Engineering toward the Best Solution

NIPPON ENGINEERING CONSULTANTS CO.,LTD.

Good faith is the basis of our relationship with clients. Some issues will present considerable challenges. As a specialized consulting firm, however, we find the solutions to fit your needs.

We possess the specialized technical skills, personnel, and experience that set us apart even among Japanese engineering consulting firms. We are ready to help when you need us.Our representatives await your call.

How to use this brochure

This is an overview of some of the solutions that Nippon Engineering Consultants can provide to address the problems and challenges that you may encounter.If any of the real-world examples in the following pages ring true for your company, scan the corresponding QR code for more info about our approach to similar kinds of challenges.

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Here are some of the issues and challenges we've heard from clients. We have the solutions that are right for you!

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ENGINEERING / DESIGN	Bridge, Road, Tunnel, River - Design and Construction Supervision →P7 →P9	MAINTENANCE	Bridge, Structure, Road, Slope - Inspection, Repair →P17
		DISASTER PREVENTION	Seismic, Wind, Tsunami/Surge, Slope - Analysis, Verification, Countermeasures, Master Planning →P11

TRAINING OF INSPECTORS →P19

19 "Our inspection team has varying skill levels and their data is unreliable. We need equipment that can conduct a uniform assessment."

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https://www.ne-con.co.jp/ne-con/pub/english/

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21 “We want to conduct inspections but lack the necessary facilities to do so.”

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24 “We need to optimize our logistics inefficiencies.”

“We want a quantitative basis for decision making. We need convincing data that will help build a consensus with the public.”

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25 “Traffic congestion is severe.”

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28 “What about appearance? Function? Or perhaps speed and cost is priority?”

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29 “We don’t have the budget for new construction. We want to find a way to keep using the bridge we currently have.”

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30 “We don’t have anyone who understands the technical side of things.”

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“Our structure is complete, but finding someone who can conduct repairs and maintenance has proven difficult...”

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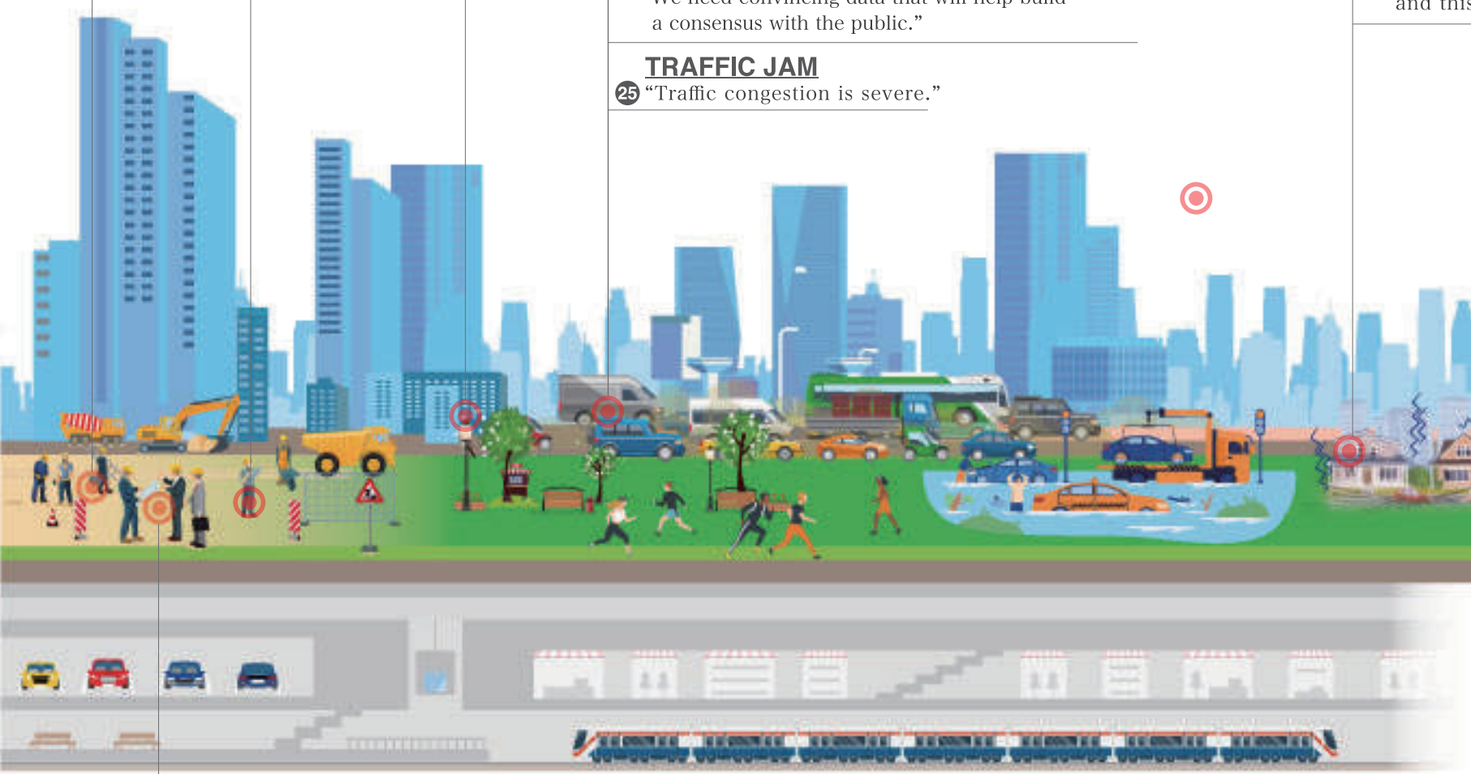
34 “There are many cons to drilling surveys: cost, time, equipment...”

