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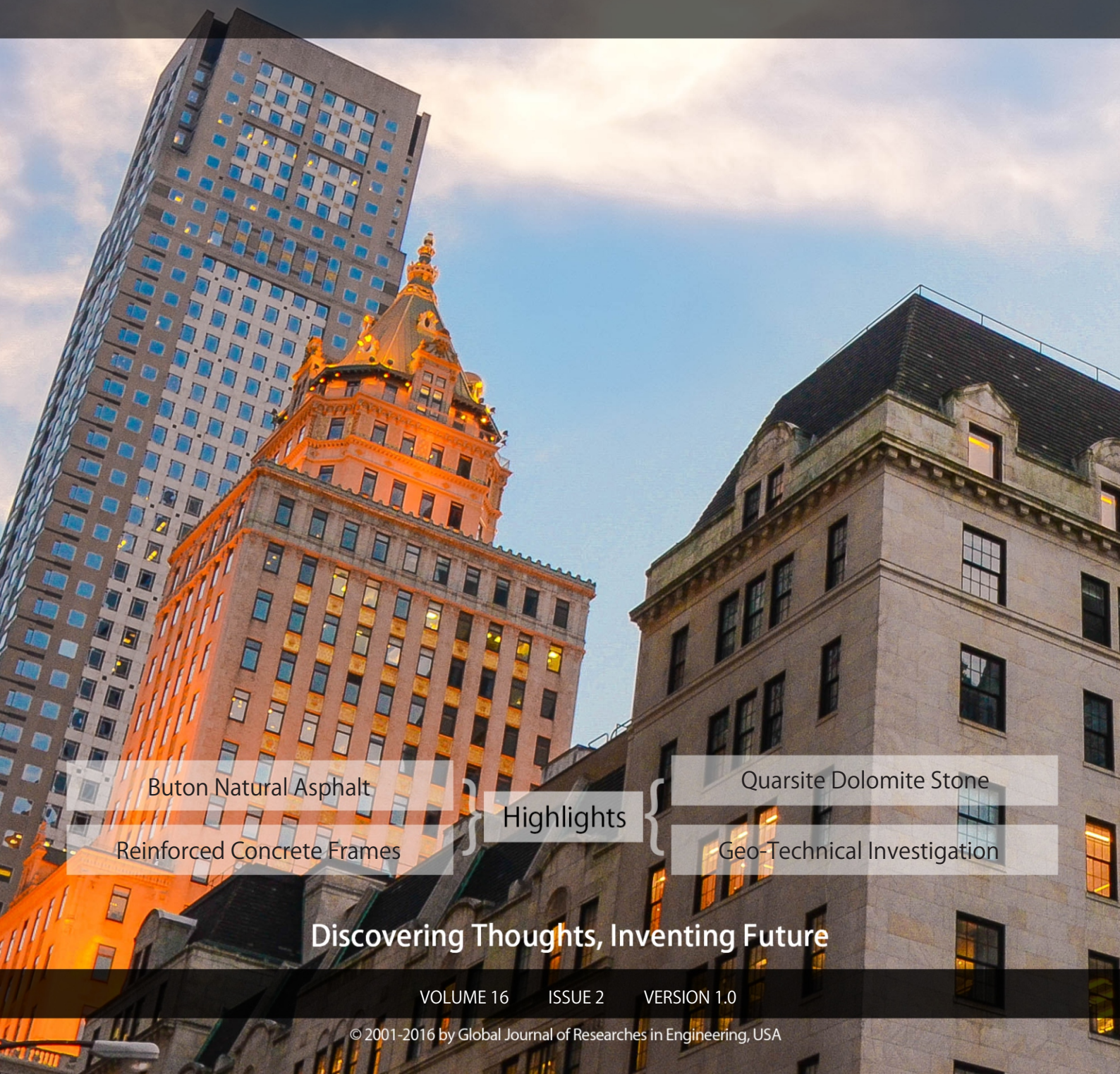

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Reinforced Concrete Frames

Highlights

Quarsite Dolomite Stone

Geo-Technical Investigation

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 2 VERSION 1.0

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Experimental Investigation on Dual Column Frame System for Seismic Resistance of Reinforced Concrete Frames

By Joel Shelton J, Venkatesh V & Dr. Hemalatha G
Karunya University, India

Abstract- Structures subjected to seismic forces must have adequate strength and stiffness to control inter storey drift in order to prevent damage to structural and non-structural elements during excitations. Linked column frame system (LCF) for steel structures was proposed by Peter Dusicka et.al (2009) with the objective of utilizing replaceable components that are strategically placed to protect the gravity load carrying system. In this paper the concept is extended to Reinforced concrete structures. A design procedure is proposed that ensures that plastic hinges form in the links of the link column at a significantly lower story drift than when plastic hinges develop in the moment frame beams. The experimental investigation consisted of cyclic load test on a single bay frame with and without link column. The test results showed a significant increase in the energy dissipation of the link column frames with a decrease in relative story drifts.

Keywords: non-linear pushover analysis, lateral loading, link column frame, seismic response, energy dissipation.

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Joel Shelton J [α], Venkatesh V [σ] & Dr. Hemalatha G [ρ]

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Keywords: non-linear pushover analysis, lateral loading, link column frame, seismic response, energy dissipation.

I. Introduction

The objective to construct structures that are safe and can withstand natural calamities like earthquake, wind, blast etc., has been essential for all construction activities. Peter Dusicka et.al.,(2009) recommended a lateral load resisting system, referred to as the linked column frame (LCF) system. This system combines features of conventional components to attain a system that can be designed for multiple performance objectives. In the LCF building system, selected columns are spaced in close to each other in specific areas and linked independently of the gravity system throughout the height. Under earthquake induced lateral loads, the relative deformations of the closely spaced columns engage the links which are designed to yield in shear to dissipate energy, control drift and limit the forces transferred to the surrounding structural members.

In this paper, lateral resisting system i.e. the link column frame (LCF) system, is extended to Reinforced concrete frame as shown in Figure 1. This system consists of easily replaceable link beams between two closely spaced columns and an adjacent flexible moment resisting frame. The links act as sacrificial structural elements that yield to provide nonlinear softening behaviour, ductility, and energy dissipation while limiting the inelastic deformation and related damage to the structural members of the adjacent moment resisting frame. The LCF links behave similarly to links in eccentrically braced frames, that is, they yield in shear and/or flexure depending on their length.

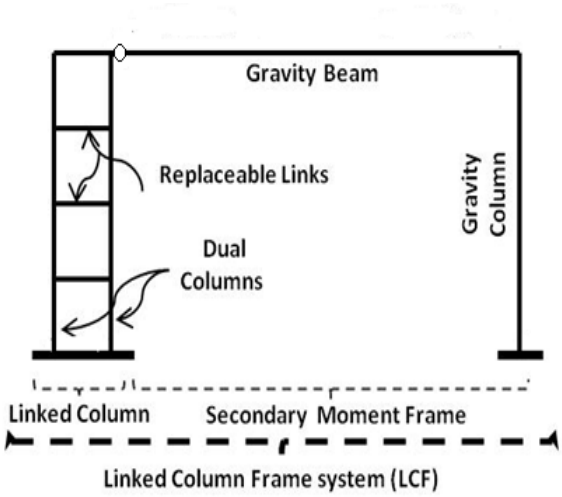

Figure 1 : Typical elevation of the Link Column Frame System

The secondary frame system is designed as a sacrificial beam column system to yield in the inelastic range whereas the main system is in the elastic range. The link beams are designed as reinforced concrete members to resist shear and are connected to columns through bolted connections to offer a hinge connection and transfer only shear.

II. Specimen for Experimental Investigation

To carry out experimental Investigation three reinforced concrete frames were taken with and without link column system. Model 1 (M1) was cast as bare frame without link column. Model 2 (M2) had link column with rigid connection between the frame and the column, Model (M3) was designed with hinged connection between the beam and the link column. The dimensions of the specimen were scaled down in the ratio 1:3 based on the availability of the facilities in the laboratory. The details of the specimens cast are shown in table 1. Figure 1 shows the schematic view of the specimens.

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Table 1 : Details of the Specimen

		M1	M2	M3
Beam	Dimension (m)	0.77 x0.77		
	Reinforcement (nos.)	#4, 8mm		
Column	Dimension (m)	0.77 x0.77		
	Reinforcement (nos.)	#4, 8mm		
Link	Dimension (m)	-	0.2 x 0.2	
Link column	Dimension (m)		0.4 x 0.4 m	
Bay length	in m	1		
Height	in m	1		

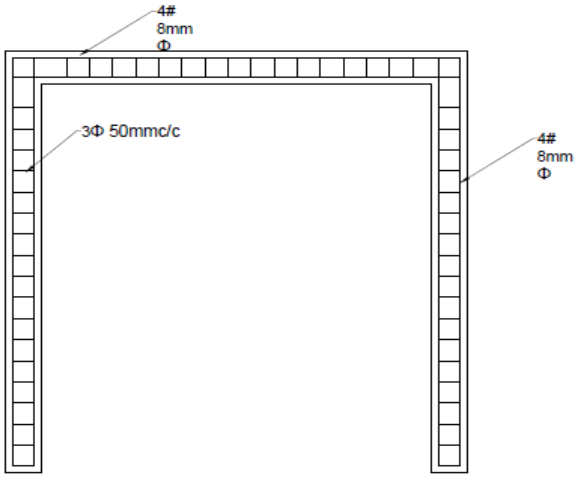

Figure 2a : Bare Frame (M1)

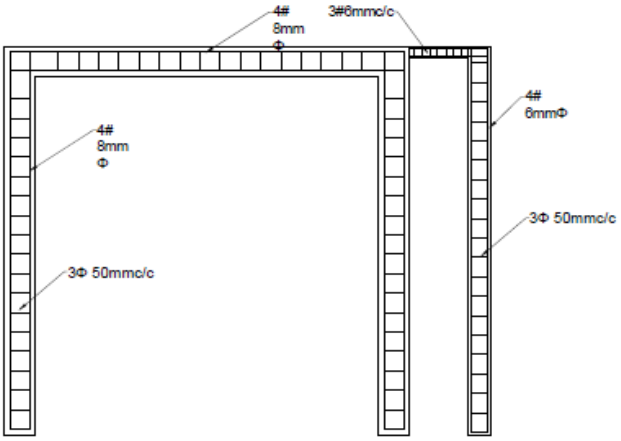

Figure 2b : Frame with rigid beam to column connection (M2)

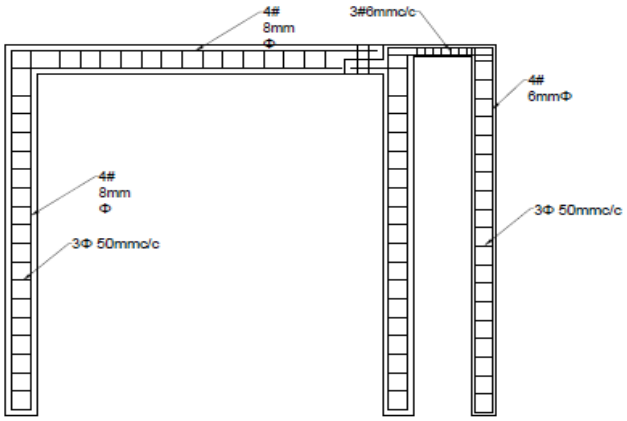

Figure 2c : Frame with hinged beam to column connection (M3)

III. Design Procedure for Link Beam

The links are designed similarly to links in eccentrically braced frames and their yielding behaviour depends on their length and section properties. AISC Seismic Provisions (AISC) divides links into three categories based on their link length, e, plastic shear capacity, Vp, and plastic moment capacity, Mp. Vp and Mp, respectively, defined as follows [4]:

$$V_p = \tau_y \times A_v \times (1/\gamma_m) \quad (1)$$

$$M_p = Z_p \sigma_y \quad (2)$$

From the above equation, τ_y is the shear stress for the section, A_v is the shear area of the section, γ_m is the partial safety factor of the material, σ_y is the yield stress of the material, and Zp is the plastic modulus Shear links, which yield primarily in shear, have:

$$e \leq 1.6\ (Mp/Vp) \quad (3)$$

flexural links, which yield primarily in flexure, have:

$$e \geq 2.6\ (Mp/Vp) \quad (4)$$

and intermediate links, which may yield in a combination of shear and flexure, have:

$$1.6\ (Mp/Vp) < e < 2.6\ (Mp/Vp) \quad (5)$$

The above equations were used to design the length of the links and the values are given in table 2.

