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Technical Committee on Effective Utilization of Concrete with High Volume Supplementary Cementitious Materials in Asian Region

Takafumi NOGUCHI, Hiroshi WATANABE, Tadatsugu KAGE, Eisuke NAKAMURA

Abstract

The Technical Committee on Effective Utilization of Concrete with High Volume Supplementary Cementitious Materials in Asian Region aims to implement concrete containing large quantity of supplementary cementitious material (SCM) in Asia and has surveyed specifications and standards for SCM, blended cement and concrete with high volume of SCM or blended cement in various countries of the world, investigated technical problems for using concrete containing large quantity of SCM in Asia and practical methods for enabling use of a large quantity of SCM, and conducted experiments by using SCM imported from some ACF member countries. The committee summarized its 2-year activities in a report, which includes construction examples in which concrete containing large quantity of SCM was used and proposals about effective ways of using SCM in Asia.

Keywords: SCM, large amount, Asia, specifications, standards, climatic condition, performance code, precast concrete, construction example

1. Introduction

The amount of concrete produced in Asia accounts for 3/4 of the total production in the world today but will surely increase further. It is demanded to reduce the CO_2 emissions accompanying cement clinker production and the consumption of limestone. Recently as a method to achieve the goal, concrete with high volume of SCM, such as ground granulated blast-furnace slag and fly ash, to substitute the majority of Portland cement has been actively investigated in countries in Asia. Export of ground granulated blast-furnace slag from Japan to other Asian countries is increasing, and the export of fly ash is also expected to increase. However, information has been scarcely collected on the actual utilization state of SCM and concrete that contains a large amount of SCM in countries outside Japan. In Japan, use of SCM has resulted in slow strength development, special attention required to determine the time of formwork removal and curing days at low temperatures, and low resistance to carbonation; and uses and utilization methods of SCM have not been standardized.

Technical Committee on Effective Utilization of Concrete with High Volume Supplementary Cementitious Materials in Asian Region, which was established in 2013, aims to implement concrete in which a large amount of Portland cement is substituted by SCM, for which R&D has been performed in the civil engineering and construction fields in Japan and other Asian countries. Over a period of two years, the committee has surveyed the present states of using such concrete in all parts of the world and investigated effective methods for using the concrete depending on the kind and required performances of concrete structure and also by considering the climatic conditions and sites of by-production in Asia toward preparation of references that will contribute to formulation of guidelines for using the concrete.

To achieve the aforementioned goals, two working groups were established in the committee for surveying standards in oversea countries (WG1) and investigating use of a large amount of SCM (WG2). The former has collected and investigated documents and references on technical standards related to use of SCM in member countries of Asian Concrete Federation (ACF); and the latter has investigated concrete methods for solving technical problems for using a large amount of SCM and enabling such use and experimentally produced concrete by using SCMs sent from several member countries of ACF, in SCM to the investigation based on the documents and references.

Members of the committee are shown in **Table-1**.

Table-1 Constitution of the committee

<table>
<tr><td>Chairperson</td><td colspan="2">Takafumi NOGUCHI</td></tr>
<tr><td>Secretary</td><td colspan="2">Hiroshi WATANABE (Working Group 1 Chair)
Tadatsugu KAGE (Working Group 2 Chair)</td></tr>
<tr><td rowspan="3">Member</td><td>WG1</td><td>WG2</td></tr>
<tr><td>Eiji OWAKI
Wataru SASAKI (7/2014~)
Masahiro SUZUKI
Yasuhiro DAN
Naoko TSUCHIYA
Yasuhiro DOSHO
Akihiro SHIBA (~6/2014)
Eisuke NAKAMURA
Noriaki YAJIMA
Kazuhisa YODA
Yuya YODA</td><td>Takeshi IYODA
Chizuru KIYOHARA
Shinichi KOIZUMI (7/2014~)
Toshimitsu KOBAYASHI
Tomoyuki KOYAMA
Tatsuhiko SAEKI
Yasuhiro DAN
Daijiro TSUJI (3/2014~)
Naoko TSUCHIYA
Yasuhiro DOSHO</td></tr>
<tr><td colspan="2">Masaro KOJIMA (~2/2014)</td></tr>
<tr><td>Correspondence Committee Member</td><td colspan="2">Atsushi MATSUI</td></tr>
</table>

