Interview

Contribution of civil engineers to carbon neutrality

Interviewee: Oki Taikan (Professor, Department of Infrastructures, Graduate School of Engineering, The University of Tokyo)

Interviewer: Kanako HANAKADO, Taisei Corporation and Editorial Board Member, Journal of Japan Society of Civil Engineers

Moves toward carbon neutrality are accelerating in Japan and other countries around the world. As we face global warming, how should we civil engineers change our awareness and tackle the issue in the domestic and global context?

Interviewer One of the reasons for promoting carbon neutrality is to tackle global warming, which is said to be behind an increase in natural disasters. What is the reality?

Oki Taking a global view, if we compare the last 20 years of the 20th century with the first 20 years of the 21st century, the number of reported natural disasters has certainly increased. The number of reported natural disasters unrelated to global warming, such as earthquakes and volcanic eruptions, has increased by about 1.2 times due to the globalization of information, including the spread of the Internet.

So let's consider the magnitude of the damage. Looking at the number of people killed or missing and the cost of damage caused by floods in Japan between 1875 and 2019, the loss of life has been gradually decreasing since Typhoon Kathleen and the Isewan Typhoon (Typhoon Vera) in the immediate postwar period, while the cost of damage has been gradually increasing in recent years.

The magnitude flood damage is evident in insurance payouts. The insurance payout for Typhoon No. 21 in September 2018 was the largest ever, exceeding a trillion yen. The tenth largest typhoon and torrential rain also led to a payout that exceeded 100 billion yen. This is more than for most earthquake disasters. While the Great East Japan Earthquake of 2011 resulted in insurance payments of about 1.274 trillion yen, all other cases with the exception of the Kumamoto and northern Osaka earthquakes, have seen payouts of less than 100 billion yen.

Of course, another reason for an increasing number of flood disasters is urbanization. Similarly, urbanization and the heat island effect contribute to an increasing number of heat waves. So we cannot say that increased flooding is caused by global warming alone, but as a long-term trend, the effects of climate change are obvious.

Interviewer So is one reason for the increased cost of damage that development of the country has progressed and more areas are now susceptible to flooding?

Oki That is a part of the answer. For example, in September 2000, the Shonai River basin in Nagoya was inundated after torrential rains in the Tokai region, but development of this area took place long before that flood. It is better to think that the potential vulnerability of the area had increased and then the vulnerability became apparent when unprecedented heavy rain fell.

What seems to be theoretically certain, and this is supported by observations, is that rain is likely to fall more heavily over shorter periods of time as temperatures rise due to global warming and other factors. The relationship between daily average temperature and rainfall intensity, based on data from the Automated Meteorological Data Acquisition System (AMeDAS), shows that this is indeed the case for all seasons in Japan.

Decarbonization efforts are a social decision, not a scientific one

Interviewer That's why we need to work towards carbon neutrality, isn't it?

Oki No, this is a social decision. Carbon neutrality is based on the scientific knowledge that the world as a whole needs to achieve net zero emissions of greenhouse gases by 2050 in order to limit temperature rise to 1.5 degrees Celsius compared to pre-industrial times. However, the actual choice of acceptable temperature rise and associated climate change risks differs from person to person. It is not scientifically determined.

Last October, Prime Minister Yoshihide Suga mentioned carbon neutrality in a policy speech. One of the reasons for this was probably the fact that Joe Biden was ahead in the US presidential election. It can be interpreted as a preemptive move against the likelihood that the United States would take a proactive stance toward carbon neutrality if Biden were to become president.

We also have to be aware of the race between Europe and China. The European Union (EU) has sent a clear message that any product or service that imposes what environmental economists call "external costs" on society will be shut out of the market. As a result, China has also begun to set carbon neutrality as a goal. We believe that Suga's mention of carbon neutrality was motivated by his strong interest in international trade. The EU and the US are currently considering the introduction of a "border carbon adjustment measure", also known as a border carbon tax. This is a tariff based on the idea that it is unfair to allow goods produced using renewable energy and goods produced using, say, energy from coal-fired power stations to compete in the same market while the cost of renewable energy is high. If Japan does not change its energy policy, the time may come when it will no longer be able to purchase industrial products and services from Europe and the United States.

