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1 message

Anas Puri <anaspuri@eng.uir.ac.id> Fri, Sep 2, 2016 at 4:30 PM
To: nsuwartha@eng.ui.ac.id
Bcc: ijtech@eng.ui.ac.id

Dear IJTech

There was 2 of my papers submitted in IJTech (ID 1623 and 1688), but they are still in "under review round 1". I need to know when can I get the review results, because the submission was over than one year.

Best regards,

Dr. Anas Puri, S.T., M.T.
Associate Professor, Geotechnical Engineering, Department of Civil Engineering
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International Journal of Technology
ISSN 2086-9614

January 13, 2017

Re: **Acceptance Letter**

Dear Mr./Mrs. Anas Puri

Greetings from Depok,

The editorial board is delighted to inform you that your paper entitled "VALIDATION THE THEORY OF ADDITIONAL MODULUS OF SUB GRADE REACTION FOR PAVEMENT OF NAILED-SLAB SYSTEM BASED ON FULL SCALE TEST: DEVELOPING THE CURVE OF DISPLACEMENT FACTOR BASED ON SINGLE PILE NAILED-SLAB " has been accepted to be published in the next issue of IJTech. At the present, we are conducting further necessary action to complete the publication process.

On behalf of IJTech, we appreciate your intention and willingness to publish your work with IJTech.

Warmest regards,

Dr. Mohammed Ali Berawi
Editor in Chief
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[IJTech-03-89] Please Revised Based on Reviewer Comment

IJTech <ijtech@eng.ui.ac.id> Nov 7 at 2:06 PM
To anaspuri@yahoo.com

Dear Mr./Mrs. Anas Puri,

The editorial board is pleased to inform you that your paper entitled
"VALIDATION THE THEORY OF ADDITIONAL MODULUS OF SUB GRADE REACTION FOR PAVEMENT OF NAILED-SLAB SYSTEM BASED ON FULL SCALE TEST: DEVELOPING THE CURVE OF DISPLACEMENT FACTOR BASED ON SINGLE PILE NAILED-SLAB" has been reviewed by referee.

Please find in the attachment referee's comments, and please make a necessary revision based on the comments. Also please read the submission guidelines.
Any revision of the paper should be submitted to ijtech@eng.ui.ac.id no later than **November 21, 2016.**

It is compulsory to return the revise paper with response comment as attached.
Please state clearly the revision based on reviewer's comment.

We look forward to receiving your revised paper at your earliest convenience.

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Anas Puri <anaspuri@eng.uir.ac.id>

Fw: [IJTech-03-89] Please Revised Based on Reviewer Comment

3 messages

a. puri <anaspuri@yahoo.com> Tue, Nov 8, 2016 at 9:47 AM
Reply-To: "anaspuri@yahoo.com" <anaspuri@yahoo.com>
To: Anas Puri <anaspuri@eng.uir.ac.id>

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On Mon, 7 Nov, 2016 at 14:06, IJTech
<ijtech@eng.ui.ac.id> wrote:

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> necessary revision based on the comments. Also please read the submission guidelines.
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3 attachments

- **IJTech-03-89_ 1st comment review paper #2.docx** 551K
- **IJTech-03-89_ 1st comment review #1.pdf** 119K
- **IJTech-03-89_ 1st comment review #2.docx** 67K

a. puri <anaspuri@yahoo.com> Fri, Nov 18, 2016 at 6:41 PM
Reply-To: "a. puri" <anaspuri@yahoo.com>
To: Anas Puri <anaspuri@eng.uir.ac.id>

Dr. Anas Puri, S.T., M.T.
Associate Professor, Geotechnical Engineering, Department of Civil Engineering,

INTERNATIONAL JOURNAL OF TECHNOLOGY
ISSN: 2086-9614

Offline Review Form

SECTION I: Comments per Section of Manuscript

General comment:	The manuscript is original, but it would require some clarification as listed below.
Introduction:	--

Methodology:	• Modulus: Secant modulus? Tangent modulus?
	• Provide a figure describing deltas (δ, δ_0, δ_s) so that readers could understand what these deltas really mean. For example: what relative displacement between pile and soil mean?
	• Table 1:
	  o Difference between 3) natural water content and 4) water content?
	  o 5) Clay content? Or fines content (<#200)?
	• Sub-Section 4.3:
	  o Slab only test not described? Any slab thickening?
	  o Pile compression load test setup? Pile tension load test setup?
	  o Water content for compaction?
	  o … continued CBR test and plate load test after 3 days? Where and why related to lean concrete pouring? Locations of soil investigations should be drawn on Figure 2a.
	  o Provide descriptions of types (load ring/load cell/pressure gage? dial gages/LVDT?) and sketch of locations of monitoring devices? (For example: how to get deltas?)

Results:	• Sub-Section 5.1: Stiffness from pile tension load test appears to be greater than stiffness from pile compression load test. This suggests that the pile tip resistance has some influence on the load-displacement curves. Furthermore, as the nailed-slab system is in compression, this suggests that Eq. 2 (relying on shaft resistance) might not be factually appropriate.
	In fact, in a typical slab on ground – pile system, the pile would experience some degree of negative shaft friction due to the load transmitted by the slab. (Compatibility issue)
	• Sub-Section 5.2:
	  o Slab only test not described yet.
	  o 'Since the loading position … tends to lower': What is the basis for this statement? It appears to be a speculation.
	• Sub-Section 5.3: 'The average loading pressures and settlement were used': What does 'average' mean?
	• Sub-Section 5.4:
	  o Table 2 should be referred in the discussion?
	  o 'Curtain': What does this refer to?
	  o 'This curve is similar with …': The similarity should be discussed further, because they do not look similar for slab settlement >2 mm.
	• Sub-Section 5.5:
	  o 21.21 kPa? Why not 19.82 kPa?
	  o Suggestion: Authors to describe the general formulation of the

	system, not only comparing the results. This is particularly of interest because, in this research, the effect of pile on the overall modulus is relatively insignificant (only 14%). • Sub-Section 5.6: The purpose of this sub-section is unclear, as the flexibility and the bending moment of the slab are not evaluated.
Discussion:	See 'Results'
Bibliography/References:	References • Section 1: Hardiyatmo (2007) not in reference list • Sub-Section 5.3: Hardiyatmo (2001a) not in reference list • Eng-tips Forum is a discussion forum. It is not an appropriate reference for academic papers.
Others:	Editing • The title is too long. Focus on the main message. • Please do English editing • Soil pond = Test pit? • Sub-Section 5.4: Figure 1? (Not Figure 2) Abstract • In general, an abstract should not have references