2. Standards in oversea countries

2.1 Overview of the survey

The working group in charge of surveying oversea standards surveyed standards, etc. related to blended cement, SCM and ready mixed concrete in and outside Japan aiming to extract problems of implementing concrete with high volume SCMs in Asia and investigate points to note and possible countermeasures. The surveyed standards are listed in **Table-2**. The target area of the survey included 10 member countries of ACF (at that time), North American and European countries because their standards are sometimes applied in Asia with necessary modification, and China, which is the largest producer of cement in the world today. This chapter gives an overview of the results of the survey and an investigation on problems for implementing concrete with high volume SCMs in Asia and countermeasures.

Table-2 List of standards surveyed

Target	Cement	Ground granulated blast-furnace slag	Fly ash	Precast product	Ready mixed concrete	Related standards
Japan	JIS R 5210 JIS R 5211 JIS R 5212 JIS R 5 13	JIS A 6206	JIS A 6201	JIS A 5371 JIS A 5372 JIS A 5373 JIS A 5364	JIS A 5308	Standard Specifications for Concrete of the Japan Society of Civil Engineers JASS 5 of Architectural Institute of Japan
Australia	AS 1315 AS 1317 AS 3972	AS 3582.2	AS 3582.1		AS 1379	AS 3600
Indonesia					SNI 03-4433	
India	IS 269 IS 455 IS 1489		IS 3812		IS 4926	IS 456
Korea	KS L 5201 KS L 5210 KS L 5211 KS L 5401	KS F 2563	KS L 5405		KS F 4009	
Mongolia	MNS 3091				MNS 1185	
Singapore	SS EN 197 (SS 26) (SS 476) (SS 477)				SS EN 206 (SS 544)	
Taiwan	CNS 61 R 2001 CNS 15286 A 2290	CNS 12549 A 2233	CNS 3036 A 2040	CNS 3090 A 2042		
Thailand	TIS 15 TIS 849				TIS 213–2552	ACF 2-02 001-14 ACF 2-02 002-14 EIT1014-46
Vietnam	TCVN 2682 TCVN 4316 TCVN 5439 TCVN 6260	TCVN 4315			TCVN 9340	
USA	ASTM C 150 ASTM C 595 ASTM C 1157	ASTM C 989	ASTM C 618	ASTM C 478 ASTM C 913 ASTM C 990	ASTM C 94	ACI 211.1 ACI 318
Canada					CSA A23.1	
Europe	EN 197	EN 15167	EN 450	EN 13369	EN 206 EN 13670	EN 1990 EN1992-1
China	GB 175 GB 200 GB 1344 GB 13590	GB/T 18046	GB/T 1596		GB/T 14902	

2.2 Results of the survey on standards for blended cement and SCM

The results of the survey on ground granulated blast-furnace slag revealed that most Asian, American and European countries have established specifications for ground granulated blast-furnace slag to be used in Portland blast-furnace slag cement, but few had specifications for using ground granulated blast-furnace slag as SCM for concrete. It was estimated that ground granulated blast-furnace slag is distributed premixed in form of Portland blast-furnace slag cement in the majority of the countries surveyed. The maximum replacement ratio of ground granulated blast-furnace slag in cement specifications is relatively high in American and European countries with over 70% in US ASTM C 595 and 81 to 95% in European EN

197, while it is only about 70% in Asian countries, such as India, Korea and Vietnam. The value of 70% is similar to the maximum replacement ratio of Portland blast-furnace slag cement Class C in Japan. In Asia, ground granulated blast-furnace slag is estimated to be used as an SCM or blended cement, which is out of the scope of the specifications, when it is used beyond a replacement ratio of 70%. On the quality, most countries have specifications for grading ground granulated blast-furnace slag into several classes based on specific surface area like the Japanese Industrial Standards (JIS) for ground granulated blast-furnace slag.

