The people involved in the project often joked that the plant would never be completed because of a lack of cement. Most of the cement for the construction had to be imported from Japan.

The first cement production plant was Munkyung cement factory which was established with support from the UN Korean Reconstruction Agency (UNKRA). Although the Danyang cement factory was the third plant, it was particularly important for the independence movement as an increased supply of cement was vital for economic development.

2nd Oil Upgrading Facility for Hyundai Oilbank, Korea (June 2011)

Daesan Petrochemical Complex, Korea (February 1992)

solved and it was only worsening as the demand for steel rapidly continued to increase. The third and fourth steelwork projects were commissioned accordingly which kept HDEC busy for many years.

The four steelworks were completed 11 years after the project began and HDEC was responsible for approximately a quarter of the work in terms of the amount of material used. The project served as both a capacity building experience as well as a demonstration to the world of HDEC's growing capacity. In particular construction of the blast furnace, which is the core technology of a steelworks, gave confidence for HDEC to take on advanced projects in overseas.

A leader in petrochemical and iron & steel projects

In the 1980s, HDEC began to focus on complex petrochemical projects. Although the petrochemical industry was at that time led by Europe and Japan, emerging economies were beginning to participate in the petrochemical industry.

At the time, the Hyundai Group had publicly declared its intention to expand into the petrochemical sector and had purchased reclaimed land in Daesan-myeon of Chungcheong province. Daesan-myeon is close to Seoul and Incheon and ideally positioned for export to the Chinese market.

The site was 50 percent owned by the Keuk Dong Oil Refinery and HDEC began construction of a large-scale oil refinery and cracking plant on the site, which later became the Daesan Petrochemical Complex. The Keuk Dong Oil Refinery was later renamed the Hyundai Oil Refinery. In 2000, it was separated from the Hyundai Group and renamed the Hyundai Oil Bank in 2002. In 2010, it was acquired by Hyundai Engineering.

Up to the early 1980s, the site of the Daesan Petrochemical Complex was a rustic coastal. However, a large reclamation project created 132 hectares of new land and HDEC built its first refinery here with a daily processing capacity of 60,000 barrels of heavy oil and a cracking center, which began operating in November 1988.

Since August 1989, eleven more plants have been built on 430 hectares of reclaimed land; producing caprolactam, ethylene glycol and naphtha. The ethylene plant alone had an annual production capacity of 350 thousand tons. HDEC has to expand the complex with construction of additional facilities such as a synthetic rubber production plant and a waste water processing facility.

HDEC completed the Clean Fuel Project for Hyundai Oil Bank in April 2006. Construction of a heavy oil upgrading facility was commissioned by SK Holdings and completed in September 2008. In October 2008, HDEC began work on the second heavy oil upgrading facility for Hyundai Oil Bank.

The heavy oil upgrading facility enable the production of LPG, propylene, gasoline, diesel, and low sulfur bunker C oil by separating sulfur from the heavy oil. Since the facility enables the production of highly valuable petrochemical products using cheap heavy oil, it is sometimes referred to as a man-made oil-well. However, the heavy oil upgrading facility is very expensive to build as it requires high-precision technology.

With a 2.6 trillion KRW budget, the second heavy oil upgrading plant for Hyundai Oil Bank was completed in June 2011. It has the capacity to convert up to 52,000 barrels of heavy oil per day into more expensive light oil. The new facility increased the upgrading capacity of Hyundai Oil Bank to an industry-leading 30.8 percent.

In November 2014, HDEC began construction of a mixed xylene plant for Hyundai Oil Bank as an EPC contractor. The work, which consisted of a condensate distillation plant and mixed xylene production plant, was completed in December 2016 using fast track method.

HDEC also continued to take on steelwork projects, which alongside petrochemical plants was the largest part of HDEC's work. Only six months after HDEC joined Hyundai Motor Group, it was commissioned to construct the third blast furnace plant for Hyundai Steel in September 2011.

The third blast furnace project was an essential part of the Hyundai Motor Group's goal of achieving a recycling-based business structure. Hyundai Steel began construction of an integrated steel mill with three blast furnaces, with a combined annual production capacity of 12 million tons. The first and second blast furnace began operating in January 2010 and February 2011 respectively, which gave an annual production capacity of 8 million tons.

Construction work for the third blast furnace began in April 2011. HDEC was chosen to be responsible for the electric generation system and steel frameworks as well as for construction of the coke plant. Construction was completed in December 2013.

The integrated steel mill allowed the Hyundai Motor Group to create a complete recycling oriented business structure. For example, hot-rolled steel sheets are then used to produce cold-rolled steel sheets for automobile parts for Hyundai Motor and Kia Motors. The scrap metals from automobiles can later be turned into steel beams for construction.

Setting a new record: 4 furnaces brought on line ahead of schedule at Pohang Iron & Steel Plant

HDEC led on construction of the four blast furnace plants within the Pohang Integrated Steelworks, the most vital components of a steelworks. Although construction of the blast furnace plant was a challenging task, HDEC was able to successfully complete the work thanks to its experience in plant works since the 1960s and unmatched drive for excellence. Successful completion of the 4th blast furnace plant project demonstrated HDEC's maturing capacity in plant construction. The project required installation of a new blast furnace and repair of an existing furnace to be carried out simultaneously. HDEC completed all of the tasks flawlessly before the deadline, which particularly impressed the experienced overseas engineers involved in the project.

Hyundai Oilbank Mixed Xylene Project EPC, Korea (December 2016)

In the mid-1970, HDEC won its first overseas plant contract; construction of a cement plant in Indonesia. HDEC was able to take part in the project thanks to the successful completion of the fertilizer plant and cement plant projects such as the Danyang cement plant in the 1960s. In addition, HDEC's strong relationship with the Indonesian government created during the Jagorawi Expressway Project also worked in HDEC's favor.

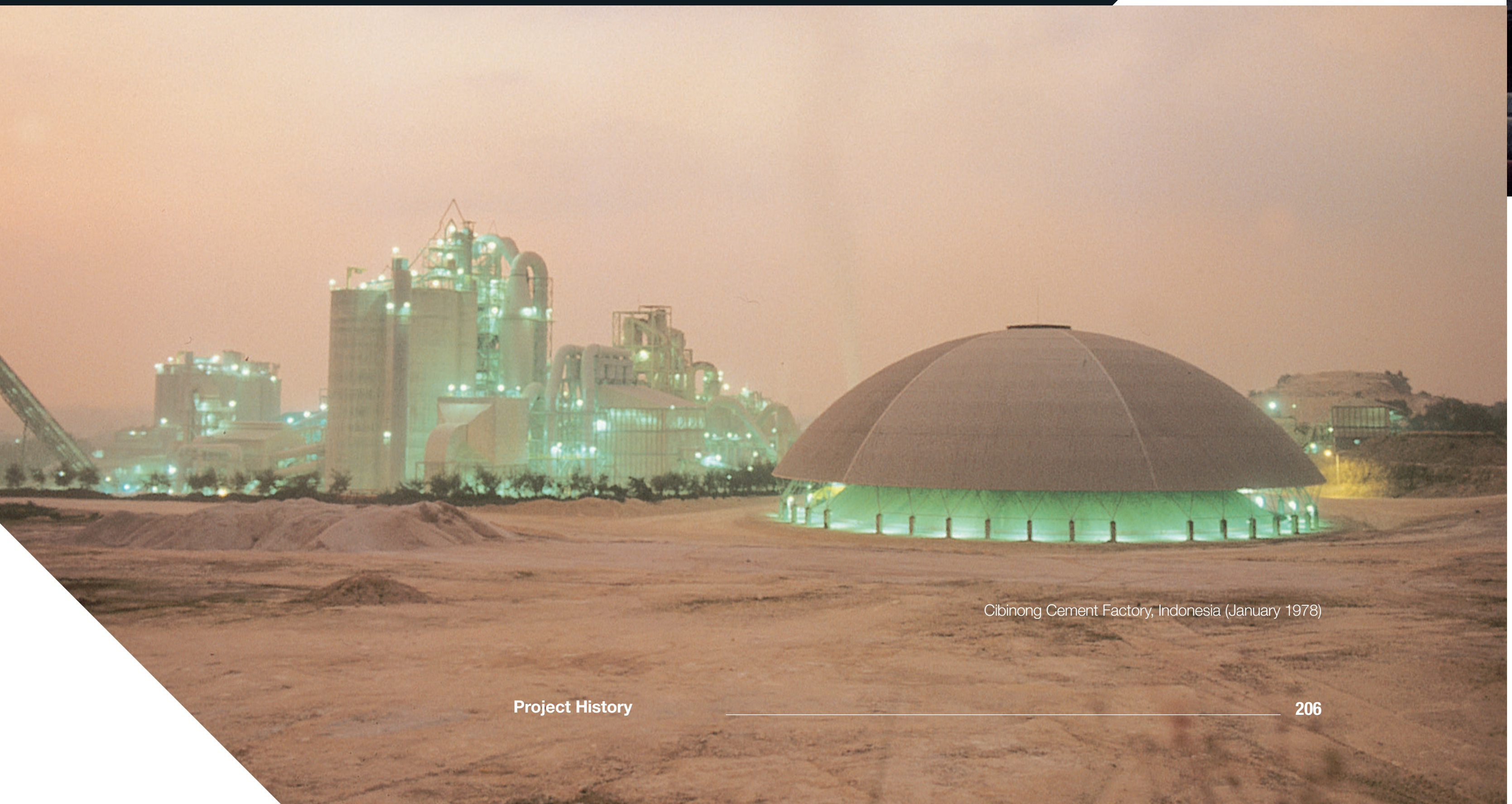
Taking on new challenges: Overseas oil and gas plant projects

Springboard into the Middle East

In March 1976, the Indonesian government awarded the contract for construction of the Cibinong Cement Factory Project, with an annual production capacity of half million tons, to Kaiser Engineering who then subcontracted the construction work to HDEC for 14.6 million USD. Completed in January 1978, although it was a relatively small contract, HDEC delivered high quality work helping build upon an already strong reputation.

The Cibinong Cement Factory project marked a turning point for HDEC because it was the first project which relied on the labor force under the supervision and support of HDEC staff. This experience allowed HDEC to carry out a wide range of large-scale projects such as the Gas Injection Facility at The Gachsaran Oil Well in Iran (Completed in May. 1979), Gas Extraction Plant in Bu Hasa Oil Field in UAE (Jun. 1980), Expansion of Dumai Oil Refinery in Indonesia (Feb. 1984), Zuluf Marine Oil and Gas Separation Facility in Saudi Arabia (Oct. 1985) and Marjan Offshore Oil and Gas Separation Facility (Apr. 1986).

Although the projects in the Middle East were not superbly profitable, they allowed HDEC to gain invaluable experience and capacity for oil and gas plant projects.



Cibinong Cement Factory, Indonesia (January 1978)

Dumai Oil Refinery, Indonesia (February 1984)

For example, the positive reputation from earlier projects allowed HDEC to win the Marjan offshore oil and gas separation facility from Aramco which is well-known for only awarding contracts to experienced contractors. It was the successful completion of the Yanbu Oil Port & Deballast Facilities in January 1981 that allowed HDEC to win the Aramco project.

The Zuluf and Marjan offshore oil and gas separation facilities have daily processing capacities of 0.3 million and 0.4 million barrels of oil, respectively. Unlike other on-land projects HDEC has completed such as port construction, the two projects presented new challenges due to their offshore location. Despite, HDEC successfully completed both projects, establishing their reputation as a strong contender in both onshore and offshore oil and gas plant project market.

In the 1990s, HDEC began to take on major plant projects in Southeast Asia. In January 1990, the Malaysian Oil Agency awarded a 360 million USD contract to HDEC for the second and third phase of the expansion of the gas refinery plant. At the time this was the

Gas Refinery Plant Extension Work, Malaysia (July 1995)

Zuluf Marine Oil and Gas Separation Facility, Saudi Arabia (October 1985)

largest plant contract won by a Korean company in Southeast Asia.

HDEC successfully completed all work which helped ensure they won the fourth phase of the expansion project. The fourth phase was different from the second and third as it was all subcontracted to local companies. HDEC established a training center in order to train up to 300 technicians per year. The project was carried out by an international workforce from China, India, the Philippines and Indonesia, in addition to the newly trained locally-based technicians.

One of the greatest achievement by HDEC was completion of construction work over 27 months with zero accidents, which equates to 10,805,268 accident free hours. This was a new world record which boosted HDEC's image and strengthened their reputation. HDEC carried out more large projects in Malaysia including expansion of the LNG 2 plant and Bintulu LPG plant, which were completed in July 1995 and April 1998 respectively.

HDEC also continued to win plant contracts in the 1990s such as a polymer processing and film manufacturing plant in Ras Lanuf, Libya (completed in Jul. 1997), Tatarstan fertilizer plant (May. 2000), and a polypropylene production plant in Turkmenbasi Turkmenistan (Aug. 2001). HDEC did not win many project in the Middle East mainly due to the major slow down in economy as a result of the low oil price and the Gulf War. However, HDEC was awarded the contract for the South Pars Gas Extraction Plant in the late 1990s, which marked a turnaround in the Middle East construction market.

Setting a new benchmark in Iran: South Pars Gas Field Development Project

Approximately 15 percent of natural gas and 8.4 percent of oil resources are buried in Iranian territory. The Iranian government announced a 24-phase development plan for the South Pars gas field which has estimated gas resources of 32,516,000km^2. HDEC won the contract for the 2nd and 3rd phase of the project. The contract for the second phase alone was worth more than one billion USD and construction period lasted 40 months.

The contract involved the construction of four gas processing units with a processing capacity of 35.64 million barrels each, a natural gas condensate and a sulfur production plant with a daily production capacity of 80,000 barrels and 400 tons, respectively. HDEC had to use 130,000 tons of resources and mobilize up to 11,000 workers per day in order to complete construction. The project helped HDEC vastly strengthen its capacity to carry out complicated plant projects.

During the project, HDEC made significant investments in IT systems, recognizing the importance of improved work efficiency using IT systems, particularly when it comes to the successful completion of large plant projects with a vastly complex work scope.

Pipeline construction accounted for approximately 45 percent of the project. HDEC adopted a Flux-Cored Arc Welding (FCAW) process in order to complete 38,100 pipe diameter in meter of welding works that was required in record time with minimal man hours. Painting of a total area 250,000m^2 was also completed within six months thanks to the introduction of an auto sand blasting machine.

Moreover, HDEC deployed its first field IT teams to operate the Welding Joint Control System (WJCS) and Integrated Commissioning & Progress System (ICAPS), establishing a comprehensive IT monitoring system to manage the field operation. The two systems The WJCS, introduced with the FCAW enabled sustained monitoring and prioritization of works

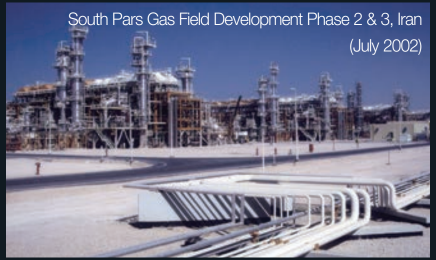
South Pars Gas Extraction Plant Phase 4 & 5, Iran (February 2005)

leading to vastly enhanced welding quality.

Thanks to the various measures introduced, HDEC was able to complete all of the construction work five months prior to the deadline. Thanks to the successful completion of the second and third phase South Pars gas field project, the Iranian government awarded HDEC with the contract for the third and fourth phase.

The contract for the 3rd and 4th phase was awarded to HDEC in March 2002 as phase 2 and 3 works were finalized. The work scope of the new contract was similar yet the contract was for 1.623 billion USD, which accounted for 67 percent of HDEC's 2002 overseas contract goal of 1.8 billion USD. The revenue from the 2nd to 5th phase of the South Pars gas field project helped HDEC end corporate workout which began due to lack of liquidity since Asian Financial Crisis in 1997.

HDEC continued to complete work in advance of the deadline for the 4th and 5th phase of the South Pars project. The 'Fuel Gas-in' process, which is a procedure for testing the integrity of a newly built plant, began only 24 months after construction work



South Pars Gas Field Development Phase 2 & 3, Iran (July 2002) had begun which was unprecedented. All of the new South Pars gas field plant facilities began production in January 2005.

Recognised as an unrivalled leader in the international EPC market

The Khurais gas processing plant construction project was commissioned by Saudi Aramco, which is a Saudi Arabian National petroleum and natural gas company. Although successful completion of the Zuluf Marine oil and gas separation facility in Saudi Arabia and Marjan offshore oil and gas separation facility had provided evidence of HDEC's capacity, Aramco awarded HDEC the contract with some skepticism because a gas processing plant is fundamentally different from a gas separation plant.

Yet HDEC surprised Aramco by completing the project successfully. Aramco's confidence in HDEC grew after successful completion of the Khurais gas processing plant and Aramco began to treat HDEC as a trusted partner. The trust of Aramco not only helped HDEC win future Aramco projects but also many other plant projects in Saudi Arabial.

The contract for the gas processing plant at the Karan gas field was awarded to HDEC by Aramco even though another contractor had made a lower bid, which was 100 million USD less than HDEC's bid. With a capacity of 32.07 million barrels, this is the world's largest gas processing plant. Construction began in March 2009 and was completed in February 2012.