Decarbonizing technology without changing socioeconomic activities

Interviewer Do you think that achieving the goal of carbon neutrality by 2050 is a very high hurdle? How do you see the situation in Japan?

Oki Last year, in order to prevent the spread of the new coronavirus, people were asked to refrain from traveling, especially in large cities, under the state of emergency declaration. Despite this self-restraint, carbon dioxide (CO_2) emissions were down only about 6% from the previous year. In order to achieve carbon neutrality, it is calculated that if we continue to reduce CO_2 emissions by 7.2% year on year, then over the next 30 years we will ultimately reduce CO_2 emissions by one-eighth. How can we continue to achieve even that level of emission reduction every year? When you think about it, you can't help but be pessimistic about achieving the neutrality goal just by changing the way we behave in our daily lives.

What is needed is not a backward-looking approach by which we stop using airplanes or cars, or decide to live with excessive heat or in darkness. What we need to do is build a social system that dramatically reduces greenhouse gas emissions while traveling as we have in the past and using air conditioning and lights. We need to develop technologies that support such a social system.

On the other hand, while CO_2 accounts for about three-quarters of the world's total greenhouse gas emissions, it accounts for more than 90% of Japan's emissions. This makes it easy to focus on reducing CO_2 emissions as a target. In fields closely related to civil engineering, it is essential to innovate. We need to manufacture materials such as cement and iron, the production of which emits large amounts of CO_2, without the use of fossil fuels. Of course, the reality is that each and every one of us contributes to global warming, so energy-saving efforts such as turning off lights in unoccupied rooms, for example, are not in vain. But we will never achieve the goal of carbon neutrality unless we make bolder changes as a society.

Interviewer In terms of the development of new technologies, many companies in the construction industry are already working on the problem. For example, there are techniques for storing CO_2 within concrete, but they are more costly than the production of conventional concrete. Therefore, the question arises

as to what extent society will adopt such new ideas.

Oki That's true. My observation is that the companies providing products and services are ever ready to make the transition to carbon neutral. In Japan, however, consumers tend not to change their own behavior, so even companies that introduce innovative products and services lose out in price competition. This is a bottleneck, and it is difficult to steer the course in reality.

Interviewer In the EU, do you think society is more ready to accept environmentally friendly products?

Oki I think the attitude is that if you want to protect the environment, or if you want to continue to live a happy life, you must bear the cost, even if it is a little higher. But there is more than one EU country; the answer depends on the country. Germany, for example, is very thorough in terms of protecting the environment. Surprisingly, people reuse plastic bottles and even continue to use them when the surface has become scratched and damaged. I think many Japanese consumers are resistant to this.

However, this does not mean that there is a limit to how much we can do just by developing more educational activities and raising environmental awareness. The best thing to do is not only to appeal to each person's awareness, but also to institutionalize it, just as we did with the plastic bag charge.

Think about it. It was about 20 years ago that Japanese airlines went smoke-free on their planes. Before that, smoking was allowed. Whether you allow it or forbid it, if you institutionalize a behavior, it will become the norm.

In the world of civil engineering, one example of such institutionalization would be the provision of incentives by the client, such as a system in which a significant number of technical points is awarded during bidding if a construction method with very low CO_2 emissions is proposed.

The infrastructure we build now will still exist in 2050

Interviewer Please give us your views on what the civil engineering world can do and what we need to think about in order to reach carbon neutrality.

Oki The infrastructure that we deal with in the civil engineering world remains in use for 50 years or more. In other words, what we build now will continue to exist in the carbon-neutral society we are aiming for in 2050. It would be wrong to take it easy and say that 2050 is still a long way off, so we can just take our time. We need to start updating and improving our infrastructure 30 years from now. The city of Berkeley in California has already banned the use of natural gas in new low-rise buildings from this perspective.