For fly ash, all countries (including the Asian, American and European countries) have specified and graded the quality into several classes. However, the kind of index (such as chemical components, density and specific surface area) and standards used for the classification vary by country. For example, the quality standards in Thailand was likely to have been formulated based on test results of coal ash produced in the country. In other words, it was estimated that each country formulated its own quality standards by considering the circumstances of fly ash production in the area, resulting in the difference. It should be noted that there are countries that use different quality regulations between using fly ash as SCM and blending fly ash into cement.

There are several different points in the quality standards for blended cement and SCM between Asia, North America and Europe. To implement concrete with high volume of SCM in Asia, it is important to have correct understanding of the quality standards in the country and properties of the materials used.

2.3 Results of the survey on standards for ready mixed concrete

Production methods and quality standards of ready mixed concrete should also be known as well as standards on aforementioned blended cement and SCM in order to investigate implementation of concrete with high volume of SCM. Therefore, standards in Asia, North America and Europe on ready mixed concrete were surveyed.

The US ASTM C 94 contains few regulations on determining SCMs and their replacement ratio, but ACI 318, which is code requirements for structural concrete, stipulates the maximum replacement ratio of SCM for concrete structure to be in service in severe freezing environment (for example, 50% for ground granulated blast-furnace slag conforming to ASTM C 989 and 25% for fly ash conforming to ASTM C 618).

Canadian CSA A 23.1 stipulates that concrete containing at least 35% ground granulated blast-furnace slag or 30% fly ash is a concrete with high volume of SCMs and states standard curing period of concrete with high volume of SCMs. It also stipulates performance-based and prescription-based methods for ordering concrete. In the former, a contractor selects materials and mix proportion so as to satisfy the performances required by the administrator of the structure. Therefore, there is likely to be a room for flexibly using SCM as long as the required performances are satisfied.

On the other hand, European EN206 stipulates the conformed SCMs in EN, such as ground granulated blast-furnace slag, fly ash, and silica fume, to be Type II SCM and note to use the k-value concept in calculating cement content and water to cement ratio. EN 206 shows the maximum water to cement ratio and minimum amount of cement for a service life of 50 years for each environmental condition as reference. The k-value concept is a specification-based design method in terms of durability and is likely to have an advantage of simplifying the designing of mix proportion of concrete.

Of standards for ready mixed concrete in Asia, those that are likely important from the view point of using a large amount of SCM are given below.

- Indonesian SNI 03-4433 shows two systems of responsibility allocation: 1) the purchaser setting the required performances such as strength and the manufacturer designing the mix proportion so as to satisfy the requirement, and 2) the purchaser specifying the mix proportion and the manufacturer producing the concrete according to the design. In the former method, there is possibility of using SCM flexibly.
- Indian IS 456 mentions a yardstick of replacing at least 50% of cement by ground granulated blast-furnace slag and at least 20% by fly ash to control alkali silica reaction and standard wet curing period for concrete that uses blended cement for each climatic condition.
- Korean KS F 4009 includes many stipulations that are relatively similar to Japanese JIS also on handling of SCM.
- Singapore adopts EN 206 after modifying the temperature (27±2°C) for quality testing and the k value for SCMs based on the differences in climatic condition from Europe.
- Thailand has issued two standards of Level 2 documents in Asia concrete model code and stipulated a number of regulations for using fly ash such as on durability control and the period of wet curing.
- Chinese GB/T 14902 adopts a performance-based order method and classifies ready mixed concrete not only by strength but also by required performance, such as resistance to sulfate and chloride penetration.

Beside these points, standards for ready mixed concrete differ between countries in Asia also in the shape and dimensions of specimen to be used for compressive strength measurement, measurement error of the materials, and measure for controlling slump loss at high temperatures.

2.4 Effective ways for using SCM based on the results of the standards survey

By using the results of the survey on standards for blended cement, SCM and ready mixed concrete in Asia, North America and Europe, problems for implementing concrete with high volume of SCM in Asia and countermeasures were investigated and summarized as “Effective ways of using SCM in Asia”. An overview is given below.