The Pearl Gas To Liquid (GTL) #5 project at Ras Laffan Industrial City in Qatar is one of the most advanced oil refinery plants in the world and demonstrated HDEC's advanced technology. Equipped with additional processing units, the GTL plant liquefies natural gas and converts it into diesel, which is cleaner and much more expensive. HDEC formed a consortium with a Japanese company and won the 1.3 billion USD contract commissioned by Qatar Shell. Construction work was carried out between August 2006 and January 2012.

HDEC also carried out plant work outside of the oil and gas sector most notably the Qatar 5th and 6th fertilizer plants. The two plants have a daily production capacity of 2,300 tons of ammonia and 3,850 tons of urea, making them the largest fertilizer production plants in the world. The project also included construction of supporting facilities including power plants, substations, liquefied ammonia storage tanks, urea storage and transport facilities and sea ports.


Natural Gas Liquid Refining Facility, Qatar (December 2005)


Karan Gas Processing Plant, Saudi Arabia (February 2012)


Khurais Gas Processing Plant, Saudi Arabia (April 2009)


Fertilizer Plant #5, 6, Qatar (September 2012)

HDEC maintained and even strengthened its upcycle growth after its merger with the Hyundai Motor Group in 2010. Since then, HDEC has prioritized profitability over gross turnover. South America has become its dominant market as a result of the active exploration of new profitable business around the world.

Infinite challenges ahead: The journey continues into new markets across the globe

Ma'aden Alumina Refinery, Saudi Arabia (February 2015)

Expanding portfolio while ensuring financial credibility

HDEC renewed their efforts to grow their business in plant works after joining the Hyundai Motor Group. For example, it won a 1.652 billion USD contract for construction of the Ma'aden alumina refinery which is the world's largest refinery with an annual production capacity of 1.8 million tons.

In 2011, the Saudi Arabian government announced a new long-term strategy commonly known as Vision 2024 which focuses on energy and mineral resource development. The Ma'aden alumina plant is the first mineral resource project which is part of the Ras Al Khair development plan, which aims to create a large-scale industrial complex on a par with the Jubail industrial complex. HDEC employed the Smart Plan method which simulates all parts of a project from designing to construction using 3D models, in order to improve quality and reduce construction time.

Significant achievements accomplished in major South American refineries

The 2 billion USD contract for construction of the Puerto la Cruz Refinery in Venezuela had special significance for HDEC, as it was the first major petrochemical plant project in South America.

The 1.56 billion USD Batalla de Santa Ines Refinery project was the second energy project awarded to HDEC in Venezuela. In November 2014, HDEC won its third project in Venezuela to upgrade the Puerto la Cruz Refinery. The combined value of the three projects in Venezuela was 7 billion USD.

In the Middle East, a stronghold for HDEC, HDEC was awarded the SARB 4 contract in March 2013 which was the first large-scale contract following the Karbala Oil Refinery Project in Iraq.

The 1.9 billion USD SARB 4 Offshore Crude Oil and Gas Processing Project

Puerto La Cruz Refinery, Venezuela (December 2018) involves the construction of facilities to transfer oil from the Satah Al-Razboot offshore oil field, 140 kilometers northwest of Abu Dhabi. Facilities related to collection and transport will be constructed on two artificial islands. This is the first project with an offshore plant component which HDEC is fully responsible for as an EPC contractor.

HDEC employed a modular construction method for construction of the offshore oil refinery plant and gas processing facility because Zirku Island, the construction site for the onshore processing facilities, is a high-security military controlled island under strict civilian access control. HDEC pre assembled the four main facilities including pipe racks, processing plants, substations and control buildings and transported them to Zirku Island, minimizing work on the island.

A joint venture established by HDEC, Hyundai Engineering and two other South Korean companies won the 6.04 billion dollars Karbala Refinery Project in Iraq. The work began in June 2014 and is expected to be completed in November 2018.

SARB 4 Offshore Crude Oil and Gas Processing Project, UAE (September 2017)

Karbala Oil Refinery, Iraq (November 2018)

UAE SARB 4 Offshore Crude Oil and Gas Processing Project

Module	Quantity	Maximum weight (ton)	Dimension (meter)		
			Length	Width	Height
Piperack Module	37	368	32.7	7.8	16.8
Process Module	30	1,769	36.9	21.0	23.2
Substation Module (MEES)	10	888	42.0	10.2	8.9
Control Building Module (LER)	2	401	32.0	10.5	10.6

GALLERY
PLANTS

Oil Refinery
October 1982
Oman

Borouge 3 XPLE
December 2016
UAE

Yeosu Oil Tank
March 2013
Korea

Hyundai Steel 3rd Blast Furnace Plant
December 2013
Korea

Bintulu Fertilizer Plant
October 1985
Malaysia

Mellitah Gas Processing Plant
October 2006
Libya

Complex Fertilizer Plant
May 1998
Thailand

LIST PLANTS

* The list below consists of select projects out of 257 projects.

Country	Project Name	Time of Completion
Korea	Honam Fertilizer Plant in Naju	Jan. 1963
Korea	Danyang Cement Plant	Jun. 1964
Korea	Hankook Fertilizer Plant in Ulsan	Dec. 1966
Korea	Fertilizer Plant in Jinhae #4	Dec. 1966
Korea	Honam Jungyu Oil Refinery #2	Jan. 1968
Korea	Ulsan Complex	Jan. 1970
Korea	Ulsan Jungyu Oil Refinery Extension Work	May. 1972
Korea	Chungju Fertilizer Plant	Dec. 1972
Korea	Ulsan Dockyard	Jul. 1973
Korea	Ulsan Plant Caprolactam	Feb. 1974
Korea	Hyundai Motor Automobile Factory Extension Work	Dec. 1975
Korea	Pohang Steelworks 2nd Blast Furnace Plant	May. 1976
Indonesia	Cibinong Cement Factory	Jan. 1978
Korea	Pohang Integrated Steelworks Construction	Dec. 1978
Iran	Gachsaran Oil Well	May. 1979
UAE	Ruwais Oil Refinery	Aug. 1979
UAE	Arzanah Island Crude Oil Processing Facility	Sep. 1979
Korea	First blast furnace retrofit at Pohang Integrated Steelwork	Sep. 1979
Korea	Onsan Copper Refinery Machine Shop	Dec. 1979
Korea	Gwangyang Steel Mill	Jan. 1980
UAE	Bu Hasa Gas Extraction Plant	Jun. 1980
Saudi Arabia	Yanbu Oil Port & Deballast Facility	Jan. 1981
Bahrain	Bahrain Aluminum Steel Frame and Cladding	Apr. 1981
Korea	Pohang Integrated Steelworks Construction	May. 1981
Saudi Arabia	East-West Crossing Oil Pipeline Work	Aug. 1981
Korea	T-1-1 Tank Project	Sep. 1981
Iraq	Basrah Sewerage Scheme Ⅰ	Apr. 1982
Oman	Oil Refinery	Oct. 1982
Indonesia	Dumai Oil Refinery	Feb. 1984
Saudi Arabia	Jubail Oil Refinery Phase Ⅰ Causeway Plumbing Work	Aug. 1984
Saudi Arabia	Yanbu Oil Port Gasoline Transport Equipment Repair Works	Dec. 1984
Saudi Arabia	Concrete Production supply Work	Dec. 1984
Malaysia	Bintulu Fertilizer Plant	Oct. 1985
Saudi Arabia	Zuluf Marine Oil and Gas Separation Facility	Oct. 1985
Saudi Arabia	Marjan Offshore Oil and Gas Separation Facility	Apr. 1986
Libya	Benghazi Oil Refinery	Jul. 1986

Country	Project Name	Time of Completion
Kuwait	Al-Zour Drainage Complex Plant Works	Jan. 1988
Korea	Electrical Instrumentation Works for Exapnsion of Daesan Petrochemical Complex	Nov. 1988
Iraq	Fertilizer Plant Installation Work	Apr. 1989
Qatar	Oil Product Export-Import and Distribution Facilities	Jun. 1989
Korea	Phase Ⅰ construction work for Foundary pig for 5th Blast Furnace Pohang Integrated Steelwork	Sep. 1990
Korea	Okgye Cement Plant Extension Work	Jan. 1991
Korea	Electrical Instrumentation Works for Hyundai Petrochemical Complex	Jul. 1991
Korea	Hyundai 65 Complex Project Phase Ⅰ	Dec. 1991
Korea	Daesan Petrochemical Complex	Feb. 1992
Korea	Hyundai Petrochemical Daesan Plant	Feb. 1992
Indonesia	Cibinong Cement Factory #3 Extension Work	May. 1992
Malaysia	Shell Gas Oil Synthesis Plant	Sep. 1992
Malaysia	2nd and 3rd Phase Gas Processing Plant and Export Terminal Expansion	Nov. 1993
Libya	Ras Lanuf Polyethylene Plant	Apr. 1994
Malaysia	LNG #2 Extension Work	Jul. 1995
Malaysia	Gas Refinery Plant #2, 3 Extension Work	Jul. 1995
Singapore	Offshore and support facilities for Merbau Ethylene Plant	Aug. 1995
Bangladesh	Cement Factory Construction Work	Dec. 1995
Thailand	Fertilizer Plant Construction Work	Mar. 1997
Korea	LNG Main Pipeline Construction for Honam Region	Apr. 1997
Libya	Ras Lanuf Polymer Processing and Film Manufacturing Plant	Jul. 1997
Korea	Hyundai Petrochemical Complex N.C.C. Plant	Sep. 1997
Qatar	Dukhan Gas Extration and Reprocessing Facility	Jan. 1998
Korea	U-1 Crude Oil Storage Tank	Apr. 1998
Malaysia	Bintulu LPG Plant	Apr. 1998
Thailand	Complex Fertilizer Plant	May. 1998
Korea	Gwangju-Mokpo LNG Pipeline Project	Sep. 1998
Korea	Incheon International Airport Gas Pipeline Project	Apr. 1999
Pakistan	PEPCEM Cement Factory	Nov. 1999
Korea	Sungnam Yeongjongdo Oil Pipeline Project	Dec. 1999
Qatar	LNG Plant	Jan. 2000
UAE	Arab Gas Well Development Project	Mar. 2000
Bangladesh	Low Temperature Gas Processing Plant	Mar. 2000
Tatarstan	Fertilizer Plant	May. 2000
Libya	Khoms-Tripoli Gas Pipeline Project	Oct. 2000
Libya	A.U.C.C. Fertilizer Plant	Oct. 2000

Country	Project Name	Time of Completion
Kuwait	KCC Petroleum Hydrotreating Catalyst Plant	Nov. 2000
Philippines	Hyundai Diamond Cement Investment Project	Dec. 2000
Saudi Arabia	The 7th and 8th Thermal Plant	Feb. 2001
Kuwait	New Monitoring and Control Facilities	Apr. 2001
China	Hyundai Electronics Dalian Plant	May. 2001
Indonesia	Natural Gas Processing Plant	May. 2001
Bangladesh	Hyundai Cement Extension Work	Jun. 2001
Australia	Pipeline Supply Works	Jun. 2001
Turkmenistan	Turkmenbasy Polypropylene Production Facility	Aug. 2001
Korea	Incheon LNG Storage Tank Units 11 and 12	Oct. 2001
Indonesia	Sumpal Gas Project	Mar. 2002
Iran	South Pars Gas Extraction Plant #2, 3 Phase	Jul. 2002
Indonesia	Subang Gas Processing Plant	Dec. 2002
Korea	Hankook Caprolactam Plant Expansion Ⅱ	Nov. 2004
Iran	South Pars Gas Extraction Plant #4, 5 Phase	Feb. 2005
Qatar	Mesaieed Natural Gas Liquid Refining Facility	Nov. 2005
Qatar	Natural Gas Liquid refining Facility	Dec. 2005
Korea	Hyundai Oilbank Clean Fuel Project	Apr. 2006
Libya	Mellitah Gas Processing Plant	Oct. 2006
Libya	Attahadi Gas Well Development Project	Dec. 2006
Indonesia	Subang Gas Processing Plant #2 Phase	Feb. 2007
Libya	Western Libya Gas Project	Apr. 2007
Kuwait	Olefin Ⅱ Ethylene Production Plant	Jul. 2008
Korea	Donghae-1 Gas Extraction Plant Expansion	Aug. 2008
Korea	SK Corporation Oil Upgrading Facility	Sep. 2008
Saudi Arabia	Khurais Gas Processing Plant	Apr. 2009
Iran	Olefin ethylene production plant	Jul. 2009
Korea	Onsan Alkylation Plant Expansion	Sep. 2009
Korea	Incheon LNG Storage Tank Units 19 and 20	Jul. 2010
Korea	Tongyeong LNG Production Base #13, 14 Tank	Aug. 2010
Kuwait	KPPC Heavy Aromatics Offshore	Oct. 2010
Kuwait	Ethane Collection and Processing Plant	Nov. 2010
Korea	Namyangju-Gunja Pipeline Construction Work	Dec. 2010
Korea	Intake Pipeline Installation for Yeongwol Combined Cycle Power Plant	Jan. 2011
Korea	2Nd Oil Upgrading Facility for Hyundai Oilbank	Jun. 2011

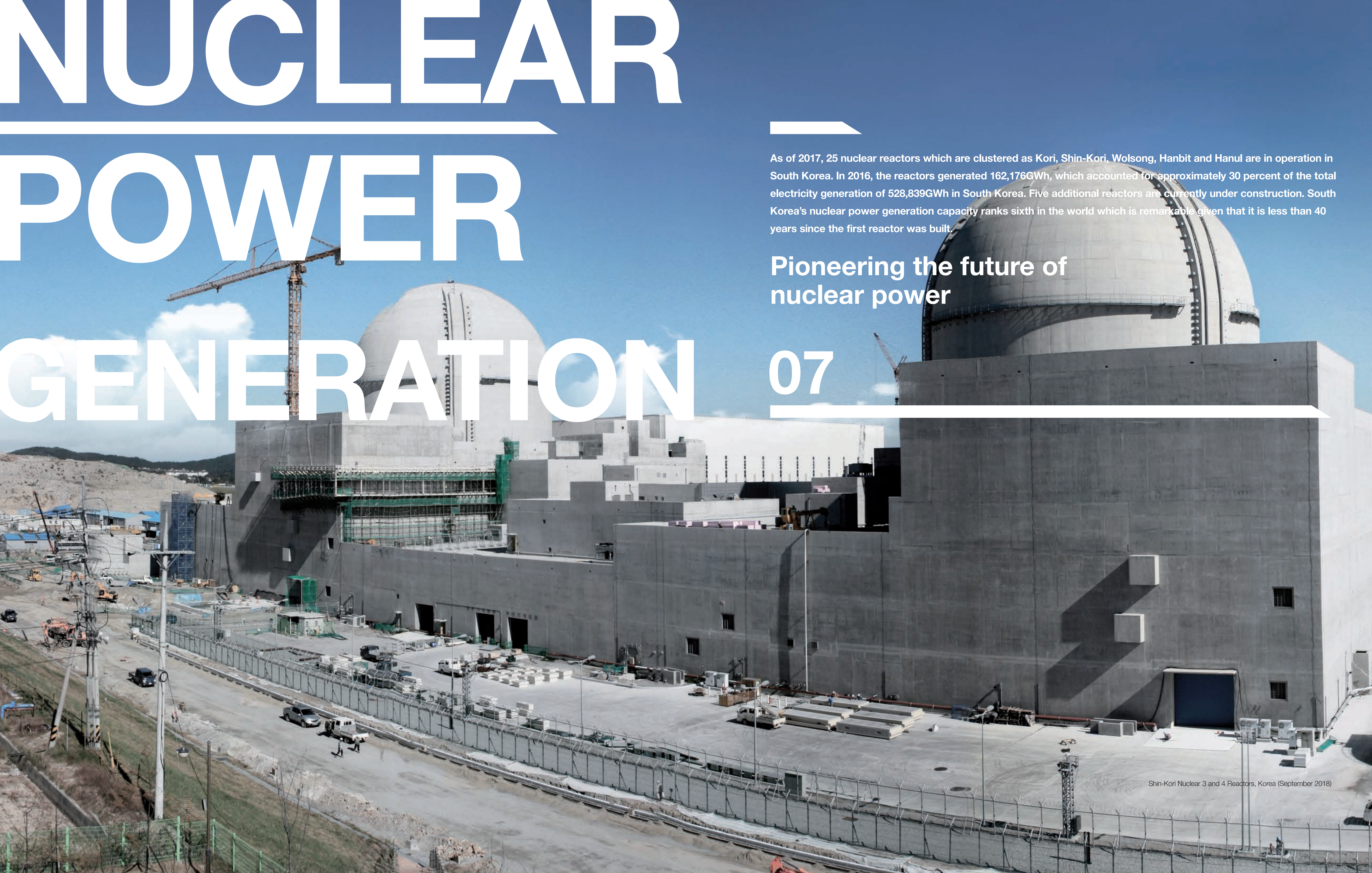
Country	Project Name	Time of Completion
Korea	Installation of #20 and #21 Tanks for 2nd Plant of Pyeongtaek Production Base	Aug. 2011
Korea	Low pressure compressor installation for East Sea-1 Gas Extraction Plant	Sep. 2011
Qatar	Pearl GTL-5	Jan. 2012
Saudi Arabia	Karan Gas Processing Plant	Feb. 2012
Kuwait	Al-Zour New Oil Reinfery-PKG 5	Mar. 2012
Korea	Pyroprocess Integrated Inactive Demonstration Facility	Mar. 2012
Qatar	Fertilizer Plant #5, 6	Sep. 2012
Korea	RI-BIOMICS Technology Reserch Center	Oct. 2012
Korea	Jangdeung-Danyang, Okkwa-Namwon Main Pipeline	Dec. 2012
Korea	Tongyeong-Geoje Main Pipeline	Dec. 2012
Korea	Yeosu Oil Tank	Mar. 2013
Kuwait	Kuwait Oil Company Pipeline Construction	Apr. 2013
Korea	Cheongna Gas Pipeline Management Facility	Jun. 2013
Malaysia	2nd Phase Petronas Gas Plant Retrofit Project	Jul. 2013
UAE	Abu Dhabi-Habshan-5 Support Facilities	Sep. 2013
Korea	Sangju-Yeongju Main Pipeline	Dec. 2013
Korea	Hyundai Steel Third Blast Furnace Plant	Dec. 2013
Korea	LNG regasification and transmission facilities at Incheon Production Base	Dec. 2013
UAE	Borouge 3 Extension Work	Jan. 2014
Korea	Hyundai Steel 3rd Blast Furnace, sintering and heavy plate plants	Mar. 2014
Korea	Seomjin River Dam	Jul. 2014
Korea	Iron Powder Plant	Oct. 2014
Korea	SKenergy Incheon Complex V-Project	Dec. 2014
Saudi Arabia	Ma'aden Alumina Refinery	Feb. 2015
Thailand	Linear Alkyl Benzene Project	Aug. 2015
Korea	Storage tank #8 and #9 for Samcheok LNG Production Base	Jun. 2016
UAE	Borouge 3 XPLE	Dec. 2016
Korea	Hyundai Oilbank Mixed Xylene Plant	Dec. 2016
UAE	SARB 4 Offshore Crude Oil and Gas Processing Project	Sep. 2017
Venezuela	Puerto La Cruz Refinery	May. 2018
Turkmenistan	Ethane Cracker Plant	Aug. 2018
Iraq	Karbala Oil Refinery	Nov. 2018
Venezuela	Puerto La Cruz Refinery	Dec. 2018
Saudi Arabia	Uthmaniyah Ethane Collection and Processing Facility	Nov. 2019
Uzbekistan	Natural Gas Liquid Refining Facility	Apr. 2020

