

Committee Report : JCI- TC103A

Technical Committee on the examination of the relationship between social environmental and concrete industrial system

Yoshitaka KATO, Takeshi IYODA, Masanori ITO, Masaro KOJIMA, Tomoya NISHIWAKI and Manabu KANEMATSU

Abstract

In Japan, construction investment has been decreasing in recent years amidst complicated social conditions including globalization, a technologically-oriented society, a decrease in population, and aging with a slowing down of economic growth. Under such circumstances, keywords with a bad image are mentioned regarding the construction and concrete industries such as “sense of dead end,” “excessive competition,” “disadvantageous contract,” and “unpopular.” In order to discuss countermeasures to escape from this negative climate, we established a committee chiefly comprised of relatively young engineers and researchers to study social conditions, changes in domestic technologies and industrial structure, and overseas conditions that mold environmental conditions, with an awareness of the connection between the past, present, and future. This report summarizes the study results.

Keywords: social conditions, infrastructure development, changes in the domestic construction industry, changes in the overseas construction industry

1. Introduction

In the 45th general election of members of the House of Representatives held on August 30, 2009, the Democratic Party, who used the catchphrase of “From Concrete to People,” won an overwhelming victory and became the ruling party. While it is unpleasant for concrete engineers that “concrete” was used as a misnomer for investment in wasteful public facilities, it is apparent that wasteful investment should be avoided either in public facilities or people. The Ministry of Land, Infrastructure, Transport and Tourism (former Ministry of Construction) has decided to implement projects by evaluating the effects of public works based on a cost-benefit analysis since 1999; however, it is extremely difficult to quantitatively estimate all the benefits from investment in the public sector. In Japan, in particular, where social conditions are complicated by globalization, a technologically-oriented society, a decrease in population, and aging as well as a slowing down of economic growth, views on

Table 1: Committee members

Chairman	Yoshitaka KATO	Tokyo University of Science
Secretary-General	Takeshi IYODA	Shibaura Institute of Technology
Secretary	Masanori ITO	Tokyu Construction
	Manabu KANEMATSU	Tokyo University of Science
	Masarou KOJIMA	Takenaka Corporation
	Tomoya NISHIWAKI	Tohoku University
Member	Hiroyuki IGARASHI	Kanto Ube Concrete Corporate
	Masahiro OUCHI	Kochi University of Technology
	Masakazu KOBAYASHI	Kansai Ube Co., Ltd
	Takahiro SAGAWA	Nittetsu Cement Co., Ltd. (Nippon Steel & Sumikin Cement Co.,Ltd.)
	Sachie SATO	Tokyo City University
	Ayanori SUGIYAMA	Taiheiyo Cement Corporation
	Mika SUZUKI	Taisei Corporation
	Junichi TANAKA	Kumagaigumi Co.,Ltd
	Hirofumi TANIGUCHI	Hazama Corporation
	Masaki TAMURA	Kogakuin University
	Kohei NAGAI	Institute of Industrial Science, The University of Tokyo
	Yasuhiro FUCHIDA	Obayashi Corporation
	Toshimi MATSUMOTO	BASF Pozzolith Ltd. (BASF Japan Ltd.)
	Ipppei MARUYAMA	Nagoya University
	Masashi MORIKAWA	Central Japan Railway Company
	Michael HENRY	Institute of Industrial Science, The University of Tokyo
	Junji YAMASAKI	Asanuma Corporation
	Toshinobu YAMAGUCHI	Kagoshima University
	Takashi YAMAMOTO	Kyoto University
	Takehiro KAMAMOTO	Nippon Expressway Research Institute Company Limited (until June 2011)
	Kenichi MIYANAGA	Nippon Expressway Research Institute Company Limited (from July 2011)

the effects of public-works projects vary significantly among knowledgeable people including researchers, with seemingly few of them insisting that active investment should be made in the public sector in a climate of deflation. In any case, it is an obvious fact that construction investment in the public and private sectors as of fiscal 2011 has decreased to approximately half of the peak level in 1992, an obvious indication that the changes in social conditions are closely related to the structure of industrial investment.

As domestic construction investment thus decreases, keywords with a bad image like

“sense of dead end,” “excessive competition,” “disadvantageous contract,” and “unpopular” come to be increasingly mentioned by construction workers. This tendency seems to be stronger among those who remember the high economic growth period or the bubble economy period. Although not limited to the construction industry, those who remember the high economic growth period or the bubble economy period seem to seek a different significance in their occupation from those who did not (university graduate workers in the generation aged 43 or younger as of fiscal 2011 have not experienced the bubble economy in their career), and this tendency seems prominent for younger generations.

On the other hand, companies seeking growth may select overseas expansion as a means of growth if it is difficult for them to create new customers in the domestic market. While it seems that the construction industry has repeatedly attempted to expand the business overseas, the overseas presence of Japanese construction companies is not high due to their difference from overseas construction companies in the way they do business.

In the concrete field, while some concrete materials are both imported and exported for their characteristics such as ease of procurement, abundant production, and low cost, which are reasons why concrete has been used as a principal construction material, concrete is, in principle, a material to be locally produced for local consumption. As concrete is basically used within approximately 1 hour and a half after preparation, the spatial market area of concrete manufacturers is inevitably limited (temporal and spatial constraints). In addition, unlike major construction companies, as it is extremely difficult for concrete manufacturers to create demand by themselves, they are inevitably a passive industry, and thus the decrease of construction investment will directly result in a smaller market for concrete manufacturers. Accordingly, while the number of plants decreases with decrease of construction investment, as it would be impossible to reduce the number of plants according to the decrease in demand if the above supply of fresh concrete were taken into account (temporal and spatial constraints), the plants may suffer a decline in profits.

Against a backdrop of the above situation, we set up the “JCI-TC103A Technical Committee on the examination of the relationship between social environmental and concrete industrial system” in fiscal 2010, chiefly comprised of relatively young engineers and researchers as shown in **Table 1**, to conduct research and study activities during the period until March 2012. In discussing the future, in order to have fruitful discussions with an awareness of the connection between the past, present, and future instead of just a mere casual idea, previous technologies and changes in the industrial structure need to be properly understood. In addition, given the importance of properly understanding the social conditions

that mold environmental conditions as well as what should be learned from overseas conditions, the following three WGs were established:

- WG for Study on Social Conditions (headed by Manabu Kanematsu from Tokyo University of Science and Tomoya Nishiwaki from Tohoku University)
- WG for Study on Changes in Concrete Industry (headed by Masanori Ito from Tokyu Construction)
- WG for Study on Overseas Concrete Industry (headed by Masaro Kojima from Takenaka Corporation)

The report is composed of the following parts. This report summarizes the results of these activities. For details, see the full report.

