

THE INTRODUCTION OF CEMENT AND CONCRETE TECHNOLOGY IN VIETNAM AND JAPAN

Atsushi MATSUI¹

SUMMARY

It is widely recognized that cement and concrete technology is developing and concrete production amount and batching plant increases year after year in Vietnam. On the other hand, Japan is one of advanced country on cement and concrete technology. This paper introduces the present conditions of cement and concrete technology comparing in Vietnam and in Japan, to put it concretely, materials for concrete such as cement, aggregate and admixture, concrete properties and ready-mixed concrete.

Keywords: *Cement, Concrete, Ready-mixed concrete, Standard, Aggregate, Admixture, Vietnam, Japan*

INTRODUCTION

This paper introduces technical conditions of cement and concrete, comparing in Vietnam and in Japan. Nghi Son Cement Corporation is a Japanese-Vietnamese joint company, so it is easy to collect useful technical information in both countries through our general work. And we hope this information will provide fundamental understandings on technical conditions of cement and concrete in both Vietnam and Japan.

¹ *Technical Team Manager, Nghi Son Cement Corporation, email: amatsui@nghison.com.vn*

CEMENT

There are some cement standards in both countries. Concerning quality of cement, “Portland Cement – TCVN 2682” and “Portland Blended Cements – TCVN 6260” are specified in Vietnam. And “Portland Cement – JIS R 5210” is specified in Japan. The comparison of these standards is shown in table 1.

Table 1 Comparison of cement standards in Vietnam and Japan

		Vietnam					Japan		
		PC30	PC40	PC50	PCB30	PCB40	N	M	H
Chemical composition (%)	LOI	≤ 5.0					≤ 3.0		
	IR	≤ 1.5							
	MgO	≤ 5.0					≤ 5.0		
	SO ₃	≤ 3.5			≤ 3.5		≤ 3.0		≤ 3.5
	R ₂ O						≤ 0.75		
Fineness	Blain(m ² /g)	≥ 2700		≥ 2800	≥ 2700		≥ 2500	≥ 2500	≥ 3300
	0.08mm	≤ 1.5		≤ 1.2	≤ 1.2				
Setting time	Initial (min)	≥ 45			≥ 45		≥ 60		≥ 45
	Final	≤ 6h15m			≤ 1.0h		≤ 1.0h		
Soundness		≤ 1.0			≤ 1.0		≤ 1.0		
Compressive strength (N/mm ²)	1 day								≥ 10
	3 days	≥ 16	≥ 21	≥ 31	≥ 14	≥ 18	≥ 12.5	≥ 7.5	≥ 20
	7 days						≥ 22.5	≥ 15	≥ 32.5
	28 days	≥ 30	≥ 40	≥ 50	≥ 30	≥ 40	≥ 42.5	≥ 32.5	≥ 47.5

N: Normal portland cement (which is equivalent to ASTM Type I and PC 40)

M: Moderate heat portland cement (which is equivalent to ASTM Type II)

H: High early strength cement (which is equivalent to ASTM Type III)

Except for these typical cements, Low Heat Portland Cement, Ultra High Early Strength Portland Cement and Sulfate Resisting Cement are specified in JIS R 5210. Further, Blast Furnace Slag Cement which is popular in Japan is specified in other standard, JIS R 5211.

In Vietnam, PCB cement especially PCB40 is widely used. On the other hand, the PC cement production comes to decrease year by year. The type of cement product is shown in Fig 1.

Typical property of cement and difference of cement situation between in Vietnam and in Japan is shown in Table 2 and Table 3 respectively.