35 “Unlike the two-dimensional data we get from drilling surveys and seismic surveys, we want a 3D survey that is efficient and low-cost.”



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27 “We are worried about whether construction will be carried out according to the design and construction plans.”

“We are looking for an IDC to verify design documents.”

DISASTER PREVENTION →P11

36 “The rainy season is the season of road closures... and there is nothing we can do about the effect that has on our economy and the mobility of people.”

37 “We have completed roads that were designed without fully considering disaster prevention.”

Scenery Design

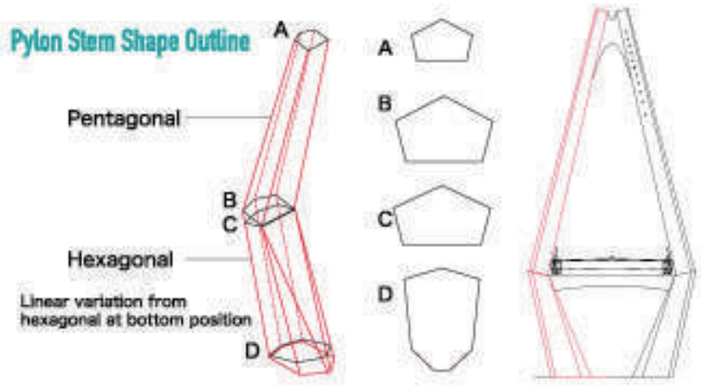
History proves that beautiful things stand throughout the centuries.

We believe that a sustainable society needs beautiful structures that are cherished by its people.

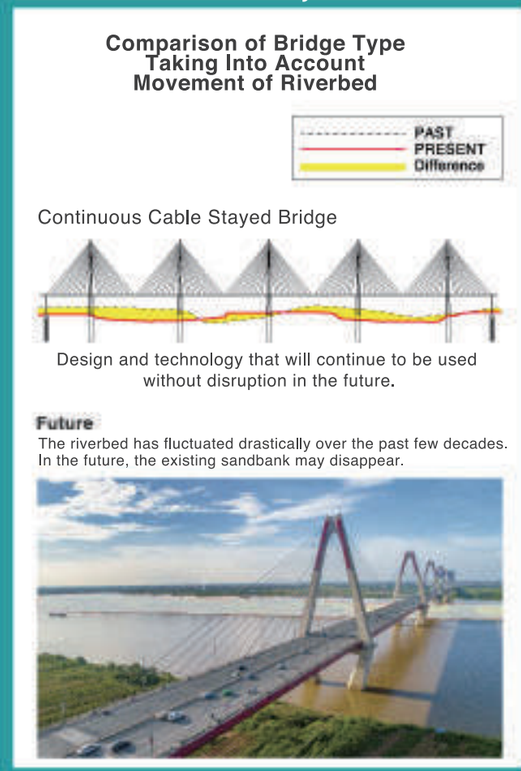
The Nhat Tan Bridge in Vietnam, which includes a 1.5 km cable stayed section, was completed in 2014 in commemoration of the 1000th anniversary of the transfer of the capital to Hanoi.

The landmark symbolizes the friendship between Vietnam and Japan. It is convenient for residents, economically viable, and features a scenic design that complements the historical cityscape of Hanoi.Due to the topography and environment, it was decided that the bridge would be built as a continuous cable stayed bridge *(see "The Functional Rationality of 5 Main Towers").*However, it became clear that a conventional design would be awkward-looking, with short legs. We solved this aesthetic issue by giving the towers a polygonal cross-section *(see the figure below)*. The complex shape transitions from a hexagon around the base into a heptagon, and then into a pentagon after the bend. By tempering the inherent bluntness of bridge columns with a slim, modulated design, the five towers appear to be linked together —transforming the bridge into a monument.

However, complex designs can be time-consuming and costly to build, and there was fierce debate among the designers, engineers, and contractors as to how to proceed. But difficult does not mean impossible. The uncompromising approach we each have in our work spurred the ingenuity to effectively complete difficult tasks, and the completed Nhat Tan Bridge now stands proudly. Our purpose is to apply the wealth of experience we have building the largest number of long span bridges in Japan to challenging projects that push the boundaries of engineering to the limits—and beyond.



The Functional Rationality of 5 Main Towers



In designing the Nhat Tan Bridge, the changes in the riverbed over time posed a problem. A self anchored suspension bridge would have been an inexpensive solution for the morphology at the time, but considering the significant changes to the riverbed over the previous two decades, we could foresee a need for reinforcement work and partial reconstruction at multiple points in the future. The 1000-year-old city of Hanoi called for a different solution: we proposed a continuous cable stayed bridge with a rare five towers supporting it. Our aim was to weave the flow of time and history into the design in order to construct a bridge that would be cherished by the city and its people for a long time to come.