SECTION II - Please rate the following: ***(1 = Poor) (2 = Fair) (3 = Average) (4 = Above Average) (5 = Excellent)***

Originality:	4
Technical Quality:	3
Methodology :	3
Readability :	2
Practicability:	3
Organization:	3
Importance:	3

SECTION III - Recommendation: (*Kindly Mark with an X*)

Accept As Is:	
Requires Moderate Revision:	X
Reject On Grounds of (Please Be Specific):	

SECTION IV: Additional Comments (if any)

RETURN OF COMMENTS

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Reviewer's Guide

PART A: ***Editorial Office Only***

SECTION I

Reviewer's Name:	
E-Mail:	
Manuscript Number:	IJTech-03-89
Title:	VALIDATION THE THEORY OF ADDITIONAL MODULUS OF SUB GRADE REACTION FOR PAVEMENT OF NAILED-SLAB SYSTEM BASED ON FULL SCALE TEST: DEVELOPING THE CURVE OF DISPLACEMENT FACTOR BASED ON SINGLE PILE NAILED-SLAB

PART B: ***Reviewer Only***

SECTION II: Comments per Section of Manuscript

General comment:	1. The title is too long. Please rewrite the title. Make it concise . It is suggested "DETERMINATION OF THE ADDITIONAL MODULUS OF SUBGRADE REACTION ON NAILED-SLAB SYSTEM" 2. The English is very poor. The paper, as it received, is **unacceptable for publication**. Need improvement in grammar etc. ***3. The paper is lack of novelty.*** 4. Are the section 2 and 3 trully needed in this paper?
Introduction:	1. The first paragraph was unnecessary; it can be dropped. 2. Some Indonesia names cannot be translated directly to English, since it is the trademark, then mention in Bahasa Indonesia. Do not translate the KSLL and CAM into English! 3. What do you mean with "additional modulus of subgrade reaction"? What is the difference with modulus of subgrade reaction itself? Explain briefly in Introduction section. 4. The parameter of δ/δ_0 suddenly appears in Introduction without any remark in previous sentences or paragraph. Make confuse! 5. The objectives and conclusion remarks mismatch. Recheck the objectives, then the conclusions shall be written based on the what objectives are.

Methodology:	If the section 2 and 3 are needed as theoretical framework to develop a curve, they shall be placed in Methodology section.
Results	
Discussion :	The discussion need a deep analysis and elaboration of results. The conclusion need to be rewrite to answer the objectives
Bibliography/References:	Too many self-citation, It is not a good way for scientific paper.
Others:	The acknowledgement need to be rewrite correctly.

SECTION III - Please rate the following: ***(1 = Poor) (2 = Fair) (3 = Average) (4 = Above Average) (5 = Excellent)***

Originality:	
Technical Quality:	
Methodology :	
Readability :	
Practicability:	
Organization:	
Importance:	

SECTION IV - Recommendation: (*Kindly Mark with an X*)

Accept As Is:	
Requires Moderate Revision:	**X (Major revision)**
Reject On Grounds of (Please Be Specific):	

SECTION V: Additional Comments

Please add additional comments, if any:

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VALIDATION THE THEORY OF ADDITIONAL MODULUS OF SUB GRADE REACTION FOR PAVEMENT OF NAILED-SLAB SYSTEM BASED ON FULL SCALE TEST: DEVELOPING THE CURVE OF DISPLACEMENT FACTOR BASED ON SINGLE PILE NAILED-SLAB

IJTech-03-89

ABSTRACT

Pavement of Nailed-slab System has been proposed as an alternative solution for rigid pavement problem on soft soils. This system is a kind developing of rigid pavement. Simple method by using equivalent modulus of subgrade reaction (k') in Nailed-slab System analysis was proposed by Hardiyatmo (2009). This modulus consists of the modulus of sub grade reaction from plate load test (k) and additional modulus of sub grade reaction due to pile installing (Δk). The additional modulus of sub grade reaction has been also proposed by some authors. Displacement factor was used in determining the additional modulus of sub grade reaction. This factor is difficult to define. The curve of invers this factor was proposed by Hardiyatmo (2011b) and it was developed based on single pile Nailed-slab in stiff clay and the connection between pile and slab was not perfect monolithically. In this research, prototype test of Nailed-slab with single pile installing was conducted to learn the validation of the theory of additional modulus of sub grade reaction on full scale dimension. The prototype was constructed on soft clay and the connection between pile and slab was perfect monolithically. This system was loaded by centric load. The new curve of displacement factor is proposed. Calculated deflections based on several method of the additional modulus of sub grade reaction were compared to the observed deflection and result in good agreement with the observation.

Keywords: Nailed-slab system, soft clay, sub grade modulus, displacement factor, rigid pavement.

Comment [M1]: PLEASE REWRITE THE TITLE. MAKE IT CONCISE . IT IS SUGGESTED "THE FULL SCALE TEST ON NAILED-SLAB SYSTEM "

Comment [M2]: It is uncommon to state reference in Abstract

Comment [M3]: It is uncommon to state reference in Abstract

1. INTRODUCTION

Natural soils with low to medium density tend to experience large deformation when passed through by repetitive loads of vehicles. Then the pavement is needed to protect the soils from over load of vehicles. Pavement also functions as flat and smooth surface of road for drivers and protects soil formation due to bad effects of weather changing (Hardiyatmo, 2007). The type of pavement chosen is generally depending on base and subgrade. For soft subgrade, rigid pavement is one of generally used pavement type. Rigid pavement slab on soft soils tends to experience differential settlement as the results of the differential loads distribution or inhomogeneity of soil. Working load on the rigid pavement can be cyclic loads from traffic or temperature loads that cause the warping on the slab. These points can cause the negative effects to the pavement, such as cracks or damages on the pavement structures due to differential settlement of soils, as well as pumping, etc. Some construction methods has been developed to overcome or eliminate those problems, for instance the using of soil improvement, spider nest construction (in Indonesia: *konstruksi sarang laba-laba*), chicken foot foundation (in Indonesia: fondasi cakar ayam), and slab on piles. Each method has over plus and deficiency.