We have natural resource of good quality as raw materials for cement in North Vietnam. But the qualities of cement are various even if they

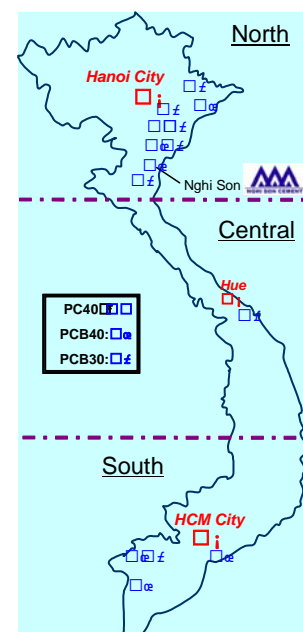


Figure 1 Type of Cement Product in Vietnam

are same type, PCB40, and depend on the product type and cement company, because additive type and content against cement varies. This condition is clear from table 2.

Table 2 Typical Properties of PCB40 Cement in Vietnam

	lg.loss (%)	insol (%)	SO ₃ (%)	R ₂ O (%)	Blaine (cm ² /g)	Compressive Strength(N/mm ²)		
						3days	7days	28days
Cement in Vietnam	1.2 - 6.5	2 - 13	1.7 - 2.4	0.4 - 1.1	3,200 - 3,900	21 - 33	30 - 46	41 - 54
Nghi Son Cement	2.9	3.3	1.91	0.71	3,620	30.3	43.1	52.1

Table 3 Difference of Cement Situation between in Vietnam and in Japan

	Vietnam	Japan
Portland Cement	Portland Cement (PC30, PC40, PC50) Portland Blended Cement (PCB30, PCB40)	Normal portland cement High early strength portland cement Ultra high early strength portland cement Moderate heat portland cement Low heat portland cement Sulfate resisting cement
Additive Content	No Additive - PC, <20 - PCB (<40 in case of active -PCB)	<5
Typical Additive	Limestone, Basalt, Natural Pozzolan	Blast Furnace Slag, Fly Ash, Limestone, Silica
Quality	Depends on Product or Company	Equivalent in case of same type
Other Cement	Pozzolanic Portland Cement Blast - Furnace Portland Cement White Portland Cement Sulfate Resisting Portland Cement Low Heat Portland Cement	Portlan Blast - Furnace Slag Cement Portland Fly Ash Cement Eco-Cement Portland Pozzolan Cement (Silica Cement)
Bag Percentage	>90%	<5%

OTHER MATERIAL FOR CONCRETE

Aggregate

<Vietnam>

Quality control of aggregate is scarce, so it is difficult to grasp the quality of aggregate. But especially in South area, fineness modulus of fine aggregate becomes smaller and that affects unit water of concrete increased. Some skilled companies attempts to develop and use grinding stone for adjustment of fineness modulus.

<Japan>

Resource of aggregate become exhausted gradually, so utilization technology for aggregate has advanced. (such as artificial aggregate made from blast furnace slag, fly ash, recycled glass and so

on). Moreover concrete using recycled aggregate is also developed. It is said that quality control of aggregate is more severe than that in Vietnam. Fineness modulus of fine aggregate varies depending on area.

Admixture

<Vietnam>

Admixture such as Blast Furnace Slag and Fly Ash is hardly used in concrete, because their quality is low compared with foreign country. However lately seminar and study on admixture for concrete is found, so there is some possibility that admixture for concrete will become popular. Blast Furnace Portland Cement is specified in TCVN although it isn't used for concrete in Vietnam.

<Japan>

Blast furnace slag is widely applied not as admixture for concrete but as material for pre-mixed slag cement. Fly ash is applied to dam concrete such as RCC which is called RCD in Japan. Blast furnace slag and fly ash is specified in JIS as both pre-mixed cement and admixture for concrete. Moreover, silica fume for high strength and/or durable concrete, expansive additive and so on is specified in JIS.

Chemical Admixture

<Vietnam>

Generally, many batching plants usually use chemical admixture for concrete, but in case of house construction except for supply from batching plant, waterproofing admixture is merely used into concrete at some site. Most popular type of chemical admixture for concrete is water reducing and set retarding type which complies with ASTM C494 Type D. And air entraining agent is rarely used except for some big project.