- Part I : Social conditions and infrastructure development
- Part II : Changes in the domestic construction industry
- Part III : Changes in the overseas construction industry

2. Social conditions and infrastructure development

Part I introduces a questionnaire survey on the condition of infrastructure development, globalization of the industry, etc., including population movements and green issues, with the objective of overviewing social conditions. Information about those factors surrounding the concrete industry may also have a strong impact on the industry itself.

The survey results are summarized below.

2.1 Social conditions

(1) Population movements

While the entire world population reportedly exceeded 7 billion at the end of 2011, the population of Japan started to decline in 2004. The so-called depopulation society will inevitably have a large influence on the social structure. That is exactly the case in the concrete industry. The report outlines population movements in Japan in the light of “Long-Term Land Prospects / Interim Guidelines” (February 2011) reported by the Long-term Prospects Committee established within the Ministry of Land, Infrastructure, Transport and Tourism, and shows the changes in construction investment and fresh concrete shipment based on various statistics with respect to the influence associated with the changes in population movements.

(2) Green issues

Now that global green issues have come to the surface, it is necessary to give consideration to the environment. This section summarizes the information required for grasping the present state of green issues associated with the concrete industry from a wide perspective. **Fig. 1**¹⁾ shows prospects of energy-derived CO₂ emissions in the world. While CO₂ emissions obviously tend to increase with population growth, **Fig. 2** shows that the rate of increase has tended to become smaller with 2005 as a turning point. Green issues need to be discussed continuously from a comprehensive perspective, including the frameworks of conventions and laws.

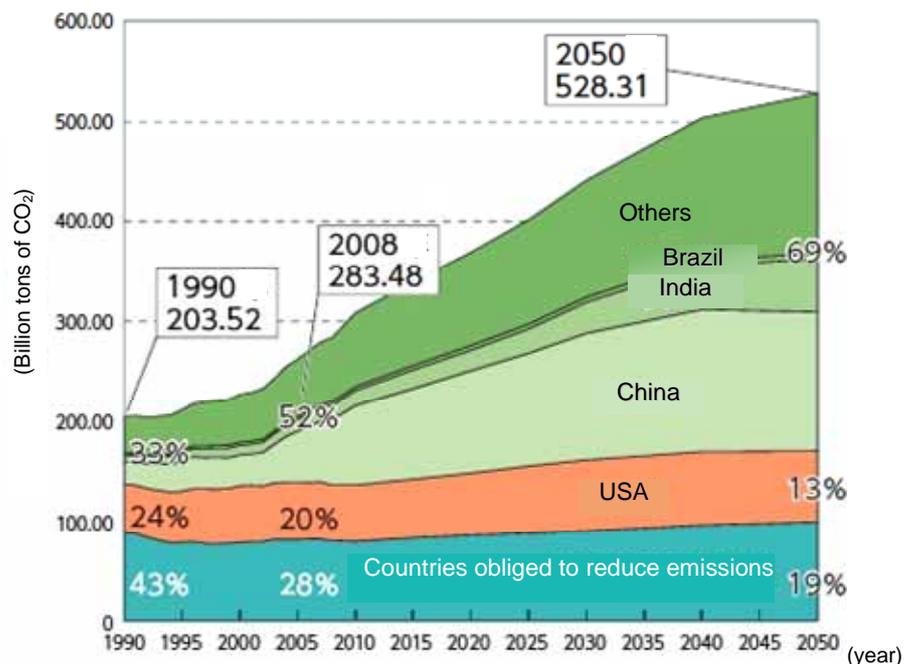


Fig. 1: Prospect of energy-derived CO₂ emissions in the world¹⁾

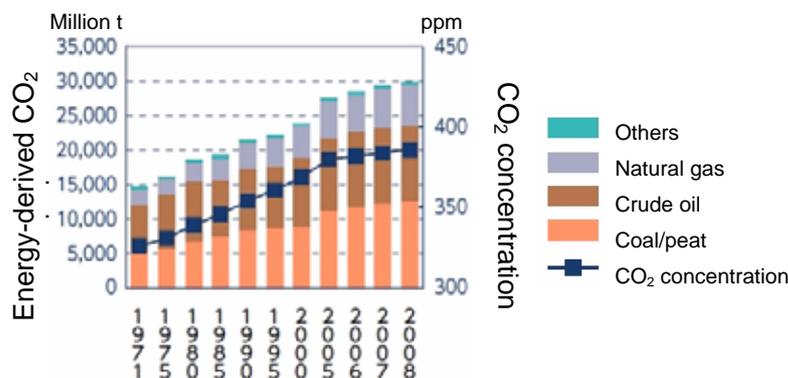


Fig. 2: Changes in atmospheric CO₂ concentration and energy-derived CO₂ concentration¹⁾

(3) Energy/resources

In the construction field with a large environmental impact, energy conservation needs to be ensured throughout including work done with concrete. The previous changes and future trends of energy consumption were outlined both overseas and in Japan to discuss efforts especially in the cement field. As is well known, the cement industry emits significant CO₂ with inevitable raw material-derived CO₂ emissions as well as energy-derived CO₂ required for manufacturing. On the other hand, Japan has an extremely high level of technology and holds a very prominent global position in the energy amount required for unit clinker production. While Japan promoted improved energy efficiency making it possible to cut energy consumption by approximately a half compared with the 1970 level, it is pointed out that large quantities of products are produced in the United States and China with an energy consumption at a level equivalent to Japan's previous level before 1970. From such a perspective, international technology transfer from Japan may be an effective means even as regards the aspect of energy consumption and environment.

2.2 Infrastructure development/new investment and maintenance

(1) Supply and demand, new investment/maintenance

In the downward trend of construction demand, future prospects are increasingly important. This section shows a method of effectively using the changes in construction demand obtained from advanced cases irrespective of the differences in time period and country. Specifically, this method predicts the future demand in Japan by defining indicators for the “concrete increase rate”, and by comparing them with advanced nations where infrastructure development is regarded as quantitatively sufficient. As shown in **Fig. 3**, the concrete increase rate in many advanced nations remains at a stable value ranging from 1.0% to 2.5%, while the concrete increase rate in Japan is tending to decline at present, suggesting that it will settle at a certain value in near future.