NUCLEAR POWER GENERATION

07

Pioneering the future of nuclear power

As of 2017, 25 nuclear reactors which are clustered as Kori, Shin-Kori, Wolsong, Hanbit and Hanul are in operation in South Korea. In 2016, the reactors generated 162,176GWh, which accounted for approximately 30 percent of the total electricity generation of 528,839GWh in South Korea. Five additional reactors are currently under construction. South Korea's nuclear power generation capacity ranks sixth in the world which is remarkable given that it is less than 40 years since the first reactor was built.



Shin-Kori Nuclear 3 and 4 Reactors, Korea (September 2018)

Nuclear is often referred to as the third fire. The first fire is what Prometheus stole from Hephaestus's forge. The second fire is electricity which is often credited to Thomas Edison, and nuclear energy is the third fire because of its revolutionary characteristics.

Creating the third fire

The first reactor: A journey full of challenges

The plan to construct a nuclear reactor in South Korea was first established in 1967 as part of the long-term national electricity development plan. The plan included construction of two 180MW reactors which would increase the total electricity generation capacity of South Korea by 150 percent.

In June 1970, the South Korean government signed a contract with Westinghouse Electric Corporation for construction of the Kori 1 reactor. It was a turnkey contract which giving Westinghouse all responsibilities including supply of the core equipment and construction.

A nuclear power plant consists chiefly of two components; the nuclear reactor which generates steam using the heat generated from the nuclear fission reactor, and the generator which produces electricity by using steam to turn the turbine. Westinghouse led on the engineering design and supply of equipment for the reactor while the English Electric & George Wimpey built the generator.

HDEC also took part in the historic construction of the first nuclear reactor in South Korea as a subcontractor responsible for civil engineering, construction, electrical and instrumental works. HDEC's participation was essential as the purpose of the Kori 1

Kori Nuclear Power Plant, Korea (April 1986) reactor project was not also to increase the country's electricity supply but also to develop South Korea's capacity to construct future nuclear power plants.

Taking the first step: The Kori 1 reactor

Westinghouse hired multiple subcontractors as supervisors for different parts of the Kori 1 nuclear power plant project. Reactor Equipment Ltd. led on the construction of the nuclear reactor while Nuclear Power Co. led on the electrical works. Another company called EEW was given a supervisory role for the civil works. As a result, HDEC had to deal with three companies all at once.

All of the work HDEC was doing was strictly controlled by the three supervisory companies. They were all equally strict in their requirements and pushed HDEC hard on delivery. Everything had to be delivered to perfection, strictly following the blueprints and engineering specifications.

Cisler's Energy Box and Nuclear Power

On 8th July, 1956, Walker Lee Cisler, a powerful figure in the US electricity industry, made a courtesy call to President Rhee of South Korea carrying a small box he referred to as the "Energy Box".
The box contained samples of coal and uranium. He showed the President what was inside and said: "If this coal is incinerated, it produces 4.5 kWh of electricity. Do you know what happens if we incinerate this uranium, which weighs the same? It produces 12 million kWh. Coal is mined from the land, but nuclear energy is mined from the brain. Countries like Korea that are poor in natural resources should proactively develop this energy."

Kori 1 Nuclear Reactor Fuel Loading

The quality assurance process presented the greatest challenges for HDEC. Since almost every part of the nuclear power plant has stringent safety rules, HDEC was required to record everything in a methodical way. At the time, this was a new practice for HDEC and it took some time for HDEC to become accustomed to it.

There are four safety classification of structures, systems and components in nuclear power plants. The Q-class is for safety related items such as nuclear reactors and fuel. The T-class is for safety impact items which may have negative impact on safety in case of malfunction. The R-class is for reliability items including turbines and generators which are important for stable operation of nuclear power plant. Finally, the S-class is for industrial standard items.

Building the first reactor: An invaluable experience

Almost everything carried out by HDEC in respect to the nuclear reactor construction belonged to Q-class which means it is directly related to safety. Everything had to be delivered exactly as specified by Westinghouse and all work plans had to be documented before the actual work began. This presented dual challenges because HDEC has never been involved in a nuclear reactor project and creating a work plan in English was a challenge in itself.

All of the work plans had to be improved and revised multiple times until they were approved by Westinghouse. No work could be carried out until the work plan was approved and subsequently Westinghouse conducted frequent quality checks.

One of the biggest challenges HDEC experienced throughout the project was ensuring the quality of concrete. At the time, domestically produced cement was of varying quality and was generally overly alkaline making

Kori Nuclear Power Plant, Korea (April 1986) it prone to micro cracks. As a result, Westinghouse and the other supervisors strongly demanded the use of imported cement.

HDEC quickly resolved the cement quality issue by hiring US-based engineers to improve the quality of cement produced at HDEC's own Danyang cement factory.

Welding quality was yet another area HDEC faced many challenges due to the high quality standard required. Regular welding techniques were simply not good enough to weld the 3.1 centimeter thick steel plates used in nuclear power plants. The supervisors tested all the welders at the Kori site and used X-rays to assess the quality of their work. Every single welder failed the test, which was not unexpected as none of them had been trained for such high precision work.

Initially, HDEC tried to address the issue by setting up a training center on site. However, the sixty top performing welders could still not pass the test even after a month of intensive training. HDEC then recruited highly experienced welders from a shipyard operated by Hyundai Heavy Industries and trained them. Thankfully, some of these welders passed, allowing HDEC to meet all of the 18 Q-class safety standards of nuclear reactor construction.

Frequent delays in construction was yet another challenge of the project. Although the Kori 1 reactor was originally scheduled as a 60 month project, four major modifications were made to the plan, delaying completion by 30 months. The delays were increased by frequent changes in the specifications, delays in the arrival of supplies, and the inexperience of the engineers. Although none of these were part of HDEC's responsibility, HDEC still had to deal with the negative impacts caused by these delays.

Installation Of Turbine for Kori Nuclear Power Plant

Despite all the challenges, participating in the Kori 1 reactor construction was an invaluable experience for HDEC. Not only was HDEC able to vastly improve its capacity for process and quality management in nuclear reactor construction, but it gave HDEC the foundation to become an independent contractor for future nuclear projects. The project led to the creation of an advanced quality management system which enabled HDEC to deliver high-precision work which could satisfy the strictest safety standards, which in turn boosted HDEC's credentials.

Increasing capacity for independent reactor construction

Construction of the Kori 2 nuclear reactor began shortly before completion of the Kori 1 reactor. Although the Kori 2 project was a turnkey project commissioned to an overseas company, HDEC took on a much larger role by leading on the reactor construction including site design, quality control and technical management.

At the time, the South Korean government began implementation of a nuclear reactor technology development plan, which made HDEC's capacity building even more important. HDEC continued to increase their experience by participating in the Wolsong 1 reactor project which was a pressurized heavy water reactor unlike Kori 1 and 2 which were light water reactors.

This experience allowed HDEC to take on the Kori 3 and 4 nuclear reactor construction project as the sole contractor, as the project was commissioned as a non-turnkey project with the goal of 95 percent local sourcing. HDEC firmly established its leadership position in South Korea by taking on the Kori 3 and 4 project.

Kori 3 Reactor Dome Construction

The ceremony celebrating completion of the Kori 1 reactor was held on 20th July 1978. President Chung-hee Park hailed completion of the Kori 1 reactor as an important milestone in modernization and restoration of South Korea. Completion of the Kori 1 reactor prepared South Korea for the 21st country and made them only the second country in Asia only after Japan, to have a nuclear power plant. President Park also encouraged the continuing development of South Korea's own capacity to build nuclear power plants.

During the Kori 1 and 2 and Wolsong 1 reactor projects, South Korea was heavily reliant on overseas technologies. However, South Korean companies and engineers began to build their capacity through Kori 3, 4 and Hanbit 1, 2 reactor projects. Construction of the 3rd and 4th Hanbit reactors marked the beginning of the country's independent capacity.

The epic journey to independent nuclear power plant construction

Hanbit Nuclear Power Plant, Korea (December 2002)

HDEC's emergence as the main contractor in nuclear projects

By 1983, HDEC had built a strong capacity for nuclear reactor construction work thanks to the two Kori and one Wolsong reactor projects. The Wolsong reactor, the 2nd reactor completed in South Korea, had to be completed several months before the original deadline in order to meet the national electricity supply target. HDEC was able to accelerate construction of the reactor, which was a remarkable achievement since it was the first time HDEC had built a pressurized heavy water reactor.

Earlier completion of the Wolsong reactor was even more remarkable because it was the first heavy water reactor built by Atomic Energy Canada who supplied the core technology, and numerous modifications were

Hanbit Nuclear Power Plant, Korea (December 2002)

made during the project. Although early completion was regarded as ‘miraculous’ by many, HDEC once again pulled off a ‘miraculous’ achievement for the Kori 2 reactor construction. Not only had HDEC completed the Kori 2 reactor six months before the deadline, it also achieved an extra 10MW of capacity for the generator unit.

HDEC’s vastly improved construction capacity was the key to ending the country’s heavy reliance on overseas capacity. Thanks to HDEC’s quick learning it became possible to commission future nuclear projects as non-turnkey projects.

HDEC’s capacity for nuclear reactor construction continued to grow even more quickly. For example, HDEC was able to position itself as the main contractor for the Kori 3 and 4 reactor projects. HDEC signed a contract directly with the Korea Electric Power Corporation for the project, for civil works.

HDEC continued to increase its capacity for electrical and mechanical engineering work. In 1987, HDEC was awarded a contract for the electrical and mechanical engineering work for the Hanbit[1] 3 and 4 reactors through private tender.

By the late 1970s, HDEC had already earned a strong reputation for its independent capacity for nuclear reactor construction. In fact, HDEC even signed a technical cooperation agreement with US-based company Ebasco and dispatched several tens of engineers to the US. Prior to this agreement, HDEC began preparations to obtain the Boiler & Pressure Vessel Certification from the American Society of Mechanical Engineers, which was a requirement for conducting work with stringent safety requirements.

The N-type certificate from ASME authorizes activities involving core

1) The Hanbit 1 and 2 or originally known as Yeonggwang NPP.

Construction of Hanbit Nuclear Power Plant, Korea components including vessels. NA and NPT certificates authorize activities for field installation and assembly of core equipment, respectively. HDEC earned its N-type certificate in May 1980 and the NA and NPT-type certificates in March 1982.

Realizing technology independence: Completion of Hanbit 3&4 reactors

The Hanbit 3&4 nuclear reactor project, with a rating of 1000MW per unit, had special significance as a demonstration of South Korea's own proprietary reactor design. The engineering design and construction were carried out simultaneously by HDEC which oversaw all aspects of the project from civil engineering to quality assurance.

Construction of the frameworks for the reactor buildings began shortly after the first concrete deposition began in December 1989. Installation of the nuclear reactor, which is final stage of construction, began in December 1991. Instead of using a temporary entrance on ground level for transfer of reactors, HDEC employed a new method; loading them onto a 14 meter high platform and inserting it into the containment building through an equipment entry space.

On 14th April 1992, the power switch was turned on at the Hanbit 3 and 4 unit for a test-run. The reactors began commercial operations, using a locally-manufactured fuel rod, supplying electricity to the grid on 10th September 1994 after a series of trials. All construction work was done with local capacity and 95 percent of the design work and supplies were sourced locally. The Hanul 3[2)] reactor, which began operation in August 1998 was built following the Korea Standard Nuclear Power reactor design, and importantly eliminating the 5 percent gap in localization.

HDEC continued to strengthen its capacity for nuclear reactor construction, completing the Wolson 2 reactor project without external technical support. Heavy water reactors are more challenging to build than light water reactors. HDEC developed new construction methods such as Slip Form and Pre-Stressing methods in order to successfully complete the project. Completion of Wolsong 2 made HDEC the only company in South Korea with the capacity to independently carry out both light and heavy water reactors, and with an impressive track record.

2) Project was originally named Wuljin and later changed to Hanul.

Construction of Wolsong 1 Reactor, Korea (April 1983)

The History of Nuclear Power Plant Construction Capacity

Heavy Overseas Reliance
- Turnkey contract to overseas company

Kori 1, 2 and Wolsong 1

Capacity Building
- Non-turnkey to overseas companies
- Local company participation as subcontractor

Kori 3 & 4, Hanbit 1 & 2 and Hanul 1 & 2

Technology Independence
- Korea Hydro & Nuclear Power as project lead
- Local company participation as main contractor
- Development of South Korea's own proprietary reactor design

Hanbit 3~6, Wolsong 2~4, Hanul 3~6

Technology Refinement
- Development of improved OPR1000, the Korean Standard Nuclear Power Plant
- Development of APR 1400 advanced pressurized water nuclear reactor

Shin-Kori 1~4, Shin-Wolsong 1 & 2

Technology Independence
- APR+ technology development
- Localization of core technologies (RCP, MMIS and core design codes)

Shin-Hanul 1&2 and future projects

HDEC continued to lead on nuclear power plant construction projects in South Korea after successfully completing Hanbit 3 and 4 reactors relying only on internal capacity. Completed in December 2002, the Hanbit 5 and 6 reactors were built with the latest technology, proving the merits of the Korea Standard Nuclear Power design.

Designed for the world: The Korean next generation reactor

Establishing Korea Standard Nuclear Reactor construction method

Refining the construction method for the Korea Standard Nuclear Reactor design, by reflecting on the lessons learned from the Hanbit 3 and 4 reactors was one of the most important objectives of the Hanbit 5 and 6 reactor project. Thanks to a much strengthened capacity, HDEC was able to lead on most of the project work with only a little support from overseas suppliers, who consulted where needed.

Despite some unexpected challenges due to the Asian Economic Crisis in 1997, HDEC completed the project in 58 months as planned, demonstrating the improved economics, safety and reliability of South Korea's proprietary reactor design.

Construction of the Shin-Kori nuclear 1 and 2 reactors began in May 2005. The reactor was an improved Optimized Power Reactor 1000MW, or OPR1000 in short. OPR1000 was an improved version of the Korea Standard Nuclear Reactor.

Incorporated with 97 improvement measures including an enhanced superstructure design, the improved OPR1000 was the epitome of South Korea's second generation nuclear reactor design. In 2002, the third generation APR1400 (Advanced Power Reactor 1400) reactor design was approved. Thanks to 40 percent more capacity and other enhancements, the APR1400 was expected to provide greater economics and improved safety performance.