<Japan>

Chemical admixture for concrete is specified in JIS A 6204. According to this standard, compressive strength ratio, length change ratio and deference of setting time against no use of chemical admixture shall be tested. The resistance against freezing and thawing shall be evaluated, too, because there is freezing and thawing action in Japan. Most popular type is AE and water-reducing type. High-range water reducing and air-entraining admixture was developed and added in JIS A 6204 recently.

The condition of other materials for concrete except for cement is shown as below (See Table 3).

Table 3 The Condition of Other Materials for Concrete (except for cement)

		Vietnam	Japan
Aggregate	Quality Control	Scarce	Severe
	Fineness Modulus	Small in South area	Depending on area
Admixture	Blast Furnace Slag	not applied yet	Pre-Mixed Cement
	Fly Ash	Rarely	Dam Concrete, Pre-Mixed Cement
	Others	None	Silica Fume, Expansive Additive and so on
Chemical Admixture	Use	Batching Plant only	Most Concrete
	Popular Type	Water-Reducing and Set-Retarding Type	AE and Water-Reducing Type
	Standard	ASTM C494	JIS A 6204

CONCRETE

An example of concrete test results in Vietnam is shown in Table 4.

Typical fine aggregates in South Vietnam were used for concrete. According to test results, unit water of concrete is higher than that of concrete in Japan, mainly because of fine aggregate quality. However, it is not clear because many factors such as following items affect the fresh concrete and hardened concrete properties.

- Temperature (Curing) : 27degrees in Vietnam 20degrees in Japan
- Air Content : Non-AE in Vietnam AE Concrete in Japan
- Mixer : Tilting Type is popular in Vietnam Forced Type in Japan
- Mixing Time
- Quality of Water for Concrete
- Coarse Aggregate Shape
- Test Methods and so on

Table 4 An Example of Concrete Test Results in Vietnam

Fine Aggregate	F.M.	W/C (%)	Unit Weight (kg/m ³)		Slump (cm)	Compressive Strength (N/mm ²)		
			Water	Cement		3days	7days	28days
Fine Sand	1.89	55.1	193	350	16	21.4	28.3	38.4
Good Quality	2.78	52.6	184	350	15	27.4	35.1	48.3
Fine Sand + 60% Grinding Stone	2.91	50.3	176	350	15	30.6	39.3	53.0

Example of test results of compressive strength is shown in figure 2.

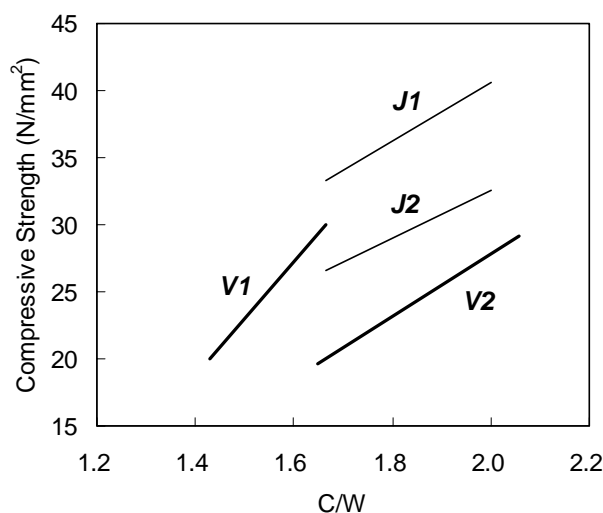


Figure 2 Examples of Relationship between C/W and Compressive Strength
V1: In case of using fine aggregate with low fineness modulus in Vietnam
V2: In case of using normal quality of fine aggregate in Vietnam
J1: In case of using high quality of aggregate in Japan
J2: In case of using normal quality of aggregate at BP in Japan

According to this figure, in case fineness modulus of fine aggregate in Vietnam is small (V1), unit water and unit cement increases. As a result, although drying shrinkage shall increase, concrete strength shall be higher than that using normal quality of fine aggregate (V2) because amount of aggregate decreases. In case of using high quality of aggregate in Japan, concrete strength is higher (J1), however actual relationship between C/W and compressive strength at average batching plant is located around the line of J2.