Using New Technologies to Solve Cost Issues

Wind Tunnel Test

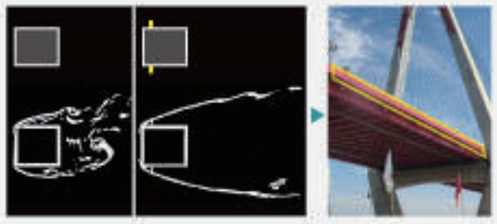


Diagram of Separation Interference Method *1

One disadvantage of cable-stayed bridges like the Nhat Tan Bridge is their vulnerability to crosswinds. This can have a negative effect on precision during construction and post-construction maintenance. In order to overcome this issue, it was initially proposed that we decrease the rectangular areas of the main girders by attaching large wind shields to their surface, but this approach was estimated to be costly given the bridge's 1.5 km span.

Our solution was to employ a method known as the Separation Interference Method, which at that time had not yet been widely used in practice. It involves improving resistance to wind and vibration control by adding wing-like structures that jut out from the rectangular areas on both sides of the girders. The efficacy of this method was debated during our technical evaluation meeting, where opinions were divided. However, it proved successful during subsequent wind-tunnel experiments, ultimately allowing us to solve the problem of the bridge's susceptibility to cross winds.

*1 Source: Improvement of aerodynamic characteristics of the pylon of cable-stayed bridge by the separation interference method (2004)

As a Leading Company in Long-Span Bridge Construction in Japan

Difficult terrain, environmental factors, construction constraints, design vision… Whatever the challenge, we possess the skill and spirit necessary to overcome it.

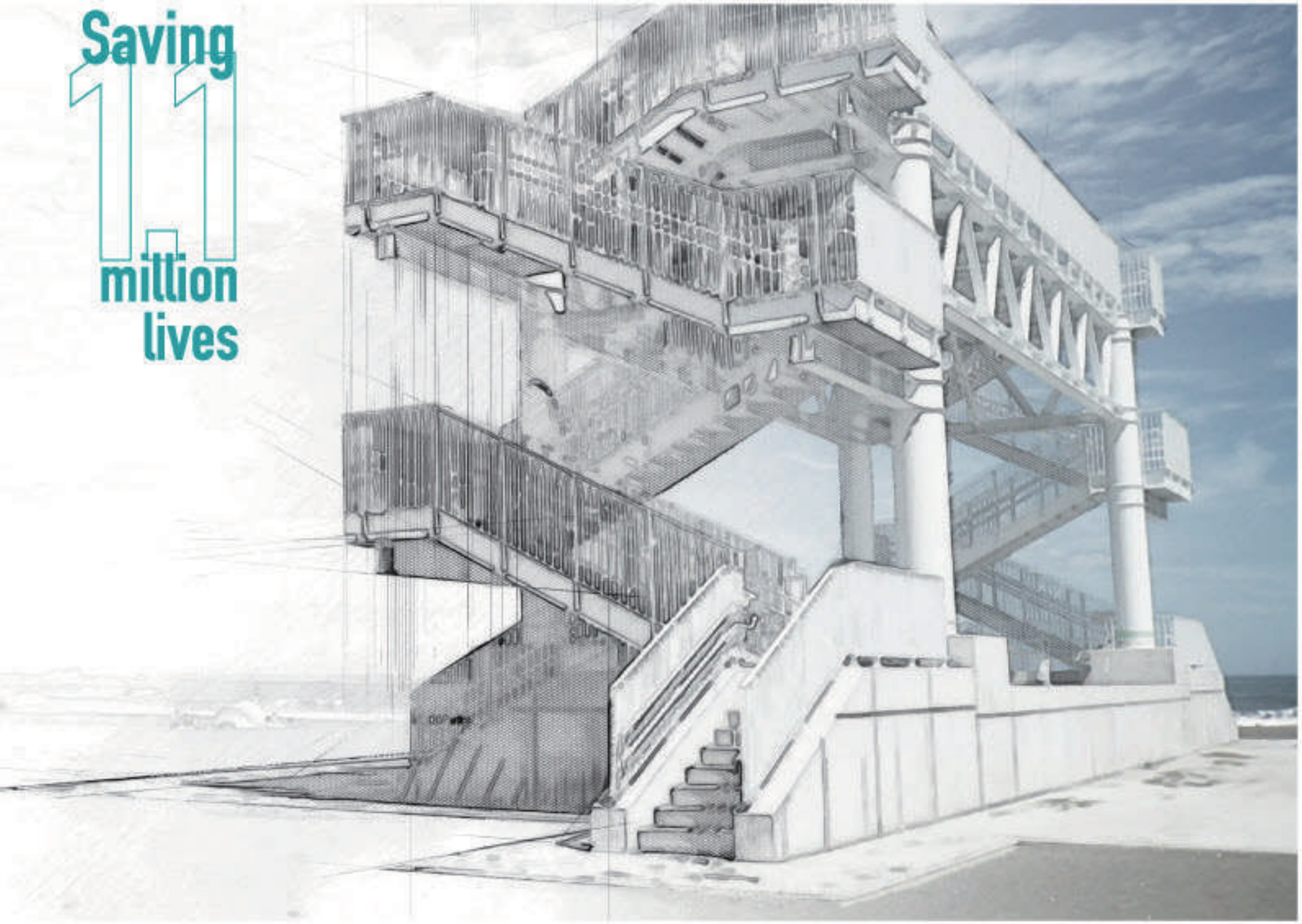
Spanning 1.5 km, Nhat Tan Bridge is one of the largest long-span bridges in Southeast Asia, with a unique structure rarely seen around the world. Due to its unprecedented form and the use of new construction techniques, extensive computer simulations were conducted prior to construction in order to analyze factors such as the effect of stress, deformation, and vibrations on different parts of the structure. We know through experience that the smallest of variables can have a detrimental effect on a bridge's structural integrity.