The new proposed method was introduced by Hardiyatmo (2008). This method is developed from pavement of chicken foot system (*Sistem Cakar Ayam*) by changing the cylindrical foundation with short micro piles. It is called Nailed-slab System. Several studying was established inter-alia Hardiyatmo (2008) for Nailed-slab under dynamic loads, and vertical loadings by Hardiyatmo (2009; 2011a), Nasibu (2009), Dewi (2009), Taa (2010), and Puri, et.al. (2011a, 2011b, 2012a, 2012b, 2013a, 2013b, 2013c, 2013d). Hardiyatmo (2011a) proposed analysis method in determining the additional modulus of subgrade reaction. And it was modified by Puri, et.al. (2012a) by consider the tolerable deflection or allowable deflection of pavement slab as an approach of safety construction. This modified method has good validation due to full scale test (Puri, et.al, 2013c).

Hardiyatmo (2011a) used displacement factor in determining the additional modulus of sub grade reaction. The displacement factor is the ratio of the relative displacement between piles and soils and the pile head settlement. The inverse of displacement factor is the ratio of δ/δ_0. Hardiyatmo (2011b) developed the curve of δ/δ_0 ratio based on full scale test of single pile in stiff clay. The pile and slab was connected by bolts. In this paper, the curve of δ/δ_0 ratio based on full scale test of single pile Nailed-slab in soft clay is developed. Pile and slab was connected monolithically. The curve of δ/δ_0 ratio is also presented as the curve of displacement factor. Validation due to single pile Nailed-slab will be explained in this paper. The application of this curve on the full scale Nailed-slab with 3 rows of piles will be presented in separated paper.

2. ADDITIONAL MODULUS OF SUB GRADE REACTION AND DISPLACEMENT FACTOR

The analytical approach in determining equivalent modulus of sub grade reaction (k') is given as follows (Hardiyatmo, 2011a; Dewi, 2009; Puri, et.al, 2012a):

$$k' = k + \Delta k \qquad (1)$$

Where k : modulus of sub grade reaction from plate load test (kN/m^3) and Δk : additional modulus of sub grade reaction due to pile installing under slab (kN/m^3). The modulus of

Comment [M4]: A low density of the natural soil tends …

Comment [M5]: Unclear sentences.

Comment [M6]: Since it is the trademark, then mention in Bahasa Indonesia. Do not translate the KSLL and CAM into English!

Comment [M7]: studies

Comment [M8]: What's this?

Comment [M9]: Consider revising this sentences

Comment [M10]: Unclear statement, what does it mean?

sub grade reaction from the plate load test (k) is usually taken by using circular plate, and it should be corrected to slab shape of the nailed-slab. Hardiyatmo (2011a) proposed Eq. (2) in determining the additional modulus of sub grade reaction (Δk). The relative displacement between pile and soil is considered.

$$\Delta k = \frac{\delta_0 A_s}{\delta^2 s^2}\left(a_d c_u + p_0 K_d \tan \varphi_d\right) \qquad (2)$$

Where δ_0 : relative displacement between pile and soil (m), δ : deflection of surface of slab (m), A_s : surface area of pile shaft (m^2), s : pile spacing (m), a_d : adhesion factor (non-dimensional), c_u : undrained cohesion (kN/m^2), p_o': average effective over burden pressure along of pile (kN/m^2), K_d : coefficient of lateral earth pressure in pile surroundings (non-dimensional), and ϕ_d : soil internal friction angle (degree).
Hardiyatmo (2011b) re-published the relation between δ_0/δ and slab deflection for full scale model (Figure 1) while the pile and slab was connected by bolt. The pile diameter was 20 cm and the length of pile was varied between 1.0 m to 2.0 m.

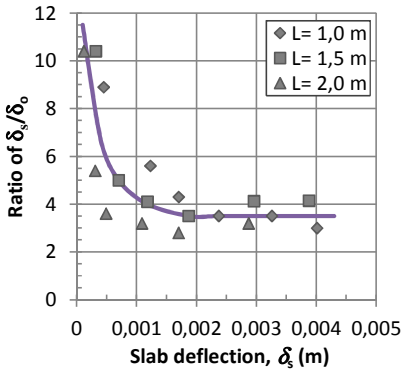


Figure 1 Relationships of δ_s/δ_0 ratio vs. slab deflection for single pile Nailed-slab (Hardiyatmo, 2011b).

In the case of Nailed-slab System, the relative displacement between pile and soil is difficult to define. Puri, et.al. (2012a) obtained Eq. (3) to calculate the additional modulus of sub grade reaction which considered the tolerable deflection of rigid pavement slab (δ_a).

$$\Delta k = \frac{0.4 f_s A_s}{\delta_a A_{ps}} \qquad (3)$$

Where δ_a : tolerable deflection of rigid pavement slab (m), f_s : ultimate unit friction resistance of pile shaft (kN/m^2), A_s : surface area of pile shaft (m^2), A_{ps} : area of slab zone which supported by single pile (m^2).
This equation was not considering differential settlement yet. The maximum differential settlement that a concrete pavement can tolerate may be expressed in terms of angular distortion or the allowable strain in the concrete (Eng-tips, 2006). Eq. (3) is already validated to the full scale test in good results (Puri, et.al, 2013c).

Nailed-slab resting on soft soils should consider the ignored end bearing resistance of pile. Ultimate unit friction resistance of the pile shaft in saturated clay is expressed by

$$f_S = a_d c_u \tag{4}$$

The displacement factor is the ratio between relative displacement between pile and soil and the displacement of pile head (Hardiyatmo, 2011a). This factor is

$$\alpha = \frac{\delta_0}{\delta_p} \tag{5}$$

The δ_p is displacement of pile head (m). Since the soft clay is considered, the term of $p_0 K_d \tan\phi_d = 0$, and then the Eq.(2) can be re-arranged as Eq.(6).

$$\frac{\delta_0}{\delta_s} = \frac{\Delta k \delta_s A}{A_s a_d c_u} \tag{6}$$

And to find the displacement factor, the Eq.(6) is used by assuming that the displacement of pile head is equal to the displacement of slab surface.