For reference, there are some consultant companies to evaluate concrete properties in Vietnam, but it is rather difficult for them to execute special test such as evaluation of durability and thermal property, so we have little data of durability and thermal properties.

READY-MIXED CONCRETE

Ready-mixed concrete conditions are much different each other as below.

<Japan>

- Production amount of ready mixed concrete 120 million-m³/year
- Number of ready-mixed concrete company around 3,800
- Number of ready-mixed concrete batching plant around 4,300

Production amount of ready mixed concrete in the last 10 years is shown in Fig 3. It is well known that production amount and ready-mixed concrete company decreases year after year. Regarding standard, “Ready-mixed concrete” is specified in JIS A 5308.

<Vietnam>

It is widely recognized that production amount and batching plant increases year after year. It is expected that number of batching plant including concrete product plant is only around 100 in Vietnam.

As opposed to Japan, there is no effective standard or guideline against batching plant in Vietnam. So, it is supposed that one of important theme will be to set up an effective standard or guideline for ready-mixed concrete, including facilities and method for quality control.

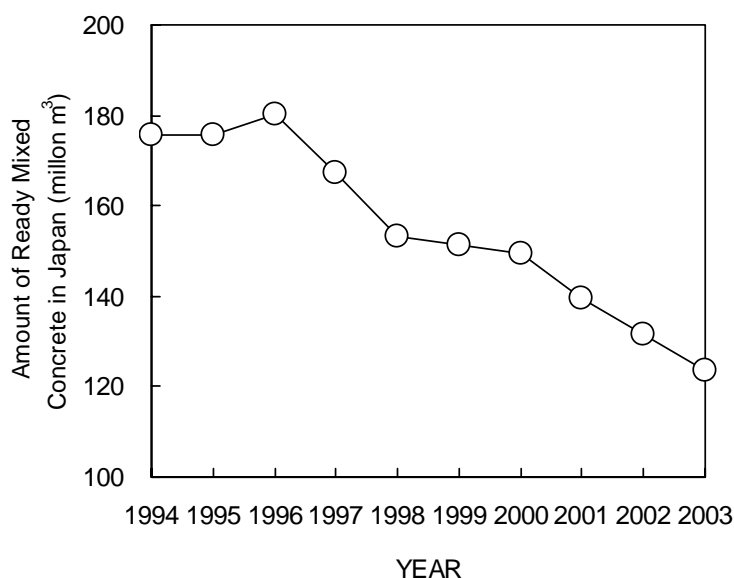


Figure 3 Production Amount of Ready Mixed Concrete in Japan

The some main items which are specified in JIS and actual conditions of batching plant in Vietnam are shown in Table 5.

Table 5 Comparison of Conditions for Ready-Mixed Concrete

	Japan (JIS A 5308)	Vietnam (Actual Condition at General BP)
Strength (N/mm ²)	18 - 60	20,25,30 are popular. (Actually some BP can produce more than 60.)
Type of Concrete	Normal, Light Weight, Paving and High Strength	Some Special Concretes are specified in TCVN or TCXDVN
Slump (cm)	2.5 - 21	Depending on Construction
Slump Flow (cm)	50, 60	None
Air Content (%)	4.5% except for Light weight concrete	Non-AE except for big project
Storage of Material	decided in detail	Depending on Batching Plant (or Construction)
Precision for Measuring		
Quality Control		

CONCLUDING REMARKS

Based on above information, we can grasp the difference of conditions on cement and concrete technology between in Vietnam and in Japan. The concrete condition in Vietnam, especially ready-mixed concrete (batching plant), is far from that in Japan. It's a pity that there are some actions of adding water after mixing, no measure of surface moisture and so on here and there at some batching plant now. So, it will be important not only to make effective guideline but also to make use of technical system effectively in Vietnam. And we hope this seminar including our information will help technology of each country advanced, especially in Vietnam, because concrete technology is making rapid progress in Vietnam now.

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