Take a crack of 0.2mm, for example.

Composite cable-stayed bridges with two main girders have been popular in recent years due to their low cost. However, after just a few years in use they become prone to deck cracking near the center of their span, which dramatically decreases their durability. Given that Nhat Tan Bridge was structurally similar to such bridges in these areas that are prone to cracking, we utilized concrete along its center span that was prestressed in the direction of the bridge axis. Preventing cracks of even 0.2 mm along a 1.5 km bridge prolongs its life span and allows for easier maintenance.

As part of our mission to build the best quality bridges, we conduct technical evaluation meetings during each construction period that bring together everyone from the veteran engineers who learned to make structural calculations for long-span bridges by hand to the young engineers who specialize in conducting numerical analyses using state-of-the-art computer software. At these meetings, we discuss the ways in which we can apply the newest available technology to solve complex existing issues, and review all micro and macro aspects of the project in order to determine potential problem areas. Every employee has a stake in every project. This is the approach that has made us Japan's leading bridge construction consultants.

Saving 1.1 million lives



Disaster Prevention

Our mission is to ensure the survival of people and civilization in the era of climate change.

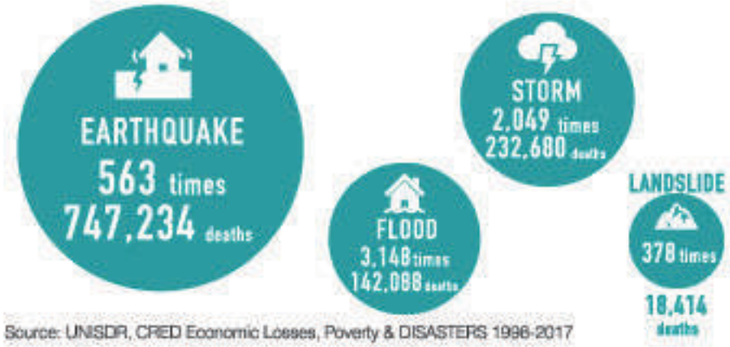
According to UNISDR, in the 20 years between 1997 and 2017, more than 1.3 million people died due to natural disasters. Of that number, 1.14 million people died in disasters such as earthquakes, storms, floods, and landslides. But we stand resolute. As civil engineers, we believe we can prevent, mitigate, and reduce disasters.

For example, we can conduct seismic evaluation of special bridges. Japan is an earthquake-prone country, and we have extensive experience in conducting diagnoses and developing countermesures. We can also conduct tsunami and storm surge risk analysis.

We can conduct extensive 2D and 3D simulations and create disaster prevention master plans and hazard maps based on flooding and drainage patterns (see case studies below). In structural studies, we also take into account tsunami-induced ground deformation such as scour and liquefaction in order to develop more realistic models.

In case of slope collapse, landslide, road flooding, road sinking, or bridge collapse, rapid emergency response and recurrence prevention measures are essential. To minimize damages we can take necessary measures such as construction of flood evacuation towers and underground water storage facilities, and modifying asphalt to improve pavement drainage.

Number of deaths per disaster type 1998–2017
(around the world)



Source: UNISDR, CRED Economic Losses, Poverty & DISASTERS 1998-2017

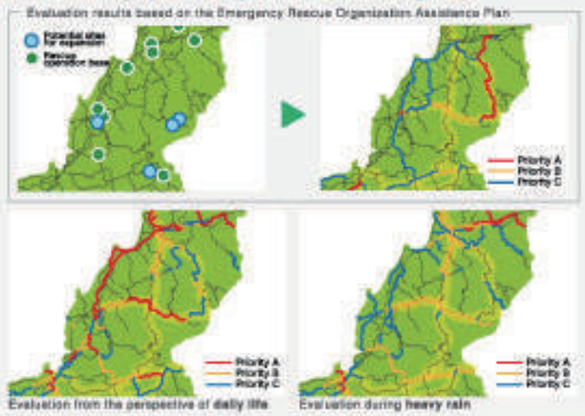
Saving 1.1 million lives with the power of civil engineering

In a area, which faces the Pacific Ocean in western Japan, earthquake preparedness is an urgent issue, as there is considered to be a high risk of a Nankai megathrust earthquake in the future. When we think about disaster prevention with respect to road planning, the tendency is to consider measures for each route individually. But we evaluate the safety of the entire road network on a prefectural scale. We predict road disruptions due to slope collapses and flooding across a wide area, establish road maintenance priorities based on factors such as travel time in the event of a disaster, identify areas that require seismic reinforcement in advance, and designate effective bases for road restoration after a disaster.