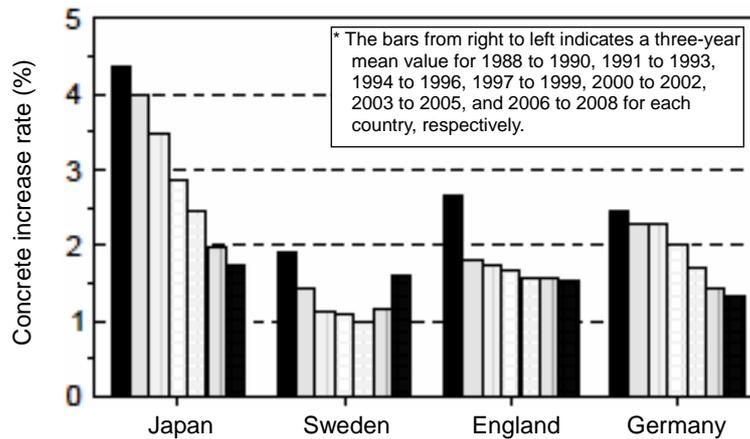


Fig. 3: Changes in concrete increase rate over the last 21 years in various countries²⁾

(2) Social capital improvement

This section discusses roads and railroads in civil infrastructures, and summarizes the previous development condition of roads and new trunk lines based on statistical data. It is reported that while new roads have been developed at a certain length so far, road development is showing a decreasing trend in recent years, and the construction of new trunk lines involves a significant percentage of tunnel structures. Thus, handling of tunnels is important.

(3) Building/housing capital

In order to get a future vision of building/housing capital, this section organizes statistical information such as construction, dismantling and disposal of structures, and existing stock. **Fig. 4** shows the relationship between the supply of super high-rise condominiums as of 2010, and the predicted number of buildings starting major repair works in future. In terms of super high-rise alone, it is shown that while development has rapidly increased since 2000 as a turning point, major repairs may rapidly increase beyond 2014 assuming a general planned repair of 15-year, 30-year, and 45-year cycles. While it is rare that the framework will be subject to planned repair, it is suggested that the importance of long-term maintenance will increase more and more in future.

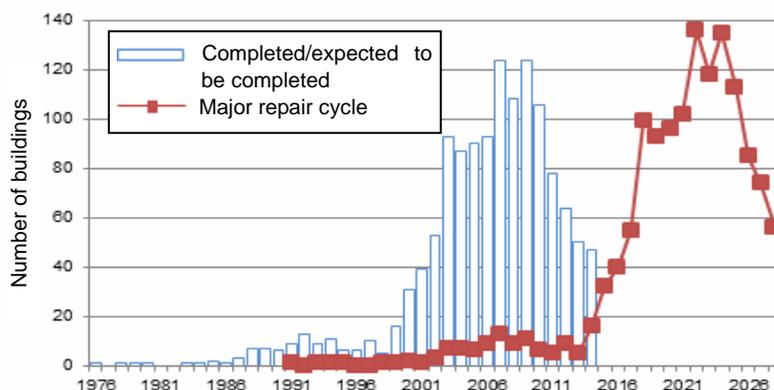


Fig. 4: Supply trends of super high-rise condominiums and predicted number of major repairs (based on 3))

2.3 Human Resources/education and globalization

(1) Globalization

While the construction industry in Japan is on a decreasing trend, there are many robust overseas markets in the world including the Asian region, and here, Japanese construction companies may have a chance to compensate for the reduction in domestic demand and to make a leap forward. This section summarizes the present condition of overseas expansion and globalization of the construction industry, given that the overseas expansion of construction companies also suggests the direction of the concrete industry. Overseas construction contracts peaked in fiscal 2007, and then significantly declined after the Lehman Shock in fiscal 2008. However, there was a resurgence of contracts both in number and amount in fiscal 2010 after the industry hit bottom in fiscal 2009. In the meantime, comments on the efforts on overseas projects are summarized from data on the amounts of overseas projects taken from financial statements of construction companies, and from interview accounts with the presidents of construction companies published in trade journals. In the comments, company presidents report on their positive efforts on overseas projects in the regions and countries within their sphere.

(2) Human resources/education required for globalization indicated in questionnaire

The present state of overseas construction and matters related to the human resources and education required to promote globalization in future were summarized based on the results of a questionnaire conducted by this committee. It is pointed out that Japanese concrete is recognized to be superior in quality, and that it is important to sufficiently grasp and understand local social customs and contracts, and material conditions.

(3) Opinion survey with concrete-industry-oriented students

Separately from the above questionnaire survey, a survey was conducted on the future occupation and work style of university students and graduate students who will shoulder the future of the concrete industry. The results were sorted according to such features as whether the respondents live in the metropolitan areas or other areas, and whether they intend to work for the construction industry or the civil engineering industry, etc. However, no significant difference in orientation was necessarily observed.

3. Changes in the domestic construction industry

In order to further revitalize the construction industry to continuously construct a care-free and safe society, it is necessary to understand the relations between social conditions and development construction technologies by going back to the relevant time. In Part II, an investigation was made of the changes in the domestic construction industry, changes in the main materials for concrete such as cement and aggregate, and changes in the fresh concrete industry. In addition, an investigation was made of maintenance, repair/reinforcement and dismantling technologies, which are considered to be important in future, as well as of changes in construction technologies on site. A further investigation was made of the present status and future vision of concrete-related standards and university education separately for the construction field and the civil engineering field.

The investigation results are summarized below.

3.1 Changes in the construction industry

(1) Changes in construction companies in Japan

The changes of construction companies in Japan were investigated with reference to the Handbook of the Construction Industry published by the Japan Federation of Construction Contractors, etc. **Fig. 5** shows the construction investment amount and the number of licensed contractors. The number of construction companies in Japan increased from the post-war high economic growth period to the late 1990s with credit-based business in principle, unlike those in foreign countries. After the bursting of the bubble economy, however, as the economic climate in the whole country slowed down and investment in the public sector decreased, the number of construction companies started on a downward trend as well. In particular, the number of companies going bankrupt is tending to increase among such companies as they are subcontracting to many small-to-medium sized companies and microenterprises due to fierce competition. As the economic climate is not expected to recover for the time being in future, the construction industry will remain in an extremely difficult condition, and

companies may inevitably have to strengthen and reform their corporate structure including globalization.