An enhanced containment vessel extended the design life by 20 years

Construction of Shin-Kori Nuclear 1 Reactor, Korea (July 2012)

Shin-Hanul Nuclear Power Plant, Korea (February 2019)

and was designed to withstand an earthquake with a magnitude of 7.0. Core damage frequency and the possibility of a meltdown, was reduced ten folds at one in one millionth.

The first third-generation nuclear reactor

Construction of the Shin-Kori 3 and 4 reactors began in September 2007. Commissioned to a consortium of three companies including HDEC,

Shin-Kori Nuclear Power Plant, Korea (September 2018)

it was the first project for construction of APR1400 reactors. The reactors were installed in July 2010 and July 2011 respectively. The first fuel-loading for Shin-Kori 3 reactor took place on 10th November 2015 and commercial operation began in December 2016 after a series of trail runs.

This made the Shin-Kori 3 reactor the first third generation reactor to become commercially operational. The Shin-Kori 4 reactor is expected to begin commercial operations in September 2018 and will generate 1,040TWh of electricity per year.

The Shin-Hanul 1 and 2 nuclear reactor project, which HDEC won after an intense competition, was the second APR 1400 nuclear project in South Korea. HDEC won the project as part of a consortium with two other companies and owns a 45% share.

The Shin-Hanul 1 and 2 reactor project is an ambitious project which aims to completely localize all remaining technologies which includes the Man-Machine Interface System (MMIS), the Reactor Coolant Pump (RCP) and safety analysis for the nuclear power plant. Completion of the Shin-Hanul 1 and 2 reactors in April 2018 and February 2019, will increase the number of 3rd generation APR1400 reactors built by HDEC to eight units, six in South Korea and two in the UAE.

Side by Side Comparison of APR1400 and OPR1000

Item	APR1400	OPR1000
Capacity	1,400MW	1,000MW
Design Life	60 years	40 years
Seismic Design Basis	0.3g	0.2g
Economics	• 40% more generation capacity than OPR1000 • 10%+ thermal performance improvement • Minimization of material consumption with modularization and integrated building planning	
Safety	• Automated hydrogen control in emergency situation without electricity supply or human input • Three-fold improvement in core safety	• Employs active-type igniter in case of severe accident
Environmental Performance	• Preserved natural coast line by constructing undersea tunnel for intake and release of cooling water to minimize negative impact	
Central Control Room	• Employs digital workstation for all monitoring and control management (Enhanced operation and reliability)	• Analog + Digital

Barakah nuclear power plant: South Korea's first nuclear export

The UAE wished to construct a large-scale nuclear power plant in Barakah in the west of Abu Dhabi as a response to the forecast for peak load of 40GW by 2020. In December 2009, the Emirates Nuclear Energy Corporation (ENEC) awarded a coalition led by Korea Electric Power Corporation (KEPCO) a 20 billion USD contract to build the first nuclear power plant in the UAE. The South Korean coalition consisted of KEPCO, Korea Hydro & Nuclear Power and HDEC.

Barakah was chosen as the first nuclear power plant site where four

APR1400 nuclear reactors were to be built with 5,600MW of generation capacity. The project made South Korea the fifth country to export its own nuclear technology and the sixth country to build a nuclear reactors overseas.

The Barakah site is 8 kilometers in width and 1.8 kilometers in length, and the highest structure, the round dome on top of the nuclear reactor building will be 80 meters tall, equivalent to a 30-story building. Two 1,600-ton tower cranes, the largest in UAE, were employed for construction.

Barakah Nuclear Power Plant, UAE (May 2020)

Barakah Nuclear Power Plant, UAE

Barakah Nuclear Power Plant, UAE

Construction of the four nuclear reactors is expected to require four times more concrete that Burj Khalifa, the tallest building in the world. Special rebar, 55mm in diameter, which is 2.5 times thicker than regular steel bars will be used in order to ensure safety in all conditions including earthquakes, tsunamis and even missile attacks. 20,000 workers from all over the world, including 1,400 from South Korea have participated in the gigantic Barakah nuclear power plant project.

The groundbreaking ceremony for the Barakah project was held on 14th March 2011. The first reactor was installed in May 2014 and test operations began in February 2016. The second and third reactors were installed in September 2014 and June 2015, respectively. Work on the reactor building has begun and as of mid-2017 is currently under construction. Completion of the first reactor is scheduled for 2018 and all four reactors are scheduled to be operational by 2020.

Nuclear Power Plant Projects led by HDEC Since 2000

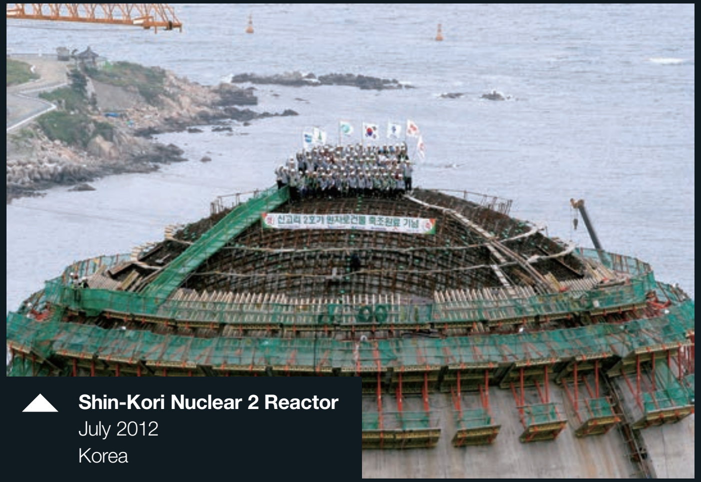
	Shin-Kori 1, 2	Shin-Kori 3, 4	Shin-Hanul 1, 2	UAE Barakah 1, 2, 3, 4
Reactor Type	Pressurized light water reactor	Pressurized light water reactor	Pressurized light water reactor	Pressurized light water reactor
Country of Reactor Origin	South Korea	South Korea	South Korea	South Korea
Capacity	1,000MW x 2 units	1,400MW x 2 units	1,400MW x 2 units	1,400MW x 4 units
Construction Period	81 months	126 months	86 months	103 months
Construction Schedule	2005.10~2012.07	2008.04~2018.09	2011.12~2019.02	2011.09~2020.05
Contract Type	Contractor-driven	Contractor-driven	Contractor-driven	Turnkey
Main Contractor	HDEC	HDEC	HDEC	KEPCO
Subcontractors	1st and 2nd tier HDEC	1st and 2nd tier HDEC	1st and 2nd tier HDEC	1st and 2nd tier HDEC

GALLERY NUCLEAR POWER GENERATION

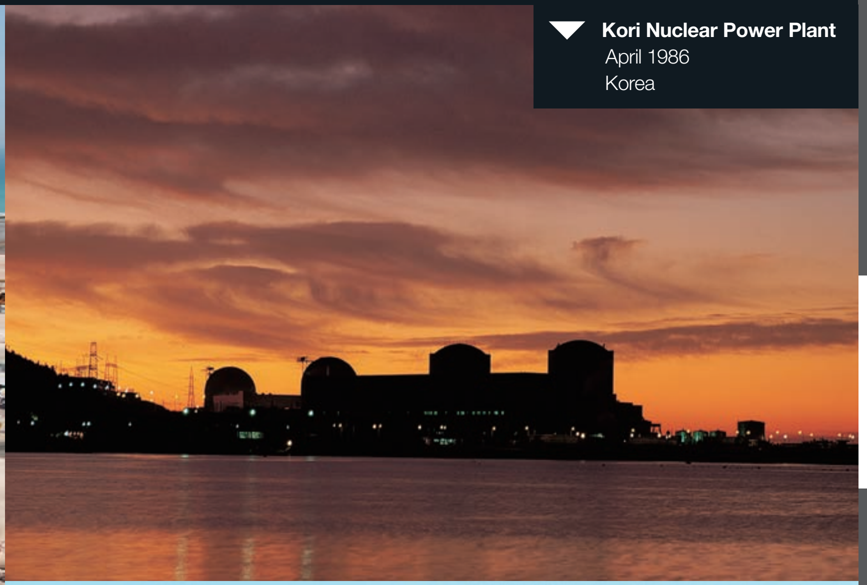
Barakah Nuclear Power Plant
May 2020
UAE

Construction of Barakah Nuclear Power Plant
May 2020
UAE

Shin-Kori Nuclear 1 Reactor
July 2012
Korea



Shin-Kori Nuclear 2 Reactor
July 2012
Korea



Kori Nuclear Power Plant
April 1986
Korea

Wolsong Nuclear 1 Reactor
April 1983
Korea

Shin-Hanul Nuclear Power Plant
February 2019
Korea

LIST NUCLEAR POWER GENERATION

Country	Project Name	Time of Completion
Korea	Kori Nuclear 1 Reactor	Apr. 1978
Korea	Wolsong Nuclear 1 Reactor	Apr. 1983
Korea	Kori Nuclear 2 Reactor	Jul. 1983
Korea	Kori Nuclear 3 & 4 Reactors	Apr. 1986
Korea	Hanbit Nuclear 1 & 2 Reactors	Jun. 1987
Korea	Daedeok Science and Technology Park Nuclear Facility	Apr. 1995
Korea	Hanbit Nuclear 3 & 4 Reactors	Jan. 1996
Korea	Wolsong Nuclear 2 Reactor	Jul. 1997
Korea	Hanbit Nuclear 5 & 6 Reactors	Dec. 2002
Korea	Nuclear Fuel Test Loop	Nov. 2007
Korea	Cold Neutron Research Facility	Dec. 2009
Korea	Hanbit #1 and #2 Station BlackOut Management Facility	Apr. 2010
Korea	Korea Pyroprocessing Complex	Mar. 2012
Korea	Shin-Kori Nuclear 1 & 2 Reactors	Jul. 2012
Korea	RI-Biomics R&D Center	Oct. 2012
Korea	Temporary Penetration Hole of Kori 1 Reactor Containment Building	May. 2013
Korea	Shin-Kori Nuclear 3 & 4 Reactors	Sep. 2018
Netherlands	The Oyster Experimental Reactor Retrofit	Mar. 2018
Korea	Shin-Hanul Nuclear 1 & 2 Reactors	Feb. 2019
Korea	Hanbit 3 and 4 Steam Generator Replacement	Oct. 2019
UAE	Barakah Nuclear Power Plant	May. 2020

SCIENTIFIC STATION IN ANTARCTICA

Construction can be viewed as the process of modifying the natural environment to enable the expansion of human territory. Human civilization originally developed beside rivers, where water was plentiful and farming land was good. As civilizations advanced, humans gradually expanded their habitats. Although many parts of the world are not ideal for human settlement, with will and technology new territories have been pioneered. However, there are still a few where mankind has not yet settled such as the polar regions.

Overcoming the challenges of extreme environments

08

Bird's-eye view of Antarctic Jang Bogo Station

The polar regions are one of the most hostile environments in our world. In engineering terms, temperatures below -17.8˚C are regarded as cold while below -30˚C is regarded as extreme cold. Surprisingly a fairly large portion of the world, including parts of northern China, Siberia, Alaska and northern Canada, experience extreme cold temperatures. In fact, nearly 14 percent of land on our planet experiences extreme cold temperatures and 60% of the this is covered with very thick glaciers.

Building in extreme condition: How it all begun

Antarctic: The last untapped territory

The Antarctic continent covers an area of 1.4 million square kilometers including ice shelf. Spanning an area sixty two times larger than the Korean peninsula, the average thickness of the ice is 2,200 meters and temperatures can go as low as -89 degrees℃. Humans first began to explore Antarctica in the 20th century.

Despite its harsh environment, Antarctica hides a great amount of fossil fuels and minerals buried deep underground. The sea of Antarctica also has great deal of food resources such as krill. It is also the last remaining unoccupied land.

In 1911, a Norwegian explorer Roald Amundsen succeeded in reaching the South Pole. Since then many nations have attempted to claim possession of Antarctica. By the 1950s, many countries had built bases in Antarctica. However, the Antarctic Treaty came into effect in 1961, ensuring Antarctica remains a common resource and mainly for scientific research.

Joining the Antarctic Treaty and construction of a new Research Base

The first South Korean expedition team left for Antarctica in November 1985. The expedition team included two researchers from the Korean Ocean Research & Development Institute. The team stayed on King George Island for three weeks and collected information on other countries base construction activities and the environment. The team of professional mountain climbers who joined the team, became the sixth team to climb the 3,897-meter Vinson Massif, the highest mountain on Antarctica.

In 1986, South Korea became the 33rd signatory to the Antarctic Treaty and the government decided to establish a base on Antarctica. In 1987, the Ministry of Foreign Affairs reported to the President and he ordered an acceleration of base construction in order to give South Korea a voice in Antarctica-related issues in the international society and to build status within the group. South Korea also wanted to obtain preemptive rights to participate in resource development in the future. With the support of the President, base construction progressed rapidly.

HDEC staffs landing on Antarctica for construction of King Sejong Station

The Korean Polar Research Office, which was established in March 1986 as part of the Korean Ocean Research & Development Institute, took on responsibility for establishing the King Sejong Station. The office dispatched an expedition team of eight including four Hyundai engineers. The team stayed on King George Island for two weeks from 23rd April until 7th May, searching for a suitable site for the new base.

King Sejong Station: The nurturing ground for advanced research

Commemoration plate for first landing on King Sejong Station site

Tackling the challenge

King George Island is the largest of the South Shetland Islands. Ninety eight percent of the island is covered with 100 meter thick glaciers. Its climate is the least hostile in the region and it has served as a gateway to Antarctica since it was discovered by England merchants. However, late April and early May was not an ideal time to explore as the hostile Antarctica winter is already beginning.

The team hired helicopters and relentlessly surveyed King George Island. The team found an ideal site on the northwestern coast of the Baton peninsula on 4th May a few days before the end of the expedition. It had low hills, small pebbles on the ground and it had a freshwater lake which could serve as a water supply. During construction the lake became known as Hyundai lake until it was renamed as Sejong station.

HDEC's first construction project in an extreme climate zone was carried out in collaboration with Hyundai Heavy Industries and Hyundai Engineering. HDEC led on the construction work while Hyundai Engineering was responsible for the base design, inspection and purchase of materials. Hyundai Heavy Industry was responsible for transport of the construction materials and equipment as specified by Hyundai Engineering.

Unlike other construction sites, sourcing of construction materials required very special attention as lack of even a single bolt or welding pipe could delay the whole project and it could take months to secure the part.

Transporting the huge amount of construction materials and equipment that was required was a

Construction of King Sejong Station

challenge in itself. For example, it was necessary to build a temporary harbor for unloading. HDEC hired two barges with 800 ton and 500 ton capacity each, a 1,600hp tug boat and a 730hp ferry boat to transport workers in and out of the harbor.

A construction simulation site was setup in late August to practice assembling the steel frame and exterior panel before leaving for Antarctica in October.

Speedy construction in white nights

On 6th October 1987, a Heavy Lift Vessel, the HHI-1200, began its journey to Antarctica loaded with containers of building materials and 30 heavy construction equipments. A team of 158 construction workers, 13 engineers and supervisors and reporters later flew to Chile. The HHI-1200 arrived at Valparaiso harbor in Chile on 27th November. The ship arrived at Maxwell Bay, King George Island at 11:00 am on the 15th December.

Construction of the temporary harbor was completed before the next day's high tide and unloading quickly began. The groundbreaking ceremony was held shortly thereafter. HDEC had two months to complete the project and finish the center which seemed almost unachievable.

Fortunately, construction progressed smoothly. Antarctica in November and December is enjoying the peak of summer, and with it the famous white nights. Taking advantage of the long daylight, HDEC workers would work from 7:00 am to 10:00 pm and sometimes as late as 2:00 am, taking shifts.

Thanks to the swift and smooth progress, HDEC built the roof of the first building on 10th January 1988. Eight buildings including the main building, residential quarters, research center, summer workstation as well as the harbor and fuel tanks were completed one by one. An artificial lake of 1,000m^3 was also created, to collect melt water and use it as a water supply for the base. A desalinization facility was also built for winter when there is no melt water.

Naming the station: The King Sejong on King George Island

The Antarctica research station project was not a major project for HDEC in terms of its size. However, it presented a good opportunity to demonstrate HDEC's capability for construction in extreme environments. The project gave HDEC confidence and allowed HDEC to take on the Jang Bogo Station, South Korea's second research station.

A public contest to name the first Antarctic research station was conducted and the King Sejong Station became the official name historic completion ceremony for the station on 17th February 1988. The King Sejong Station was an important national project for both the advancement of scientific research and for engineering in extreme cold regions.

Since Antarctica is one of the last remaining uncharted territory on Earth, there is significant potential for development of the continent and its coasts for energy, mineral and biological resources as well.

Still in operation almost 30 years after its establishment in 1988, the King Sejong Station has made significant contributions in various areas of scientific research and by monitoring the environmental changes of the coastal region, serving as a stepping stone for the future.

Construction of King Sejong Station

The King Sejong Station served its role well as South Korea's first research station. However, its location on King George Island at 62 degrees southern latitude was not ideal as it could only support research activities within a radius of 200 kilometers. The location, therefore, of the King Sejong Station is limiting for more serious research of the Antarctic.