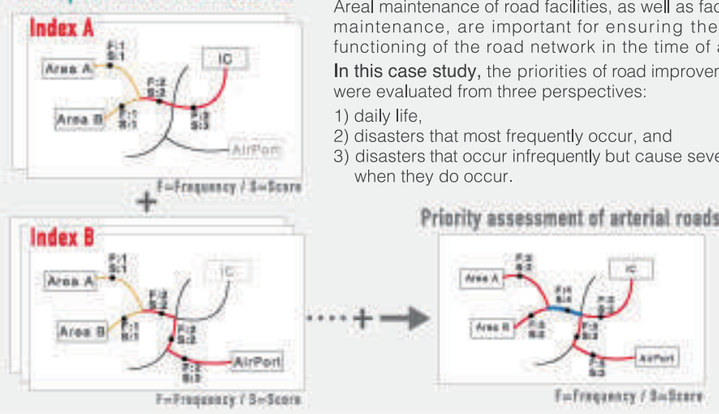
This allows municipalities to save the maximum number of lives in the shortest possible time, while optimizing the use of their budget. At the same time, the effectiveness of a municipal response can be evaluated objectively and quantitatively, making it easier to communicate and gain the understanding of local citizens.

We create new value for our clients by combining advanced technologies to address their challenges. We offer our unique technical skills, insights, and expertise—the product of years of experience and being driven by the spirit of taking on challenges.

Road Planning Optimized by AI (Artificial Intelligence)



Concept of Shortest Path Search



Areal maintenance of road facilities, as well as facility-based maintenance, are important for ensuring the effective functioning of the road network in the time of a disaster.

In this case study, the priorities of road improvement plans were evaluated from three perspectives:

1) daily life,
2) disasters that most frequently occur, and
3) disasters that occur infrequently but cause severe damage when they do occur.

G-FORCE is a green, cutting-edge solution for the age of SDGs.

The construction of electricity infrastructure is essential for the expansion of human activity. Areas without infrastructure, however, pose particular challenges. Take, for example, outlying islands, wilderness areas, and isolated villages in mountainous regions. The cost to lay the electricity infrastructure to connect these remote areas to existing power grids increases considerably in accordance with the number of households, and keeping up regular maintenance is no easy feat. At the same time it is important to support the lives of residents in such areas, ensure the stable operation of local facilities like meteorological stations, astronomical observatories, and base stations for telecommunications, and strengthen disaster prevention capabilities.

The G-FORCE, a pure hydrogen fuel cell system, is a clean solution for such situations. The surplus energy generated by wind and solar power generation systems is used for water electrolysis to produce hydrogen, which can be stored. As a stand-alone dispersed power source, maintenance is easy and requires less human effort. The system is in high demand in urban areas with a vulnerable electricity infrastructure that nonetheless require a stable power supply for facilities such as hospitals and hotels. It is a clean, quiet, convenient renewable energy source that can power essential electrical equipment. G-FORCE is a green, cutting-edge solution for the age of SDGs.

