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The Birth of Sustainability and Its Development in fib

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Abstract: The history of human being is a result of various activities to live. Humanity has lived with the nature which has enabled to sustain the lives. Humanity has gained great benefits by the use of nature and its alternation. The comfortable environment development made the increase of population and the alternation of nature has extended. The past few hundred years can be said the era of fossil fuels. Surprisingly, it has caused the global warming. The construction sector is the industry in which the foundation for social and economic activities is created. It has been believed that a comfortable and safety life, production and use of environments will lead to happiness for humanity. However, we could not put a break on the development. Of course it is, the construction-related sectors that consume the most large natural resources and energy, and therefore emit the largest quantity of CO_2. Fortunately, a concept in which we can deal with this situation was developed. It is sustainability concept. In this paper, firstly the concept "sustainability" which was born at the end of 20th century is reconfirmed. As the performance-based design has played a significant role in sustainability design, secondly the concept is explained based on the author's paper and book. Thirdly the development of sustainability in fib is comprehensively discussed including sustainability-resilience dispute and ethics.

Key words: CO_2, ethics, fib, performance-based design, resilience, sustainability.

1. Introduction

The history of human being is a result of various activities to live. Some bundling mechanisms are incorporated in herd society. The Earth was born 4.6 billion years ago after the space was created. The lives were created by many chemistry reactions and eventually humanity has born. Humanity has enhanced its resilience due to the battle and symbiosis in complicated environments. The development of science and technology has spurred. Eventually, humanity has had a tremendous force at the top of lives.

Humanity has lived with the nature which has enabled to sustain the lives. As the result, humanity has gained great benefits by the use of nature and its alternation. The comfortable environment development made the increase of population and the alternation of nature has extended. The consumption of natural resources and energy have increased. The past few hundred years can be said the era of fossil fuels. Surprisingly, it has caused the global warming. When the homo-sapiens meaning wise humanity left Africa towards the world, they never would imagine such future. The current situation is the appearance of "foolish humanity".

The construction sector is the industry in which the foundation for social and economical activities is created. It has been believed that a comfortable and safety life, production and use of environments will lead to happiness for humanity. However, we could not put a break on the development. Of course it is, the construction-related sectors consume the most large natural resources and energy, and therefore emit the largest quantity of CO_2.

On the other hand, the construction sector is very conservative because it maintains the social and economic activities of human being. It seems that as the mission of construction sector is to ensure the safety of structures, people might unconsciously think that it is difficult to change the accumulated systems. There are many constraints in the law and standards on structures. However, there are partial alterations. It causes a turmoil unless they are not systematically dealt.

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Therefore, this means that it was very difficult to deal with global warming in the classical framework. A new framework is required.

Fortunately, a concept in which we can deal with this situation was developed. It is sustainability concept. Although there was tortuousness, our direction towards the future became clear as of 2020. It means that we have to change our technologies and systems which have been developed on the basis of fossil fuel over the few hundred years. However, we need to go forward as our responsibility for the future generation.

As humanity is conducting their social and productive activities within limited space of the Earth, civil engineers have to think of various things in the construction of structures. Classically the safety of a structure is the first and therefore we have paid attention to the structural design method. However, due to the gigantism of fossil fuel, CO_2-induced climate change has to be considered. The global resource depletion cannot also be ignored. These requirements increase the costs. Thus, we need to deal with all requirements in the same concept. In the performance-based design, performance requirement can be set based on the performance. Therefore, we can systematically deal with all sustainability factors if we have an appropriate evaluation method in each. We call it performance-based sustainability design system.

In this paper, firstly the concept "sustainability" which was born at the end of 20th century is reconfirmed. As the performance-based design has played a significant role in sustainability design, secondly the concept is explained based on the author's paper and book. Thirdly the development of sustainability in fib is comprehensively discussed including sustainability-resilience dispute and ethics.