3. ANALYSIS OF DEFLECTION

The theory of beams on elastic foundation (BoEF) can be used to calculate the deflections due to the load acting on plate-supported piles (Hardiyatmo, 2009, 2011a; Taa, 2010; Puri, et.al, 2011b, 2012a). They used the Hetenyi's formulas (1974). The deflection of the finite length of the beam resting on an elastic foundation was considered due to a single concentrated load. The modulus of subgrade reaction, k is replaced by k' in Eq.(1) for analysis of Nailed-slab System. The BoEFW simple software is used to analyze slab deflections.

4. TESTING INVESTIGATION

4.1 Soil Pond and Materials

Nailed-slab has been conducted on soft clay. Soft clay was filled into a soil pond which 6 m x 3.7 m width and 2.5 m depth. On the 2 longer side was retained by masonry walls and supported by some temporarily girder. The anchorage system was built near the pond. Separator sheets were set on the pond walls and base to avoid the effects of surrounding existing soils. A 2.15 m of pond depth was filled by soft clay which taken from District Ngawi, East Java, Indonesia. The soft clay properties are presented in Table 1.

The slab and piles were reinforced concrete. The concrete strength characteristic of slab and piles were 29.2 MPa and 17.4 MPa respectively.

4.2. Dimension of single-pile Nailed-slab

The dimension of Nailed-slab was 1.20 m × 1.20 m, 0.15 m in slab thickness, and the slab was stiffened by installing micro piles underneath. Micro piles dimension was 0.20 m in diameter and 1.50 m in length. The pile was installed under the slab and connected monolithically by using thickening slab connectors (0.40 m × 0.40 m and 0.20 m in thickness). There was a 5 cm lean concrete thickness under the slab. The nailed-slab detail is shown in Figure 2.

Table 1 Soft clay Properties

No.	Parameter	Unit	Average
1	Specific gravity, G_s	-	2,55
2	Consistency limits:		
	- Liquid limit, *LL*	%	88,46
	- Plastic limit, *PL*	%	28,48
	- Shrinkage limit, *SL*	%	9,34
	- Plasticity index, *PI*	%	59,98
	- Liquidity index, *LI*	%	0,36
3	Natural water content, w_n	%	50,49
4	Water content, *w*	%	54,87
5	Clay content	%	92,93
6	Sand content	%	6,89
7	Bulk density, γ	kN/m^3	16,32
8	Dry density, γ_d	kN/m^3	10,90
9	Undrained shear strength, s_u		
	- Undisturbed	kN/m^2	20,14
	- Remolded	kN/m^2	11,74
10	CBR	%	0,83
11	Soil classification:		
	- AASHTO	-	A-7-6
	- USCS	-	CH

4.3. Testing Procedures

The steps in construction of Nailed-slab can be briefly described as follows: the pond was filled by soft clay until the soil thickness reach 2.15 m. Soft clay was spread about 15 cm in thickness per layer with controlled water content, and then it was compacted by 3 passing of manual compaction. Each soil layer thickness was decreased to about 10 cm per layer. Soft clay was cured by covering its surface with plastic sheet and wet carpet. Some soil investigations were conducted, i.e. soil boring, vane shear test, CBR test, and plate load test. After that, a pile was driven by pre-drilled method and then continued by hydraulic jacking until the pile top reach the design level. The pile was tested for compression bearing capacity and tension capacity. Soil was excavated for thickening slab. The 5 cm lean concrete then poured on the soil surface, and continued by conducting CBR test and plate load test after 3 days. The slab and vertical wall barrier reinforcement rebar were assembled. And then concrete was poured for slab. Slab was cured by wet carpet and after 28 days of concrete age the loading set up was assembled. Loading test was conducted on the slab for different load positions. Loads were transfer to the slab surface by using circular plate with 30 cm in diameter (the plate represents the single wheel load contact area). Loading position was centric of slab. Then the instrumentations were recorded. Some photographs in construction and testing were presented in Figure 3.

