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FEASIBILITY STUDY TO USE CRUSHING STONE FILLER INSTEAD OF SAND IN LOW STRENGTH CONCRETE

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ABSTRACT

Concrete is one of main materials for construction industries especially in construction of road, bridge, housing, irrigation, tunnel, terminal, airport, port, retaining wall and other civil works. The main components of concrete includes cement, sand, stone (gravel) and water while in the northern region of Laos is really lack of sand and costly to transport of milestone through mountainous road in the north. Sand resources in Oudomxay province is mostly imported from Pakbeng district (150km to central of the province) to support the construction industry in the province and waste more cost. However, Oudomxay province is plenty of stone resources and there are many crushing stone plants in the vicinity the town and many amount of crushed stone filler wasting around the crushing plants This research was focused concrete mixed design without fine aggregate or sand by using those crushing stones in 3 plants named 1) Angnumhin pit located 6km away from city, B. Konkane Pit, 18km away from city along with National Road No. 2W and Mueang Lha Pit, 11km from city along with National Road No. 2E to possibly mix the low strength concrete for specific purposes of construction. From the results shown that the general properties of filler is accountable to be mixed in low strength concrete (<25MPa) while cleaning was required where the high dust remaining. Filler from B. Konkane Pit is the best from 3 sampled sources in this study to use filler instead of sand to mix the low strength concrete.

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Introduction

According the economic development policy of the government, Lao PDR plays a central of corridor of ASEAN region which all infrastructures are required to support the policy through the country. Concrete is one of main materials for construction industries and the basic materials for concrete includes cement, sand, stone (gravel) and water while in the northern region of Laos is really lack of sand and costly. Oudomxay province is in the central of Northern Laos covered by limited sand sources which most of sand is imported from Pakbeng district by 150km mountainous road to support the construction industry in the province and makes costly. However, Oudomxay province is plenty of stone resources and there are many crushing stone

plants mostly waste the crushed stone filler around the stone crushing plants. In this study, those crushed fillers shall be possibly considered to be used instead of sand in low strength concrete for specific purposes of construction such as 10-15 MPa used for lean concrete, 15-20 MPa used for opened ditch and other appropriate purposes. Industrial sector in Vientiane and south of Laos has some experiences to mix crushed stone filler on concrete mixture but not really details for public awareness. But not any published study found to use crushed stone filler completely instead of sand for north region if this study indicates possibility, we will be able to reduce the cost of construction materials especially concrete.

Figure 01: Location of Studied Crushing Stone Plants

Methodology

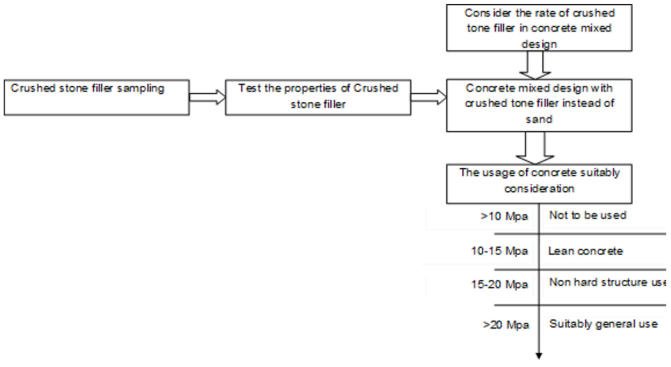

Figure 02: Research Conceptual Frameworks

Sampling

- Sampling was conducted from 3 near crushing stone plants (Km5,6 and 9) which these samples are for properties test and also for concrete mixed design
  Plant 1@Angnumhin Area: located 6km away from city proper
  Plant 2@B. Konekaen Pit: 18km from city proper along with National Road No. 2W
  Plant 3@Mueang Lha Pit: 11km from city proper along with National Road No. 2E
- Samples were collected in the sack (each plants took 3 sacks of ½" stone and 3 sacks of ½" stone filler)
- Samples had been sent to Vientiane by truck on the day after
- Cement Elephant brand will be used for concrete mixed design which we could be able to find this product around the Oudomxay province

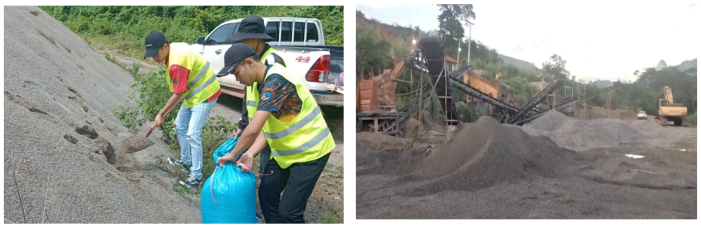

Figure 03: Sampling at Angnumhin Pit

Figure 04: Sampling at B. Konkane Pit

Figure 05: Sampling at Mueang Lha Pit

Lab works

The properties of both chip and filler were tested before design the concrete mixed ratio include sieve analysis, LA, specific gravity, unit weight, soundness, flakiness, concrete slump, strength compression. The Strength 10, 15, 20 MPa mixed design was designed and tested.