Table II : Length of Links

(Z) mm^3	(A_v) mm^2	Shear link mm	Flexure link mm	Intermediate link mm
6750	196	160	258	200

IV. Analysis of the Links

To choose suitable links for the LCF system, the performance of various types of the links was studied using push over analysis in SAP 2000. The performance point of the frames with various link lengths was observed and is shown in figure 2.

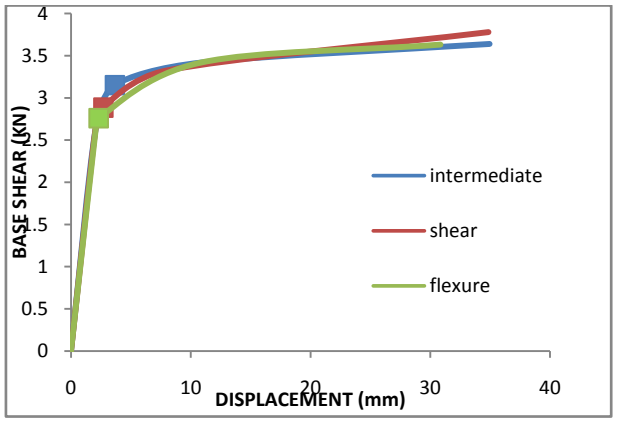

Fig. 3 : Performance levels of various types of links

The performance level of various types of link models were found between IO-LS (Immediate occupancy to life safety). Performance point is higher for the intermediate link model when compared with the shear and the flexural link. The shear links and flexural links started to yield earlier when compared to the intermediate links.

V. Beam to Column Connection with Dowels

For hinged connection in linked column frame (M3), the beam of the moment frame is connected to the linked column using dowel bars. The dowel bars are used to transfer shear loads across construction and movement joints in concrete. With reference to the beam to column connections, the shear force V at the top of the columns was calculated from the resisting moment M_r of the section at the base of the columns with $V = M_r / h$ so that, introducing a Υ_R factor, the force on the connection becomes

$$H = \Upsilon_R V = \Upsilon_R M_r / h \quad (6)$$

$$\text{and } R_d = 0.9n \phi^2 \text{ SQRT } (f_y f_{ck} (1-\alpha^2)) \quad (7)$$

Where, n = no of dowels, ϕ = diameter of dowels, f_{ck} = characteristic strength of concrete, f_y = yield strength of steel, σ = normal tensile stress. 2 no's of 20mm ϕ bar as dowel reinforcement was provided for hinge connection. The dowel bar of 20 mm diameter was embedded in the column to a length equal to the development length.

VI. Experimental Investigation

Cyclic load test was conducted on the three frames the behaviour of the specimens were studied. Discussions of the results are as follows

a) Bare frame (M1)

This specimen (M1) was designated as the reference frame to compare its performance against linked column frame specimens. Ten full displacement cycles were applied to the frame. First shear cracks were observed at a displacement of 5.583mm. The corresponding restoring force was measured as 6 kN. At the end of the 5th cycle, at 8.56mm displacement, first yielding of the longitudinal reinforcement was observed. At this drift level, the restoring force was measured as 10 kN and the maximum crack opening was obtained as 1.0 mm. The base shear versus story drift relationship of bare frame and its crack patterns at the final stage of the test are given in Figure 4.

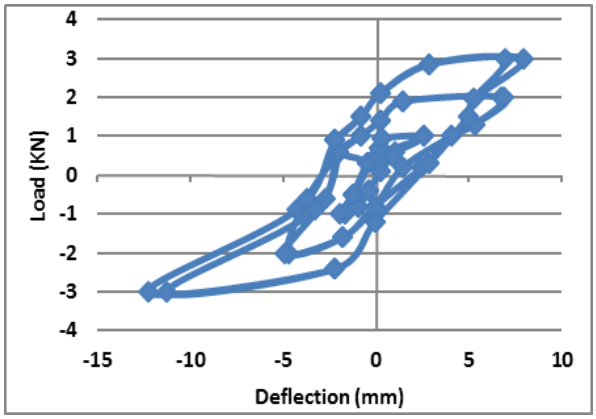

Figure 4a : Base shear vs. story drift (M1)

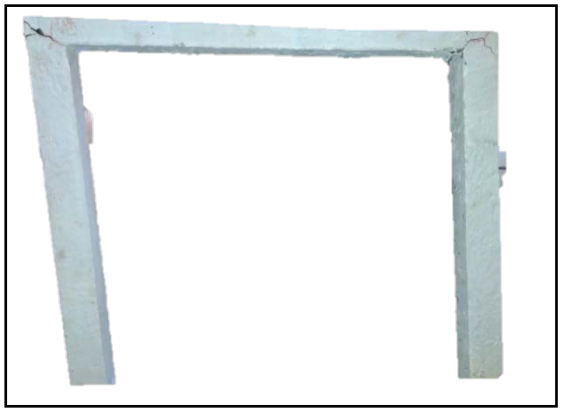

Figure 4b : Damage pattern for bare frame (M1) specimen

b) Rigid link column frame (M2)

This specimen is a linked column frame in which the normal beam is rigidly connected to the linked column. Sixteen full displacement cycles were applied to the frame. First flexural cracks were observed at a displacement of 9.6 mm which is occurred at the link joints. The corresponding restoring force was measured as 18 kN. First shear crack were observed at a displacement of 10.26 mm. The corresponding restoring force was measured as 20 kN. At the end of the 10th cycle, at 15.56mm displacement, first yielding of the

longitudinal reinforcement was observed. At this drift level, the restoring force was measured as 30 kN. The base shear versus story drift relationship of bare frame and its crack patterns at the final stage of the test are given in figure 5.

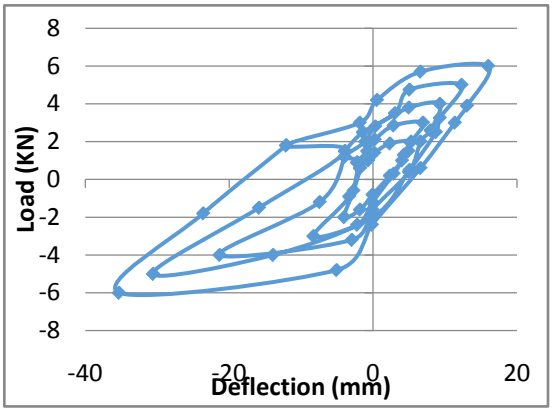

Figure 5a : Base shear vs. story drift

Figure 5b : Damage pattern for M2

c) Hinged link column frame(M3)

This specimen is a linked column frame in which the normal beam is flexibly connected to the linked column. Sixteen full displacement cycles were applied to the frame. First shear cracks were observed at a displacement of 15.6 mm which is occurred at the hinged joint. The corresponding restoring force was measured as 20 kN. At the end of the 10th cycle, at 20.57 mm displacement, first yielding of the longitudinal Reinforcement was observed. At this drift level, the restoring force was measured as 33 kN. The base shear versus story drift relationship of bare frame and its crack patterns at the final stage of the test are given in figure 6.

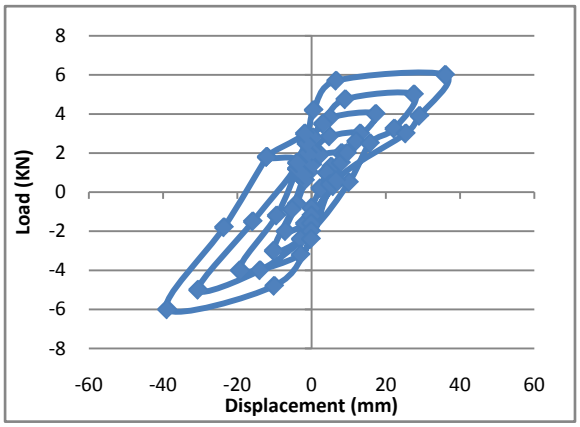

Figure 6a : Base shear vs. story drift (M3)

Figure 6b : Damage pattern for M3

The ability of a structure to dissipate the seismic input energy is an accurate measure of its expected seismic performance. The cumulative dissipated energy is determined as the sum of the area enclosed by each hysteretic loop. The dissipated cumulative energy versus deflection relation for all specimens is given in figure 7. The normal frame is the specimen which has the minimum energy dissipation capacity. The linked column frame which has a flexible connection is the one which dissipates maximum energy when compared with the rigid connection. The hinged linked column frames dissipated 65% more energy than the rigid linked column frame. This enables the plasticization to occur in links in lower drift compared to beams in higher drifts.

d) Lateral stiffness

The lateral stiffness was defined as the slope of the line connecting the positive and negative peaks of a given load–displacement cycle. Variation of the lateral stiffness with respect to story drift for all specimens is given in figure 8. Presence of hinged connection reduces the lateral stiffness of hinged linked column frames. As expected, the lateral stiffness decreases for hinged linked column when compared with the rigid linked column. Initial lateral stiffness is reduced by about 11.7%. The overall stiffness of rigid linked column frame is 1.59 times greater than the normal frame's stiffness, respectively.