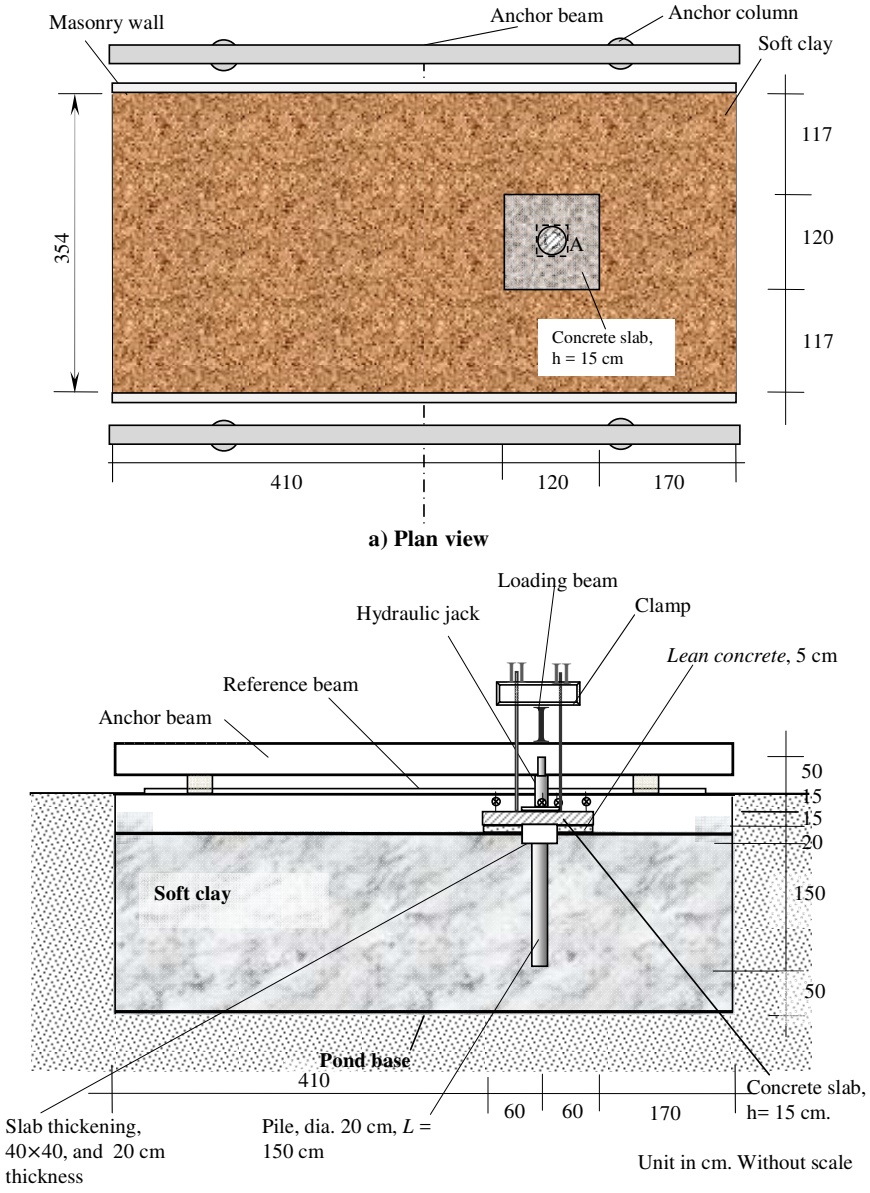


Figure 2 Schematic diagram of testing investigation.

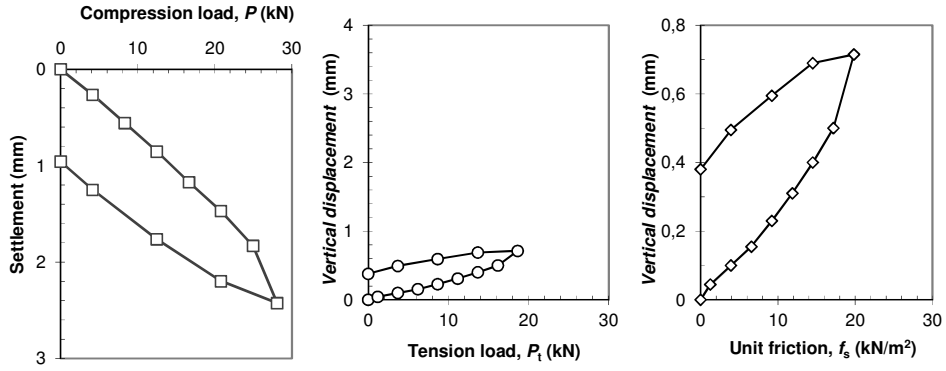
a) Slab reinforcement b) Loading test

Figure 3 Photographs of investigation on single pile Nailed-slab system.

5. RESULTS AND DISCUSSION

5.1. Single Pile Loading Test

Figure 4 shows the results of loading testing. Testing was conducted after 30 days of pile driving. Loading test on single pile was not reached failure condition except until reached the beginning of plastic zone. Pile axial compression bearing capacity is 28 kN, and has linear elastic behavior up to 25 kN (Figure 5a). Tension bearing capacity is 20 kN (Figure 4b). The relationship between unit friction (based on pile tension test) and displacement is shown in Figure 4c. The ultimate unit friction f_{su} is 19.82 kPa at displacement 0.715 mm. Unit friction was corrected to pile weight (1.13 kN) and loading yoke weight (0.18 kN).



a) b) c)

Figure 4 Single pile test results; a) Axial compression, b) Axial tension, c) Pile unit friction.

5.2. Loading Test Results of Slab and Single Pile Nailed-slab

Figure 5 shows the P-δ relationship for both tests. Installed pile under slab reduced slab settlement and increased bearing capacity of structure. Since the loading position was in line with pile position, the increasing of bearing capacity tends to be lower. It means that pile will give significant effect if the loading position ex-centric to the pile position.

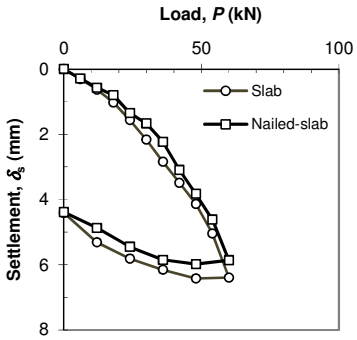
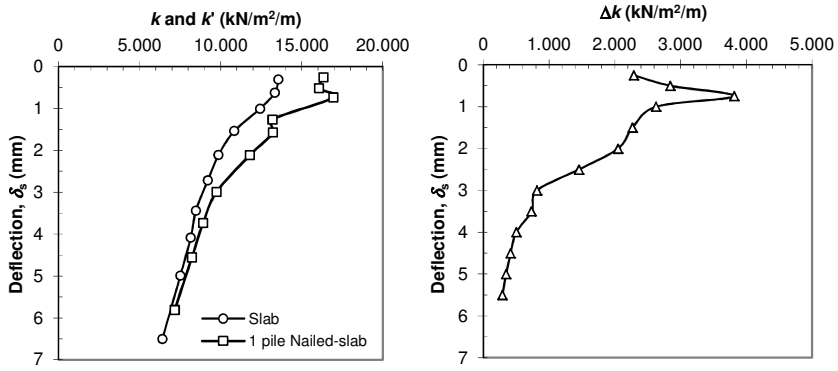


Figure 5 P-δ relationship for loading tests of slab and single pile Nailed-slab.

5.3. Calculating the Modulus of Subgrade Reaction

Comment [M11]: Calculated or calculating?

Based on the loading tests of slab and single pile Nailed-slab, the modulus subgrade reaction is calculated for slab alone (k) and Nailed-slab (k'). The average loading pressures and settlement were used. The additional modulus of subgrade reaction for Nailed-slab (Δk) is defined. Those moduli are presented in Figure 6 and will be utilized in calculating the slab deflection by using Hardiyatmo formula (2001a).