(1) Flexible use of SCM by performance-based design

JIS classifies ground granulated blast-furnace slag into 4 grades depending on the degree of fineness to help appropriate use to the performances required. For example, coarse ground granulated blast-furnace slag is used when low heat generation is required, and fien granulated blast-furnace slag is to be deployed when strength needs to be manifested rapidly. On the other hand, fly ash may have difficulty ensuring air content depending on its quality because unburned carbon adsorbs air-entraining agent, but air content may not need to be strictly controlled under warm climatic conditions such as in Southeast Asia, where concrete is not subjected to freezing and thawing. There are also specifications that are based performance codes type such as US ASTM C 1157, which do not question the cement type or replacement ratio as long as certain performance is ensured. This suggests that opportunities of using a large amount of SCM would increase by spreading performance-based design and enabling mix proportion to be selected based on the performances required to the structure to be constructed and the replacement ratio of SCM to be flexibly determined.

(2) Use of SCM to control alkali-silica reaction and delayed ettringite formation

Use of SCM has been globally acknowledged to control alkali-silica reaction (ASR) and delayed ettringite formation (DEF). Thus use of SCM is expected to be an effective method for preventing ASR in areas where it is difficult to acquire good-quality aggregates. DEF has been scarcely observed in Japan, where the total alkali content in cement is low, compared to other countries. However, the risk of DEF is likely to be relatively high in other Asian countries because past chemical analyses of cement specimens collected in Asia have found a quite number of specimens of high total alkali and/or SO_3 contents and particularly Southeast Asia is hot and humid compared to Japan. Therefore, SCM can be expected to also control DEF.

(3) Simplification of the designing of mix proportion of concrete containing SCM by using the k value

As described above, the k-value concept has an advantage of simplifying the designing of mix proportion of concrete because the durability of concrete needs not to be tested each time the type or/and amount of SCM is changed but the mix proportion can be determined just by calculating the water to cement ratio and unit cement ratio by reflecting the amount of SCM. However, the available type of SCM and climatic conditions vary by country in Asia, and it is possibly difficult to introduce the k values used in another country without modification. To introduce the k-value concept toward implementation of concrete with high volume of SCM in Asia, it is likely necessary to appropriately set a concrete value for each country and area.

(4) Consideration on the effects of climatic conditions during use of SCM

Asia consists of regions of diverse climatic conditions, spreading from relatively cold Northern Asia to relatively warm Southeastern and Southern Asia. The quality of concrete with high volume of SCM has been reported to be easily affected by climatic conditions. For example, concrete with high volume of SCM is susceptible to delay in strength development and early-age frost damage in a cold area. On the other hand, in a warm area, it undergoes satisfactory strength development but is susceptible to slump loss and thermal cracks on mass concrete. To implement concrete with high volume of SCM in Asia, where climatic conditions are diverse, the effects of regional climatic conditions on the construction and quality of concrete should be carefully investigated. In Japan, moderate-heat Portland cement and low-heat Portland cement can be used to prevent thermal cracks on mass concrete, but low-heat Portland cement is scarcely available in some Asian countries, where use of a large amount of SCM is likely to contribute to reducing heat generated by hydration.

(5) Possibility of using SCM in precast concrete products

Precast concrete products are little affected by climatic conditions, particularly during production, or by the quality of construction work. Therefore, precast concrete products can be expected as a target of concrete with high volume of SCM. The JIS for precast concrete products permits use of SCMs that satisfy the JISs. However, SCM is seldom used in precast concrete products. Reasons include 1) there have been no production methods established for concrete that contains SCM such as curing method, 2) delay in strength development may cause delay in the conventional production cycle, and 3) shrinkage and creep properties are not clear, which are particularly important in prestressed concrete. These issues surface also for using SCM in precast concrete products in Asia and need to be clarified for using a large amount of SCM.