2. Genealogy of "Sustainability" Conception

In 1983, the World Commission on Environment and Development was created in the assembly of the UN (United Nation). The chairperson of the commission was Gro Harlem Brundtland, Norwegian Prime Minister. The missions of the commission were as follows:

(1) To propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond.

(2) To recommend ways concerning the environment be translated into greater co-operation among developing countries and between countries at different stages of economic and social development and lead to the achievement of common and mutually supportive objectives that take account of the interrelationships between people, resources, environment, and development.

(3) To consider ways and means by which the international community can deal more effectively with environmental concerns.

(4) To help define shared perceptions of long-term environmental issues and the appropriate efforts needed to deal successfully with problems of protecting and enhancing the environment.

In 1978, the achievement was published as the report "Our Common Future" [1]. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It means that we should not develop environment in which the future generations face severe difficulties. The responsibility to the future generations was clearly shown. This is a revolutionary concept which admonishes the unlimited development of human being. But, it seems that when this was shown, few people could understand the meaning and importance in the world.

It is not easy to sustain our natural situation or normal. The Corona Pandemic indicated us the essence of our free movement. The human tend to cut waste or redundancy after the detail becomes clear. The safety set by human may be shifted to dangerous side. Thus, it can be said that the development of scientific technologies has contributed to the reduction of waste. However, our thoughts are not perfect. Our experiences are limited. This happens in the cases that the essence of the problem is not properly seized. Paradoxically, if the sustainability can be reasonably understood any

confusion can be avoided.

On the other hand, fib (International Federation for Structural Concrete) was created in 1998 by the merge of CEB and FIP. One of important things was to establish commission 3 (Environment aspects). In 2009, SAG8 was founded to develop sustainability initiatives, which was approved in 2010, as follows:

(1) The fib is taking the lead in advancing the sustainability of structural concrete.

(2) The fib is proactively considering sustainability in its activities and in its guidance documents for professional practice.

(3) The fib is working with its member bodies throughout the world to keep the professionals abreast of developments in sustainability.

(4) The fib seeks collaborations with other organization to support its goal of advancing the sustainability of concrete structures over their life cycle.

(5) Through its network, the fib is striving to promote the sustainability in concrete structures to the wider community.

The author was the chair of the commission 3 (Environmental aspects) and founded SAG8 (sustainability initiative). According to the author's request, TG1.5 and TG6.3 were created as the example in which all commissions should include sustainability aspects.

The Model Code 2010, in which sustainability concept was incorporated for the first time in the world, was published in 2013 [2, 3]. In 2015, new commission 7 "Sustainability" was created by merging the commission 3 and SAG8.

Since the definition of sustainable development by the UN, "sustainable development" has become important as a guide on all activities of human being. SDG was also established. However, it is not easy to create the systems for the realization based on the proper understanding. Continuous challenges will last over the decades while repeating trial and error.

3. Genealogy of Performance-Based Design

The design methods of structures have evolved from experiences and experiments through allowable stress design and ultimate strength design, to limit state design method. The limit states include strength capacity, serviceability and fatigue. The most important thing in our activities is an accountability. It should be transparent. It is no doubt that the most important aspect in the construction of a structure is safety. The destruction of a structure has to be confirmed by a certain way. The method has been made through experiences and mechanical theory. The confirmation of the structural safety can be made through the evaluation of mechanical performance of a structure. Of course, the time-dependent change of a material should be reasonably incorporated. As our knowledge is not adequate, some parts should be dealt with in some margins based on experiences. Such comprehensive structure is a design system. Unfortunately, the different level of knowledge is mixed. But, we can reasonably deal with them by determining proper performance requirements.

The durability problem of a structure is that all materials deteriorate with time. The methods to consider it in the design of a structure include deterministic and probabilistic way. However, it is not easy to handle all deteriorations with probabilistic method because there are no objective data on long-term changes. Anyhow, we can say that the performance-based design method seems to have a certain reasonability.