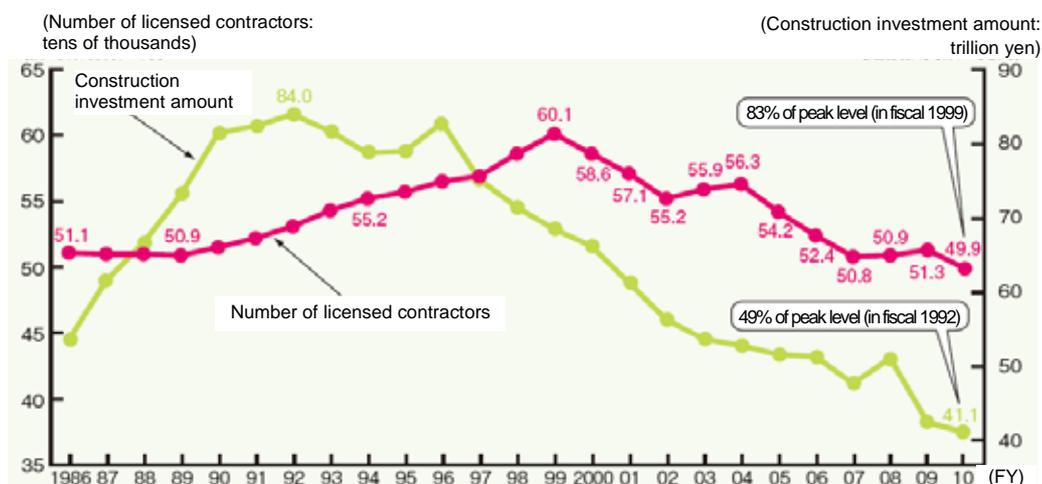


Fig. 5: Changes in construction investment and number of licensed construction contractors⁴⁾

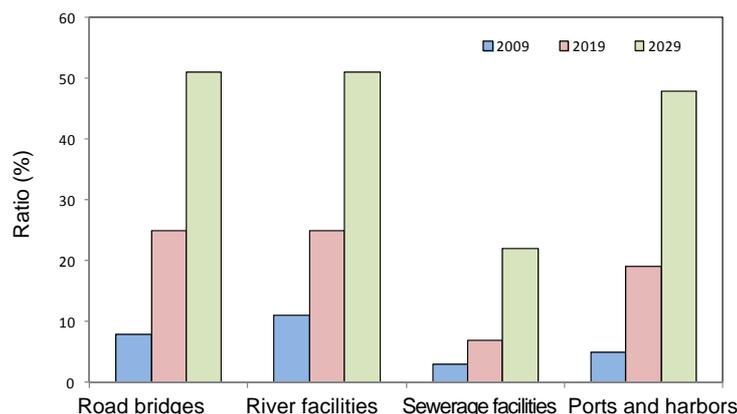


Fig. 6: Ratio of structures 50 years old or older⁴⁾

(2) Changes in the construction market

In terms of the construction market, maintenance repair work ratio tends to exceed new construction with a decline of total investment in the public sector. For example, as shown in Fig. 6, with the increased deterioration of structures built during the high economic growth period, more than a half of road bridges are expected to be 50 years old or older in 15 years or 2029. Under such circumstances, upgrading of technologies relating to maintenance, repair and reinforcement is under way. However, because structures with higher quality need to be constructed and because the future prospect of the domestic market depending on repair and reinforcement work is limited, relatively large-sized construction companies tend to gradually

increase the ratio of overseas work.

(3) Contracting of domestic work, and changes in type of contracting

The construction industry in Japan reportedly started as early as before the sixth century. It developed with the construction of shrines and temples, and the form of contracting work has changed with time. After the completion of the basis for the present contracting system in the Meiji era, the contracting method for public works has shifted to overall evaluation bidding since fiscal 2005 via the post-war to high economic growth period. A questionnaire survey conducted to evaluate this method reveals that both the owner and the contractor evaluate it at a certain level.

3.2 Changes in the concrete industry

(1) Concrete materials

While there is much data on the history of concrete materials, this section looks at the history of reformation of cement manufacturers as the history of the cement industry, and discusses how manufacturers came to be merged into larger manufacturers with the trend of the times. In addition, the report summarizes the result of a survey on changes in the number of cement plants and demand during the period from 1990 to the present.

(2) Changes in the fresh concrete industry

Since Japan's first fresh concrete plant was inaugurated in 1949, the number of fresh concrete plants has increased with the expansion of infrastructure development chiefly in urban areas. Large-scale machinery introduced from overseas has significantly contributed to this increase, and today enables fresh concrete to be supplied with stable quality to construction sites in various regions of Japan. During the high economic growth period, however, there was too much fierce competition which partly started with the expansion of the market and which presented a significant social problem. Under such circumstances, a bureaucrat-led cooperative association was organized with the objective of ensuring sale of fresh concrete at a fair price and elimination of bad quality fresh concrete. This resulted in the establishment of Japan's proprietary business transaction mechanism, where a distributor intervenes between the customer construction company and the manufacturer as a credit management function.

In addition, as a new type of fresh concrete plant, an IT-based automated plant system has been developed and commercialized. Moreover, in urban areas etc., technologies that meet the demand of the times, such as a plant equipped with a system including a mixer inside a building for the purpose of reducing the environmental burden, started to be applied in this

field.

3.3 Changes in concrete technology

(1) Changes in concrete construction technology

Fig. 7 shows a summary of the changes in concrete work, and the changes in concrete placement amount. Since the 1920s, concrete started to be used in Japan, and the placement amount has gradually increased. At the same time, concrete construction technology developed with vertical transportation technology mechanized in construction work, and horizontal transportation technology in civil engineering work.

This section also summarizes an investigation of concrete construction technologies for transportation, pumping, forming, timbering, placing, compaction, etc.

(2) Construction/civil engineering concrete structure

Representative structures include super high-rise buildings. They are concentrated in urban areas such as Tokyo and Osaka, and ultrahigh strength concrete with a compressive strength of 100 N/mm^2 is used for them. In addition, development of various technologies required for the construction of super high-rise buildings are under way. These include technologies specific to Japan, an earthquake-ridden country, such as earthquake-resistant, vibration-control, and aseismic base isolation technologies. New technologies were used in the construction of the Tokyo Sky Tree that is now attracting attention as a new landmark.