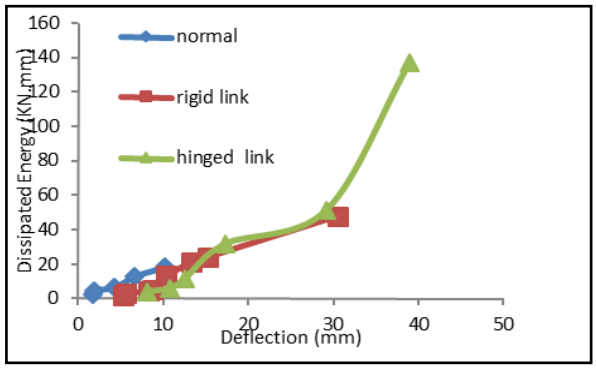

Figure 7 : Energy dissipation vs Deflection

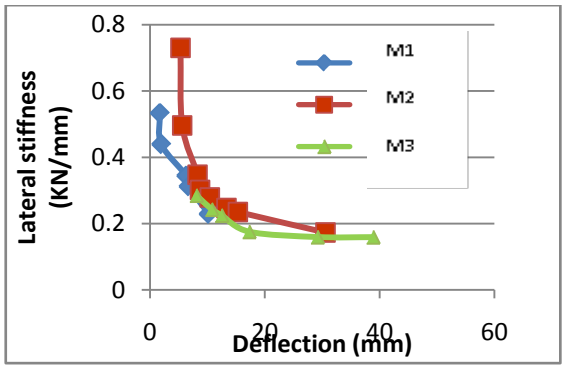

Figure 8 : Lateral stiffness vs Deflection

VII. Conclusion

The Experimental investigation carried out to study the feasibility of implementing sacrificial link beam and column system for seismic resistance of reinforced concrete structures are presented. The following are the conclusions drawn

- From the formation of the hinges and the reduction in drift, it can be said that the linked column frame effectively protects the gravity beams as well as the columns such that the structure could rapidly return to occupancy through link replacement.
- Seismic performance of building can be improved by providing link column, which absorb the input energy during cyclic loading.

Since the replaceable links are also modelled as reinforced concrete elements the cost of construction can be greatly reduced. Effective hinge formation was obtained when dowel bar is inserted and the result shows that the energy dissipation of the linked column frame is better than the normal frame.

VIII. Acknowledgement

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References Références Referencias

1. Abolmaali, Ali, Razavi, Mohammad, Radulova, Dobrinka. "On the Concept of Earthquake Resistant Hybrid Steel Frames" *Journal of Constructional Steel Research 2012, 68(1)*, 39.
2. Arlindo Lopes, Peter Dusicka and Jeffrey Berman, "Lateral Stiffness Approximation of Linked Column Steel Frame System", Structural Congress, 2015, 2408-2420.
3. Debasis Sinha. "Seismic Retrofitting of existing Structure" *IIT Roorkee , M. Tech Thesis*. 2009
4. Malakoutian, M., Berman, J. and Dusicka, P. Seismic Response Evaluation of the Linked Column Frame. Earthquake Engineering and Structural Dynamics; 42:2013, 795-814.
5. Mohd Aarif Khan."Seismic evolution of frame buildings using pushover and dynamic analysis" *IIT Roorkee, M.Tech Thesis*. 2008
6. Nabil Mansour, Yunlu Shen, Constantin Christopoulos and Robert Tremblay. [2008] "Experimental Evaluation of Nonlinear Replaceable Links in Eccentrically Braced Frames and Moment Resisting Frames" *14th World Conference on Earthquake Engineering* October 12-17, Beijing, China.
7. Peter Dusicka. "Steel Frame Lateral System Concept Utilizing Replaceable Links" *NZSEE Conference*.2009.
8. Tena-Colunga A. "Mathematical modeling of the adas energy dissipation device."*Engineering Structures*, 19(10), 1997, 811-820.
9. Thorburn, L. J., Kulak, G. L., and Montgomery, C. J. "Analysis of steel plate shear walls." *Structural Engineering Report* 107, Dept. of Civil Engineering, University of Alberta, Edmonton, Alberta, Canada. 1983
10. Tremblay, R., Lacerte, M., and Christopoulos, C. "Seismic response of multi- story buildings with self-centering energy dissipative steel braces." *Journal of Structural Engineering*, 134(1), 2008, 108-120.
11. Tsai, K. C., Chen, H.W. and Hong, C., and Su, Y. "Design of steel triangular plate energy absorbers for seismic-resistant construction." *Earthquake Spectra*, 9(3), 1993, 505-528.
12. Uang, C. M., B. D., and Lee, C.H. "Cyclic performance of haunch repaired steel moment connections." *Engineering Structures*, 20(4-6)1998, 522-561.
13. Vargas, R. and Bruneau, M. "Experimental response of buildings designed with metallic structural fuses." *Journal of Structural Engineering*, 135(4), 2009, 386-393.
14. Vargas, R. and Bruneau, M."Experimental response of buildings designed with metallic structural fuses. ii." *Journal of Structural Engineering*, 135(4), 2009, 394-403.

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Experimental Investigation of Unreinforced and Reinforced Masonry Slab

By Mahmudul Hasan Mizan & Mishuk Majumder
Khulna University of Engineering & Technology, Bangladesh

Abstract- Unreinforced Brick masonry is a non-homogeneous material made of bricks as the building units and the mortar as the interface material. Brick masonry has a high compressive strength under vertical loads but has a low tensile strength against bending. Reinforced brick masonry show greater resistance against shear and bending. Brick masonry slab have good appearance, fire resistance capacity, thermal and acoustics performance, free from corrosion of reinforcement etc. Two types of masonry slab with herring bone bond pattern were fabricated using wire mesh and minimum reinforcement in addition to that one traditional RCC slab was also fabricated using minimum reinforcement. The masonry slabs failed due to brick failure without any advance warning. The crack pattern of masonry slabs using wire mesh and minimum reinforcement were flexure-tension and web-shear respectively. The crack pattern of RCC slab was flexure-shear. The maximum flexural stress carried by RCC slab, masonry slabs with wire mesh, with minimum reinforcement were 488 psi, 194 psi and 387 psi respectively where the maximum deflections were 0.157 inch (3.98 mm), 0.083 inch (2.1 mm) and 0.05 inch(1.28 mm), respectively. Reduction of cost of masonry slabs using wire mesh and minimum reinforcement from RCC slab are 24.14% and 2.85% respectively.

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Abstract- Unreinforced Brick masonry is a non-homogeneous material made of bricks as the building units and the mortar as the interface material. Brick masonry has a high compressive strength under vertical loads but has a low tensile strength against bending. Reinforced brick masonry show greater resistance against shear and bending. Brick masonry slab have good appearance, fire resistance capacity, thermal and acoustics performance, free from corrosion of reinforcement etc. Two types of masonry slab with herring bone bond pattern were fabricated using wire mesh and minimum reinforcement in addition to that one traditional RCC slab was also fabricated using minimum reinforcement. The masonry slabs failed due to brick failure without any advance warning. The crack pattern of masonry slabs using wire mesh and minimum reinforcement were flexure-tension and web-shear respectively. The crack pattern of RCC slab was flexure-shear. The maximum flexural stress carried by RCC slab, masonry slabs with wire mesh, with minimum reinforcement were 488 psi, 194 psi and 387 psi respectively where the maximum deflections were 0.157 inch (3.98 mm), 0.083 inch (2.1 mm) and 0.05 inch(1.28 mm), respectively. Reduction of cost of masonry slabs using wire mesh and minimum reinforcement from RCC slab are 24.14% and 2.85% respectively.

I. Introduction

Brick masonry is one of the oldest forms of building construction material. Brickwork is a composite material with bricks as the building units and the mortar as the jointing material (Freeda Christy C. *et. al*, 2013).The strength of the bricks-work primarily depends upon quality and strength of the brick, the type of mortar and the method of bonding adopted in construction, type of material used, nature of workmanship and supervision. Brick masonry plays a significant role in the construction industries of bangladesh where natural stones are not available and other type of building materials like concrete, MS sheets or CI sheets, and artificial materials are costly. The rapid progress over recent past in the understanding of the materials and considerable advances in the method of design have increased acceptance of load bearing masonry as a variable structural material. (S.P. Bindra, 2013). In residential buildings, roof system is a vital part. The selection of the type of material and construction is made, keeping in view the requirements of strength, water proofing, thermal insulation, fire resistance, durability and economy. It was therefore felt to investigate the local carrying capacity of different type of masonry slab. Reinforced brickwork is a typical type of construction in which the compressive strength of bricks is utilized to bear the compressive stress and steel bars are used to bear the tensile stresses in a slab. In other words the usual cement concrete is replaced by the bricks. However since the size of a brick is limited, continuously in the slab is obtained by filling the joints between the bricks by cement mortar. The reinforcing bars are embedded in the gap between the bricks which is filled with cement mortar. The designs of reinforced bricks slab are similar to these of reinforced concrete slab. (B.C. Punmia, 2012).Ahmed, T. and Junayet, A.,(1996) carried out a comparison study between Ferro cement slab and conventional R.C.C. slab in terms of their flexure behavior and cost. In terms of appearance, durability and cost, brick masonry is comparatively superior to other alternatives (Hossain, M. M. *et al*., 1997). The main aim of this study is to investigate the mechanical properties of masonry slabreinforced with alternative materials (wire mesh and minimum reinforcement) to evaluate their performance and economy compared to conventional RCC slab. An endeavor will make to evaluate the feasibility of masonry slab to replace RCC slab.

II. Materials and Methods

a) Specification of Materials

In this study Bricks, Portland Composite Cement, Sand and Reinforcement (wire mesh and deformed bar) from the local manufactures has been used and the properties of brick and mortarare given in Table 1 and Table 2.

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Table 1 : Physical Properties of Bricks

Serial	Frog mark	Compressive strength (Ksi)	Water Absorption Capacity (%)	Price (tk/ 1000 nos)
No	NEWB	2.21	13.37	6500
1	SHAH	2.65	13.47	7000
2	CITYI	2.3	16.21	6000
3	FMB	2.6	16.78	7000
4	FINE	3.24	10.35	6500
5	AKIJ	5.70	12.22	8000

From table 1, it is found that the AKIJ brand brick have maximum compressive strength. The water absorption capacity is 12.22 % which is less than 1/6 of it's own weight. AKIJ brand brick was uniform in color, size and shape is regular, campact, free from crack and other flaws such as air, bubbles, stone nodules etc. Although it's cost is maximum but don't vary too much from the other brand. So AKIJ brand brick was selected for the final work.

Table 2 : Tests Results for compressive strength of Cement Mortar

Age	Ratio (1:2)	Average Compressive Strength (psi)
3 days	Cement : Kushtia Sand	2950
	Cement : Sylhet Sand	3125
	Cement : Sylhet + Kushtia Sand	3045
7 days	Cement : Kushtia Sand	3790
	Cement : Sylhet Sand	3750
	Cement : Sylhet + Kushtia Sand	3630

Bashundhara cement with Khustia sand having fineness modulous of 1.65 in ratio 1:2 gives greater compressive strength. So it was selected for the final work.

b) selection of slab

Two types of masonry slab reiforeced with wire mesh and minimum reinforcement and one traditional RCC slab having dimension 4ft x 2.5ft x 4.5 inch were selected for the test.

c) Design of Masonry and Rcc Slab

The slabs were designed as one way slab. In case of masonry slab reinforced with wire mesh 0.5 inch spacing wire mesh was used. The bottom clear cover was 0.75 inch and top mortar layer was 0.5 inch.