The author summarized in 1997 the advantages of introducing the performance-based design as follows [4]:

(1) The degree of freedom in design can be expanded.

(2) The reasonable design can be conducted in the large framework depending on the development level of technologies.

(3) The application of new technologies can be facilitated.

(4) Design on structural matters, durability and aesthetics and execution can be integrated. In other

words, it enables integrated design.

(5) It enables cost-down.

As there is lots of knowledge in the classical design objects, it is relatively easy to deal with them in performance-based design. However, aesthetics include social science aspects. Environmental issues like CO_2 emissions, which is regarded as the main substance in global warming, are also categorized into social sciences. The fossil fuel and other natural resources have enhanced the importance in modern society. They are completely different from classical design object and therefore there is no clear design method. Nowadays, carbon neutral is trendy even in concrete technologies. Considering the ingredients of resources and fuel, it is impossible to realize it. The only way is to capture CO_2. The carbonation causes the change of mechanical properties and durability. If other technology cannot be found, humanity will have to accept a certain temperature increase.

When the author wrote the discussion on performance-based design in 1998 at that time, it was considered that the performance-based design will lead to the cost-down. However, it is not always true. The Japanese current seismic design is based on a minimum requirement in which human is not killed. Therefore, it is not a secure design. Some redundancy is needed for the securement. Generally speaking, the redundancy is proportional to the cost.

When I wrote the discussion on performance-based design in 1998, structural aspects, durability, execution and aesthetics were considered. In addition, the whole flow of performance-based integrated-design framework classified in verification levels (micro, mezzo, macro) was shown. The examples of an integrated aesthetic design were indicated. The global environment and lifecycle issues were described. If they are expressed with “performances”, it can be dealt with in the same way. It was clearly pointed out that the diversification of performance is significant. It was a quarter century ago. The expansion into sustainability was not imagined at this stage.

4. Essential Meaning of Sustainability in the East-Japan Great Earthquake Disaster

The UN report has provided 3 aspects on the framework of sustainability. But, it was not clear how to grasp it in the construction industry. The author discussed it as follows [5, 6]:

(1) Environmental issues

There are 4 categories including global, regional, local and built.

(2) Economic issues

The economic aspect always exists in the human activities.

(3) Social issues

The activities of human are diverse. They can be dealt by social aspects. Focusing on infrastructures and buildings which support the social activities of human, the following things should be considered:

(a) Quality (as a place to live and work in a building)
(b) Safety and security
(c) Serviceability
(d) Aesthetics
(e) Efficient land use
(f) Protection of cultural heritage
(g) Protection of nature from dangerous substances
(h) Job opportunities
(i) Others

However, MC2010 [2, 3] introduced only aesthetics. It was judged that the incorporation of mechanical items as social issues cannot be agreed. This is because there is no such viewpoint.

In order to clearly indicate the origin of sustainability concept in construction industry, the discussions in the book [5] are cited below:

The Great East Japan Earthquake which struck on 11 March 2011, presented us with an opportunity to think about the essence of the issue of sustainability. We have been making use of resources and energy to build a social and economic infrastructure on which we base production and cultural and social activity. However, the major earthquake and the huge tsunami it triggered destroyed much of this in an instant. On top of it came

radioactive contamination caused by a serious accident at one of our nuclear power stations, the energy sources which have been presented as the key player in mitigating global warming. As the Japanese archipelago lies on the joining of multiple tectonic plates, earthquakes are an unavoidable part of its destiny. In the construction field, safer structural design has been implemented whenever damage has been caused by a large earthquake. The 11 March earthquake will once again have demonstrated to people the importance of infrastructural safety and reliability including in construction and housing. In other words, tragic experience has once more taught us that, without a robust infrastructure, human society has no chance of sustainability. Huge amounts of resources and energy are used for infrastructure development, requiring massive investment. As such development inevitably requires land use and land modification, it brings with it natural destruction.