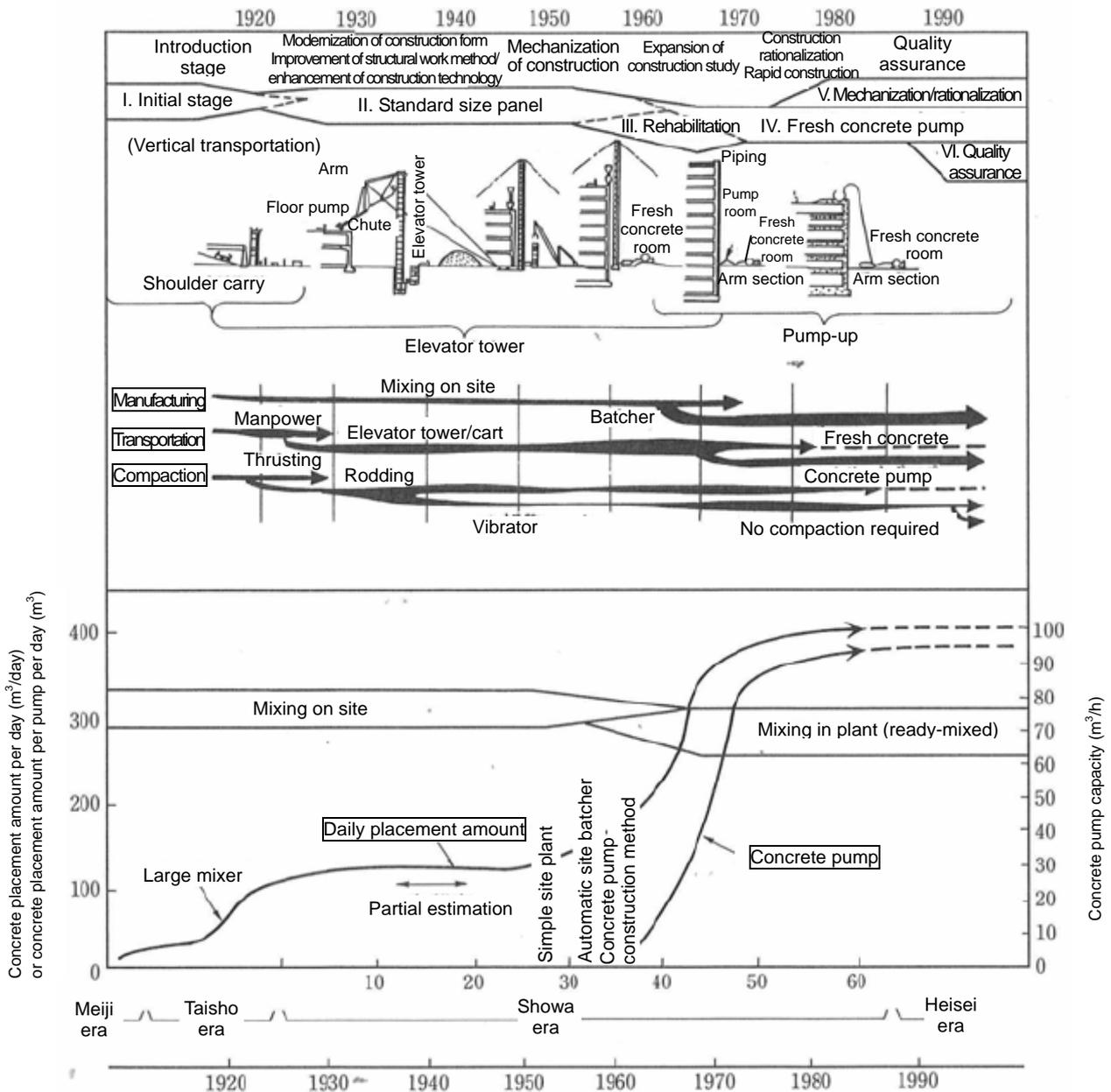


Fig. 7: Summary of changes in concrete work and changes in concrete placement amount ⁵⁾

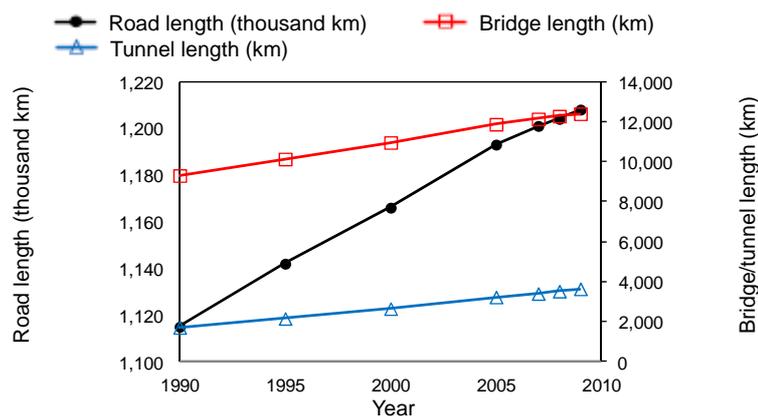


Fig. 8: Road length, bridge length, and tunnel length since 1990⁶⁾

On the other hand, bridges and tunnels are important infrastructures that support civil life in Japan, where most flatland is surrounded by mountains, and cities are scattered around the small territory. In this section, the changes in such technologies are investigated. **Fig. 8** shows the road length, bridge length and tunnel length since 1990, indicating that both bridges and tunnels have been constructed at a similar rate as road length. Various shield tunnel technologies were developed recently such as the double-track type and box type, as well as the ordinary circular cross section. Being top world-class technologies, it is expected that they will be much employed in foreign countries including Southeast Asia.

(3) Maintenance, repair/reinforcement, dismantling technologies

As civil engineering structures are highly public in nature, and where it is difficult to temporarily suspend services, they are generally used continuously by being maintained, repaired and reinforced. On the other hand, structures may be dismantled in several tens of years as the facilities deteriorate, or become unable to meet the demand of the times such as the dissemination of the Internet. In this section, the maintenance history and repair and reinforcement technologies are summarized, focusing on roads as well as other civil engineering structures.

For dismantling technologies, dismantling of high-rise buildings and dismantling of buildings tilted by earthquake were surveyed. Dismantling methods are expected to be continuously developed in future chiefly for urban areas that take the environment, cost efficiency and safety into consideration.

3.4 Changes in concrete-related standards and future issues

(1) Changes in JASS5 of Architectural Institute of Japan and in RC specifications of Japan Society of Civil Engineers

The laws, regulations and standards relating to structures are comprised of various

relevant laws and regulations, JIS and other standards, with the Building Standards Law and its enforcement order at the top. The JASS, which has been established by the Architectural Institute of Japan, aims to supplement legal regulations and provide technical support by providing construction standards in Japan based on legal regulations including the Building Standards Law and its enforcement order. This section summarizes the key points of JASS and the revised provisions of JASS5 as regards reinforced steel concrete structures, with special reference to the handling of design strength. It also summarizes the concrete standard specifications, which are standards for the design and construction of civil engineering concrete structures, with respect to the background of their establishment, details of major revisions, and the scope of the existing Design Edition, Construction Edition, and Maintenance Edition.

3.5 Relations between the concrete industry and university education, and future vision

(1) Present state and future vision of subjects and specialty in the construction department and civil engineering department

This section summarizes the recently reformed university education curricula, including qualifications for First Class Architect that were revised as a result of the fabrication of a series of structural calculation sheets which was discovered several years ago. **Fig. 9** shows the results of a questionnaire survey conducted by the Architectural Institute of Japan in 2011, and reveals that students of younger years have low interests and concerns regarding construction materials. The report therefore concludes that construction materials need to be emphasized in the first year of university education, and that efforts should be made in the human resources development of construction engineers who handle many materials including timber, metals, glass, and polymeric materials in addition to concrete.