3. Performances of concrete presumed to contain large amount of SCM

The working group (WG2) in charge of investigating use of a large amount of SCM has studied the performances of concrete with high volume of SCM. It studied references by using "use of a large amount of SCM" and "effective use in Asia" as keywords, tested the cement and SCM supplied in Asia, and investigated the methods, ideas and conditions of using a large amount of SCM.

3.1 Performances of concrete presumed to contain large amount of SCM

(1) Performances of mortar concrete containing large amount of SCM (fresh concrete property, strength properties, durability, etc.)

References in Japan and ACF references were studies to investigate the performances of concrete with high volume of SCM. The references surveyed were those of Japan Concrete Institute (JCI) (Proceedings of the Japan Concrete Institute, Concrete Research and Technology, Journal of Advanced Concrete Technology and Concrete Journal), Architectural Institute of Japan (AIJ) (collected papers, technical reports, and abstracts), Japan Cement Association (proceedings of technical meetings and collected papers), Japan Society of Civil Engineers (collected papers and abstracts) and ACF (collected papers). The surveyed references were decided to be those published in 2009 to 2014 based on the scope of investigation by a similar JCI technical committee.

In most of the surveyed references, the replacement ratio of SCM was up to 60% for ground granulated blast-furnace slag and up to 20% for fly ash. The ratio of fly ash had been particularly investigated in the field of civil engineering. There have been a little studies on use of a large amount of ground granulated blast-furnace slag and fly ash, and the replacement ratio scarcely exceeded 60% and 20%, respectively. Although studies on use of a large amount of SCM are limited, cases in which a large amount of SCM was used were re-extracted from the surveyed references by defining "use of a large amount" to be 1) replacement ratio by ground granulated blast-furnace slag exceeding 60%, 2) replacement ratio by fly ash exceeding 20% (either outer or inner percentage), and 3) others (including three-component system and clinkerless cement). Based on the extraction, information on "reason for investigating use of a large amount", "subjects examined" and "results of examination (including countermeasures)" was extracted from the Introductions and Conclusions of the references.

Most common reasons for investigating use of a large amount of SCM, besides environmental consideration, were as a measure at high temperatures and reduction of hydration heat. This trend was particularly apparent in fly ash. From the viewpoint of durability, use of SCM was investigated especially to prevent ASR and ensure resistance against chloride penetration. Common subjects examined included effects by use of a large amount of SCM (on fresh properties (slump, air-entraining, and retention), strength reduction, increase in shrinkage, reduced crack resistance, reduced resistance to carbonation, etc.). In many cases, the effects on curing conditions were also examined. Studies on curing condition are informative from the viewpoint of effective use in Asian region, where the climate is different from that in Japan. The results of examinations (including measures) included improvement by adding gypsum and development and use of chemical SCM for using SCM in a large quantity. In the field of architecture, most studies checked the strength correction value (s value) of the structure upon using a large quantity of SCM and assessed the resistance against carbonation. There were also studies that investigated use of SCM in high strength, high fluidity concrete.

(2) Properties of mortar and concrete containing SCM in Asia

The utilization state of SCM and quality standards in Asia could be surveyed up to a certain degree by studying published references. However, precise and basic information on materials used has been scarcely available. Necessary information on the actual quality and concrete properties are insufficient. The strength development of Portland cement in Japan is large when the strength and activity are measured for a combination of cement in Japan, ground granulated blast-furnace slag and fly ash. Thus, the reaction of the cement is possible to be dominant, impeding use of a large amount of SCM. Therefore, materials were obtained from six member countries of ACF, including Japan, which have been actively using SCM. Strength and durability tests (via preparation of specimens) were conducted for each combination aiming to organize the characteristics and collect experimental data that will contribute to use of a large amount of SCM. The selected cement and SCMs are shown in **Table-3**.

In the experiments, all possible combinations of cement and SCM were tested. The replacement ratio of each SCM was decided to be 70% for ground granulated blast-furnace slag and 20% and 30% for fly ash in principle to achieve high substitution (use of a large amount). Experiment items were 1) physical properties of each material, 2) strength development property (including fresh concrete property), and 3) durability (via preparation of specimens).