In masonry slab using minimum reinforcement 10 mm dia bar was used. The number of reinforcement in long direction was 5 nos and in short direction was 7 nos. Reinforcement was used only in tension zone. No shear reinforcement was used. Bottom clear cover was 0.75 inch and top mortar layer was 0.5 inch.

In traditional RCC slab the number of reinforcement was kept as same as masonry slab using minimum reinforcement so that they can be compare in a similar way. Bottom clear cover was 0.75 inch.

Herring bone bond pattern was used in masonry slabs. The contribution of brick in slabs thickness was 2.75 inch. In this arrangement of brick work, bricks are laid above bottom surface inclined at 45^0 in two directions from the center. Cross-section of the above mentioned slabs are shown in figure 1(a), figure 1(b), and figure 1(c) respectively.

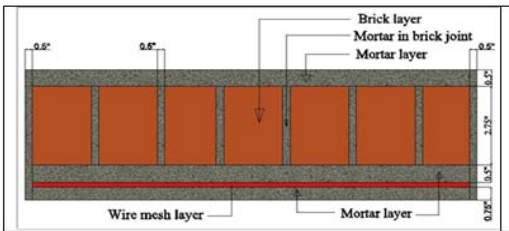

Figure 1(a) : Detailed design of masonry slab using wire mesh

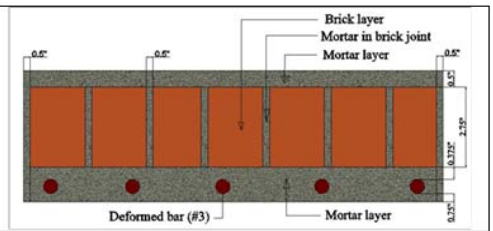

Figure 1(b) : Detailed design of masonry slab using minimum reinforcement

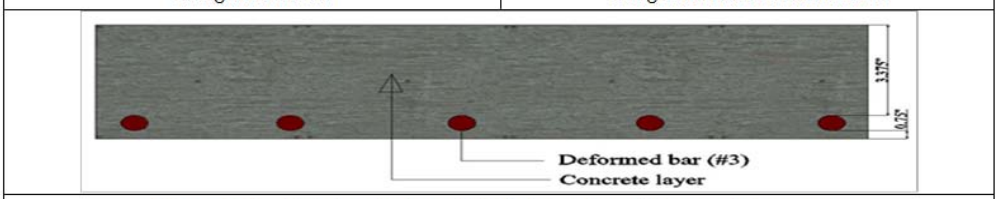

Figure 1 (c) : Detailed design of RCC slab using minimum reinforcement

d) Casting, Curing and Testing of Slabs

Three types of slabs were casted according to the design specified above and cured for 28 days. After curing the slabs were tested in the laboratory. The typical and laboratory experimental setups are shown in figure 2(a) and figure 2(b) respectively.

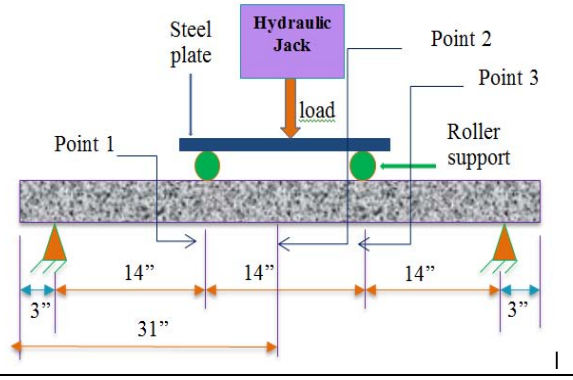

Figure 2(a) : Typical Experimental setup for two point load test.

Figure 2(b) : Laboratory Experimental setup.

The load was applied by the hydraulic jack by pumping it. The reading of deflection gauge at each point was taken with respect to each small division of pressure gauge. The data were recorded untill the failure of slab.

III. Results and Discussion

a) Masonry slab using Wire mesh

Table 3 : Load test result for masonry slab using wire mesh

Observed Pressure gauge Value	Load (kN)	Load (kip)	At Point1 Deflection		At Point 2 Deflection		At Point 3 Deflection	
			(mm)	(in)	(mm)	(in)	(mm)	(in)
0	0	0	0	0	0	0	0	0
1	15.8	3.55	0.015	0.00059	0.15	0.0059055	0.021	0.00082
2	22	4.94	0.019	0.00074	0.265	0.0104331	0.034	0.00133
3	28	6.29	0.048	0.00188	0.5	0.019685	0.055	0.00216
4	34	7.64	0.2	0.00787	1.6	0.0629921	0.168	0.00661
5	40.1	9.01	0.617	0.02429	2.1	0.0826772	0.475	0.01870

In masonry slab using wire mesh no deformed bar was provided. After curing for 28 days the slabs failed under load and the loads are shown in table 3. Deflection was measured at 3 points as remarked in the typical experimental setup. The masonry slab using wire mesh was found to take 9.1 kips load before failure which is equivalent to 1000 psf load. Maximum deflection is 2.1 mm at mid point.

b) Masonry slab using minimum reinforcement

Table 4 : Load test result for masonry slab using minimum reinforcement

Observed Pressure gauge Value	Load (kN)	Load (kip)	At Point1 Deflection		At Point 2 Deflection		At Point 3 Deflection	
			(mm)	(in)	(mm)	(in)	(mm)	(in)
0	0	0	0	0	0	0	0	0
1	15.8	3.55	0.04	0.00157	0.35	0.01377	0.014	0.00055
2	22	4.94	0.07	0.00275	0.48	0.01889	0.025	0.00098
3	28	6.29	0.092	0.00362	0.57	0.02244	0.037	0.00145
4	34	7.64	0.112	0.00440	0.7	0.02755	0.049	0.00192
5	40.1	9.01	0.14	0.00551	0.8	0.03149	0.065	0.00255
6	46.1	10.36	0.168	0.00661	0.98	0.03858	0.087	0.00342
7	52.25	11.74	0.215	0.00846	1.05	0.0413	0.12	0.00472
8	58.45	13.14	0.262	0.01031	1.1	0.04330	0.154	0.00606
9	64.15	14.42	0.298	0.01173	1.15	0.04527	0.189	0.00744
10	70.25	15.79	0.332	0.01307	1.18	0.04645	0.223	0.00877
11	76.7	17.24	0.37	0.01456	1.21	0.04763	0.264	0.01039
12	83	18.65	0.398	0.01566	1.25	0.04921	0.29	0.01141
13	89	20.00	0.45	0.01771	1.28	0.05039	0.425	0.01673

Deformed bar were used in masonry slab using minimum reinforcement. The masonry slab using minimum reinforcement carried 20 kips load before failure which is equivalent to 2000psfload. Maximum deflection was found 1.28 mm at point 2.

c) RCC slab using minimum reinforcement

Table 5 : Load test result for RCC slab using minimum reinforcement

Observed Pressure gauge Value	Load (kN)	Load (kip)	At Point1 Deflection		At Point 2 Deflection		At Point 3 Deflection	
			(mm)	(in)	(mm)	(in)	(mm)	(in)
0	0	0	0	0	0	0	0	0
1	15.8	3.55	0.03	0.00098	0.54	0.02125	0.037	0.00145
2	22	4.94	0.04	0.00173	0.96	0.03779	0.063	0.00248
3	28	6.29	0.08	0.00314	1.4	0.05511	0.125	0.00492
4	34	7.64	0.19	0.00740	1.85	0.07283	0.205	0.00807
5	40.1	9.01	0.27	0.01062	2.5	0.09842	0.29	0.01141
6	46.1	10.36	0.36	0.01417	2.8	0.11023	0.372	0.01464
7	52.25	11.74	0.46	0.01811	2.95	0.11614	0.465	0.01830
8	58.45	13.14	0.59	0.02322	3.1	0.12204	0.58	0.02283
9	64.15	14.42	0.71	0.02803	3.22	0.12677	0.79	0.03110
10	70.25	15.79	0.89	0.03484	3.4	0.13385	0.84	0.03307
11	76.7	17.24	0.95	0.03740	3.68	0.144881	1.005	0.03956
12	83	18.65	0.99	0.03897	3.85	0.15157	1.25	0.04921
13	89	20.00	1.02	0.04015	3.88	0.15275	1.305	0.05137
14	95	21.35	1.09	0.04291	3.91	0.15393	1.398	0.05503
15	100.5	22.59	1.29	0.05078	3.98	0.15669	1.435	0.05649

RCC slab using minimum reinforcement took 22.59 kips load before failure which is equivalent to 2500 psf load. Maximum deflection is 3.98 mm.

IV. Variation of Deflection at Points

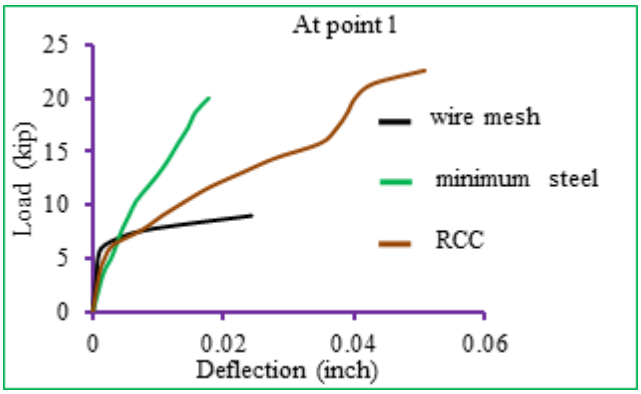

Figure 3 : Variation of Deflection (inch) with Load (Kip) at Point 1

Figure 3 shows the variation of deflection with load for all types of slab at point 1 which is located at a distance 17 inch away from the right support. The deflection at point 1 is maximum for RCC slab, second maximum deflection was found for masonry slab using wire mesh. This is due to the elasticity of the wire mesh. Masonry slab using minimum reinforcement shows minimum deflection due to use of deformed bar and brittleness of brick.

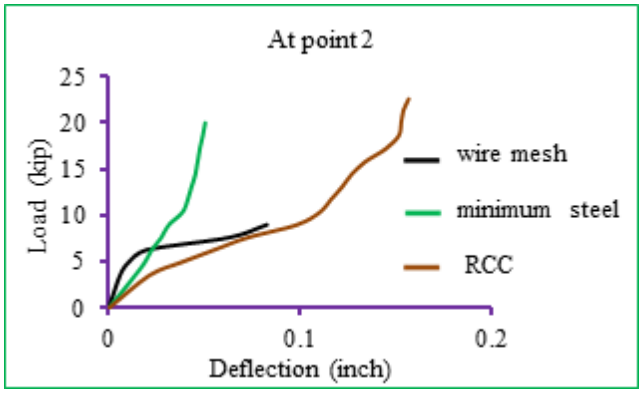

Figure 4 : Variation of Deflection (inch) with Load (Kip) at Point 2

Figure 4 shows the variation of deflection with load for all types of slab at point 2 which is located at the midpoint of the slab. All slabs show maximum deflection at point 2. Maximum deflection is 3.98 mm for RCC slab.