On the other hand, the report regards globalization and maintenance as important keywords in university education for the civil engineering department as mentioned above, and stresses that it is necessary to develop human resources with broad knowledge, in addition to education in the construction field, to respond to present needs and future issues surrounding the acceptance of students abroad and maintenance-related work. It also states that OJT for learning through experience is important to develop human resources able to do practical work, and this should also deeply involve university education.

(2) Employment awareness of students

At the end of this part, the results of an opinion survey of construction and civil

engineering students are summarized by a questionnaire survey conducted by this study committee. For details, see the full report.

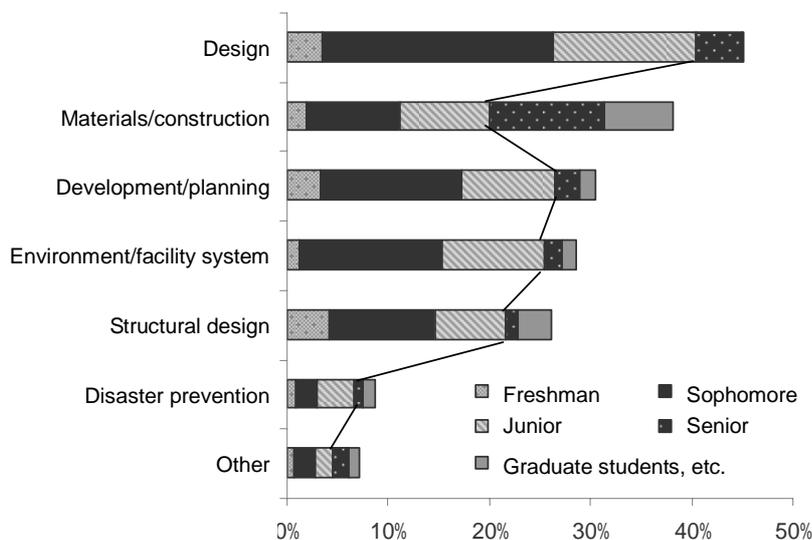


Fig. 9: Future intended career

4. Status of overseas construction industry

In considering the future of the domestic construction industry and fresh concrete industry, it is important to re-appraise the present state of Japan by investigating and comparing it with the status of other countries. To that end, in Part III, we investigated the industry in terms of markets for construction and concrete; the permits and approval system, and number of employees; the corporate structure and business results of individual companies; and overseas construction contracts based on various published statistical information and literature in various countries, chiefly advanced countries. We conducted a questionnaire on the overseas concrete industry and specific circumstances of engineers who are involved in overseas construction. The survey results are summarized below.

4.1 Survey of overseas construction industry

(1) Survey of construction markets and construction industry in various countries

Changes in investment in construction, the number of constructors, and the number of construction employees in various countries were investigated based on statistical information of the Ministry of Internal Affairs and Communications, the Cabinet Office, the Ministry of Land, Infrastructure, Transport and Tourism, the Research Institute of Construction and Economy, the International Labor Organization, etc. In addition, we also investigated the

construction industry licensing system, the bid contract system, and major construction companies in major countries.

Fig. 10 shows the changes in investment amount and the number of employees in the construction industry. The investment amount and the number of employed people in the construction industry in the United States and Japan are prominent among advanced countries. The construction investment amount per employee in the United States and Japan, which was approximately double that of other advanced countries ten years ago, is now at about the same level as that of other countries as a result of their significant increase in construction investment amount. The ratio of construction employees to all employed workers in Japan has been decreasing year by year, but remains at the highest level in major advanced countries.

(2) Survey of overseas companies

The corporate structure and the changes in business results of five major overseas construction companies and five major domestic construction companies were investigated and compared, based on annual reports of the overseas companies and financial statements of the domestic companies.

The overseas construction companies were divided into companies with a contractually-based corporate structure, and companies widely expanding their business in such fields as media/communications or transportation/electric power. The survey result shows that overseas companies have a high overseas sales ratio of approximately 40% for VINCI and Bouygues in France and more than 50% for other overseas companies, while Japanese companies have an overseas sales ratio of less than 20% (**Fig. 11**). It is inferred that European construction companies are positively expanding business in foreign countries because the size of the construction market per European country is small.

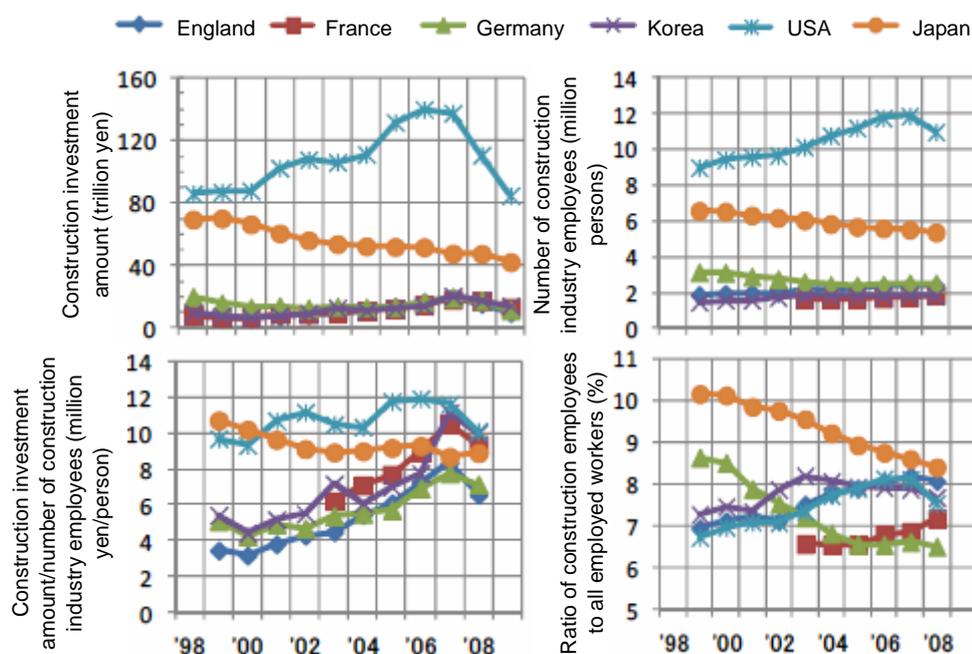


Fig. 10: Changes in construction investment and number of construction employees (based on 7), 8))

