

### 1<sup>st</sup> Field Trial of “STP” Semi-Flexible Pavement at Da Nang, Vietnam



The 1<sup>st</sup> field trial of Semi-flexible pavement has been completed successfully by using STP, cement milk modifier, provided by TAIYU Kensetsu Co., Ltd. on Vo Chi Cong street, Da Nang on 11st September, 2017. This field trial using STP has been applied to prevent severe rutting problem on heavy traffic roads.

#### «Construction Overview»

- ✧ Contractee: Da Nang City, Department of Transport
- ✧ Contractor: BK-ECC
- ✧ Technical Cooperation: TAIYU Kensetsu Co., Ltd.
- ✧ Construction Date: September 9-11, 2017
- ✧ Construction Site: Vo Chi Cong Street, Cam Le District, Da Nang city.
- ✧ Construction Scale: 80m Length \* 3.25m Width \* about 10cm Thickness

#### «Properties of Open-Graded asphalt mix “BTNR12.5”»

The mix proportion of Open-graded asphalt mix used for Semi-flexible pavement is very important because it would become the matrix or skeleton of the pavement. Especially, air void percentage and connected air void percentage need to be determined carefully because permeability of cement milk depends upon them. So, tentative three (3) mix proportions are set and tested, based on those test results, optimum mix proportion has been determined. The thickness of the Semi-Flexible pavement for this site is very thick, 10 cm.

Therefore, the air void percentage of the Open-Graded asphalt mix has been set to be a little larger, like about 27%. Furthermore, hot bin No.2 was not used in order to enlarge the connected air void percentage.

**Table-1 Mix proportion and synthetic gradation of Open-Graded asphalt mix.**

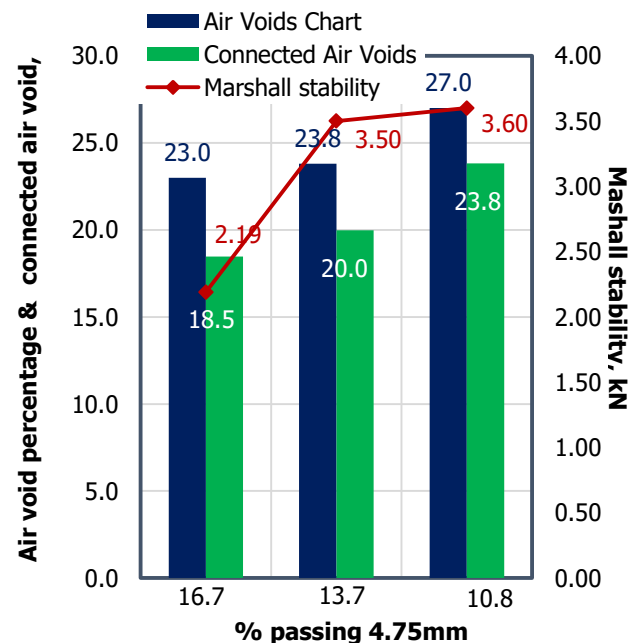
Aggregate used and Final Optimum Mix Proportion		Sieve size/Passing weight percentage (%)										Asphalt content
		19	12.5	9.5	4.75	2.36	1.18	0.6	0.3	0.15	0.075	
Hot Bin 3	90%	100	79.5	26.7	0.9	0.6						
Hot Bin 1 **	7%				99.9	78.8	53.3	29.6	9.8	5.4	3.2	
Calcium Carbonate	3%								100	96.3	87.2	
<b>Synthetic Gradation</b>	<b>100%</b>	<b>100</b>	<b>81.5</b>	<b>34.0</b>	<b>10.8</b>	<b>9.0</b>	<b>6.7</b>	<b>5.1</b>	<b>3.7</b>	<b>3.3</b>	<b>2.8</b>	<b>3.5%</b>
Japanese standard		100	95-100*	-	7-30	5-20	-	4-15	3-12	-	1-6	3.0~4.5

(Note) \* Japanese standard shows the gradation at 13.2mm instead of 12.5mm

\*\* Both of river sand and crushed sand were used as fine aggregate.

**Table-2 Properties of Open-graded mix**

		A	B	C (Adopted)	Standard (recommended)
Mix proportion (%)	Hot Bin 3	84	87	90	
	Hot Bin 1	13	10	7	
	Filler	3	3	3	
Asphalt Content (%)		3.5	3.5	3.5	3.0-4.5
Passing weight (%)	4.75mm	16.7	13.7	10.8	7-30
	2.36mm	13.7	11.4	9.0	5-20
Mixture properties	Density(g/cm <sup>3</sup> )	2.015	1.993	1.921	
	Air void (%)	23.0	23.8	27.0	20-28
	Connected air void (%)	18.5	20.0	23.8	Recommendation Min. 18
	Marshall Stability (kN)	2.19	3.50	3.6	Min. 2.94



**Figure-1 Properties of Open-graded mix**

«Production of Cement Milk using STP»

Portland cement “PCB40”, “STP” provided from TAIYU Kensetsu Co., Ltd., and water are employed for the cement milk. “STP” is a modifier to give cement milk flexibility and toughness. And, they are mixed at construction site. Each materials are added into a drum can and mixed in the order of water, cement, and STP.



PCB 40 (Portland cement)



STP



Mixing



P type Viscosity meter

Table-3 Mix proportion of Cement Milk

		Weight for 1 batch	
Mix proportion	Water (litter)	30.6	
	Cement (kg)	50.0 (1 bag)	
	STP (kg)	26.5 (1 bag)	
Amount of cement milk	Weight (kg)	107.1	
	Volume (litter)	57.9 (*)	
Viscosity (Flow value: sec)		10.07-10.79 (JP Spec. 9-15)	
Strength test (spec. after 7 days)		Compressive. (9.8-36)	Bending (Min. 3.92)
Strength of cement milk (PMa)	1 day	16.1	6.5
	3 days	26.5	6.6
	7 days	32.6	10
	28 days	38.4	10.5

«Production and paving of Open-graded asphalt mix.»

Aggregates used and asphalt plant are shown in below photos.



12.5 Aggregate



Crush dust



River sand



Asphalt plant



Lifting of mixture



Compaction



Open-graded surface & Close-up



«Injection of cement milk & completed Semi-flexible pavement»

Controlling the amount of cement milk injected, injection work has been completed. Even though the thickness is 10cm, cement milk has been perfectly injected by controlling the viscosity and using vibration roller.



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