Table-3 Selected cement and SCMs

Country	OPC	BFS	FA
Japan	○	○	○
Korea	○	○	○
Taiwan	○	○	○
Thailand	○	–	○
Vietnam	○	–	–
Indonesia	–	–	○

Table-4 Density and specific surface area

Kind	Country, etc.	Density (g/cm^3)	Blaine's specific surface area (cm^2/g)
OPC	Taiheiyo (Japan)	3.15	3260
	Sumitomo (Japan)	3.12	3310
	Mitsubishi (Japan)	3.14	3280
	Korea	3.15	3320
	Taiwan	3.12	3260
	Vietnam	3.14	3560
	Thailand	3.11	2720
BFS	Japan	2.92	3830
	Korea (i)	2.91	4200
	Korea (ii)	2.91	4190
	Taiwan (i)	2.90	5080
	Taiwan (ii)	2.90	5090
FA	Japan	2.31	4110
	Thailand	2.37	2600
	Korea	2.28	3990
	Taiwan	2.20	2990
	Indonesia	2.76	4040

The results of the physical property tests are shown in **Table-4** (density and specific surface area) and **Fig.-1** (mineral composition of ordinary Portland cement (OPC) in each country analyzed by the Rietveld Refinement method (X-ray diffraction)). The density and specific surface area were similar in all OPC specimens except those in Thailand and

Indonesia. On the other hand, the mineral composition differed by country. OPCs outside Japan contained more C_3S and less C_2S compared to Japanese OPC, and the percentages of C_3A and C_4AF were reversed from those in Japanese OPC. The development of strength was tested by preparing JIS mortar of a water to cement ratio of 50%, curing in water at 20°C and sealed at 40°C considering the climate of Southeast Asia, and measuring the strength on the 7th, 28th and 91st days. Air content and mortar flow were also measured to evaluate the flow value and the development of strength of OPC. Other conditions were 1) using standard sand as fine aggregates, 2) and preparing the cement of Japan to be combined with SCM from outside Japan by mixing cement products of three manufacturers in principle. In the durability test, specimens were prepared by selecting several mix proportions to examine dry shrinkage, resistance to carbonation, and resistance to chloride penetration. The strength development and durability tests are still ongoing as time was required to acquire the necessary materials. The results will be reported separately in a report and at a report meeting.