Jang Bogo Station: On the mainland Antarctica

Venturing within Antarctica

As of 2000, 29 nations were operating a total of 75 research stations, consisting of 39 year round research stations and 36 summer research stations. More than eight countries including the US and China had more than two year round stations.

The South Korean government decided to build its second Antarctica research station on the mainland and dispatched RV Araon, South Korea's first icebreaker. The vessel was commissioned in December 2009 and left for Antarctica to testing its ice breaking capacity and search for a suitable site for the second research base.

An expedition team consisting of 22 experts from institutes including the Korean Polar Research Institute (KPRI), Korean Environment Institute and Pai Chai University left South Korea on 12th January 2010 and explored Antarctica riding on the RV Araon between 2nd and 18th February. The team focused on exploring Cape Burks and Terra Nova Bay as potential sites for the second base.

KPRI hosted three public hearings to share their findings and ultimately chose a site near Mount Browning for South Korea's second base which was later named as the Antarctica Jang Bogo Station. A consortium led by HDEC once again won the contract for design and construction of the new station.

HDEC immediately began designing the Jang Bogo Station and organized an expedition team, in partnership with KPRI and the Korean Environment Institute, to assess the site. The team visited Browning Mountain between 2nd and 14th 2011 and brought back valuable data of the local environment.

Jang Bogo Station

RV Araon

HDEC Employees at Jang Bogo Station

Mount Browning, where the Jang Bogo Base was to be built, had a relatively flat terrain, with a flat land site of approximately 21,000 square meters. It was however more windy and snowy than other areas. Construction would only be possible during the short summer from the end of December to the end of February, a maximum of 65 days.

The site was also subject to the influence of low pressure created by the Transantarctic Mountains running across the continent from the Ross Sea. The design of the station had to compensate for the strong mountain and valley wind, barrier wind as well as the environmental impact on the South Polar skua population.

Fighting extreme conditions with a Samtaeguk Pattern

The traditional pattern of Samtaeguk was employed in the design of the Jang Bogo Station, considering its symbolic value as South Korea's first Research Station on Antarctica. The Samtaeguk consists of three colors representing heaven, earth and humans. Likewise, the three-prolonged wings of Jang Bogo Station represent atmospheric research, geophysical research and living quarters. The design is also effective at withstanding the strong winds that are often experienced.

Safety was the highest priority in establishing the floor plan of the Jang Bogo Station. The evacuation route was made as short as possible in case of fire and emergency situations which occur rather frequently due to the low temperatures and low humidity. A modular construction method was employed to shorten construction time.

Construction of the Jang Bogo Station, spanning 4,660m^2 in area, was carried out over two phases. During the first phase, between December 2012 and March 2013, temporary living quarters for the workers was constructed followed by construction of the mainframe and exterior panels for the main building, maintenance building, power generation building, fuel storage and unloading pier. The second phase including construction of various facilities such as the power plant, desalination plant, satellite communication and mechanical piping as carried out between December 2013 and March 2014.

In June 2012 HDEC, which has finished preparing the design and construction schedule, began preparations for the construction by conducting practice assembly at HDEC's Incheon Global Campus using the parts and modules for the station.

Completion of the Antarctic Jang Bogo Station and construction of 2nd Antarctic station

RV Araon carrying 300 members of staff including 115 HDEC construction crew members and researchers, and the Suomigracht cargo ship carrying 15,000 tons of materials and heavy machinery arrived at Antarctica on

Jang Bogo Station

First Phase Construction Materials of the Jang Bogo Station

Cargo Inventory	Ton
Steel frame works for four main buildings	1,100
Box-Floor Moduler 96EA	327
Precast concrete foundation for 11 structures	4,206
Exterior panels for 4 buildings	1,420
Aggregate, steel and mold for reinforced concrete works	2,258
Aggregate for pier works	2,675
Ground connections, cables, trays and etc.	187
Pipes, oil tanks and etc.	241
Temporary quarter, temporary generator, cafeteria and etc.	287
Super-high-early-strength cement x 10,000 bags, regular cement 3,000bags, insulation materials	484
Construction equipments	754
Helicopter, oil tanks, finishing and other materials	753

Source: HDEC newsletter (7th November 2012)

11th December 2012. The first phase of the construction team docked at Suomigracht on the coast of Teranova Bay about 1.2km away from the construction site, and began transporting materials to the site, using helicopters and through a route over sea ice.

In order for the transport operation to be smooth, the sea ice had to be thick enough and strong enough. The crew checked the condition of the sea ice frequently while transporting materials as fast as possible.

During the first month, everything went smoothly under favorable weather conditions. However, a blizzard with wind speeds of 51km/h began to affect the work site and visibility fell below 150meter, effectively blinding the crew. The power generator then broke down, creating a crisis. Fortunately a reserve generator was found. Despite these difficulties, the first stage of the Jang Bogo Station construction was completed and the team returned to Seoul in March of the following year.

On 11th November 2013, the second phase construction team departed from Incheon airport. Cargo ship, the BBC Danube, with 7,000 tons of materials onboard departed from South Korea on 27th October 2013. The BBC Danube arrived at Hobart harbor, Australia on 11th November and departed for Teranova Bay filled with special diesel fuel for use in extreme cold temperatures.

The BBC Danube and RV Araon arrived at Teranova Bay on December 7th and joined the construction team. HDEC has doubled its workforce 45 days earlier based on the experience of the phase 1 construction.

Three months later, on 12th February, 2014 at 10:00 am, a ceremony was held to celebrate completion of the Antarctic Jang Bogo Science Station. The second phase construction team stayed at the station until early March to make the finishing touches. They then handed over the station to the first KPRI winter crew.

KPRI have now dispatched three winter research teams to the Jang Bogo Station who together have made significant achievements through the operation and monitoring of various research programs.

APART– MENTS

An apartment refer to western-style housing which has become popular in South Korea after it became widespread in Japan. In South Korea, all high-rise buildings with multiple units per floor are commonly referred to simply as 'apart'. Although, apartment exist all over the world, they differ significantly in their size, shape and other specifications.

Hillstate and THE H: The brand of excellence and perfection

09

Gimpo Gochon Hillstate, Korea (April 2008)

In South Korea, construction of apartments began in the 1960s when the Korean economic development began. HDEC first participated in the Mapo apartment project in 1964 and with the Apgujeong-dong apartment project in 1975 had firmly established a strong reputation. HDEC is currently building apartments with Hyundai Hillstate and THE H brands.

From Mapo Apartments to Apgujeong-dong Hyundai Apartments

Mapo Apartment, Korea (January 1964)

Leading the dawn of the apartment era

In the west, apartments refers to both residential and non-residential buildings. They often referred as public housings. On the other hand, in Japan, the word 'apartment' is considered as a multi-household building. Interestingly, what is known as an apartment in Japan is usually referred to as a mansion in South Korea.

The word 'apartment' and its housing style was introduced to Korea during the Japanese colonial period. The Japanese-style apartment buildings at the time were close to town houses, quite different from today's apartment buildings in terms of size, structure and number of floors. The construction of Japanese-style apartments continued intermittently until the end of the 1950s, both before and after the Korean War. However, these apartments were not very popular as they were generally two-story buildings occupied by a single family.

Modern apartment buildings began to take root in South Korea in the 1960s when the Korean economic developments began. In 1964, five construction companies including HDEC participated in the construction of the Mapo apartment complex in Dohwa-dong, Mapo-gu, Seoul. It was the first of its kind in South Korea and consisted of four I-shaped buildings and six Y-shaped buildings.

The Hilltop Apartment complex for foreign residents was constructed between January 1967 and October 1976. It was an 11-story high-rise building equipped with Korea's first central heating, telephone system and elevators. This luxurious apartment complex was for foreigners staying in Korea long-term and HDEC was commissioned by the Korean National Housing Corporation and funded with a loan from the Japanese government and South Korean government budget.

The elevator, imported from Japan, was the first to be installed in a residential building in South Korea. HDEC gained valuable experience through the project as many high-tech materials, equipment and construction methods were applied extensively.

HDEC and ten other construction companies participated in the first Yeouido apartment project which was completed in November 1971. Commissioned by the Seoul city government, it was the first large-scale high-rise apartment complex in Korea. The complex consisted of 24 buildings, 12 or 13-story one side-corridor type

Mapo Apartment

A bonded warehouse of the Hilltop Apartment for Foreigners

After finishing the bed excavation for the Hilltop Apartment, the next step was the reinforced concrete construction but the rebar promised by the Japanese government was late, so the workers had to use the rebar from the warehouse. Unfortunately it turned out that the warehouse was designated a bonded warehouse containing imported materials from Japan that had no customs clearance, therefore it was illegal to use the rebars. The customs officers, who noticed the materials were being used without proper clearance, reprimanded the workers on site and even summoned the construction supervisor to the customs office.
The construction manager explained the situation in detail and was released shortly after with only a mild warning. It was an experience unique to the project involving rebar offered as a foreign government loan.

high-rise apartments with 1600 units in total. The success of the project led to an apartment project boom in Yeouido, which peaked in the 1980s.

As housing demands increased rapidly in the 1970s, the importance of private-sector led large-scale apartment complex projects began to emerge. The housing business emerged as a major industry with excellent value, whilst the scale of projects continued to increase. The Seobinggo Hyundai Apartment was HDEC's first independent project, which had the goal of 'providing high-quality construction and a convenient and comfortable living environment for residents'.

HDEC paid close attention to all aspects of the complex including the layout, materials, landscape and facilities in order to create the best possible residential environment. The construction of eight buildings with a total of 607 units and a small shopping center began in July 1973 and was completed in November 1975.

Pioneering a new era of high-rise apartments

With completion of the first and second Hyundai apartments, the previously barren sandy shores of the Han River in Apgujeong-dong became a popular residential area. HDEC built and sold a total of 1,392 apartments in less than two years between March 1975 and November 1976.

The construction of the Apgujeong-dong Hyundai Apartment was a major point in the history of the nation's housing culture. HDEC introduced an unprecedented amount of advanced construction technologies which had a significant impact on the construction of apartments in Korea. The completion of the Seobinggo Hyundai Apartments and the Apgujeong-dong Hyundai Apartments which were all 15-story or higher, made the high-rise apartment complex a new norm in Korea's residential complex construction.

Apgujeong-dong Hyundai Apartment, Korea (April 1987)

A complete makeover of Apgujeong–dong

When Apgujeong–dong Hyundai Apartment was first commissioned, the site of Apgujeong–dong was a desolate place with no running water or electricity. Even the technical supervisors rarely came back to the site after finding out how disorderly the operation was.

The lack of electricity was easily solved with the cooperation of the Electricity Department, but the real problem was the water. The crew dug several holes as deep as 65ft only to discover bedrock. In the end, workers had to draw water from the Han River.

Looking at Apgujeong–dong now with its nonstop neon lights glittering at night, it's not easy to imagine Apgujeong–dong was just a sandy field only some decades ago.

Apgujeong-dong Hyundai Apartment

Construction of the Apgujeong-dong Hyundai Apartments started in 1975 and continued until April 1987, by which time there had been about 6,150 households across 14 complexes built. HDEC led construction of the first four complexes and the remaining ten complexes were built by the Korean Urban Development corporation, a HDEC subsidiary.

History of HDEC's apartment brand: From Hyundai Apartments to Hillstate

Guui-dong Hyundai Prime Apartment, Korea (February 1997)

The birth of the Hyundai apartment brand

As the first high-rise apartment complex in Korea, the Apgujeong-dong Hyundai Apartments was a product of the best construction technologies available at that time. Only a few construction companies had the ability to design and build high-rise buildings over 15-stories. HDEC applied a wide range of cutting-edge technologies, which had previously been reserved for expensive office buildings in the city center, to apartment buildings located in the undeveloped Apgujeong-dong.

Apgujeong-dong Hyundai Apartment was praised for creating an ideal model of 'Korean style apartment' through achieving harmony of architectural style and residential environment. The elements that made the apartment popular were its; simple timeless design, comforting ocher-color scheme, balcony structure reminiscent of the yard of a traditional Korean house, floor plan which reflects lifestyle of Korean people and finally Hyundai's signature durable and excellent construction. Simply put, HDEC set a new standard in the apartment housing market.

Apgujeong-dong Hyundai apartment has become a model for numerous apartment complexes constructed since then and has even influenced the standardization of apartment construction and the related laws. Some of the competitors copied HDEC's design specifications.

Although they were not originally built to be luxurious housing, since the mid-1970s, the popularity of apartment living has soared and the names

'Apgujeong-dong' and 'Hyundai' have become synonymous with luxury ensuring Hyundai's place as the leading brand in the market.

Hyundai: Leading brand in apartment housing

The Garak Apartment project in Songpa-gu was divided into three sites and HDEC was awarded a turnkey contract to lead on two of the sites where 46 apartment buildings with 2,200 units were completed.

The South Korean government commissioned the Garak apartment project as a turnkey contract in order to encourage development and application of new technology in apartment buildings. In response, HDEC employed a steel mold for the first time in an apartment building. The use of a reusable steel mold, which has a lower cost than a wooden mold, helped significantly reduce the apartment construction costs.

HDEC's apartment business was highly profitable by the mid 1980's. As the reputation of Hyundai Apartments

Mok-dong Hyperion, Korea (July 2003)

Uijeongbu Nogyang Hillstate, Korea (September 2006)

Daegu Hyperion, Korea (April 2007)

continued to soar, HDEC's reputation as an apartment project leader also grew. The construction of Guui-dong Hyundai Apartments located near Guui Subway Station on #2 subway line, was praised as the perfect replication of the Apgujeong-dong Hyundai Apartment complex. HDEC also led on a large-scale redevelopment project in Bongcheon 1 district, completed in May 1987, three year after it was commissioned.

In the early 1980s, the Housing Site Development Promotion Act created an apartment construction boom in South Korea. In the late 1980s, the South Korean government's ambitious plan to create two million homes nationwide between 1988 to 1992, led to many mega-scale development projects on the outskirts of Seoul.

HDEC was responsible for a large number of apartment projects including Heukseok-dong 1 & 2 district redevelopment, Guro entertainer's guild apartments, Sanggye-dong military personnel's apartments in Seoul and in other cities such as Bupyeong, Bucheon and Anyang. HDEC also constructed apartments in other major cities such as Busan, Daejeon, Gwangju, Gwangyang, Cheongju and Chuncheon. During the 1980s alone, HDEC created 14,700 units through their own development projects and constructed approximately 82,600 apartment units nationwide.

At the same time, HDEC began to turn its focus from simply competing for the construction projects to providing better customer service.

In 1994, HDEC held an apartment design contest targeting female apartment buyers. HDEC then created standard apartment model units based on the design ideas collected through the contest and displayed them at HDEC's Gyedong HQ.

There were three model units of 850 sq.ft, 1,173 sq.ft and 1,528 sq.ft respectively and they each had features including modifiable walls, a platform for a vegetable garden and hardwood floors. Furthermore a 24 hour customer service center was established in April.

In 1996, HDEC created gardens at the eight apartment complexes built by HDEC including the Guui-dong Hyundai Apartments. HDEC widened the roads and planted trees on both sides of the road. Native flowering plants and grass were planted to create parks within the apartment complexes. The gardens were created to replicate the courtyards in traditional Korean houses and to help make residents feel at home.

HDEC has strived to build apartments which not only serve as a place to sleep but that supports a good lifestyle and culture. The new endeavours helped enhance HDEC

apartments reputation, progressing from 'durable and convenient apartment' to 'modern and stylish apartment'.

The era of brand name apartments and the birth of the Hillstate brand

In July 2000, almost 10 years after the government's announcement to build two million homes, HDEC built two apartment complexes in Incheon under a new brand named 'Hyundai Hometown'. The Hyundai Hometown in Ganseok-dong and Juan-dong had 649 and 443 units each and were very popular, particularly because of their prime location in the center of Incheon city.

Encouraged by this success, HDEC actively promoted the Hyundai Hometown brand while taking on a number of apartment redevelopment projects, competing against other construction companies with their own unique brands. Unfortunately, HDEC's Hyundai Hometown branded apartments did not compete well against other brands especially given HDEC's market position as market leader. HDEC launched 'Hillstate' to replace Hyundai Hometown in September 2006.

Launched in the early 2000s, Hyperion is yet another important brand which HDEC created for high-rise condominiums. Construction started in November 1999 of the Mok-dong Hyundai Hyperion and was completed in July 2003. At the time of its construction, the 69 story condominium was the tallest building in Korea.

HDEC proceeded to build a series of super high-rise building including the Dogok Hyperion (completed in Apr. 2004), Mok-dong Hyperion Ⅱ (Nov. 2006), Daegu Hyperion (Apr. 2007) and Hwaseong Dongtan Hyperion.

There were a number of reasons why HDEC initially failed to lead in the competition for brand named apartments. The most crucial factor was the liquidity crisis and the subsequent company restructuring which distracted HDEC, as a result of the Asian economic crisis in 1997. While rival companies invested a huge amount of money to boost their brands, HDEC was forced to sit on the sidelines and watch its reputation as a leader in apartment construction slowly deteriorate.