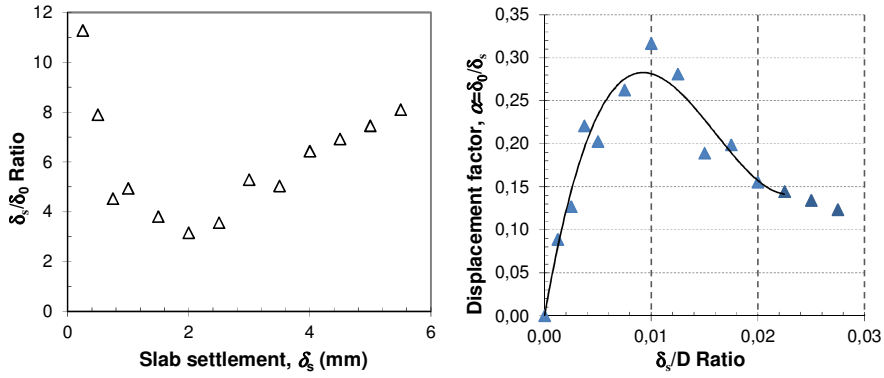
a) b)

Figure 6 Modulus of subgrade reaction of slab alone (k) and single pile Nailed-slab (k'); a) Distribution of k and k', b) Modulus Δk.

5.4. Curve of Displacement Factor α (ratio of δ_0/δ_s)

The ratio of δ_s/δ_0 is calculated by using Eq.(6) and the additional modulus of subgrade reactions Δk (as presented in Figure 6) were used. For soft clay the $p_0 K_d \tan\phi = 0$. Then the displacement factor (δ_0/δ_s) was taken by inversing the δ_s/δ_0 ratio. According to dimension of pile, it was found pile area A = 1.44 m^2 and pile skin area A_s = 1.07 m^2. The $a_d c_u = f_s$ was determined by Figure 5c. The δ_s/δ_0 ratio for single pile Nailed-slab can be determined and the calculating results are present in Figure 7a. This figure shows the distribution of δ_s/δ_0 ratio. This curve is similar with Figure 2 especially for pile length 1.5 m and 2.0 m. The δ_s/δ_0 ratio decreases to displacement of 2 mm, and then tends to increase again. For general purpose, Figure 7a is presented as Figure 7b (curve of displacement factor) and related to δ_s/D ratio. D is pile diameter. The δ_0/δ_s ratio has maximum value at maximum displacement 2 mm (δ_s/D = 0.10). The δ_0/δ_s ratio is displacement factor α as described in Eq.(5).

Mechanism of relative displacement between soils and pile (δ_0) is related with the slab deflection (δ_s). The δ_0 is not directly mobilized in the beginning of slab deflection occurred. It will begin to take place in the curtain of slab deflection. The δ_0 is smaller than slab deflection in beginning of loading, hence the α is small. Since the load is increased, the δ_s increases and δ_0 increases until maximum value is reached. Hence, α tends to increase until maximum value. Then, increasing the slab deflection makes the soils and pile moving simultaneously with slab. It causes the decreasing α to zero (at least asymptote to δ_s axis), because of δ_0 reached maximum while δ_s go in the direction.



a) b)

Figure 7 Curve for single pile Nailed-slab; a) Relationship of δ_s/δ_0 ratio and slab settlement, b) Curve of displacement factor.

5.5. Slab Deflection

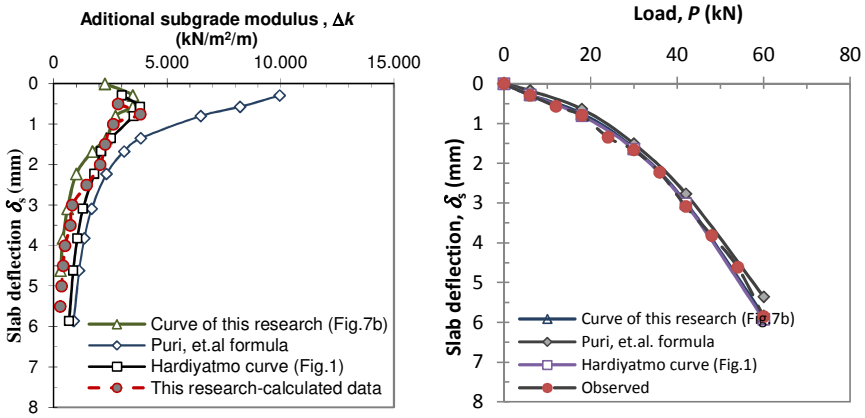
The additional modulus and equivalent modulus of subgrade reaction based on Hardiyatmo curve (Figure 2) and the curve of this research (Figure 7b) and by using Puri, et.al Formula are shown in Figure 8a. The unit friction f_s is taken the ultimate value (21.21 kPa) for deflection > 0.7 mm. The k value is taken from Figure 6 by interpolating method for appropriate deflection. It is shown that all methods are in good agreement with observation.

Comment [M12]: What is the rationale taken this value?

Table 2 The additional modulus and equivalent modulus of subgrade reaction based on this research (Figure 7b)

Load (kN)	δ_s (mm)	f_{si} (kN/m^2)	k (kN/m^2/m)	Ratio δ_s/D	$\alpha=\delta_0/\delta_s$	Δk (kN/m^2/m)	k' (kN/m^2/m)
6	0,29	11,05	12.778,99	0,0015	0,08	2.261,14	15.040,13
12	0,57	17,91	13.385,17	0,0029	0,15	3.497,79	16.882,97
18	0,80	19,82	12.929,45	0,0040	0,19	3.493,15	16.422,59
24	1,35	19,82	11.404,87	0,0068	0,25	2.723,70	14.128,57
30	1,67	19,82	10.619,28	0,0084	0,27	2.333,90	12.953,18
36	2,23	19,82	9.739,60	0,0112	0,26	1.714,83	11.454,43
42	3,09	19,82	8.831,15	0,0155	0,21	999,57	9.830,72
48	3,82	19,82	8.288,74	0,0191	0,16	616,04	8.904,79
54	4,62	19,82	7.782,14	0,0231	0,13	414,31	8.196,45
60	5,86	19,82	6.878,32	0,0293	0,12	301,19	7.179,51

[#] Diameter of pile D = 20 cm.



a) b)

Figure 8: a) The Δk - δ relationship based on several methods, b) The P-δ.