Sustainability needs to be evaluated from the environmental, economic and social perspectives. The 11 March disaster showed very graphically its destructive effects in each of these areas. The natural movements of the crustal deformation produced extensive changes in the natural environment. In other words, environments formed by nature were destroyed by nature, and as a result, environments that humans had made by modifying nature's surface were destroyed by the tsunami and liquefaction. Manmade objects suffered earthquake damage of varying degrees. The tsunami claimed approximately 20,000 victims. Moreover, at a supposedly robustly constructed nuclear power station, the loss of electric power led to interruption of the supply of cooling water so that fuel rods went into meltdown and the resulting hydrogen gas caused an explosion which damaged the building and allowed radioactive substances to scatter over a wide area. It is feared that this radioactive contamination will have damaging effects on human health and the prediction is that it will ultimately take 30 to 40 years to deal with the consequences of the accident. Nuclear power has been promoted as being free from CO_2 emissions and representing a low-cost form of electricity generation, but this accident has undermined the basis of that argument. Nuclear power generation, which is at the heart of our response to the energy problem, is beginning to be viewed very critically. In addition to the environmental issue of radioactive contamination, this accident has thrown up grave social and economic problems, notably the long-term evacuation of the local population and the suspension of local economic activity. The main cause of this situation, which ranks as an environmental crisis, is that the nuclear power station facility was not designed to withstand a major tsunami. In other words, it boils down to a question of facility design.

The people of the regions hit by the earthquake and tsunami have lost their homes, and the regions' production activity has suffered very serious damage. Some regions had a cluster of plants producing automotive and electronic parts that served the world. Although there are many enterprises which have managed a speedy recovery, it seems likely that the disaster will accelerate the overseas transfer of manufacturing. In addition to loss of human life, buildings and infrastructure, disasters thus greatly impair social and economic activity. The greater the scale of the disaster and the wider its extent, the greater the impact. The 11 March disaster produced many victims, dealt the economy a severe blow, brought societal activity to a complete standstill, and created new environmental issues by necessitating massive resource and energy deployments for the clearing of large volumes of rubble and the rebuilding of destroyed buildings and infrastructure which are necessary for recovery. There is no way of calculating the economic loss, but it is thought likely that it will ultimately be equivalent to the Japanese state budget for a whole year. In this way, the destruction of social infrastructure and facilities exerts a lethal negative impact on economic and social activity. Social infrastructure and facilities are, self-evidently, provided as a basis for social and

economic activity. This provision raises the efficiency of social and economic activity and, according to the economic principles of hitherto, encourages expansion of all activities. Thus simple expansion of economic activity is not desirable from a sustainability perspective. Nevertheless, affecting a major increase in resource and energy efficiency to facilitate economic expansion is the ultimate goal. Fig. 1 is a diagrammatic representation of the consumption of resources and energy, the production of goods and services, and their relation to environmental burden based on three different scenarios.

(1) Scenario 1:

Resource and energy efficiency stays at current levels, while population increases and living standards rise.

(2) Scenario 2:

Population increases and living standards rise, and resource and energy efficiency rises in proportion to them.

(3) Scenario 3:

Population increases and living standards rise, while the increase in resource and energy efficiency is greater than the increase of population and living standards.

In Scenario 1, the environmental burden increases while in Scenario 2 it is maintained at the current level. However, it is recognized that Scenario 2 is an inadequate solution under current global conditions. We therefore need to think of a future direction based on Scenario 3, in which resource and energy efficiency is drastically improved, the environmental burden is significantly lowered, and the volume of goods and services produced is also increased above the present level.