20 MWh
per year of clean energy

7 tons
of CO_2 reduction per generator

A self-sustaining power system

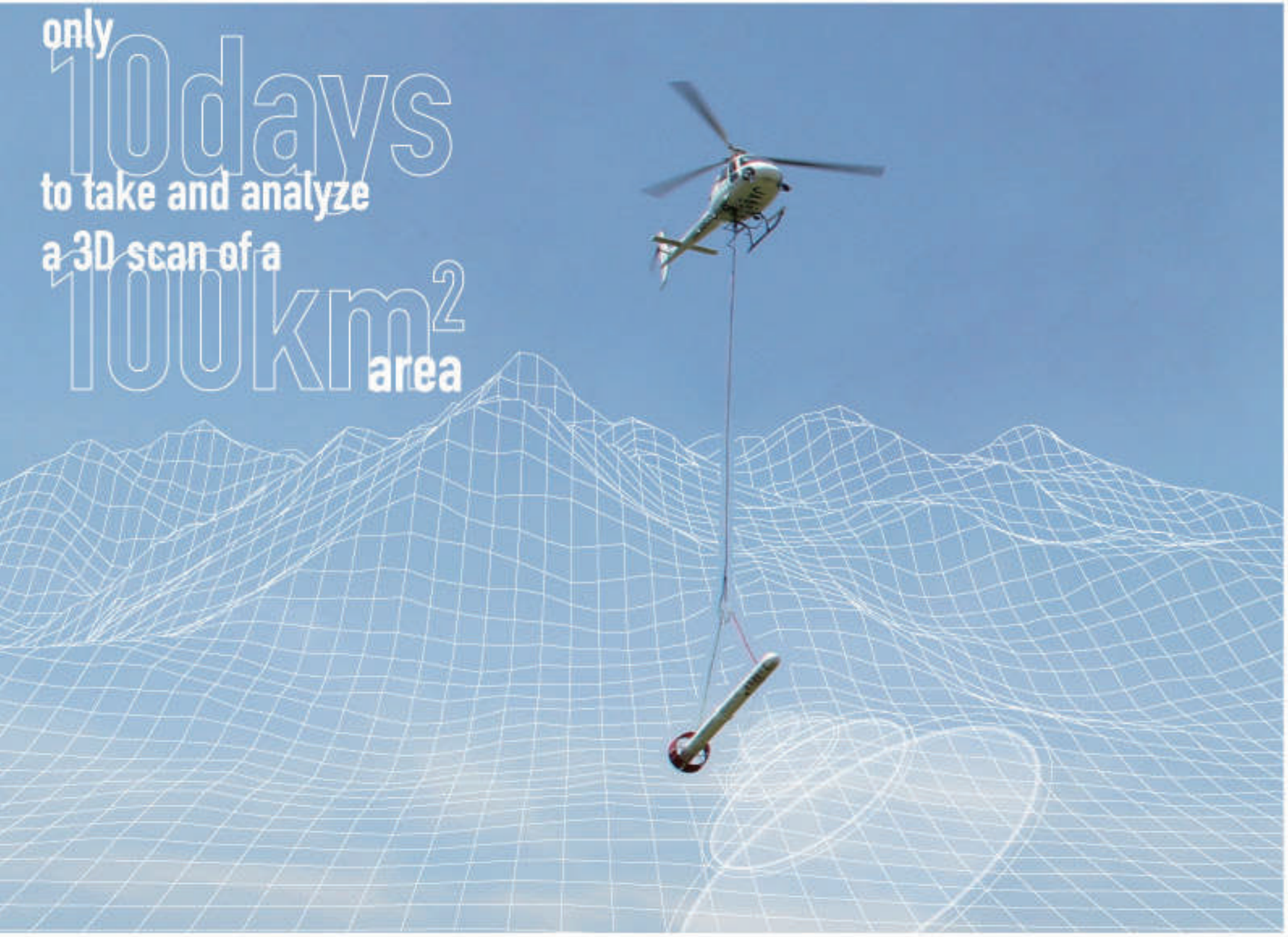
Hydrogen Drive

Nippon Engineering Consultants is currently conducting research into local microgrids in partnership with Gifu University. We are combining solar power generation, G-FORCE generators, V2H systems, and EcoCute heat pumps to create a tailor-made model for the energy needs of small towns in mountainous areas. Our goal is to develop a system that is economical, environmentally-friendly, and reliable.

Similarly, in a separate project with a private organization, we are utilizing some of the energy generated from a solar photovoltaic system and woody biomass to produce and store hydrogen. This hydrogen is being used in a G-FORCE to generate electricity and heat. We have succeeded in covering 50% of the organization's ordinary power needs with renewable energy.

G-FORCE comes with a wide variety of options

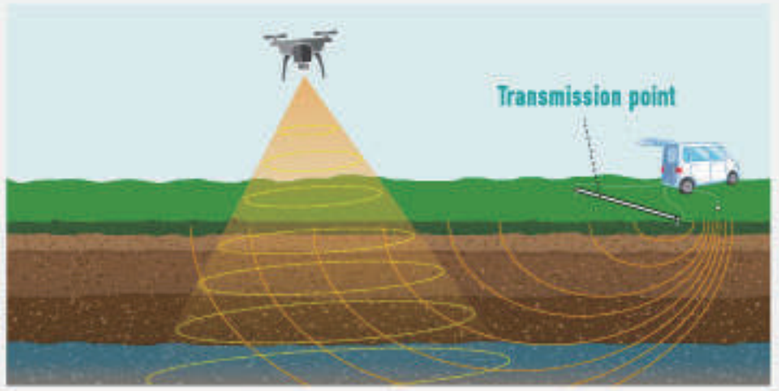
SEIRYU POWER ENERGY G-FORCE is a product of SEIRYU POWER ENERGY Co.,Ltd. which is our affiliate company.



This is a cost-effective solution for surveying on a hectare scale.

In areas where the cost of using a helicopter would be excessive, we recommend using a drone. Choose which method is best for you depending on your budget and the size of the area to be surveyed: a helicopter survey for 100 km², a drone survey for 0.5 km². We have successfully tested the applicability of lighter, drone-based aerial electromagnetic survey equipment at landslide disaster sites in Japan. Although a drone has limited range compared to a helicopter, this is a cost-effective solution for surveying on a hectare scale.

Drone airborne electromagnetic survey has been practicalized utilizing an analytic technology of Nippon Engineering Consultants Co., Ltd. with the cooperation of Neo Science Co., Ltd.