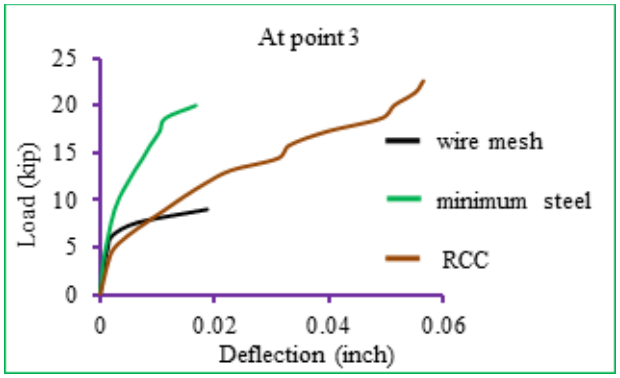

Figure 5 : Variation of Deflection (inch) with Load (Kip) at Point 3

Figure 5 shows the variation of deflection with load for all types of slab at point 3 which is located at a distance 17 inch away from the left support. The minimum deflection is for masonry slab using minimum reinforcement and maximum deflection is for RCC slab. Masonry slabs failed suddenly without any advanced warning due to the brittleness of brick. There is no yield point in the figures which ensure the sudden failure of slabs.

V. Crack Pattern

a) Masonry slab using wire mesh

Figure 6 : Failure pattern of masonry slab using wire mesh

The failure pattern of masonry slab using wire mesh is flexure-tension type. Failure occurred at almost midpoint. This type of failure may be initiated due to the increase of principle tensile stress greater than combined tensile stress of brick and mortar. The failure was sudden due to the brittleness of brick and the deflection was greater than masonry slab using minimum steel due to the greater elastic property of wire mesh.

b) Masonry slab using minimum reinforcement

Figure 7 : Failure pattern of masonry slab using minimum reinforcement

The failure of masonry slab using minimum steel occurred near the support. The failure occurred due to the shearing stress. So the crack pattern is named as web-shear. The reason of failure is the absent of shear reinforcement. Failure was brick failure and there was no advanced warning due to the brittleness of brick.

c) RCC slab using minimum reinforcement

Figure 8 : Failure pattern of RCC slab using minimum reinforcement

The crack of RCC slab using minimum steel initiated due to the flexure but the failure occurred due to the combined action of flexure and shear. This type of failure occurred due to the increase of combined flexure and shear stress greater than principle tensile stress of concrete.

VI. Economy Analysis

The amount of materials required in the manufacture process and the cost of three types of slab is shown in table 6 and table 7

Table 6 : Amount of Materials required in different types of slabs

specifications	Masonry slab with wire mesh	Masonry slab with minimum reinforcement	RCC
Cement (kg)	17	19	19
Fine Aggregate [1] (cft)	0.924	1.06	1.2
Fine Aggregate [2] (cft)	0.013	0.013	-
Coarse Aggregate (cft)	-	-	1.8
Steel (kg)	-	6.5	6.5
Brick (nos)	31	31	-
Wire mesh(sft)	7.9	-	-
Brick work (cft)	2.29	2.29	0
Casting (cft)	0	0	3.75
Plastering (sft)	10	10	0
Fabrication of steel (kg)	2	6.5	6.5

Table 7 : Amount of Cost required in different types of slabs

specifications	unit cost (tk)	Cost (tk) with wire mesh	Cost (tk) With minimum reinforcement	RCC slab
Cement (kg)	8.3	141.1	157.7	157.7
Fine aggregate [1] (cft)	60	55.44	63.6	73.2
Fine aggregate [2] (cft)	35	0.455	0.455	0
Coarse aggregate (cft)	160	0	0	292.8
Steel (ft)	55	0	357.5	357.5
Brick (nos)	8	248	248	0

Wire mesh(sft)	35	276.5	0	0
Brick work (cft)	9	20.61	20.61	0
Casting (cft)	20	0	0	75
Plastering (sft)	8	80	80	0
Fabrication of steel (kg)	6	12	39	39
Total cost		834.10	966.86	995.20

VII. Deviation of Performance and Cost of Slabs

Deviation of load carring capacity of masonry slabs using wire mesh and minimum reinforcement from RCC slab are 60.11% and 11.46% respectively; deflections are 47.24% and 67.84% respectively; flexural stresses are 60.25% and 20.70% respectively and costs are 24.14% and 2.85% respectively. The deviation of performance and costs of masonry slabs from RCC slab in shown in the following bar diagrams.

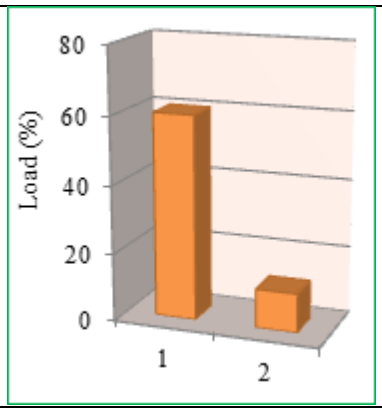

Figure 9(a) : Deviation of load capacity

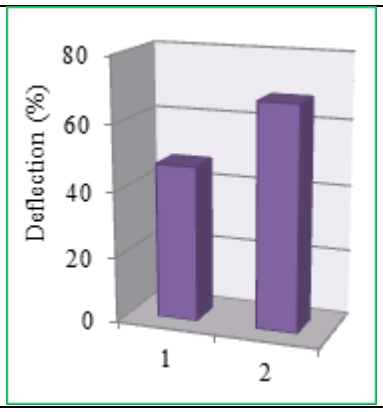

Figure 9(b) : Deviation of Deflection

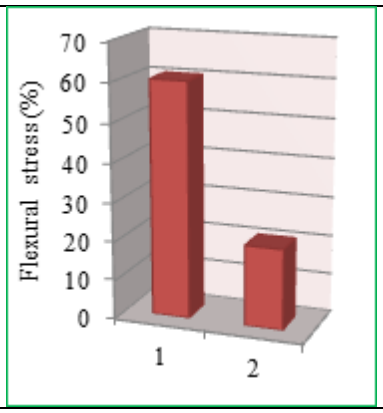

Figure 9(c) : Deviation of flexural stress

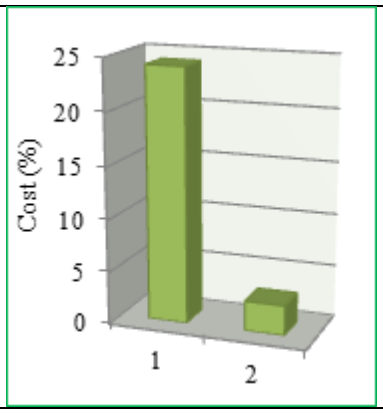

Figure 9(d) : Deviation of cost

VIII. Conclusion

- Maximum deflection of RCC slab, masonry slabs using wire mesh and minimum reinforcement are 0.157 inch (3.98 mm), 0.083 inch (2.1 mm) and 0.05 inch (1.28 mm) under load 22.59 kips, 9.1 kips and 20 kips respectively.
- Deviation of load carring capacity of masonry slabs using wire mesh and minimum reinforcement from RCC slab are 60.11% and 11.46% respectively; deflections are 47.24% and 67.84% respectively; costs are 24.14% and 2.85% respectively.
- Masonry slabs failed due to brick failure without any advanced warning. The crack pattern of RCC slab, masonry slab using wire mesh and minimum reinforcment are flexure-shear, flexure-tension and flexure-shear respectively.
- Masonry slab using wire mesh can be used in case of small span slab, restricted roof and waffle slab system. For long span slab and higher tension, masonry slab using minimum steel or RCC slab can be used. As the cost of RCC slab is only 2.85% greater than the masonry slab using minimum steel, so RCC slab is preferable for higher tension. But in case of architectural appearance and deflection restriction, masonry slab using wire mesh can be used.

References Références Referencias

1. Freeda Christy C*, Tensing D and Mercy Shanthi R. (2013): Experimental Study on Axial compressive Strength and Elastic Modulus of the Clay and Fly Ash Brick Masonry, Journal of Civil Engineering and Construction Technology, Vol. 4(4), pp. 134-141.
2. Bindra, S.P. and Arora, S.P. (2013): A Text Book Building Construction, 5th Edition, Dhanpat Rai Publication, New Delhi.
3. Punmia, B.C.; Ashok, K.J. ; Arun, K.J. (2012): A Text Book of Building Construction, 20th Edition, Laxmi Publications LTD. New Delhi.
4. Hossain, M.M. ; Ali, S.S. ; Rahman, A.M. (1997): Properties of Masonry Constituents, Journal of Civil Engineering, IEB, Bangladesh, vol. CE 25, No. 2, pp.135-155.
5. Thohid, A. and Abu, J. (1996): Low Cost Building, Undergraduate Thesis, Khulna University of Engineering and Technology, Bangladesh.

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Use of Quarsite Dolomite Stone in Permeable Asphalt, for Load Test as Research Overview and Application in the Laboratory

By Firdaus Chairuddin
Aimajaya Makassar University, Indonesia

Abstract- This study is to examine the nature of the stress and strain by using permeable asphalt and Quarsite Dolomite Stone with But on Natural Asphal. But on Natural Asphal is a type of modified asphalt is made of75% oiland25% asphalt bitumen extraction of stones, permeable porous asphalt road asphalt pavement. In the laboratory tests on strains that result aret strength: 1.95M pa for the stress:0, 012 vertical strain on the quality of the Buton Natural Asphal 3%, to 2.05 M pastress: 0,03 vertical strain on the quality of the Buton Natural Asphal 4%, to 1.75 Mpa stress: 0,031 vertical strain on the quality of the Buton Natural Asphal 5.5%. For the compressive strength test Result is the maximum quality Buton Natural Asphal is 4% and The results of Ever Stress FE analysis for multilayer soil-rigid are vertical decrease 0.5 mm, vertical micro strain (εz) $\pm$ 0 s/d 200 on deepness 150 mm, and for multilayer soil-rigid-asphalt results vertical decrease (Uz) $\pm$ 0.64 mm on the surface and $\pm$ 0.4 mm on the deepness of 50 mm, and vertical micro stength (εz) $\pm$ -6400 s/d -7200 on the surface, $\pm$ -4800 s/d -5600 on the deepness of 150 mm. As the result of laboratory test soil-rigid are vertical decrease each point 1.535 mm, 1.535 mm, 4.505 mm, 2.45 mm, 4.19 mm, dan 3.61 mm, and micro stength C1 to C4 0.36, -37.68, 44.44, 43.48, and the results of test Multilayer soil-rigid-asphalt are vertical decrease each point 1.576 mm, 0.075 mm, 3.7 mm, 1.985 mm, 2.48 mm, 0.986 mm, and the value of asphalt course micro stength is 655.