Within the sustainability framework outlined above, the position of the concrete and construction fields needs to be clarified. In the construction field, whenever an earthquake or other major disaster has caused damage, structural design has been made safer. The 11 March disaster has once again caused people to recognise the importance of safety and reliability in buildings and infrastructure. In other words, they have learned that robust buildings and infrastructure are the foundation of sustainability. Scenario 3 above refers not only to general production activity but also includes the resources and energy consumed in the concrete and construction fields. If the population increases and living standards rise, demand for buildings and infrastructure development increases, and as a direct or indirect consequence resource and energy consumption grows. It would be premature to think that the events of 11 March have swept away the problem of reducing environmental burden; the need to consider resources and energy (the environmental aspect) and the economy as well as safety and reliability (the social aspect) as part of the sustainability framework, remains.

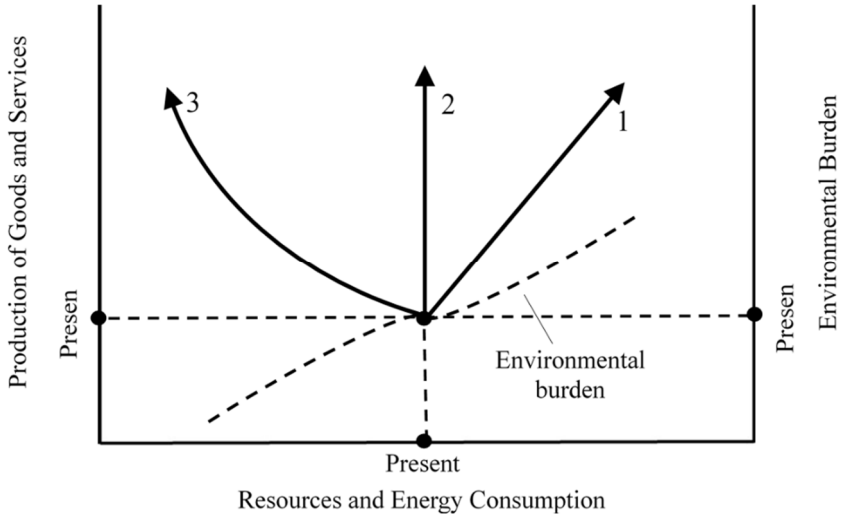

Fig. 1 Three environmental burden scenarios.

Striking a balance between these is far from simple. In fact, there are major issues regarding the robustness of existing buildings and infrastructure, and when it comes to the minimization of resource and energy use in future buildings and infrastructure development, the available technology and assessment rules are a long way from being adequate. What we can do is to learn from experience and keep our eyes on the future as we continue working to resolve the issues one at a time. Thus, the East-Japan Great Earthquake provided us an important opportunity to think how to consider social sustainability in construction industry. The basic framework of sustainability design in concrete structures was produced by this disaster. The ISO (International Organization for Standardization) 13315 series on environmental management for concrete and concrete structures have been published since 2012.

5. Sustainability-Resilience Dispute

Sustainability is the overall expression of sustainable development. As already described, it consists of three pillars (environmental, economic and social aspects). However, there is the case in which only environmental aspects like CO_2 and natural resources are considered in sustainability without social aspects. This means that as our main theme, which is structural safety etc., is detached, resilience has to be introduced. This causes a confusion. Then, an expression like "sustainable and resilient structure" is required and therefore the set of both words are still used. The theme of "Our Common Future" by the UN is the sustainable development, which means how we should do our activities to keep sustainable society on the Earth. In other words, things should be judged if it is sustainable including all aspects.

On the other hand, if we pay attention to resilience, social resilience and ecological resilience both function. Therefore, it is possible to use any of both. However, as the mission of the construction industry is to establish social foundation, we can cover all by sustainability, and resilience can be particularly used in the resistance against special mechanical actions like impacts. It is different in the field. The important thing is the definition in our use.

At present, the population increase and climate change are profoundly affecting people's life. From the world turmoil on energy supply which was caused due to the invasion of Russia to Ukraine, the consumer price rises have occurred. From the priority of human surviving, the pursue of low carbon economy is becoming fragile. Based on this collapse of the world cosmos, we have to ask questions "who owns natural resources and atmosphere in the Earth?" Depending on the answer, the framework of social resilience and ecological resilience may become possible. This is not so big issue. It is just the preference problem of individuals as far as it is systematic.