Deflection analysis results based on different method of k' are shown in Figure 8b. It is shown that the utilization of Hardiyatmo curve and this research curve (Figure 7b) produce the deflection results that in good agreement with observation, in despite of little bit under-estimated. Hardiyatmo curve was obtained from single Nailed-slab in stiff clay and the pile-slab connection was not monolithically. Calculated deflection based on Puri, et.al formula is also in good agreement with observation, in despite of more under-estimated.

In the Puri, et.al formula the observed deflections were used as tolerable deflection. In case of the tolerable deflection is determined as 5 mm, then the Δk = 1,109.87 kN/m^2/m, and k' = 7,988.19 kN/m^2/m. According to Figure 8a (curve Puri, et.al Formula), it will be obtained

the over-estimated deflection for load less than 60 kN. It is caused by *k*' lower than in Figure 8a. It can be concluded that using of defined tolerable deflection will produce calculation results in safer zone.

Table 3 Differentiation of calculation results

Load (kN)	Observed deflection (mm)	Hardiyatmo curve (Figure 1)		This research (Figure 7b)		Puri, et.al formula	
		Deflection (mm)	Diff. (%)	Deflection (mm)	Diff. (%)	Deflection (mm)	Diff. (%)
6	0.29	0.28	-2.92	0.28	-3.17	0.10	-64.18
18	0.80	0.81	0.95	0.75	-6.04	0.66	-18.10
30	1.67	1.65	-0.98	1.63	-2.56	1.54	-7.98
42	3.09	3.02	-2.15	2.99	-3.13	2.80	-9.33
60	5.86	5.93	1.13	5.84	-0.32	5.40	-7.77
Average (%)			-0.66		-2.54		-17.89

Diff. = differentiation

Table 3 shows the differentiation of calculation results based on all methods to observed deflections. All calculated deflections are under-estimated. But, using Figure 1 and 7b give smallest differentiation in average -0.66% and -2.54% respectively, while Puri, et.al formula is sufficient enough (average differentiation -17.89%).

5.6. Effects of Poisson Ratio

Since the width of slab higher than slab thickness (*h*), the Poisson's ratio (*v*) can affect the behavior of slab. The plate flexural rigidity (*D*) is presented in Eq.(8) which including the correction to Poisson's ratio.

$$D = \frac{Eh^3}{12(1-v^2)} \tag{8}$$

Table 4 Effects of Poisson ratio to slab deflections

Load (kN)	Hardiyatmo curve			This research (Figure 7b)			Puri, et.al formula		
	W/o correc-tion	Correc-ted	Diff. (%)	W/o correc-tion	Correc-ted	Diff. (%)	W/o correc-tion	Correc-ted	Diff. (%)
6	0.28	0.28	0.00	0.28	0.28	0.00	0.10	0.18	-70.05
18	0.81	0.81	0.00	0.75	0.75	0.00	0.66	0.64	2.51
30	1.65	1.65	0.00	1.63	1.62	0.18	1.54	1.51	1.72
42	3.02	3.02	0.00	2.99	2.99	0.00	2.80	2.77	1.24
60	5.93	5.92	0.10	5.84	5.84	0.00	5.40	5.36	0.89
Average (%)			0.02			0.04			-12.74

BoEF is not considered the Poisson's ratio. In this case, the *E* input is changed by corrected *E* which calculated by Eq.(9).

$$E_{corrected} = \frac{E}{1 - v^2} \quad (9)$$

The Poisson ratio was 0.15. The Effects of Poisson ratio to slab deflections are presented in Table 4. It can be concluded that the Poisson's ratio were not influenced the slab deflections. It is caused that BoEF analysis is 2D. In fact, Poisson's ratio can influence the inner stresses. Hence, the failure criteria of slab will increase.

6. CONCLUSION

According to results and discussion, it can be concluded that

1. The installed piles under the slab give contribution to increase the modulus of subgrade reaction which is represented by the additional modulus of subgrade reaction. Equivalent modulus of subgrade reaction of single pile Nailed-slab on soft clay was about 1.14 times the modulus of subgrade reaction of slab alone.
2. Puri, et.al formula where expressed as Eq.(3) and the curve of displacement factor from this research (Fig.7b) are useful for estimating the additional modulus of subgrade reaction. Calculated deflections based on these methods were in good agreement with the observation. Hence, they can be used in purpose of preliminary design.
3. The Poisson's ratio was not influenced the deflection result.
4. This proposed method and the previous one should be prove in full scale test or field application. And for further research, the additional modulus of subgrade reaction for edge load should be developed in conjunction with that the edge loads can cause critical loading.

7. ACTKNOWLEDGEMENT

Special thank you for valuable supervising by Prof. Dr. Ir. Hary Christady Hardiyatmo, M.Eng., DEA., Prof. Ir. Bambang Suhendro, M.Sc., Ph.D. and Dr.es.sc.tech. Ir. Ahmad Rifa'i, M.T. in Civil and Environmental Engineering Gadjah Mada University.

Comment [M13]: Acknowledgement

Comment [M14]: Need revision!

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Response by Authors to Reviewer's Remarks/Comments

DEVELOPING THE CURVE OF DISPLACEMENT FACTOR FOR DETERMINATION OF THE ADDITIONAL MODULUS OF SUBGRADE REACTION ON NAILED-SLAB PAVEMENT SYSTEM (*REVISED TITLE*)

Author: Anas Puri
Paper ID: IJTech-1688

The author have summarized his replies to the Reviewers' comments in this response letter in a two column format. A revised manuscript is submitted addressing all the comments to the International Journal of Technology for possible publication.