Keywords: quarsite dolomitestone, cantabro loss, indirect tensile strength, permeability, unconfined compressive strength, multi layer test, everstress. FE.

GJRE-E Classification : FOR Code: 090503

Strictly as per the compliance and regulations of :

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Keywords: quarsite dolomitestone, cantabro loss, indirect tensile strength, permeability, unconfined compressive strength, multi layer test, everstress. FE.

I. Introduction

The natural rock asphalt is a sedimentary rock containing of high hydrocarbon substances. The natural rock asphalt with deposit of approximately 60,991,554.38 ton (24,352,833.07 barrel oil equivalent) occurs in the southern area of Buton Island, Indonesia (Asep Suryana et.all, 2003). Buton natural asphalt (BNA) blend is a type of modification asphalt which is made of 75% petroleum asphalt and 25% rock asphalt extraction. The rapid growth of national economic in recent years resulted in a lot of transportation infrastructure demand. Approximately 600,000 tons of petroleum bitumen must be imported annually to fulfill the maintenances and construction of new road demand. The utilization of Buton Natural Asphal for the road development increases the national asphalt industry growth.

The water ponding on the road surface is caused by the heavy precipitation of high intensity rain fall. The water ponding problem during the rainy condition can be decreased by the employment of the permeable asphalt (porous asphalt) as a surfacing road pavement.

Many islands in Indonesia possess lime stones resources that can be used as coarse aggregate. Quarsite Dolomite stone is a local name of lime stone (quartzite dolomite) that can be found in around of Banggailaut area, Indonesia. In order to produce permeable asphalt, Firdaus et.al (2014) employed Quarsite Dolomite stone and Buton Natural Asphal as coarse aggregate and bituminous material, respectively. The results of porosity test, permeability test, stability test, flow test, indirect tensile test and material loss test (Cantabro test) showed the bonding strength between Buton Natural Asphal and Quarsite Dolomite stones can be established thus can enhanced the resistance of porous asphalt against raveling, rutting and shoving.

The solid that is subjected to the short time load are fundamentally characterized by the parameters of stress-strain curve. The failure of asphalt concrete specimens, the behavior of asphalt concrete under load as degeneration of the material and the limit of elasticity can be described by the stress-strain relationship for asphalt concrete in compression (S. Starodusbsky et.all., 1994). The unconfined compressive test combined with the indirect strength test can be used to calculate the cohesion strength and the angle of internal strength of the porous asphalt (Wu Shao Peng.all., 2006).

S. Stardubski et all, the peak strain changes on average from 19 mill strain (0.0019) to 22 (0.0022) or 23 mill strain (0,0023) in the compressive strength of dense asphalt concrete with interval of 1.6 Mpa-5.4 Mpa. As the strength of permeable asphalt increases from 1,2Mpa to 2,1Mpa, the range of its peak strain is average from 0.001 to 0.005, which is similar to the peak strain of dense asphalt concrete.

WU Shao Peng, et. all. (2006) employed asphalt butadiene styrene polymer (SBS) modified asphalt with performance grade PG76-22, crushed basalt aggregate and limestone to product porous asphalt. Unconfined

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compression test was run using 100 mm by 100 core drilled. At 4.5% asphalt content, unconfined the compressive strength and void ratio were 3601 kPa (3.6 Mpa) and approximated 19.5%, respectively.

The unconfined compressive test result of porous asphalt containing Quarsite Dolomite stone and Buton Natural Asphal showed that the mixtime with 4% has compressive strength value and void, respectively.

This work is a part of various extensive investigation projects on the development liquid Asbuton as bituminous asphalt binder and the suitability of Quarsite Dolomite stone as coarse aggregate in the permeable asphalt production. This paper reported the test results those are carried out to study the compressive strength and the strength strain curve in compression of the permeable asphalt.

As course agregate on the surface layer Road Pavement.Capasity drain porous Asphalt were connecting correlasion with spacing hight and small porousity in structure Asphalt. Stability and Durability and Hydrolic conductivity its must be hight test than 20% (*Ruz. et. al,* 1990).Asphalt porous is open graded course Aggregate. Porousity asphalt porous (10%-15%) the structure made drain for flow water (*Nur Ali, et al.* 2005).

Fig.1 : Permeable Asphalt Pavement

Aggregate was specimen mineral who was done for mixture road construktion in the asphalt pavement it's mush be 90%-95% for the total weight strukture or 77%-85% for all volume (*Alkin,et. al* 1997).Clasification agregate be measured by spacing at all : course aggregate it must be lost for filter No.8 it is higher than 2,36 mm. Fine aggregate it must be lostfor filter No.8 and stoped to No. 200 or it is 2,36 mm and 75 μm. Filler it must be smaller than 75 μm and lost filter No. 200

Fig. 2 : Quarsite Dolomite Stone (Local Containe of Banggai island in half celebes)

II. Methodology

a) Mix Design Permeable Asphalt Pavement Testing

Mix design permeable asphalt pavement the used composition open graded system. Who was Mix Trial Gradation lost of material ¾", 1/2 " be stopped filter ½" and loss of material ½" be stopped filter 3/8" with composition coMparative 50-50 to course aggregate. The used fine aggregate lost filter number 4, and stopped filter number 200 all of 10% for mould capacity. Asphalt Blend Pertamina the use variation standard 3%, 3.5%, 4%, 4.5% and 5%. Briquette make in for ∅ 10 cm and depth $\pm$ 6.5cm.

Fig. 3 : Permeable asphalt pavement

Before briket test in cantabro, briket was plum to Los Angeles machine drum, speed (V) 30-33 rpm for rotation.

$$L = \frac{Mo-Mi}{Mo} \times 100 \quad (1)$$

Fig. 4 : Test Cantabro Machine

b) Indirect Tensile Strengthtest

Permeable asphalt pavement was produced with used Quarsite Dolomite stone as course aggregate. The Quarsite Dolomite stone were broken in the spacing ∅ 3/8" ½"-¾" with the Buton Natural Asphal penetration 60/70. Briket at the Bitumen be done as the standard variation asphalt 3%, 3,5%, 4%, and 5% for testing experimental Indirect Tensile Strength (ITS) and Cantabro Test. We was controlling testing for composition asphalt permeable pavement with Standard National Indonesia (SNI) and American Association for Testing and Material (ASTM), Permeability and Marshal Test with asphalt variation 4-7% integral spacing 1% who use variation open gradation. Asphalt optimum standard is 4% be used to controlling variation asphalt. For optimum asphalt test be use variation asphalt 3% - 5% with spacing 5%.

For open gradation we use lost aggregate ¾", ½" and lost filter by comparative 50 : 50. Fine aggregate we use filter number 4, finally number 200, we used 10%. Buton Natural Asphal we use all variation asphalt category: 3%, 3.5%, 4%, 4.5% and 5%.

Test Indirect Tensile Strength (ITS) has been controlled by ASTM D6931-07.

Fig. 5 : Universal Testing Machine

Fig. 6 : Test Indirect Tensile Strength

c) Permeability Test

i. *Limitation Of Darcy's Law*

In a porous media, the hydraulic conductivity K represents the specific discharge per unithydraulic gradient, which means that the coefficient depends on both matrix and fluidproperties (*Bear*, 1972). From a dimensional analysis, the hydraulic conductivity can bederived as (*Nutting*, 1930):

$$K = \frac{k\,g}{v} \qquad (2)$$

Where k is the intrinsic permeability, v the kinematic viscosity and g the gravity acceleration.The intrinsic permeability is only a function of the matrix composing the porous media and its characteristics such as grain size distribution, tortuosity and porosity. For porous media, the Reynolds number (Re) can be defined as (*Charbeneau*, 2000):

$$\mathrm{Re} = \frac{q\,d}{v} \qquad (3)$$

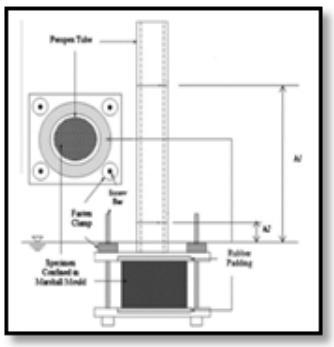

Fig. 7 : Setup of the Permeability Test

b) Multi Layer Test

The roads are very important for land transportation infrastructure especially for distribution of goods and services, and to support the economic growth. The safety, comfortable, robust and economic roads will make people easier in their movement. There are three types of pavement construction known today, such as flexible pavement, rigid pavement, and the combinations that known ascomposite pavement.

By the information the writers have, to determine the loads effect to the pavement construction of multilayer can be simulated using computer software i.e. EverStressFE.A pavement construction is a construction of pavement put over the subgrade to serves the traffic loads.

Based on the bonding materials,pavement construction can be divided to:a. Flexible Pavement, b. Rigid Pavement, c. Composite Pavement. Modulus of elasticity, often called as Young Modulus isa coMparison between stress axial strainin an elastic deformation, so that modulus of elasticity shows the trend to deformed and back to the original form when under loads (SNI 2826-2008). This shownby equation:

$$E = \frac{\sigma}{\varepsilon} \quad (4)$$

while E = modulus of elasticity, σ = stress and ε = strain

Poisson Ratio (μ) is the values of coMparison between horizontal strain (lateral strain) and vertical strain (axial strain) caused by loads thatparallel to axisand axial strain (Yoder, E.Y. and M.W Witczak. 1975). This shown by equation:

$$\mu = \frac{\varepsilon_h}{\varepsilon_v} \quad (5)$$

While:μ = poisson ratio, ε_h = lateral strain, ε_v = axial strain

EverStressFE 1.0 version 1.0 (available for download at www.civil.umaine.edu/EverStressFE 1.0) is a user-friendly three-dimensional (3D) finite-element based software package for the analysis of asphalt pavement systems subjected to various wheel/axle load combinations.EverStressFE 1.0 is useful for both flexible pavement researchers and designers who must perform complex mechanics-based analyses of flexible asphalt pavement systems.Some of the major features of EverStressFE 1.0 are summarized below, Intuitive and user-friendly graphical user interface., Ability to model systems with 1-4 layers.., Modeling of multiple-wheel systems, Batch analysis capabilities. , Visualization of results.

Research Methods

Methods that using in the tests are laboratory experimentaland analysis using software EverStressFE 1.0. The steps are :

- Unconfined Compressive Strength Tests for Material Soil, Rigid, and Asphalt.

The purposes are to determine the value of modulus of elasticity and Poisson Ratio each element. The process of the tests are:

a) Prepare the test instruments, such as: set Universal Testing Machine (UTM), Data Logger, Computer, LVDT cables, Strain Gauge, and bearing plate.
b) Connect the data logger and computer that has been installed software Visual Log.
c) Connect the LVDT cables to data logger
d) Put the testing material briquettesson UTM, and put the bearing plate upon the briquettes.
e) Install the LVDT cables around the briquettesas a sensor of deformation.
f) Start the test, as the loads doing mechanically by the UTM, and the value of deformationrecorded on computer.