In any case, appropriate indexes are needed to evaluate the performances.

6. Ethics

For the attainment of our common targets in sustainability or resilience, various systems have to be made. Politically, liberal democracy is a large framework. The individuals can take any action and select their leader by voting. However, some countries impose constrains on people's behaviors. After the democratic validity is gained, authoritarian systems are gradually made. This means a corrosion of liberalistic rules, in which people do not notice. The person who does this has a clear intention. The boundary of right and wrong is normally in ethical gray zone.

If the personality of favorable character can be expressed with ethics, all rules should be based on the common ethics. Even if it is the rule-based behavior, normally its interpretation varies. However, any problem does not occur unless self-interest is pursued.

In the development of rules, when the purpose is ethically clarified, it may be easy to understand by

setting standard like better society construction. Concerning contentious matters, the transparency of thoughts or contention is significant. It is because the clarification of contentions enables an appropriate response according to the change of situation. In academic fields, dominant positioning of personal thoughts is not frequently.

fib has developed its Model Code. The purpose of MC is that the code writers of other organizations enable to utilize the latest information or ideas. As the technology information is fast-evolving, the Model Code is not always the best. Some contents, which do not partially have adequate agreement, are included. When the code writers cannot find adequate background in any article, its adoption may be ethically discreet or some notes on the issues should be made in the complementary including black boxes.

Diverse group of people are drafting the Model Code. The basic attitudes of people as human being and engineers are not the same. Furthermore, the attitude for technology development and their experiences are different. From that point of view, the code writers may clarify their ethical basis. For example, the principle description which leads to sustainable technologies and does not cause green wash may be an ethics code. Its basis should be (a) transparency and (b) exposure of information. The governance in code maintenance is also important. We may call such a system “ethics-based sustainability”. We are now living at the era of Sustainability 2.0.

Ethics go back to Aristotle at the Greece Era. He asserted that virtues exist in the moderation which means the intermediate between exceedance and inefficiency. After about 2,300 years since Aristotle, human being found a concept “sustainability”. It is very interesting to realize that Aristotle was saying the same concept as sustainability at Greece Era. In modern society, excess and deficiency is being broadened due to the complicated advanced systems and the gap between rich and poor. Under such situation, it is very important how to contribute to the wellbeing of human being by constructing infrastructures and buildings. This means that in order to realize sustainability of our society, engineers have to be based on the ethical thoughts in their activities. This is a reason why ethics code should be added in MC2020. But, it was not included due to the time shortage.

Ethics code here is defined the ethical norm in the understanding and deal of Model Code 2020. The code writers can develop their own standard specifications by selecting principles which seems to be significant, indicated below.

Principle 1: Basic ethics as human being and engineers shall be kept.

Principle 2: Imperfection of technologies and systems shall be recognized.

Principle 3: Accountability on each provision shall be required in high priority.

Principle 4: Good communications with fib shall be kept for feedback.

Principle 5: The description that may cause green wash shall not be made.

Principle 6: MC shall not be used for war businesses.

Of course, there might be other principles to be added.

7. ICCS (International Conference on Concrete Sustainability)

In 2013, an international conference ICCS was founded in Tokyo. The purpose of the conference was to promote R&D (research and development) on sustainability. The second one was organized in Madrid. The third one was organized in Prague as fib ICCS in 2021, in which the following Prague declarations were issued:

(1) In order to recreate our society, we have to develop new ethics as human beings. The new ethics include the consideration of sustainability for the design, construction, maintenance, and reuse of concrete structures.

(2) The framework of sustainability in the fib Model Code 2020 for the sustainability of concrete structures,

that is under development, shall be shortly introduced to the world.