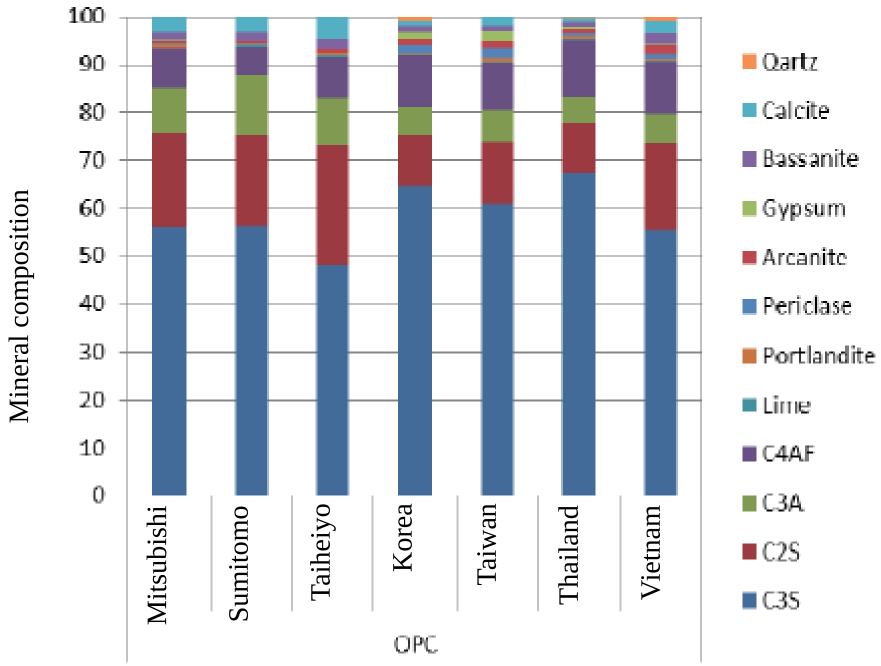

Fig.-1 Mineral composition of OPC in each country

3.2 Construction examples of concrete containing large amount of SCM

Construction examples of concrete with high volume of SCM mainly by contractors in Japan were summarized. Construction disadvantages of using a large amount of SCM, measures such as devices in materials, mix proportion, construction methods and quality control, and actual measures used were organized as much as possible within the permitted range of information disclosure.

Of the construction examples in Japan, concrete of the 2-component or 3-component system that used ground granulated blast-furnace slag, fly ash and concrete (ECM concrete) that contained a large amount of blast furnace slug (with a replacement ratio equivalent to Portland blast-furnace slag cement Class C) are described in the report. They were implemented aiming at environmental consideration (reduction of greenhouse effect gas CO_2 and effective use of industrial byproducts). The implementations faced problems such as on 1) procurement of materials (transportation cost), 2) manufacture (facility, quality control of the materials, and selection of SCM), 3) construction (points to note at placing and curing concrete), and 4) quality (strength correction value of the structure and resistance to carbonation). Future expansion of implementation and accumulation of related data are awaited.

The report also describes other construction examples of concrete with high volume of SCM in Japan. One of them is use of the 2-component system that contained cement and ground granulated blast-furnace slag and the 3-component system that also contained fly ash by using heat generation and strength development as evaluation indices (Akashi-Kaikyo Ohashi Bridge, etc.). Preparation of local construction guidelines (in Fukui and Nagasaki) for using such concrete are also introduced. The report also mentions a few examples of using a large amount of ground granulated blast-furnace slag and using Portland blast-furnace slag cement Class C (dam, high fluidity concrete, used as substitutes for cement in the latter half of 1950s until the former half of the 1970).

From the survey of the construction examples outside Japan, it was found that in the UK ground granulated blast-furnace slag and fly ash have been used in 85% of ready mixed concrete, the distribution amount of SCMs has exceeded that of cement, and the replacement ratio has exceeded 50% in simple calculation. Concrete containing ground granulated blast-furnace slag has been widely used in civil engineering structures such as dams and seashore structures and been used also in buildings. The implementation has aimed at white and light color as well as environmental consideration, suppressing initial temperature rises (thermal cracks) in mass concrete, and ensuring seawater resistance. The report also describes construction examples in Russia and UAE.

3.3 Conditions for enabling use of large amount of SCM

Besides recent investigations for reducing environmental loads and active use of byproducts, there have been few studies and construction examples of concrete with high volume of SCM (blended cement Class C or higher). Particularly in the field of architecture, the trend is strong as the part in which such concrete can be used is limited. On the other hand, a summary of the objectives of the few construction examples showed that there have been many investigations on use under restricted conditions such as severe environmental conditions and for solving mass concrete problems as well as for controlling ASR. Guidelines for designing and constructing concrete containing SCM have been already prepared by societies related to civil engineering and construction. The Architectural Institute of Japan has also issued “Recommendations for environmentally conscious practice of reinforced concrete buildings” from the viewpoint of environmental consideration. However, standard methods and concepts from the viewpoint of active use of a large amount of SCM while satisfying the major and basic performances (strength development, ensuring durability, workability, etc.) of concrete and policies for actualizing them need be further investigated, and understanding by owners is needed. There are also issues to be solved such as supply of materials and costs in the course toward materialization.

4. Concluding remarks

The amount of concrete produced in Asia will surely increase further. The current state of Asia producing and consuming at least one half of all cement in the world will probably continue for at least several decades. Southeastern and Southern Asia has climatic conditions appropriate for using a large amount of SCM. Based on the results of this committee, a similar committee is scheduled to be established in ACF. Aiming to mitigate global warming by the concrete sector, we will continue activities to promote spread of concrete with high volume of SCMs in Asia.