- *Load test multilayer*

Two types of specimens multilayer that has been done will get through the load test to find the values of deformation, stress, strain, and the capacity of maximum load that can be overhead by each specimens. The work steps of the test are:

a) Install the 1x1 m box at the portal
b) Embedding the strain gauge at the specimens
c) Put the specimens to the box
d) Install the sets of hydraulic pump to portal, then set the load cell.
e) Install the LVDT cables to data logger, connect data logger to computer that has been installed of software Visual Log.
f) Doing the test, as the loading using hydraulic pump that operated manually, and the results are recorded to the computer.

The type of asphalt that has been used in the test are asphalt gradation of 4%.

Fig. 8 : Model Test Multilayer Machine

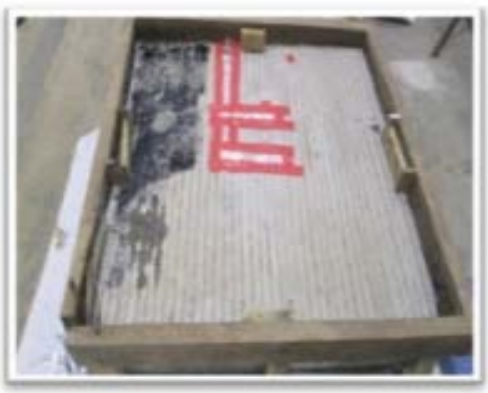

Fig. 9 : Specimen of mltilayer (rigid pavement)

III. Result and Discussion

a) *Analysis Indirect Tensile Strength*

Table 1 : Outcome Indirect Tensile Strength Test

Sampel	Percen tage asphalt quality (%)	Diameter briket	High Briket	Load Value (P)	ITS Value
		mm	mm	kgf	Mpa
		D	H		
I	3.0	102.3	66.9		0
II		102.22	69.3	75.00	0.066134591
III		102	68.5	100.00	0.089401701
IV		102.4	67.7	75.00	0.067578595
V		102.4	67	125.00	0.113807734
Average					0.067384524
I	3.5	102.5	67.5	275.00	0.24827991
II		101.8	67.2	225.00	0.205448034
III		102.4	68.4	250.00	0.222956672
IV		102.1	68.8	200.00	0.177849373
V		102	68	275.00	0.247662431
Average					0.220439284
I	4.0	102.8	69	350.00	0.308221097
II		102.5	68.2	400.00	0.357427756
III		102.2	68.9	350.00	0.310480586
IV		102	69	375.00	0.332826983
V		102.3	67.4	350.00	0.317080137
Average					0.325207312
I	4.5	102.3	68.4	300.00	0.267809539
II		102.4	68.3	250.00	0.223283109
III		102.5	69.5	275.00	0.241135164
IV		102.6	67.6	325.00	0.292702092
V		102.2	68	275.00	0.247177769
Average					0.254421535
I	5.0	102.2	61.7	275.00	0.272416342
II		102.5	68	225.00	0.201644445
III		102.4	65	250.00	0.234619021
IV		102.4	66.1	225.00	0.207643158
V		102.2	68.2	300.00	0.268857717
Average					0.237036137

Tabel 2 : Recapitulation R_{maks} Value

No.	Quality asphalt	Maximum Loading (Kgf)	ITS Value (Mpa)	RMaks
1	3,00	125	0,1140	0,0180
2	3,50	275	0,2483	0,0234
3	4,00	400	0,3574	0,0283

4	4,50	325	0,2927	0,0253
5	5,00	250	0,2346	0,0225

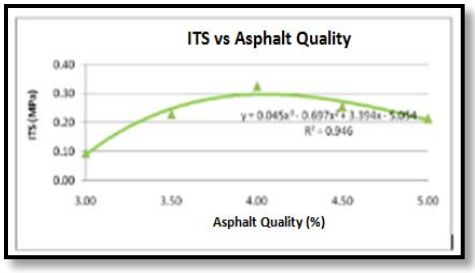

Fig. 10 : Correlation quality asphalt with Indirect Tensile Strength

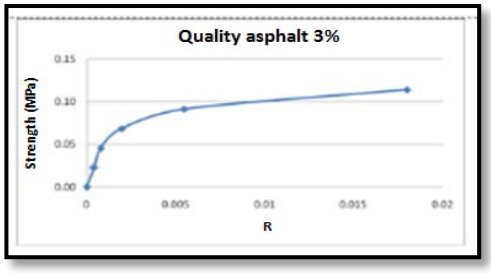

Fig. 11 : Corelation ITS Value and R value 3%

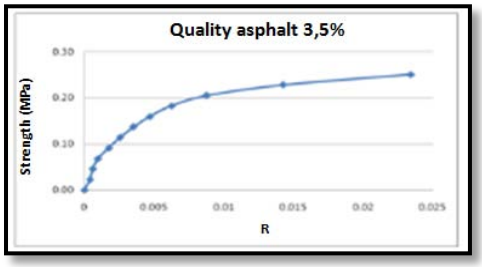

Fig. 12 : Corelation ITS Value and Rvalue 3,5%

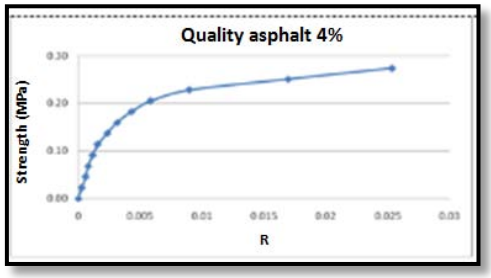

Fig.13 : Corelation ITS Value and R value 4%

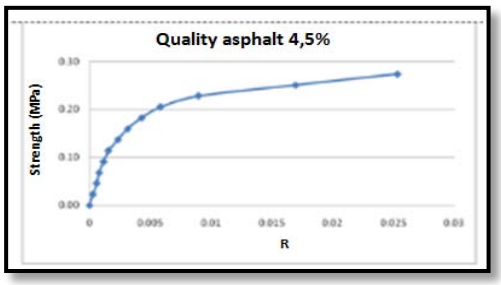

Fig.14 : Corelation ITS Value and R value 4.5%

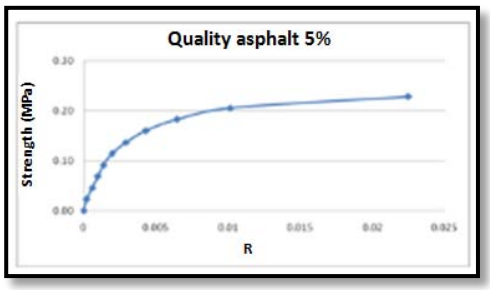

Fig. 15: Corelation ITS Value and R value 5%

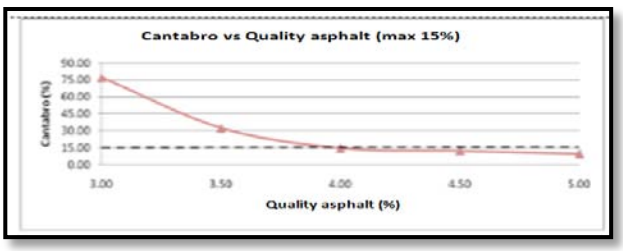

Fig. 16 : Corelation quality asphalt with value cantabro loss

b) *Analysis Cantabro*

Table 3 : Outcome CantabroTest

Sample	Percen tage quality asphalt (%)	Weight before test (Gram) M	Weight aftertest (Gram) M	Loss Weight (Gram)	Loss Weight (%) L
I	3.0	1081	244	837.00	77.43
II		1083	248	835.00	77.10
III		1090	281	809.00	74.22
IV		1091	226	865.00	79.29
V		1070	241	829.00	77.48
Average					**77.10**
I	3.5	1085	731	354.00	32.63
II		1089	760	329.00	30.21
III		1071	748	323.00	30.16
IV		1069	711	358.00	33.49
V		1088	705	383.00	35.20
Average					**32.34**
I	4.0	1081	913	168.00	15.54
II		1082	936	146.00	13.49
III		1088	931	157.00	14.43
IV		1086	944	162.00	13.09
V		1090	913	177.00	16.24
Average					**14.56**
I	4.5	1084	959	125.00	11.53
II		1082	952	130.00	12.01
III		1086	940	146.00	13.44
IV		1088	961	127.00	11.67
V		1084	948	136.00	12.55
Average					**12.24**
I	5.0	1075	956	119.00	11.07
II		1084	968	116.00	10.70
III		1090	984	106.00	9.72
IV		1078	994	84.00	7.79
V		1105	1003	102.00	9.23
Average					**9.70**

Table 4 : OutcomeUnconfined Compressive Strength

Quality Asphalt (%)	Weight (Kg)	Height (mm)	Peak Load (KN)	UCS (N/mm^2)	Vertical Strain	Modulus Elasticity	Poisson rasio
3	1,69	128,3	15,51825	1,918	0,0130875	146,543	0,095831
	1,67	127	15,347	1,897	0,030	63,683	0,309955
	1,71	131	15,12397	1,869	0,022	85,395	0,251505
3,5	1,715	117	15,22	1,881	0,020	93,452	0,268231
	1,73	119	15,516	1,918	0,065	29,357	0,270587
	1,73	120	16,118	1,992	0,021	97,013	0,420798
4	1,685	121,2	15,7653	1,948	0,021	91,450	0,206009
	1,65	120	16,1498	1,996	0,029	67,990	0,387276
	1,67	123	16,228	2,006	0,038	53,373	0,498677
4,5	1,655	133,5	10,2816	1,271	0,048	26,502	0,384759
	1,675	135	9,838	1,216	0,026	46,140	0,37275
	1,65	131	10,3113	1,274	0,039	32,710	0,371893
5	1,67	114	9,922	1,226	0,038	32,119	0,778059
	1,69	117	10,219	1,263	0,033	38,682	0,398318
	1,63	113	15,234	1,883	0,018	104,238	0,532377

c) Analysis Permeability

Table 5 : Outcome Permeability Test

Quality Asphalt (%)	Thickness (cm)	Time (det)	CoefficientPermeability per-item (k)	CoefficientPermeabilityAverage (k)	(k) Average All item
3	7.97	88	0.179507355	0.179507355	0.1873
	7.96	85	0.179507356		
	7.94	87	0.179507354		
3.5	7.56	80	0.19161554	0.19161554	
	7.60	78	0.19161553		
	7.58	77	0.19161556		
4	7.64	76	0.202917436	0.202917436	
	7.61	74	0.202917437		
	7.63	73	0.202917435		
4.5	7.45	75	0.202680493	0.202680493	
	7.47	77	0.202680494		
	7.49	74	0.202680492		
5	7.42	95	0.159640625	0.159640624	
	7.44	90	0.159640624		
	7.46	94	0.159640626		

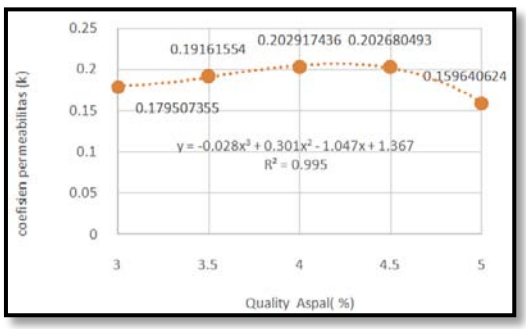

Fig . 17 : Corelation Quality Asphalt and Coeficient Vertical Permeability

d) Analysis Unconfined Compressed Test

There are two configurations of stress strain curve were seen in all mixtures irrespective of the Buton Natural Asphal content. The first configuration shows some porous asphalt specimens have the initial bottom concave part that represents the settling of the specimen, the linear zone, the nonlinear zone of the ascending branch and comprises the peak and stretch immediately adjoining it on other side. This pattern is similar to the pattern of the dense asphalt concrete. The second configuration shows some porous asphalt specimens have the linear zone, the nonlinear zone of the ascending branch and comprises the peak and stretch immediately adjoining it on other side without the initial bottom concave part. This pattern slightly differs to the pattern of the dense asphalt concrete. The nonlinear part of stress strain curve of porous asphalt reflects the degeneration of the latter rather than the flow of very thin bitumen micro layers in it. Micro cracking process

characterizes the nonlinear part of the ascending branch. The elastic behaviour is reflected by the linear part of the stress strain curve. Under the short term static compressive, all test showed no significant change in the peak strain with increasing compressive strength of porous asphalt.