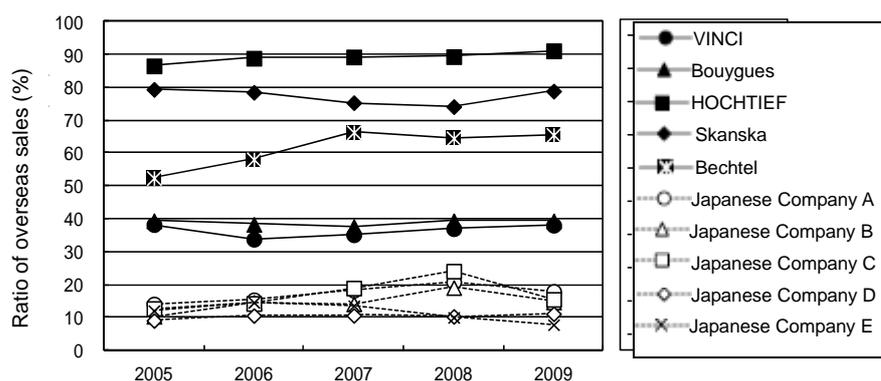


Fig. 11: Ratio of overseas sales to total sales

Fig. 12 shows the relation between sales amount and profit ratio in the contracting business, and all business. In terms of the two French companies, while Bouygues has a higher ratio in the media/communication fields and the transportation/electric power field, VINCI earns high revenue in the concession business with expressways, airports, railroads, and athletic fields. Other companies have a contractually-based corporate structure both in sales amount and profit ratio.

(3) Overseas construction contracts

Contractual troubles of Japanese companies frequently occur in overseas projects. That being the case, we investigated the outline of the legal systems (civil law, common law) and contractual conditions in various foreign countries. The conditions of contractual clauses for

FIDIC (Federation Internationale des Ingenieurs-Conseils), which is often used in international projects, were investigated, and the characteristics were listed in comparison with the Standard Conditions of Contracts for Civil Works and the General Conditions of Construction Contracts of Japan.

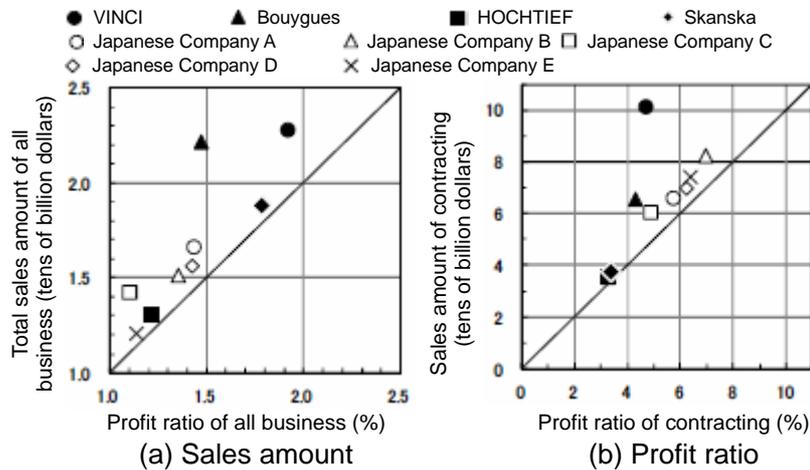


Fig. 12: Relations between sales amount and profit ratio of contracting and all business

4.2 Survey of overseas concrete industry

(1) Changes in the cement market

We investigated world production, export amount, and consumption amount of cement. Fig. 13 shows the per capita cement consumption amount, which indicate that the per capita cement consumption in China has rapidly increased in recent years. In Japan, both the production amount and the per capita consumption amount have been on a downward trend in recent years to a similar level as in major advanced countries.

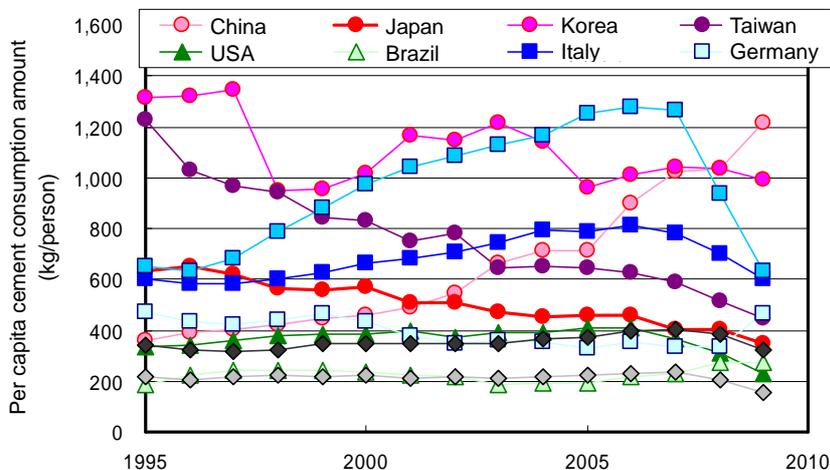


Fig. 13: Per capita cement consumption amount

(2) Survey of ready mixed concrete industry

We investigated the actual status of ready mixed concrete in various countries such as shipment amount, fresh concrete unit price, number of companies, number of plants, sales amount, and number of employees based on the statistical data of ERMCO (European Ready Mixed Concrete Organization), etc.

Fig. 14 shows the Big Mac Indices for fresh concrete prices of various countries published in statistical data, obtained by dividing fresh concrete prices by Big Mac prices in the respective countries. According to the Big Mac Indices, the fresh concrete price in Japan is around the middle, and is highest next to France among advanced countries.

Fig. 15 shows the relation between the number of ready-mixed concrete plants in various countries and the annual shipment amount. The shipment amount per plant in Japan (trend in the figure) is relatively close to that in advanced countries in Europe such as Germany, France, England, and Spain. The United States has a two to three times higher shipment amount with an equivalent number of plants.