The situation slowly began to improve as years of restructuring began to bring stability to the company. In February 2004, HDEC launched a full-scale review of its apartment brand strategy; a new direction was required for brand strategy. HDEC considered three strategy options: Revitalizing the Hyundai Apartment brand, revitalizing the Hyundai Hometown brand, and launching a new brand.

HDEC's Hyundai Apartment brand used to be the market leader was associated with many positive images such as 'traditional', 'durable', 'luxurious', 'elegant', 'friendly and familiar'. Yet the brand was also associated with other negative images such as 'formal', 'conservative', 'old-fashioned' and 'boring'. Overall, it was decided that the Hyundai Apartment had some fatal weakness.

Similarly, conclusions were drawn after assessment of revitalization of the 'Hyundai Hometown' brand. Ultimately, the only way forward was to create a new brand. HDEC started to explore new concepts which could encompass both Hyundai's legacy of 'traditional' and 'high value' and yet be appealing and vibrant to the target audience. In the end, 'luxurious apartment with history and culture' was chosen as the new brand concept.

Even after the concept was decided, developing a new brand was still an extremely tenuous task. Initially seven names were suggested and rejected. In the second phase, HDEC adopted a new development method which incorporated elements of design and storytelling. HDEC strived to maintain two keywords in the new brand. First, the aspect of legitimacy that matches with history and the status of HDEC. The second was novelty and creating new value.

The creation of THE H emblem was the beginning of HDEC's new apartment brand which would both preserve its legacy while achieving the desired renewal of HDEC's image. The creation of THE H emblem represented HDEC's history, trust, pride and sense of envy and served as a foundation for a new brand for HDEC's apartments.

The word Hill was chosen as a keyword as it is often associated with luxury residential areas and this matches well with the brand concept of 'luxurious apartment with history and culture'. HDEC launched a new naming project focusing on the new keyword and concept and finally announced 'Hillstate' as a new brand for HDEC's apartment houses.

Gwangjang Hillstate, Korea (March 2012)

Banpo Hillstate, Korea (September 2011)

HILLSTATE

Naming & Design Concept

	Hill	State
Motif	Gives sense of luxury due to its association with names such as Beverly Hills, Notting Hill and Roppongi Hills	Gives sense of dignity, high status, pride and also means territory or homeland
Meaning / Implication	Associated with well-known luxury residence	Associated with higher value, display of social status, emotional satisfaction, community and network
Interpretation	HDEC's advanced technology and superior quality provides customers with great modern convenience and comfort	Highest level of emotional satisfaction delivered by master builders with long history and tradition
Naming Concept	The word Hill is often associated with high-class residential complexes, and the word State is often associated with high social status. HDEC's new brand Hillstate was created to mean residence for high society. HDEC aimed to create a new residential culture by creating an apartment which offers the best quality and services.	
Design Concept	A hand-script type font was used to convey a sense of HDEC's history and its intention to revive its market leadership in the apartment housing market. The Hillstate logo was created by combining H,S and T in script letters. A burgundy wine color was used, partly because wine is associated with deepening taste over time and the burgundy color itself looks luxurious.	

A brand represents the identity of a product. If a brand wants to position itself as a luxury brand, the product and marketing needs to convey a sense of luxury, in order to provide consumers with a luxury experience. HDEC's two apartment brands 'THE H' and 'Hillstate' were created to represent 'Excellence' and 'Perfection'.

Hyundai Hillstate: Setting a new benchmark
THE H: Prestige living for the chosen

Creating luxury housing: Hillstate
Seoul Forest Hillstate, unveiled in May 2009 as the first Hillstate apartment, demonstrated what the brand represented. Located by the great Han River, the Hillstate apartment complex was designed to resemble a yacht about to depart on a journey.

Hillstate apartments are built in three different styles depending on the landscape of the site; a classic style for rural areas, a semi-classic style for suburban areas and a modern design for urban areas.

Built beside both the Han River, that runs through the center of Seoul, and Seoul Forest, the Seoul Forest Hillstate is an excellent example of a modern exterior design. Completed in 2008, the Samsung-dong Hillstate was built with a number of large environmental facilities following the carbon free strategy and was also the first Hillstate complex in the sought after Gangnam area.

The entrance of Samsung-dong Hillstate was designed to welcome residents and visitors with its Jeju Hackberry tree and water-theme, creating a natural sanctuary. The incorporation of renewable energy at the Samsung-dong Hillstate is a good example of what the Hillstate brand represents. The solar pergola system converts and stores solar energy as electricity and provides lights at night. Rain water is also collected and then used for gardening.

A much more advanced renewable energy system was incorporated

Exterior Design Classification by Type of Hillstate

Classic Type	Semi Classic Type	Modern Type
Rural area	Suburban area	Urban area
*** Design** Architecture: LWK company Landscape: ASPECT *** Philosophy** Realization of European classic apartment design, Landscape design inspired by natural ecology	*** Design** Appearance and landscape: Politecnico di Milano *** Philosophy** Design incorporated with natural terrain of the site Creation of ecological space Landscaping in harmony with building exterior	*** Design** Architecture: KMD company *** Philosophy** Highlight Han River's natural image and modern urban feel Incorporate a yacht-shaped exterior design
Yongin Gwanggyo Hillstate	**Bukhansan Hillstate**	**Seoul Forest Hillstate**


Baengnyeonsan Hillstate Ⅰ·Ⅱ·Ⅲ, Korea


Gimpo Gochon Hillstate Central garden, Korea (April 2008)


Gimpo Gochon Hillstate Community Center, Korea (April 2008)

into the Banpo Hillstate, which was completed in 2010. The solar PV modules installed on the top of the building generate up to 297kWh of electricity per day which is then used by the residents. The complex is also equipped with small wind turbines which generate 5.6kWh of electricity daily for powering the garden lights, saving 2,000kWh of electricity per year.

One of the main features of Banpo Hillstate is the many state-of-the-art automated systems such as the Ubiquitous Parking Information System, which automatically notifies the parking location to corresponding residents. The system also enables drivers to call the elevator from their car.

Completed in April 2008, the Gimpo Gochon Hillstate was the first city-scale private development project in South Korea, consisting of a 2,605-unit apartment complex and 9,993 houses on a 330,000 square meter site. The project earned a reputation for its bold use of color which was described as 'radical' and 'out of this world'.


Gangseo Hillstate, Korea (June 2014)


Hillstate Model Unit

Distinctive colors, which had never been used before in other apartments in South Korea were used for the exterior of the Gimpo Gochon Hillstate buildings. A unique combination of three groups of colors - Cool, Natural, and Hot - creates a vibrant vista for not only the residents, but also everyone who passes the complex.

Professor Jean Philippe Lenclo, the world's leading colorist served as color director for the project and visited the site twice in order to make sure that the color scheme was implemented as he originally intended.

Gangseo Hillstate, which was built as a 2,603 unit complex in 2014, received the three prestigious iF, reddot and IDEA design awards for innovative elements including the Nature Energy Playground, Solar Music Pergola and Econology Bicycle Rack. The Nature

Energy Playground is an educational playground where children can interact with clean energy. Whilst the Solar Music pergola is an outdoor resting space with sensors that turn on music and lights. The Econology Bicycle Rack is a high-tech bicycle storage space with a refreshing look.

The design concept of Haeundae Hillstate Weave is 'Sea Colony', an apartment surrounded by the sea. With a stunning view of Haeundae, the most popular beach in South Korea, the buildings are designed to blend in with the sea and apartment landscape. Completed in 2014, the complex has become an exemplary residential complex with a unique combination of 53-story towers and low-rise buildings such as the Landmark Tower, Terrace House, and Artist Village.

Evolution of Hillstate brand

The brand Hillstate, which set a new benchmark in apartment housing in South Korea since it was launched in 2006, was refined in 2014.

First, HDEC decided to use Korean characters, rather than English characters to make it more recognizable to its target customers. The decision was also made to use Hyundai, a leading brand in the construction sector, as part of Hillstate's branding. The core brand concept, 'luxury housing', was also replaced with 'excellence' for brand differentiation. And a new brand slogan was chosen 'Excellent space provided by Hyundai'.

The name 'Hyundai Hillstate' signifies HDEC's renewed determination to create a new housing culture through design, construction, location and superior management. In addition, HDEC announced the Hillstate Style as a measure of maintaining the freshness of the brand. The focus of 2015 Hillstate Style was safety, education and convenience.

For example, the Hillstate Youngtong that was completed in 2014 became the first complex to receive Crime Prevention Through Environmental Design (CPTED) certification. In 2016, Hillstate Dongtan was incorporated with the Internet of Things technologies according to the 2016 Hillstate Style which promotes eco-friendliness, health and convenience.

Ulsan Yangjeong Hillstate, Korea (June 2007)

Suwon Jangan Hillstate, Korea (February 2012)

Namseoul Hillstate I-want, Korea (September 2011)

THE H

THE H Honor Hills Model Unit

THE H Honor Hills Model Unit

Bird's-eye view of Samho Garden Ⅲ THE H

A class of its own: THE H

In April 2015, HDEC launched a new premium apartment brand 'THE H'. The new brand utilized the 'H' to build on Hyundai's brand legacy while the prefix 'THE' was incorporated in front of 'H' signifying its uniqueness, as the one and only housing for a prestigious lifestyle.

Residents of so-called 'Prime Location' areas such as Seoul's Gangnam area have differentiated housing needs. THE H was created to deliver a unique experience by supplying housing and services unlike any other. For example, a minimum of three or more unique features are incorporated into THE H brand apartments and each unit has at least 70 percent unique design elements and design layout.

The redevelopment of the 3rd Samho Garden complex demonstrated what sets THE H apart from other brands. For example, the shape of the apartment building is asymmetrical which was a first in the Gangnam area. The Energy High Save System was incorporated into the apartments which enabled a dramatic reduction in utility bills. The Hyundai Energy Recovery System for ventilation and the Total Energy & Environment Management System were also incorporated to reduce greenhouse gas emissions.

In October 2016, THE H Honor Hills, was built on the 3rd Gaepo Jugong apartment complex as a redevelopment project, it has a 240mm-thick slab to effectively block floor noise from the unit above. It also has the largest community space in the Gangnam area. In addition to the uniquely-styled housing, a hotel-style concierge service and an art garden and interior are available to residents.

The complex also boosts the first independent terrace house in Gangnam. HDEC offered presales at 10% higher than other recently constructed apartments. Despite the high price the competition the bidding was 1 to 101 on average and as high as 1 to 1198.

THE H Honor Hills Model Unit

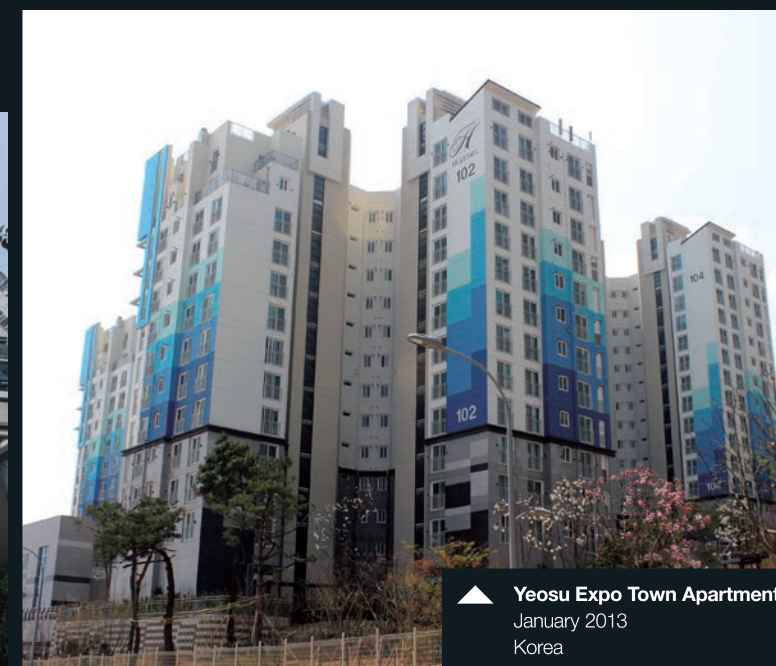
GALLERY
HOUSING

Hanoi Hillstate
June 2013
Vietnam

Paju Hillstate I
October 2009
Korea

Gwanggyo Jayeon-n Hillstate
December 2012
Korea

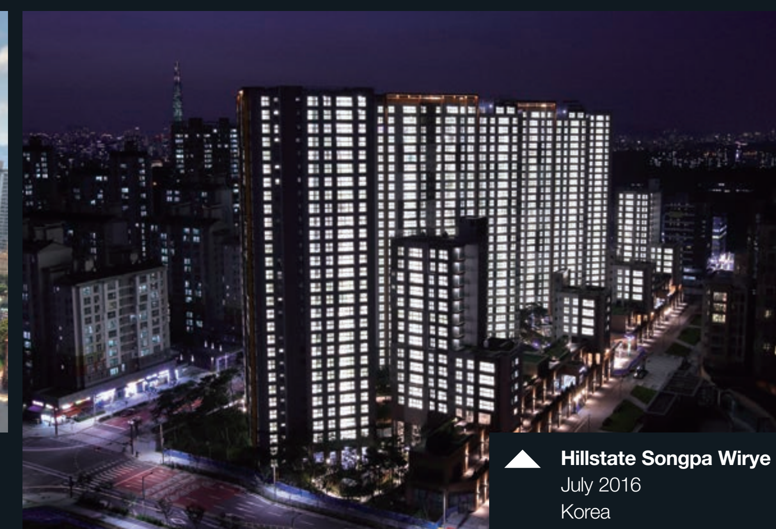
Hoi Fan Road High-rise House
October 2008
Hong Kong



Yeosu Expo Town Apartment
January 2013
Korea

Bukhansan Hillstate I
June 2008
Korea

Incheon Guwol Hillstate
July 2007
Korea



Hillstate Songpa Wirye
July 2016
Korea

LIST HOUSING

* The list below consists of select projects out of 481 projects.

Country	Project Name	Time of Completion
Korea	Mapo Apartment	Jan. 1964
Korea	Sewoon Arcade Apartment	Oct. 1967
Korea	Yeouido Sibeom Apartment	Nov. 1971
Korea	Seobinggo Hyundai Apartment	Nov. 1975
Korea	Hill Top Foreigner's Apartment	Nov. 1975
Bahrain	Adliya Apartment	May. 1977
Bahrain	Policeman's Apartment	Apr. 1978
Bahrain	Ministry of Interior Officer's Apartment	Apr. 1978
Korea	Guro Entertainers Guild's Apartment	Jan. 1980
Korea	Bucheon Yakdae-dong Hyundai Apartment	Jan. 1980
Korea	Anyang Gwanyang-dong Hyundai Apartment	Jan. 1980
Korea	Incheon Bupyeong-gu Hyundai Apartment	Jan. 1980
Korea	Heukseok-dong 1-2 Jigu Redevelopment Apartment	Jan. 1980
Korea	Apgujeong-dong Hyundai Apartment	Apr. 1984
Korea	Gwangjang-dong Hyundai Apartment (5 Danji)	Apr. 1984
Korea	Ssangmun-dong Hyundai Apartment Ⅱ	Nov. 1990
Korea	Korean Air Housing Cooperative Apartment	Aug. 1992
Korea	Guui-dong Hyundai Apartment (2 Danji)	Aug. 1992
Korea	Hyundai KEPCO Housing Cooperative Apartment	Sep. 1993
Korea	Ssangmun-dong Cooperative Apartment	Dec. 1993
Korea	Ulsan Hyundai Heavy Industries Dongbu Apartment	Dec. 1993
Korea	Guui-dong Hyundai Prime Apartment	Feb. 1997
Korea	Guui-dong Hyundai Apartment (7 Danji)	Dec. 1997
Korea	Gwangjang Hyundai Apartment (9 Danji)	Apr. 1998
Korea	Gyodong Hyundai Apartment Ⅲ	Apr. 1998
Korea	Ibam-dong Hyundai Apartment	May. 1998
Korea	Asan Bangchuk-dong Hyundai Apartment	Nov. 1998
Korea	Jayang-dong Hyundai Apartment Ⅵ	Apr. 1998
Korea	Jamwon-dong Hyundai Silk Villat April	Nov. 1998
Korea	Galhyeon Hyundai Apartment	Dec. 1998
Korea	Seongsu Hanyang Hyundai Apartment	May. 1999
Korea	Hyundai World Tower	May. 1999
Korea	Daechi Hyundai Apartment	Jun. 1999
Korea	Jukjeon Hyundai Home Town	Jun. 1999
Korea	Hangang Hyundai Apartment	Jun. 1999
Korea	World Cup Hyundai Apartment	Dec. 1999