If we are serious about decarbonization, we need to gradually rethink the way we build our cities from the perspective of energy efficiency. We can reduce the need for people to move by bringing meetings online, but this doesn’t work for the movement of goods. It is essential that the concept of the so-called "compact city" be more thoroughly implemented in national land planning than ever before. It will be impossible to achieve the goal of carbon neutrality by 2050 without at least reviewing the state of our energy infrastructure, mobility, and logistics infrastructure.

However, if we take advantage of this need for change, we can create a great business opportunity for the private sector. If we seriously consider what kind of infrastructure and what kind of technology will be needed in a society with zero greenhouse gas emissions, the answer will naturally become clear. You will be able to improve your performance. I would like you to keep this in mind.

Moreover, it is believed that successful efforts in this area will lead to the export of infrastructure overseas, a long-cherished desire of the nation. Japanese companies have struggled with infrastructure exports due to their high cost. But as companies around the world move toward carbon neutrality, the cost of energy and materials will have to rise. As a result, the ratio of labor costs will fall relatively. I am hopeful that we can find a way to make the most of this.

Interviewer You are right that we are struggling to compete for orders. We have yet to become a global company that can compete in overseas markets.

Oki I think that some civil engineering structures are being built to specifications that are excessive compared to international standards. Rather than building structures to the quality required by the client, it seems that the client is trying to determine the necessary quality and provide it.

The quality of a civil engineering structure should be judged by whether or not there will be issues under critical conditions. But the reality is that many civil engineering structures are replaced without ever reaching a critical state. No matter how good a product is in terms of quality and reliability, it will not be appreciated if it does not fully demonstrate its true value. On the other hand, there are also circumstances where the lifecycle cost is low even though the initial cost is high.

I think that we struggle to meet the demands of the client. We do not meet the demands of the client side.

Open up a new era of decarbonization

Interviewer Let's return to the topic of carbon neutrality. When you look at industry as a whole, are there any fields that are making good progress in their efforts to decarbonize?

Oki The chemical industry is the one that I am most familiar with. Since the 1960s, when the issue of pollution became a hot topic, this industry has been particularly concerned about environmental issues in light of the air and water pollution it caused.

In considering such questions, it is also essential to address indirect impacts. To become a society that uses only renewables, not only do we have to give up using fossil fuels as fuels, but also as raw materials. Sulfur, for example, has been available at low cost as a by-product of oil refining and desulfurization processes. However, if fossil fuels are no longer used as a raw material or fuel, we will no longer be able to obtain sulfur in the same way.

You need to face the changing times, foresee how your business is likely to be affected by them in the future, and determine what kind of technological development is necessary to avoid rough times ahead. In the future, whole industries and individual companies will need to be able to respond flexibly to a variety of environmental changes in order to survive.

Interviewer Finally, do you have a message for civil engineers on what they should do to achieve the goal of carbon neutrality?

Oki Infrastructure will continue to be a part of our future. So, to become a carbon-neutral society with a shrinking population, we have no choice but to change our ways of thinking about infrastructure.

For example, consider cement, an important material for civil engineers. It is in common use now because it is cheaper than other materials. However, if we take into account carbon pricing, which is a mechanism that puts a price on greenhouse gas emissions, the price of cement should be higher than it is now. This will inevitably lead to a change in the choice of what is the best material for civil engineering structures. However, as a prerequisite for this, it is necessary for countries around the world to work in unison towards carbon neutrality. Otherwise, companies that are serious about becoming carbon neutral will be unable to compete and will not survive, which is unfair.

We have entered an era in which we must seriously consider how to replace and maintain our infrastructure within the larger framework of carbon neutrality. It is my hope that the carbon-neutral approach will be pursued with the enthusiasm needed to open up a new era.