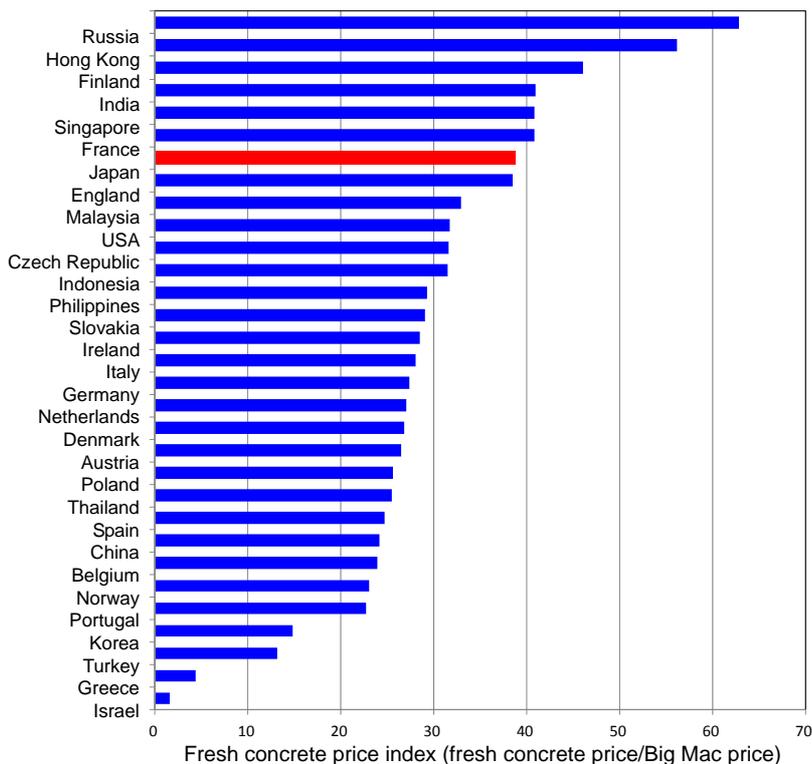


Fig. 14: Big Mac index of fresh concrete in various countries

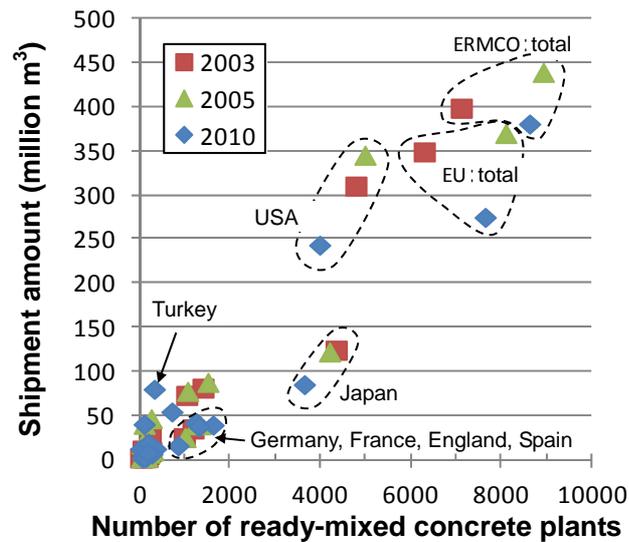


Fig. 15: Number of plants and annual concrete shipment amount in various countries (based on 11), 12))

Fig. 16 shows the relation between the annual shipment amount per employee and sales amount in various countries. The per capita annual production ranges widely from 640 m³ to 9,000 m³, and the sales amount from 8 million yen to 37 million yen. The production/sales ratio of Japan is about the same level to slightly higher than that of major advanced countries in Europe.

(3) Concrete structure design standards in Asia

The design standards adopted in the Asian countries, Korea, China, Thailand, Vietnam, Indonesia, Malaysia, and Singapore, are listed in a table. In addition, the application status of ACI, ASTM, ASHTTO, BS, ISO, and Asian model codes are summarized as international design standards. This section also discusses the significance of the Japanese design standard in Asia, existing issues, and the possibility of future contribution by Japanese standards.

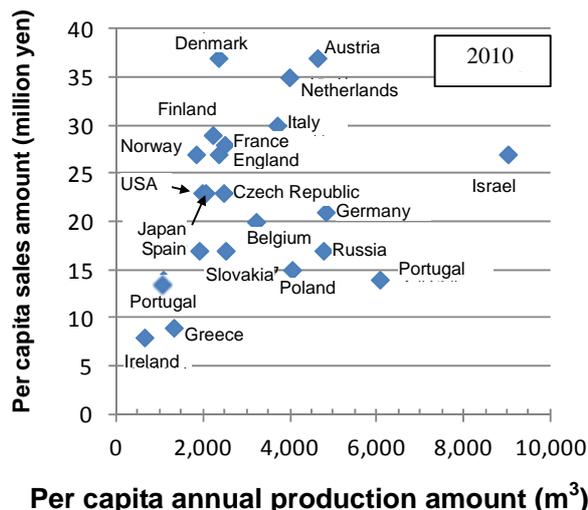


Fig. 16: Annual production and sales amount per employee (based on 11),12))

4.3 A questionnaire survey of the overseas concrete industry and the concrete situation

A questionnaire survey was conducted with engineers, who have experience in overseas construction, with multiple choices and free description of the actual situation of the overseas concrete industry, overseas fresh concrete condition, and their differences from the situation in Japan based on their actual experience.

We investigated reports of trouble overseas and its causes, important points to be careful about in overseas construction, laws to be observed, experience or lack of experience in application of Japanese standards, concrete ordering method, comparison of concrete quality, etc. For details, see the full report.

5. Conclusion and future activities

While we were expected to incorporate our proposals for the future in the report based on the study results when the committee was set up, we finally included only study results in the report as it would not be appropriate to include proposals based solely on the views of committee members. However, we were able to achieve very valuable results. The committee conducted two questionnaire surveys. We would like to express our gratitude here to those who cooperated in the surveys.

The detailed reports of this study committee and our proposals are expected to be reported in the briefing session to be held on November 9, 2012 (Fri) at the Shibaura Institute of Technology.

References

- 1) Ministry of the Environment : Annual Report on the Environment, the Sound Material-Cycle Society and the Biodiversity in Japan 2012
- 2) M. Ohuchi : Demand for Construction in Developed Countries in Terms of Increasing Rate in Amount of Concrete Structures to Accumulation, Journal of Japan Society of Civil Engineers, F4 , Vol. 66, No. 1, pp.297-306 , 2010
- 3) Housing statistics, Ministry of Land, Infrastructure, Transport and Tourism
- 4) Japan Federation of Construction Contractors : Construction Contractors Handbook
- 5) Japan Concrete Institute : Concrete, Concrete diagnosis technology '10 “Application”, 2010
- 6) Ministry of Land Infrastructure and Transport : Annual Statistical Reports of Roads
- 7) Japan Federation of Construction Contractors : Construction Contractors Handbook 1999~2011
- 8) International Labour Organization : Statistics data “ <http://laborsta.ilo.org/> ”
- 9) Japan Cement Association : Cement Handbook
- 10) Cement Shimbun Co.,Ltd : Cement Yearbook, Vol. 63
- 11) ERMCO : Ready Mixed Concrete Industry Statistics
- 12) ZENNAMA : Statistics document