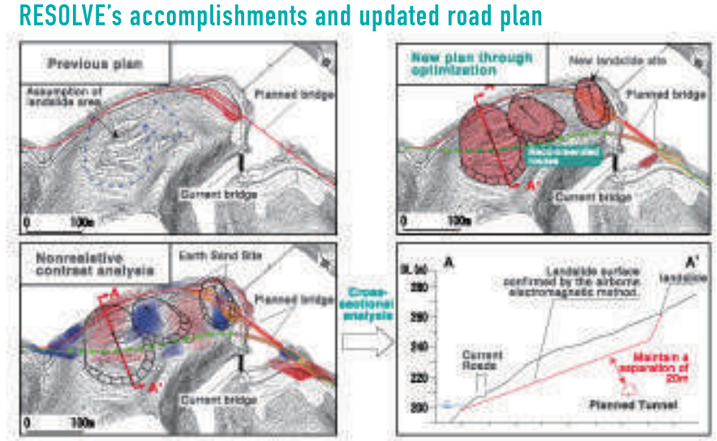
Aerial Geophysical Surveying "RESOLVE"

100 boring survey can be superseded by one day of aerial surveying.

Collect data from beneath the Earth's surface... efficiently from the sky. This innovative, disruptive technology exists today. When considering the construction of new roads, the standard approach is to gather data through boring and seismic surveying—which can be expensive and time-consuming. Whether you are building a highway covering a considerable distance or a road through mountainous and other hard-to-access terrain, the need to understand the geological and conditions on a planned route remains the same. What if you could conduct a 3D scan of the subsurface via helicopter in a fraction of the time? RESOLVE is our patented* aerial geophysical surveying technology that makes it possible.

**Patent No. 5243476*
Analysis method of ground using aeria electromagnetic survey method

RESOLVE's accomplishments and updated road plan



Determining the best route

RESOLVE works by emitting a primary magnetic field toward the ground from a measuring instrument carried aloft by a helicopter. By measuring the secondary magnetic field generated by its interaction with the ground geology, faults, and groundwater, we are able to gather 3D information about the subsurface down to a depth of about 150 meters.

This method allows for efficient geophysical surveys—as long as the area in question is a helicopter fly zone. Pre-survey preparation and planning is simple and easy too! In addition to route planning and tunnel surveying, this technology is also used in Japan for disaster prevention and mitigation, namely dam surveying, surveying of reclaimed land, and prediction of shallow and deep-seated landslides. It is also possible to forecast slope failure caused by heavy rainfall, groundwater, and earthquakes. This technology is essential for optimizing life cycle costs at the area level, which includes road maintenance and management, and disaster prevention measures.

Maintenance Management

A structure that lasts 100 years can only be maintained with a 100-year maintenance management plan.

The key to long lifespans is the use of drones, AI, cutting-edge tools, and the implementation of operational manuals made in conjunction with local engineers to fit local needs.

Roads, bridges...all civil engineering structures will deteriorate over time. Proper maintenance management is essential to keep structures in use. We have systematically organized our vast experience into a road and bridge maintenance management manual, making it possible to take appropriate measures in a timely manner against the causes of structural deterioration, such as salt damage, structural fatigue, and alkali-aggregate reaction. This manual is continually revised and improved upon.

To date, this manual has been adapted for several countries; each region utilizes it according to its unique challenges. As local engineers are trained, their manual is successively revised as the need arises. Our approach to maintenance management is to cultivate human resources in anticipation of the operational phase. In other words, we help address the shortage of human resources engaged in maintenance work.

We can also help with solutions for other issues related to maintenance management of civil engineering structures.

For example, budget limitations. The implementation of a road asset management system or bridge management system is an effective way to prioritize your budget. Based on the results of an inspection, these systems calculate the level of risk and the estimated cost of repairs, and analyze the budget required as well as the sequence in which repairs should be carried out over the coming decades.

In environments where human inspection is not possible, we recommend the use of a drone. If you have a shortage of skilled personnel, tablet-based monitoring systems and AI-based damage assessment systems are also effective.

For special bridges, we utilize field techniques such as anomaly detection and diagnosis through ambient vibration and non-destructive cable testing, and propose appropriate repair methods.

Let us help you extend the lifespan of your roads and bridges by another 20 years.

Crack analysis results

Multicopter MULCO®

For inspections that need to be done on bridges in valleys or with high piers, the use of a drone can sometimes be cheaper than more conventional methods like the use of large inspection machines or rope access. The autonomous drone will face the bridge and fly alongside it, capturing comprehensive images that the operator can use to assess the extent and spread of damage. In Japan, everything down to the delivery of inspection results has been digitally automated.

Technical Cooperation Project
Human Resource Development

Participants in our project will be the future teachers.

To be a place for learning about the leading Japanese civil engineering technology. To act as a bridge of learning to the world.

Our work, civil engineering, is to contribute to the creation of a human-friendly environment that supports civilized society.

As Japan's leading bridge design consultants, we have dedicated ourselves to refining civil engineering techniques in order to improve the living standards of people around the world. Our job is not only about construction; rather, it is to ensure that bridges can be utilized for a century.

To reach our goals, we have undertaken a number of efforts. One example is the JICA-Technical Cooperation Project "Improvement of Quality Management for Highway and Bridge Construction and Maintenance Projects in the Philippines," which was conducted over three phases of three years, one year apart.Working together with local goverment engineers, we were able to improve the capacity of maintenance management in the Philippines and establish a maintenance management cycle that adapted to their needs through the actual maintenance and repair work of local roads and bridges.

Our approach is to apply Japan's state-of-the-art technology and knowledge from our experience to the target country, and refining it into civil engineering technology that will continue to evolve.