Reviewer I

	Reviewer_A's Comments	***Authors Response***
General comments	1. The title is too long. Please rewrite the title. Make it concise . It is suggested "DETERMINATION OF THE ADDITIONAL MODULUS OF SUBGRADE REACTION ON NAILED-SLAB SYSTEM" 2. The English is very poor. The paper, as it received, is **unacceptable for publication**. Need improvement in grammar etc. 3. ***The paper is lack of novelty.*** 4. Are the section 2 and 3 trully needed in this paper?	1. The title is revised as **Developing The Curve Of Displacement Factor For Determination Of The Additional Modulus Of Subgrade Reaction On Nailed-Slab Pavement System.** Because this study is focus on developing that curve. 2. - 3. See the introduction to fine the novelty of this study. Please study references which refered in this study. Novelty: 1) single pile Nailed-slab where the pile and slab is connected monolithically, 2) curve of displacement factor for Nailed-slab in softclay. 4. Section 2 and 3 are needed and moved to methodology.
Introduction	1. The first paragraph was unnecessary; it can be dropped. 2. Some Indonesia names cannot be translated directly to English, since it is the trademark, then mention in Bahasa Indonesia. Do not translate the KSLL and CAM into English! 3. What do you mean with "additional modulus of subgrade reaction"? What is the difference with modulus of subgrade reaction itself? Explain briefly in Introduction section.	1. This paragraph is dropped as per the reviewer's comments. 2. Some Indonesia names are corrected as per the reviewer's comments. 3. The meaning of the additional modulus of subgrade reaction and its defferentiation with modulus of subgrade reaction are corrected as per the reviewer's comments. 4. It is corrected as per the

	4. The parameter of δ/δ_0 suddenly appears in Introduction without any remark in previous sentences or paragraph. Make confuse! 5. The objectives and conclusion remarks mismatch. Recheck the objectives, then the conclusions shall be written based on the what objectives are.	reviewer's comments. 5. It is corrected as per the reviewer's comments.
Methodology	If the section 2 and 3 are needed as theoretical framework to develop a curve, they shall be placed in Methodology section.	It is corrected as per the reviewer's comments.
Results	-	-
Discussion :	The discussion need a deep analysis and elaboration of results. The conclusion need to be rewrite to answer the objectives	The discussions are elaborated. The conclusions are elaborated.
Bibliography/ References:	Too many self-citation, It is not a good way for scientific paper.	-
Others	The acknowledgement need to be rewrite correctly.	The acknowledgement are elaborated.

Reviewer II

	Reviewer_A's Comments	***Authors Response***
General comments	The manuscript is original, but it would require some clarification as listed below.	Require some clarifications are clarified as below.
Introduction	---	---

Methodology	• Modulus: Secant modulus? Tangent modulus?
	• Provide a figure describing deltas (δ, δ_0, δ_s) so that readers could understand what these deltas really mean. For example: what relative displacement between pile and soil mean?
	• Table 1:
	  ○ Difference between 3) natural water content and 4) water content?
	  ○ 5) Clay content? Or fines content (<#200)?
	• Sub-Section 4.3:
	  ○ Slab only test not described? Any slab thickening?
	  ○ Pile compression load test setup? Pile tension load test setup?
		• It is secant modulus and described in introduction.
		• It is described in introduction.
		• Table 1: It is used water content only, and fines content.
		• Slab only test is described and had no thicknening.
		• Pile test set up is decribed as per the reviewer's comments.

	○ Water content for compaction? ○ … continued CBR test and plate load test after 3 days? Where and why related to lean concrete pouring? Locations of soil investigations should be drawn on Figure 2a. ○ Provide descriptions of types (load ring/load cell/pressure gage? Dial gages/LVDT?) and sketch of locations of monitoring devices? (For example: how to get deltas?)	• Water content for compaction was about 55% and described in the text and fig. 3. • … continued CBR and plate load test... is delletted. • It is corrected as per the reviewer's comments except sketch of locations.
Results	• Sub-Section 5.1: Stiffness from pile tension load test appears to be greater than stiffness from pile compression load test. This suggests that the pile tip resistance has some influence on the load-displacement curves. Furthermore, as the nailed-slab system is in compression, this suggests that Eq. 2 (relying on shaft resistance) might not be factually appropriate. In fact, in a typical slab on ground – pile system, the pile would experience some degree of negative shaft friction due to the load transmitted by the slab. (Compatibility issue). • Sub-Section 5.2: ○ Slab only test not described yet. ○ 'Since the loading position … tends to lower': What is the basis for this statement? It appears to be a speculation. • Sub-Section 5.3: 'The average loading pressures and settlement were used': What does 'average' mean? • Sub-Section 5.4: ○ Table 2 should be referred in the discussion? ○ 'Curtain': What does this refer to? ○ 'This curve is similar with …': The similarity should be discussed further, because they do not look similar for slab settlement >2 mm. • Sub-Section 5.5: ○ 21.21 kPa? Why not 19.82 kPa? ○ Suggestion: Authors to describe	• In this paper, this issue is not studied yet. Hope, it will be studied further in other time. Thank you • Sub-section 5.2 is corrected as per the reviewer's comments. • Sub-section 5.3 is corrected. • Sub-section 5.4 is corrected as per the reviewer's comments. • Ultimate unit friction f_{su} is 21.21 kPa

	the general formulation of the system, not only comparing the results. This is particularly of interest because, in this research, the effect of pile on the overall modulus is relatively insignificant (only 14%). • Sub-Section 5.6: The purpose of this sub-section is unclear, as the flexibility and the bending moment of the slab are not evaluated.	• Sub-section 5.6 is purpose to explaine the consideration in design. Poisson's ratio were not influenced the slab deflections. It is caused that BoEF analysis is 2D. In fact, Poisson's ratio can influence the inner stresses. Hence, the failure criteria of slab will increase. It means that the prelemanary design by using Figure 7b will be on safety zone.
Discussion :	See 'Results'	See 'Results
Bibliography/ References:	References • Section 1: Hardiyatmo (2007) not in reference list • Sub-Section 5.3: Hardiyatmo (2001a) not in reference list • Eng-tips Forum is a discussion forum. It is not an appropriate reference for academic papers.	• It is corrected as per the reviewer's comments.
Others	Editing • The title is too long. Focus on the main message. • Please do English editing • Soil pond = Test pit? • Sub-Section 5.4: Figure 1? (Not Figure 2) Abstract • In general, an abstract should not have references	It is corrected as per the reviewer's comments.

The author appreciates the valuable comments from the Reviewers.