Country	Project Name	Time of Completion
Korea	Namsan Town	Jul. 2000
Korea	Gwangjang-dong Hyundai Apartment Ⅹ	Aug. 2000
Korea	Ilsan Hyundai Home Town Ⅰ	Dec. 2000
Korea	Hyundai 41 Tower	Jun. 2001
Korea	Geoje-dong Hyundai Home Town Ⅰ	Aug. 2001
Korea	Hyundai Cartier 710	Nov. 2001
Korea	Anjung Hyundai Home Town Ⅰ	Apr. 2002
Korea	Ilsan Hyundai Home Town Ⅱ	Apr. 2002
Korea	Geoje-dong Hyundai Home Town Ⅱ	May. 2002
Korea	Juan-dong Hyundai Home Town	Nov. 2002
Korea	Hogye-dong Hyundai Home Town	Nov. 2002
Korea	Hannam Hyperion Ⅰ	Dec. 2002
Korea	Ganseok-dong Hyundai Home Town	Apr. 2003
Korea	Asia Seonsuchon Apartment	Apr. 2003
Korea	Mok-dong Hyperion	Jul. 2003
Korea	Hannam Hillstate	Sep. 2003
Korea	Jangan Hyundai Home Town Ⅰ	Oct. 2003
Korea	Seocho Hyundai Super Ville	Oct. 2003
Korea	Mapo Gangbyeon Hillstate	Feb. 2004
Korea	Dogok Hyperion	Apr. 2004
Korea	Hannam Hyperion Ⅱ	Jul. 2004
Korea	Arboretum Hyundai Home Town Sweet	Dec. 2004
Korea	Jeongneung Hillstate	Dec. 2004
Korea	Seocho Hyundai Rexion	Jan. 2005
Korea	Songpa Hyundai Home Town	Feb. 2005
Korea	Suwon Maetan Hillstate	Dec. 2005
Korea	Jangan Ⅱ Hyundai Home Town	Dec. 2005
Korea	Dogok Rexle	Jan. 2006
Korea	Surisan Hillstate	Apr. 2006
Korea	Uijeonbu Nogyang Hillstate	Sep. 2006
Korea	Haeundae Hyperion	Sep. 2006
Korea	Dogok Hyperion Ⅱ	Nov. 2006
Korea	Busan Gwangan Hyperion	Jan. 2007
Korea	Incheon Geomdan Hyperion	Jan. 2007
Korea	Daegu Hyperion	Apr. 2007
Korea	Jeongneung Hillstate Ⅰ	May. 2007

Country	Project Name	Time of Completion
Korea	Gangneung Hongje Hillstate	Jun. 2007
Korea	Ulsan Yangjeong Hillstate	Jun. 2007
Korea	Incheon Guwol Hillstate	Jul. 2007
Korea	Chungju Yeonsu Hillstate	Jul. 2007
Korea	Seongbuk Hillstate	Aug. 2007
Korea	Jamsil Ⅲ-Zium	Aug. 2007
Korea	Jangan Hillstate	Aug. 2007
Korea	Jeongneung Hillstate Ⅲ	Mar. 2008
Korea	Gimpo Gochon Hillstate	Apr. 2008
Korea	Bukhansan Hillstate Ⅰ	Jun. 2008
Korea	Jamsil Parkrio	Aug. 2008
Korea	Yongsan Park Town	Sep. 2008
Korea	Jamsil Els	Sep. 2008
Hong Kong	Hoi Fan Road High-rise House	Oct. 2008
Korea	Samseong-dong Hillstate	Dec. 2008
Korea	Seoul Forest Hillstate	May. 2009
Korea	Osan Wondong Hillstate	Jul. 2009
Korea	Yongin Gwanggyo Hillstate	Jul. 2009
Korea	Jukjeon Hillstate Terrace House	Oct. 2009
Korea	Paju Hillstate Ⅰ	Oct. 2009
Korea	Ulsan Yangjeong Hillstate Ⅱ	Dec. 2009
Korea	Paju Hillstate Ⅱ	Jan. 2010
Korea	Busan Geumjeong Hillstate	May. 2010
Korea	Bukhansan Hillstate Ⅲ	Aug. 2010
Korea	Incheon Nonhyeon Hillstate	Oct. 2010
Korea	Hwaseong Dongtan Hillstate	Nov. 2010
Korea	Incheon Songdo Hillstate	Jan. 2011
Korea	Yongin Seongbok Hillstate Ⅰ	Apr. 2011
Korea	Hoegi Hillstate	May. 2011
Korea	Bukhansan Hillstate Ⅶ	Jul. 2011
Korea	Banpo Hillstate	Sep. 2011
Korea	Namseoul Hillstate I-want	Sep. 2011
Korea	Baengnyeonsan Hillstate Ⅰ · Ⅱ · Ⅲ	Dec. 2011
Korea	Seongnam Jungang-dong Hillstate Ⅰ	Feb. 2012
Korea	Incheon Geomdan Hillstate Ⅳ	Feb. 2012
Korea	Suwon Jangan Hillstate	Feb. 2012

Country	Project Name	Time of Completion
Korea	Gwangjang Hillstate	Mar. 2012
Korea	Geoje Suwol Hillstate	Apr. 2012
Korea	Seongnam Jungang-dong Hillstate Ⅱ	Oct. 2012
Korea	Incheon Yeongjong Hillstate	Oct. 2012
Korea	Gwanggyo Jayeon-n Hillstate	Dec. 2012
Korea	Yeosu Expo Town Apartment	Jan. 2013
Korea	Isu Hillstate	Feb. 2013
Korea	Incheon Geomdan Hillstate Ⅴ	Feb. 2013
Vietnam	Hanoi Hillstate	Jun. 2013
Korea	Incheon Geomdan Hillstate Ⅵ	Nov. 2013
Korea	Changwon Gamgye Hillstate Ⅰ	Mar. 2013
Krorea	Gangseo Hillstate	Jun. 2014
Krorea	Gangnam Hillstate Eco	Oct. 2014
Krorea	Toegyewon Hillstate	Nov. 2014
Krorea	Sejong Hillstate	Dec. 2014
Korea	Changwon Gamgye Hillstate Ⅲ	Dec. 2014
Korea	Haeundae Hillstate Weve	Apr. 2015
Korea	Gwanggyo Hillstate Lake	Sep. 2015
Korea	Hillstate Wirye	Nov. 2015
Korea	Magok Hillstate	Dec. 2015
Korea	Hillstate Hwanggeumsan	Dec. 2015
Korea	Hillstate Mok-dong	Feb. 2016
Korea	Hillstate Eco Magok	May. 2016
Korea	Gwangju Universiade Hillstate	Jun. 2016
Korea	Hillstate Songpa Wirye	Jul. 2016
Korea	Hillstate Songdam	Oct. 2016
Korea	Munjeong 2 Areas M State	Nov. 2016
Korea	Wangsimni Centras	Nov. 2016
Korea	Hillstate Dangjin	Nov. 2016
Korea	Godeok Raemian Hillstate	Mar. 2017
Korea	Hillstate Nokbeon	Sep. 2018
Korea	Hillstate Eco Misa	Sep. 2018
Korea	Songpa Heliocity	Dec. 2018
Korea	Hillstate Ilsan	Mar. 2019
Korea	Hillstate Lake Songdo	Jun. 2019
Korea	THE H Honor Hills	Aug. 2019

R&D SYNERGY

HDEC is widely regarded as the leader in South Korea's construction industry. With a history spanning 70 years, HDEC also has a strong reputation in the international market. It is no exaggeration to say that HDEC's history is very much the history of South Korea's construction industry. Will HDEC continue to play a central role in the construction industry? HDEC's R&D is a good indication of the bright future that awaits HDEC.

R&D: Creating new possibilities

10

Green Smart Innovation Center

SYNERGY

The Hyundai Motor Group publicly declared its goal of nurturing the construction and engineering business as its core business. Enhanced R&D capacity and enhanced collaboration with other group member companies will play an essential role in creating business synergy and enable recycling-based business from steel production to automobiles and construction.

Navigating the future of HDEC

Creating synergy by integrating technologies
Creating new technologies through the integration of concepts and technologies from different academic disciplines and industry sectors has become an important new trend.

Specializing in construction and production of automobiles and steel, the Hyundai Motor Group is pioneering the creation of new integrated technologies.

The creation of new construction material using blast furnace slag is a prime example of successful collaboration between HDEC and Hyundai Steel. Blast furnace slag is a rock-like by-product from the steel production process. By working together with Hyundai Steel, HDEC succeeded in producing a non-cement adhesive material and slag concrete which has outstanding fireproof and insulation properties.

Development of the new technology opened door for use of blast furnace with excellent properties as construction materials while alleviating Hyundai Steel from the burden of disposing of 5 million tons of blast furnace slag per year.

Green Smart Innovation Center

Green Smart Innovation Center

Another example is the Development of Road Pavement Materials from byproducts of the Steel and Automobile Industry, which HDEC and Hyundai Motor discovered together. The waste automotive adhesive film additive for recycling allows production of asphalt at 120℃ which is significantly lower than the temperature required for regular asphalt production of 150 to 160℃, which in turn allows for a reduction in consumption of fossil fuels such as bunk-C oil.

HDEC developed a steel manufacture waste water treatment and reuse technology in partnership with Hyundai Steel R&D Center. Developed over five year since 2012, the technology is being tested for its capacity to cleanse heavily contaminated wastewater enough to be reused in the steel manufacture process.

Rooftop Solar PV

If proven successful, the technology will enable Hyundai Steel to secure 15,000 tons of process water per day, significantly reduce water consumption as well as negative environmental impact on local waterways.

The Korean pavilion at the Yeosu Expo is equipped with the largest dome screen in the world Big-O; Certified with the highest energy efficiency, everything in the Korean pavilion is powered using zero carbon energy such as solar PV, solar thermal, wind and heat from sea water. Furthermore, Hyundai Motor incorporated a zero emission hydrogen fuel cell system, developed for cars, as a generator for the building.

The Intelligent Transport Systems installed in the Lusail Expressway in Qatar and the 2nd Youngdong Expressway in South Korea, the new steel product by Hyundai Steel for super high-rise buildings, and the Building Energy Management System (BEMS) for green buildings are all prime examples of the Hyundai Motor Group's latest technology innovation.

Hyundai Motor Group Collaborative Research Projects Status (In-progress: 13, Completed: 7 as of 2016)

HMG Company Partner	Project Title	Status
Hyundai Motor	Building Integrated Photovoltaics for windows and doors	In progress
	Intelligence Transport System	Completed
Hyundai Motor Hyundai Mobis Hyundai AutoEver Hyundai MnSoft	Improved road operation using vehicle operation information	Completed
Hyundai Steel	Waste water recycling Lightweight aggregate from slag waste Road paving using byproducts Hydrogen fuel cell system	In progress
	Recycled precast materials High-strength steel for construction	Completed
Hyundai AutoEver	Integrated monitoring software for tidal power generation plant construction safety Smart BEMS	In progress
	Underwater high-precision construction monitoring system Floating structure sinkage estimation technique	Completed
Hyundai Engineering	Foundation pile arrangement scheme analysis Rotating component vibration management technology Pipe dynamic design technology Nuclear decommissioning technology collaboration Solar thermal generation technology development Next-generation MBR process demonstration	In progress
	Experimental modular housing	Completed

Multi-Test Cell

Overcoming physical limitations with technology

Building skyscrapers is all about overcoming any height limiting factors. Height of a building in itself makes construction much more difficult. HDEC developed a number of innovative technologies, such as the advanced long-range concrete pumping technology, in order to overcome the challenges of building skyscrapers.

Capable of shooting up high-strength concrete more than 100-stories high, it requires high-precision pressure control, an optimized concrete mix recipe and the use of a special tube which can withstand the high pressure. HDEC eliminated tube congestion and breakage while maintaining the quality of high-strength concrete, opening up new possibilities for high-rise building construction.

As of 2017, HDEC holds the world record, having been able to send concrete 1.2 kilometers high using the advanced long-range concrete pumping technology. The technology is not only used in high-rise buildings but in long-span cable-stayed bridges such as the 289 meter high Busan


Integrated Control Room

International Finance Center and the 322 meter high main tower of the 3rd Bosphorus bridge in Turkey.

Wind and gravity present challenges to ensuring the safety of skyscrapers. HDEC has developed and proven effective technologies to mitigate their impact including the Tuned Mass Damper and Tuned Liquid Column Damper which are capable of effectively mitigating the vibrations caused by strong winds or earthquakes. The technologies were successfully developed through repeated testing in HDEC's own wind tunnel laboratory, for effectiveness against various levels of wind power, pressure and wind vibration.

Long-span bridge projects are ideal for demonstrating a company's capabilities. The total length and span length serve as clear indicators of a company's technological capabilities. By the time of completion, the Ulsan Bridge with a 1,150 meter-long main span was the third longest bridge following the Runyang South Bridge and Jiangyin Bridge. HDEC developed a special high-strength 1,960MPa-class PPWS cable, the world's first.

While the cables special high-strength effectively mitigates the forces of gravity, the impact from strong winds is handled by a curved shaped box-girder. HDEC incorporated a stiffened curved reinforcement box-girder for torsion resistance as well as reduction in wind resistance, helping increase structural integrity.

HDEC has developed high-strength 2,100MPa-class PPWS cable, another world's first, and a twin curved box-girder suitable for use in suspension bridges with a main span of up to 3,000 meters.

These technologies were developed as a result of the Long-span bridge technology R&D project funded by the South Korean government in 2009. The newly developed technologies enabled HDEC to successfully complete the 3rd Bosphorus bridge in Turkey and were also used in the Chacao Channel bridge project in Chile.

HDEC is also currently developing technologies for underground construction such as a Tunnel Boring Machine. An automated tunnel boring machine is capable of excavating tunnels, applying reinforcement and soil removal all at the same time.

Since 2013, HDEC has improved its capacity to select effective boring equipment, increase boring speed and better predict the completion date. As a result, HDEC won projects such as the Hanoi metro project, the water conduction tunnel project for the Juam dam and the T308 metro project. HDEC has also succeeded in developing propriety disc cutter lifespan prediction and soil removal technology while participating in a government-funded research project for undersea tunneling which began in 2014.

Advanced construction material technologies are pivotal for construction technologies which aim to go higher, longer and deeper. Among them concrete technology is of paramount importance. In 2015, HDEC succeeded in developing a new automated mass concrete curing method.

The innovative new curing method prevents cracks forming during curing, due to temperature differences between the different parts of the concrete, by applying warm water based on real-time temperature measurements. The new method can significantly enhance durability and strength and shortens the overall construction period by reducing the curing period by more than two days.

HDEC demonstrated the effectiveness of the new automated mass concrete curing method using it for the Dangjin thermal power plant #1 and #2 and the Yulchon Ⅱ combined power plant. It was also employed for the Tuas Finger One project, which was the first application of this proprietary technology on an overseas project.

Building Information Modeling (BIM) is yet another promising area where HDEC is concentrating its R&D efforts. HDEC has used BIM on 30 projects since it first employed the technology for the Gochon Hillstate apartment project in 2005. HDEC has also continued to refine BIM through R&D investment, ensuring their position as a market leader. Key examples of HDEC's BIM technology are the Hyundai Motor Studio in Goyang which employs largest number of asymmetrical mega-truss frame and the National Museum of Qatar which resembles a desert rose and was created using 316 round disk shaped panels.

Creating new opportunities: Environment and energy technologies

According to the 2030 Megatrend Prediction, businesses must focus on resolving four issues; urban population growth, water shortage, energy depletion and resource depletion. Since three of the four issues are related to the environment and energy, it is clear that the future of the construction industry will depend largely on how it deals with energy and the environment. HDEC has vastly increased its investment in the development of environmental technologies and energy conservation technologies.

Restoration technology for heavy metal contaminated soil is one of HDEC's advanced environmental technologies. HDEC carefully analyzed contaminated soil near the Janghang smelter and developed two new technologies for its restoration. One technology is a particle size selective remediation system, which is a method whereby heavy metals-contaminated soil is restored through a dry-disintegration and separation technology. The second is a restoration technology for arsenic contaminated soil, which employs a combination of zero-discharge cleansing and Fe^{3+} activated carbon.

The cleansing technology uses a centrifugal separator to create a cyclone like motion to separate out the soil particles by size and then matches the cleansing techniques to particle size and contamination level. The cleansing operation can take place quickly and requires a minimal amount of chemicals. It has been verified to cause minimal changes to the chemical properties of the soil, minimizing environmental degradation while reducing costs.

Minimizing rises to seawater temperature using a deep water intake and release system was yet another important technological achievement for HDEC. Applied at the Shin-Hanul nuclear power plant, the cooling water intake was installed more than 1 kilometer away from the coast, 20 meters below sea level. The intake pipe is located at the least ecologically sensitive area. This allows for the supply of lower temperature water for more effective cooling while minimizing the negative impact from discharge of higher temperature water after cooling. In 2015, HDEC also employed this technology at the LNG gasification plant in Al-Zour, Kuwait.

HDEC has recently made significant achievements in energy technology development. For example, the Samcheok Green Power Plant, which began operating in December 2016, has 550MW Circulating Fluidized-Bed Combustion (CFBC) boilers,

Ulsan Bridge built using HDEC's special high-strength 1,960MPa-class PPWS cable and equipment.

Yulchon Ⅱ Combined Power Plant built using new automated mass concrete curing method.