Think Globally, Act Locally.

To develop the human resources that can construct and maintain better roads and bridges on a global scale—that is our dream.

We have provided courses for over 2,000 engineers all over the world.

Another JICA Technical Cooperation Project, "Bridge Maintenance Capacity Building Project in Zambia," was undertaken in the Republic of Zambia from 2015 to 2017. The purpose of this project was to institutionalize the capacity of engineers and strengthen bridge maintenance planning and operational management, including outsourcing contracts. Practical courses were provided with local bridges in Zambia to teach routine bridge maintenance, inspection, and repair. Furthermore, we conducted counterpart-courses not only in Japan but also other countries such as South Africa and the Philippines. We successfully nurtured independent bridge engineers through those courses and improved the bridge maintenance capacity throughout Zambia.

Scenes from our Technical Cooperation Program

NIPPON ENGINEERING CONSULTANTS CO.,LTD.

Our Global Business Activities

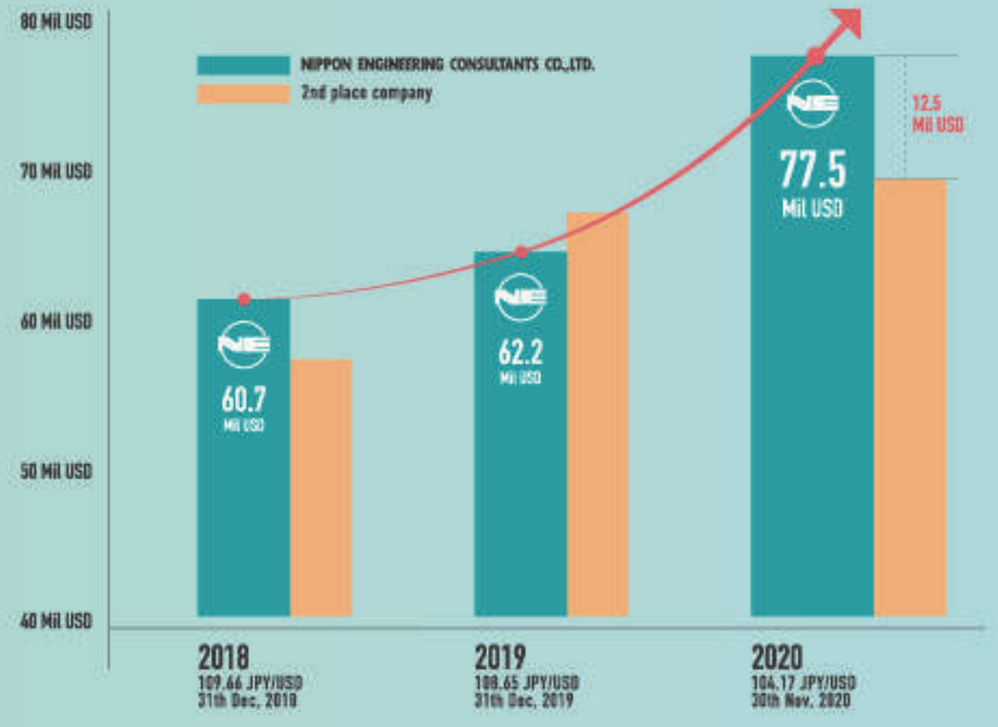
Benin's Hill

Meghna Bridge / Meghna, Bangladesh

Rwanda rural road

Shui Ji Bridge / Taipei, Taiwan

Civil engineering consultants track record of completed works in Japan
(Steel structure and concrete sector)



Source: Japan Civil engineering Consultants Association

Performance of other major sector in Japan

Road sector

Consistently in the top 10

2018	31.6 Mil USD	RANK 10
2019	32.1 Mil USD	RANK 10
2020	35.3 Mil USD	RANK 10

Tunnel sector

Consistently in the top 20

2018	3.7 Mil USD	RANK 18
2019	4.3Mil USD	RANK 16
2020	3.8 Mil USD	RANK 19

Source: Japan Civil engineering Consultants Association

Profile

NAME	NIPPON ENGINEERING CONSULTANTS CO., LTD.
Established	January 23, 1963
Capital	13.5 million USD
President & COO	Nobuhiro Arai
Annual Turnover	153.2 million USD (fiscal year ended June 30, 2020)
Head Office	300 Kanda Neribeicho, Chiyoda-ku, Tokyo 101-0022 JAPAN
Employees	661 [As of June 30, 2020]

Business Areas

◎ENGINEERING CONSULTING COMPANY
- River, Coasts and Landslide Precaution
- Harbors and Airports
- Roads and Highways
- Railways
- Sewerage
- Irrigation and Drainage
- Landscaping
- Regional and Urban Development
- Geological and Soil Investigation
- Foundations
- Steel and Concrete Structures
- Tunnels
- Construction Planning, Facilities Design, Cost Estimates
- Public Works Environment

◎TOPOGRAPHIC SURVEYING
◎GEOTECHNICAL SURVEYING
◎FIRST-CLASS ARCHITECT OFFICE

NIPPON ENGINEERING CONSULTANTS CO.,LTD.

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