Figure 06: Lab Preparations

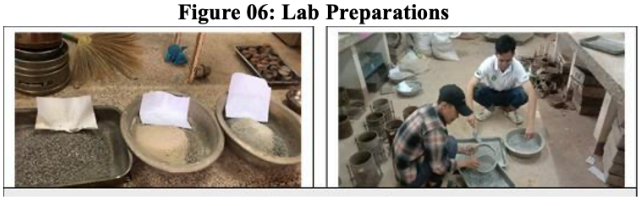

Figure 07: Sieve Analysis

Figure 08: Specific Gravity Test

Figure 09: Unit Weight Test

Figure 10: Los Angeles Test

Figure 11: Finer 75µm Test

Results and discussion

Properties of Crushed Stone Filler

The properties of crushing stone filler from 3 borrow pits (B. Konekaen, Angnamhin and Mg La pits) were tested including basically grading and specific gravity to optimize the sources of filler for concrete mixed design. From the result found that the properties of filler from B. Khonekaen was selected to be used for concrete mixed design which the properties of filler from B. Khonekaen were tested as the results below:

Table 01: The results of testing the Sieve Analysis (Grading)

Seive Analysis of Crushing Stone Filler					
Seive No. (mm)	Percent Passed by Weight				
	Lab Results			ASTM C33	
	B. Konkane	Angnumhin	Mg Lah	Min	Max
9.5	100	100	100	100	
4.75	83	100	94	95	100
2.36	25	70	67	80	100
1.18	6	32	42	45	80
0.6	3	15	22	25	60
0.3	2	8	12	10	30
0.15	1	3	6	2	10
0.075	1	2	3		
FM	**4.8**	**3.72**	**3.59**		

Table 02: The results of testing the Specific Gravity (SG)

Specific Gravity of Crushing Stone Filler			
Lab Descriptions	**B. Konkane**	**Angnumhin**	**Mg Lah**
Bulk Specific Gravity A/(B+S+C)	2.601	2.613	2.564
Bulk Specific Gravity (SSD) S/(B+S+C	2.644	2.618	2.613
Bulk Specific Gravity A/(B+A+C)	2.716	2.652	2.696
Water Absorption ((S-A)/A)x100	1.6	0.6	1.9

Properties of Chip stone:

According to the result of the properties filler testing, the properties of chip from B. Khonekaen was also tested for concrete mixed design as following results:

Table 03: The results of testing the Sieve Analysis (Grading)

Seive Analysis of Chip (B. Konkane)			
Seive No. (mm)	Percent Passed by Weight		
	Lab Results	ASTM C33	
		Min	Max
25	100	100	
19	63	95	100
12.5	34		
9.5	12	20	55
4.75	0	0	40
2.36	0	0	305

Table 04: The results of testing the Specific Gravity (SG)

Specific Gravity of Chip (B. Konkane)			
Lab Descriptions	**Test No.**		
	1	**2**	**Average**
Bulk Specific Gravity A/(B+S+C)	2.673	2.673	**2.673**
Bulk Specific Gravity (SSD) S/(B+S+C)	2.683	2.683	**2.683**
Bulk Specific Gravity A/(B+A+C)	2.699	2.699	**2.699**
Water Absorption ((S-A)/A)x100	0.36	0.36	**0.36**

Table 05: The results of testing the Unit Weight

Unit Weight of Chip (B. Konkane)				
Lab Descriptions	**Test No.**			
	1	**2**	**3**	**Average**
Bulk Specific Gravity (Dry Basis) T84 or T85s	2.673	2.673	2.673	**2.673**
Density of Water (kg/m3)	998	998	998	**998**
Percent of Void=[{(SxW)-M}/(SxW)]x100	41	41	40	**40.7**

Properties of Cement:

SCG Type 1 was selected to be sampled for concrete mixed design which be able to find in local market. The Specific gravity of SCG Type 1 cement was tested as the result below:

Table 06: The results of testing the Cement Properties

Specific Gravity of Cement (SCG Brand)			
Lab Descriptions	Flash No.		
	1	2	Average
Specific Gravity of Cement (SCG Brand)	3.15	3.15	**3.15**

Concrete Mixed Design

The design was mixed from materials that we found the best properties in terms of Engineering characteristic which the properties of crushing stone filler in B. Konekaen borrow pit was the selected and Chip also was selected from this plant to be composed in mixed design with SCG Portland Cement Type 1. The design was focus on concrete Class 10, 15 and 20 MPa (C10, C15 and C20). According to the ASTM Standard, the concrete strengths were tested on the age was 3 and 7 days. From the results we found that all designs C10, C15 and C20 were shown below:

Table 07: The results of testing the Concrete Strength

No	Class of Concrete	Sample Code	Age	Compressive Strength, Mpa			
				Sample 1	Sample 2	Average	ASTM
1	10 Mpa	CLY- 1, 2	3 days	5.2	5.3	52.50%	≥50%
		CLY- 1", 2"	7 days	7.8	7.9	78.50%	≥75%
2	15 Mpa	CLY- 3, 4	3 days	7.7	7.8	51.67%	≥50%
		CLY- 3", 4"	7 days	11.5	11.6	77.00%	≥75%
3	20 Mpa	CLY- 5, 6	3 days	10.3	10.4	51.75%	≥50%
		CLY- 5", 6"	7 days	15.4	15.5	77.25%	≥75%

Figure 12: Concrete Strength testing

Conclusion

From this study we found that the properties of crushed stone filler from B. Konkane Pit is the best from 3 sources and accountable to mix in low strength concrete instead of sand while cleaning is required. The results of compressive strength rest of mixed design are acceptable for 10, 15 and 20 MPa. Hence, crushed stone filler from B. Konkane Pit is be able to mix instead of sand in low strength concrete in case of Oudomxay province. However, these results are based on few samplings and operate in the lab while trial application is required before in to action and also materials from other pits/plants must be tested before use on actual construction implementation.

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