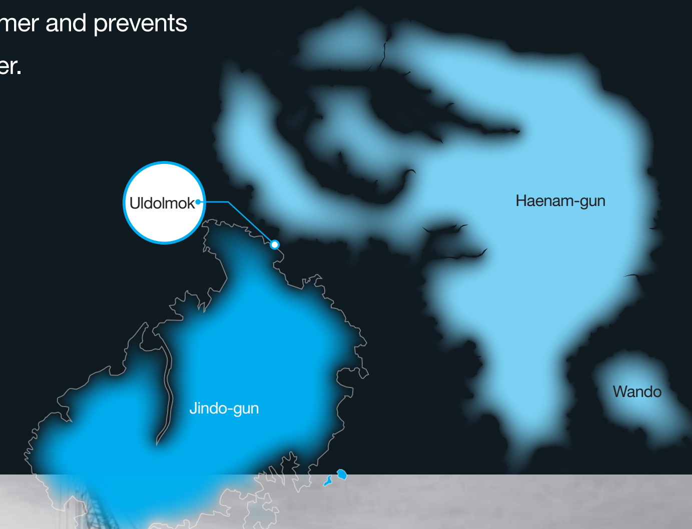
Hyundai Motorstudio Goyang built using 3D Building Information Modeling method which enabled detailed planning at pre-construction stage, high-precision construction using high-tech equipment, and use of prefabricated modular parts.

which enables the use of low-grade coal and biomass, thereby lowering operation costs while limiting pollution. Supercritical pressure technology was also employed for improved energy efficiency. HDEC is commercializing the ultra supercritical pressure boiler for the Cirebon Ⅱ coal power plant project in Indonesia, which will be the world's first.

Bio-energy production technology and active control tidal power foundation support system are two important areas in renewable energy research. Built as a demonstration plant, the Chungju Bio Energy Center produces 9,300Nm^2 of biogas by processing 80 tons of food waste per day. The amount of gas generated is enough to fully charge 210 taxies converted to run on gas.

A tidal power generator can reliably produce electricity using the tides and is not affected by weather conditions or the seasons. Furthermore, tidal power does not require the construction of dams or breakwaters. HDEC is currently operating a demonstration system testing an active control tidal power foundation support system. The system automatically adjusts the turbine direction for greater generation efficiency. The success of the demonstration is expected to lead to the commercialization of second generation tidal power technology in South Korea.

Solar heating and cooling is a promising technology for realizing zero energy building design. Unlike solar PV which converts a maximum of 20 percent of solar energy into electricity, solar heating and cooling can utilize more than 60 percent of solar energy. Expecting a great surge in demand, HDEC has recently succeeded in improving system efficiency by 30 percent. It is equipped with a drainback system which mitigates overheating during the summer and prevents freezing in winter.



Active Control Tidal Power Foundation Support System at Uldolmok

GLOBAL

A glimpse into

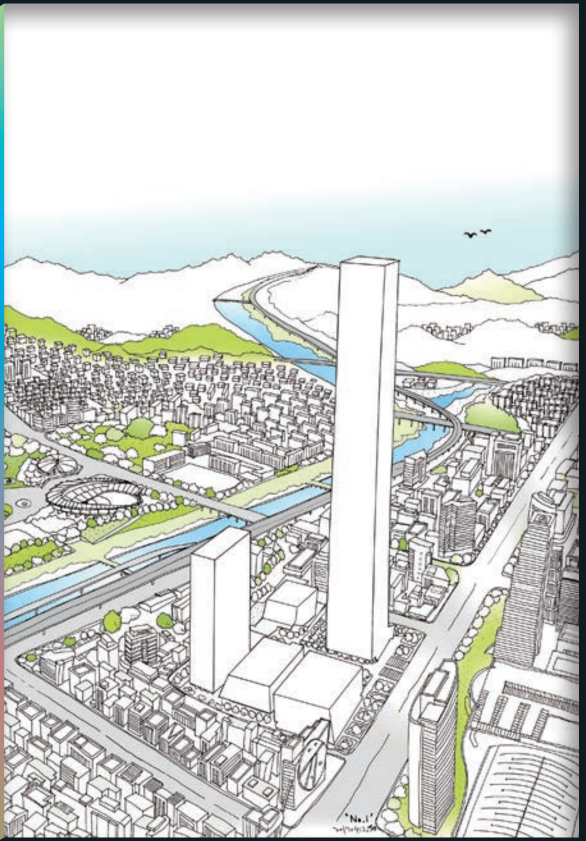
BUSINESS

the future of

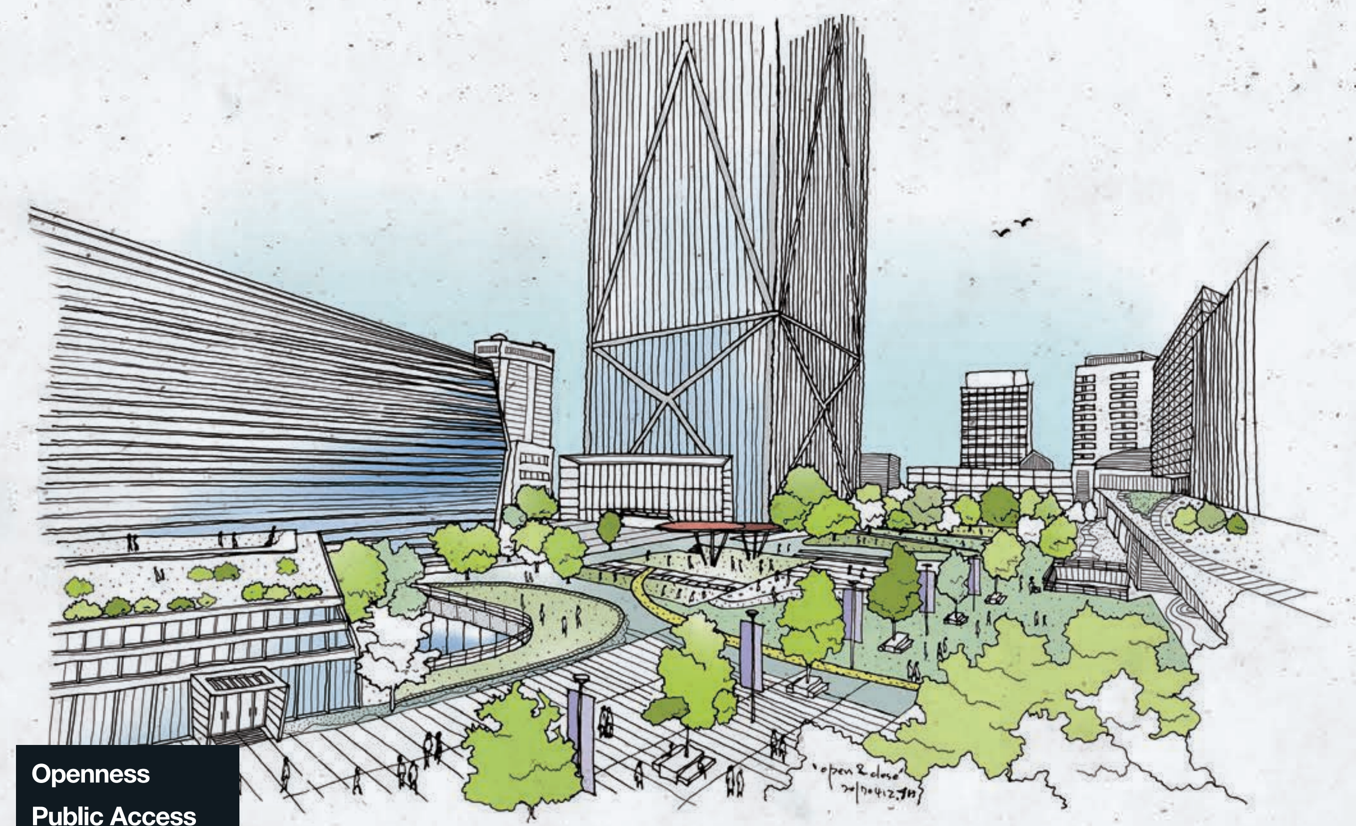
CENTER

Hyundai Motor Group

Global Business Center (GBC) is a business complex which will soon include the Hyundai Motor Group's new headquarters and become a new landmark in South Korea. To be constructed utilizing HDEC's advanced capacity accumulated over the past 70 years, the innovative complex will be designed with an emphasis on interaction and communication.
Designed with a focus on Concentration, Communication and Flexibility, the buildings in the GBC are designed to each have their own unique purpose and to work together with an organic link to one another.

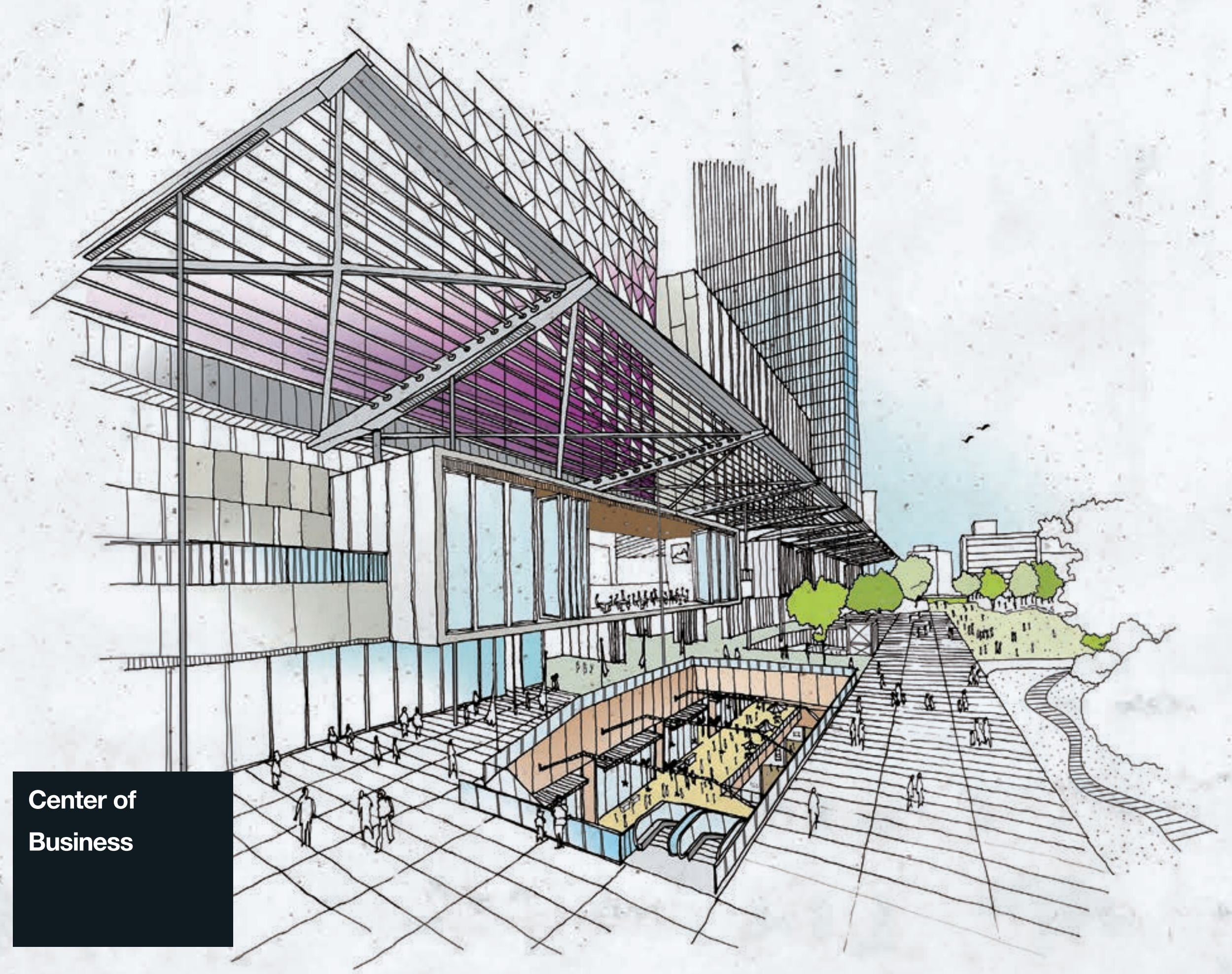


GBC



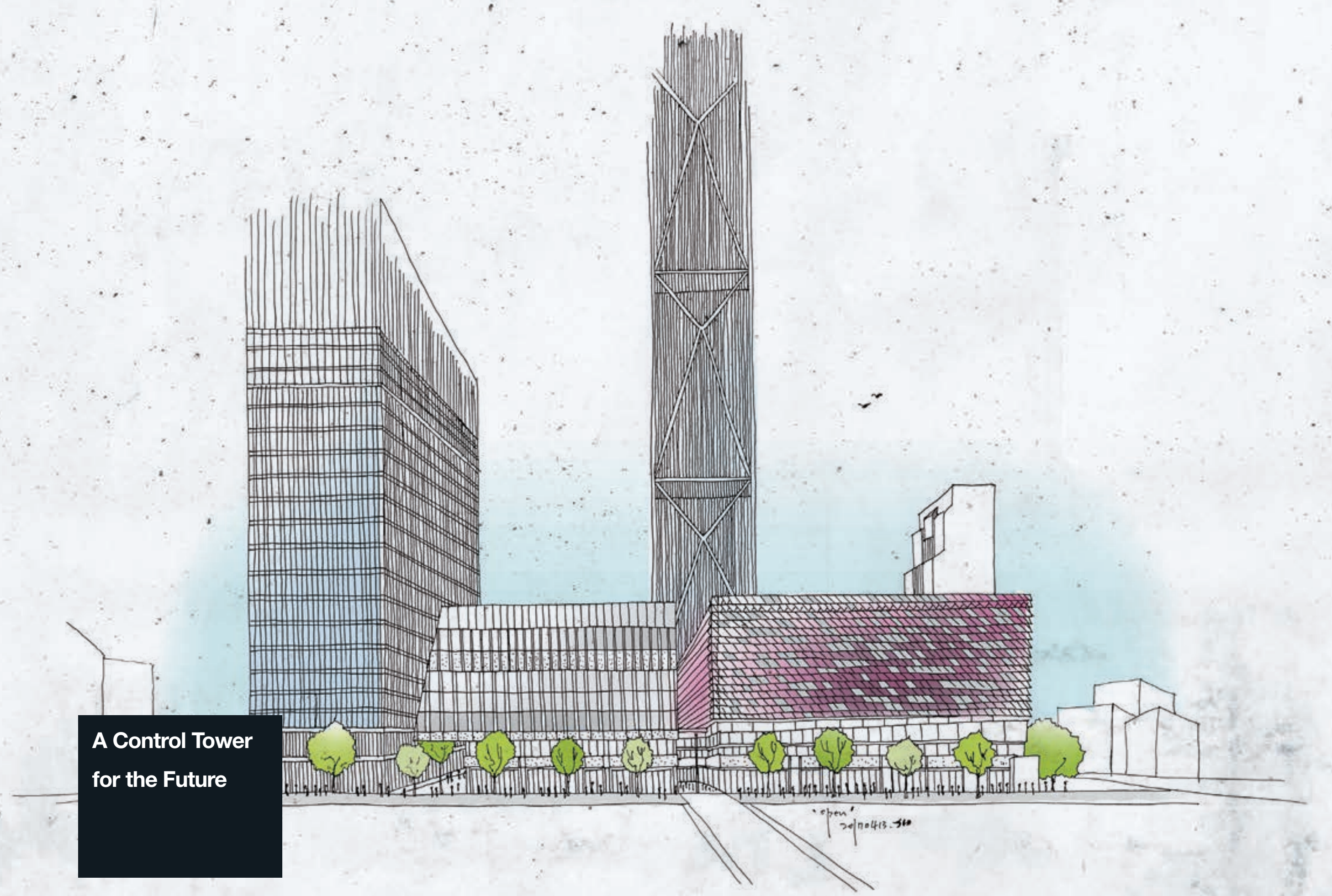
Openness Public Access

A high-rise square-shaped tower will be the centerpiece of the GBC and the Hyundai Motor Group headquarters. Other facilities include a performance center, an exhibition center, a convention center and hotel, will be built around the tower. The Urban Plaza will serve as the town square of the complex, for the public and visitors to enjoy. It will also be connected to the COEX convention center and as the Jamsil Sports Stadium.



Center of Business

GBC is intended not just for Hyundai Motor Group but to be an integral part of Seoul, a leading international city. The Global Business Center will be located at the cross section between Youngdong Bridge and the public walkway through the international collaboration and exchange district and linked to the center of the Meeting Incentives Conference Exhibition (MICE) industry cluster.



A Control Tower for the Future

In 2000, the Hyundai Motor Group was one of the world's top ten automakers for the first time. By 2017, the Hyundai Motor Group had become one of the five largest automakers in the world with 31 factories and an annual production volume of eight million vehicles. HDEC became a part of Hyundai Motor Group in April 2011 completing a recycling-based business structure. The Global Business Center is a visionary control tower. Creating a bright future for the Hyundai Motor Group.

Illust Jung-hun Han

Site area 79,342m² / 569-meter 105-story integrated HQ / performance center, exhibition & convention center shopping mall and more

HYUNDAI
ENGINEERING & CONSTRUCTION
70 YEARS HISTORY 1947-2017

a leader

in

BUILDING,

CONNECTING ——— and

OPENING

up the world

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