(3) More research on the essence of sustainability shall be promoted and fib ICCS shall be a platform for discussions around the world for sustainability of concrete structures.

(4) An evaluation system to promote sustainable technologies shall be developed. The fib will strongly support the development of this system. The remaining time for transition is very short and we must act quickly.

(5) Some insights shall be given in any research to avoid the linkage with greenwash.

This declaration is focusing on a completely new era in which a true sustainability is established under healthy ethics. In EU (European Union), AI (artificial intelligence) ethics are under discussion. Although our industry is different from AI industry, we can often see green wash activities. The world is becoming more and more complicated. Therefore, we will have to pay attention to the essence of sustainability.

It failed to incorporate ethics into MC2020, in which there were some serious arguments. In addition, we still have some technical problems to be resolved in the future. It would be obvious that "sustainability" will be realized under proper ethics. It is an endless challenge. This is the reason why I proposed the necessity of ethics code in TG10.1 and/or fib. As the proposer's responsibility, an action was taken for setting the small group to discuss how to go forward. The members were nominated from the past, current and future presidents, and a MC2020 coordinator. All accepted this invitation.

8. Concluding Remarks

The previous construction engineering has been mainly focused on the mechanical design of a structure. However, it is in the future required to build infrastructures and buildings considering sustainability which consists of social, economic and environmental aspects. The fib Model Code 2020 has followed this concept. In this design system, each performance has to be clarified to confirm the satisfaction of requirements. It can be said that the construction engineering has finally evolved into a comprehensive engineering. The concept of performance-based sustainability design enabled this. In other words, this new concept can lead the extension of classical mechanical-oriented design system to more global design system, which is sustainability. This is a revolutionary evolution. This concept was shown in 1997, a quarter century ago, by fib [2]. One of the reasons why this design system is becoming important is that human being is being required zero-carbon as the common target until 2050. In order to protect the Earth from the disaster due to global warming, humanity has to last the challenge toward its target. And then, endless social sustainability will be pursued.

In the construction industry, design standards and guidelines have been established taking a long time. Even if it were, the history is around 100 years. It seems that the engineers are preoccupied with them and are not interested in new region required as earthling. However, it is better to think that we are at the stage it is not allowed. Even though the construction industry has influenced a great impact on environments, the engineers could avoid such problems in the work. However, it is obvious that the construction engineers have to change their attitude.

Norwegian female Ex-prime Minister Brundtland played an important role in producing a concept "sustainability". And right now the current Prime Minister Solberg is promoting government-led actual scale CCS (carbon capture storage) project in cement production. Viking descendants take action to avoid the disaster of the Earth. Humanity is living in individual and organization. This seems to indicate the necessity of a society in which the will of individual can determine the direction of an organization and nation.

Since the setting of zero carbon target, the green wash type of activities is rampant. One of them is the use of carbonation in concrete. It is a theory in which $Ca(OH)_2$ in concrete can absorb CO_2 by chemical reaction like the absorption of CO_2 in wood. This

theory is shady in two points. It takes a long time in carbonation. The hardened cement product changed by carbonation. The carbonation will change the basic properties of hardened cement products. It is also a shady idea that produced $CaCO_3$ can be used in cement production because the cement production emits CO_2 constantly. After all, only ways are (a) no CO_2 emission or (b) capturing the emitted CO_2. The former is not possible as far as $CaCO_3$ is used as ingredient. The latter is possible, but will cause other problems on how to store or use the captured CO_2. We should not forget the fact that human being is utilizing the limestone which has been generated over hundreds of millions of years. We will need to find more reasonable way.

The fib issued sustainability statement in 2021 [7]. If the origins are traced, all come to R&D concerning the UN sustainable development definition, the previous commission 3, SAG8 and the East-Japan Great Earthquake disaster. The author has conducted them, as shown in this paper. It can be said that the consequence of these works on sustainability has produced MC2010 and MC2020 which is most important in fib.

Acknowledgments

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