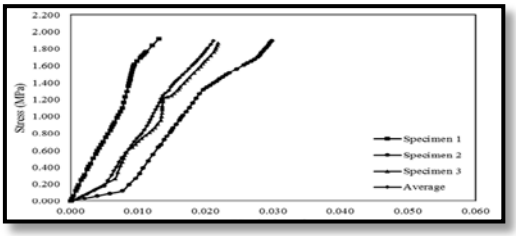

Fig. 18 : Stress strain curve (Buton Natural Asphal Content 3%)

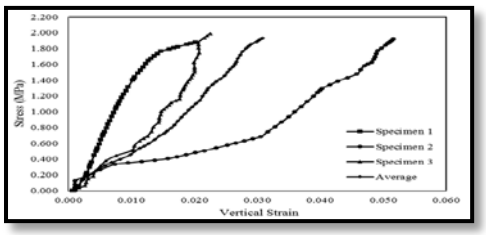

Fig. 19 : Stress strain curve (Buton Natural Asphal Content 3,5%)

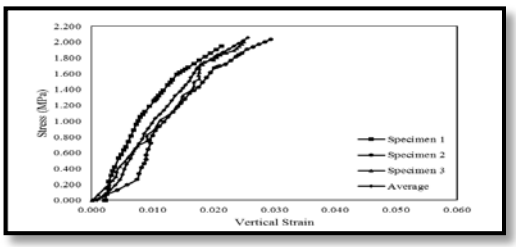

Fig. 20 : Stress strain curve(Buton Natural Asphal Content 4%)

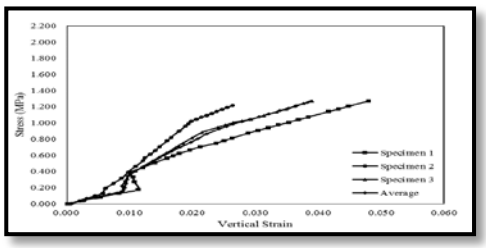

Fig. 21 : Stress strain curve(Buton Natural Asphal Content 4.5%)

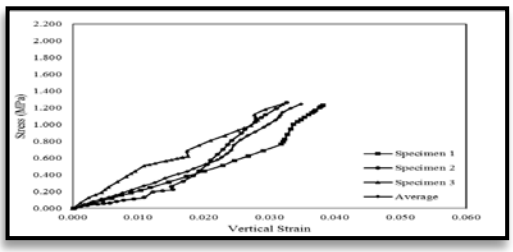

Fig. 22 : Stress strain curve(Buton Natural Asphal Content 5%)

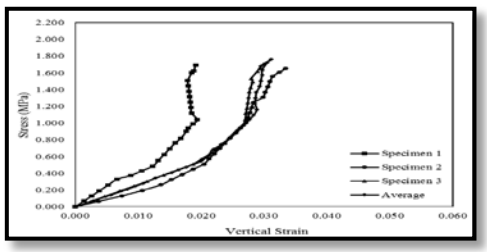

Fig. 23 : Stress strain curve(Buton Natural Asphal Content 5.5%)

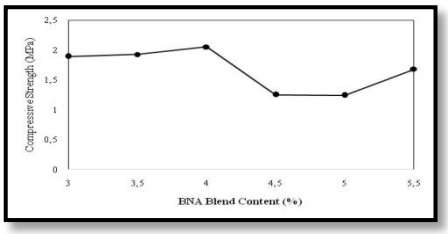

Fig. 24 : Compressive strength

e) *Multilayer Test*

Fig. 25 : Specimen of multilayer model test ofrigid pavement with asphalt

i. *Analysis Load test for Multilayer Soil-Rigid*

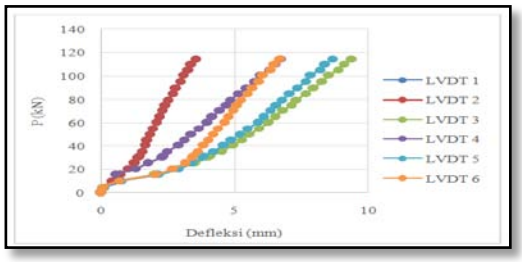

Fig. 26 : Graphs of correlation between loads and decrease

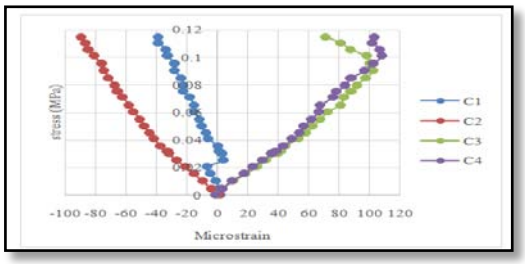

Fig. 27 : Graphs of correlation between stress and strain

ii. *Testing Multilayer Soil-Rigid-Asphalt*

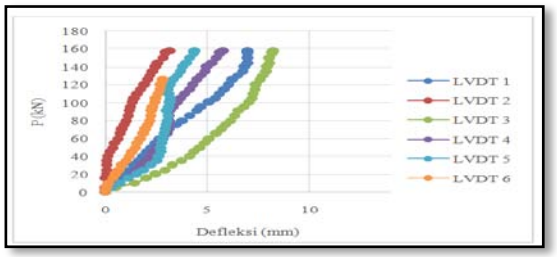

Fig. 28 : Graphs of correlation between loads and decrease

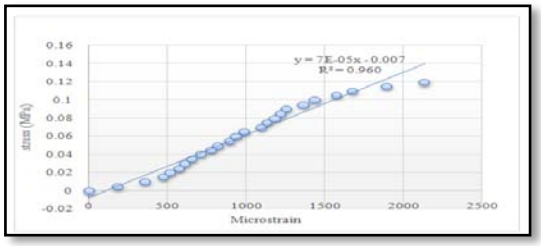

Fig. 29 : Graphs of correlation between and strain of asphalt course

iii. *Analysis Multilayer using Software EverStressFE*

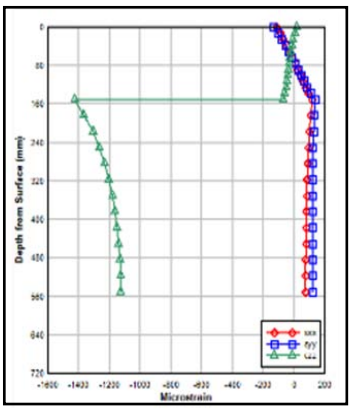

Fig. 30 : Graphs of correlation between depth and strain formultilayer soil-rigid

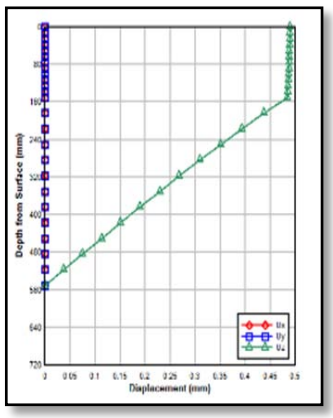

Fig. 31: Graphs of correlation between depthand eflection/displacement for multilayer soil-rigid

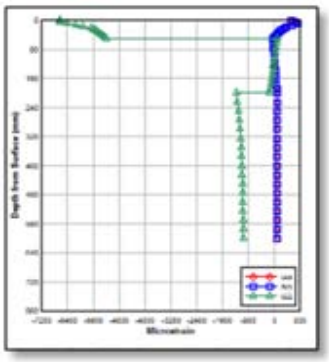

Fig. 32 : Graphs of correlation between depth and strain for multilayer soil-rigid-asphalt

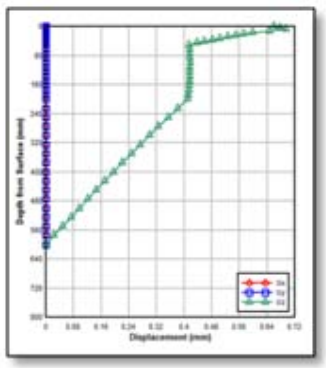

Fig. 33 : Graphs of correlation between depth and deflection/displacement for multilayer soil-rigid-asphalt

IV. Conclusions

1. Permeable asphalt pavement mixture for Cantabro test we can see that optimum Buton Natural Asphal for the coarse aggregate Quarsite Dolomite stone it was bigger porous when quality asphalt 3%. Loss weight Cantabro 77.10% correlation with quality asphalt 3%, loss weight Cantabro 32,34% correlation with quality asphalt 3.5%, loss weight Cantabro 14,56% correlation with quality asphalt 4%, Loss weight Cantabro 12,24% correlation with quality asphalt 4.5% and loss weight Cantabro 9,70% correlation with quality asphalt 5%.
2. Unconfined Compressive Strength, Modulus elasticity 146.543 and ratio poisson 0.095831 for asphalt 3%, Modulus elasticity 93.452 and ratio poisson 0.268231 for asphalt 3,5%, Modulus elasticity 91.450 and ratio poisson 0.206009 for asphalt 4%, Modulus elasticity 26.502 and Poisson rasio 0.384759 for asphalt 4,5%, and Modulus elasticity 32.119 and Poisson rasio 0.778059 for asphalt 5%.
3. The result of test Multilayer Soil–Rigid are: the values of deflection at the maximum load on LVDT 1 to LVDT 6 are 3.545 mm, 3.545 mm, 9.4 mm, 6.745 mm, 8.65 mm, and 6.705 mm. At the maximum stress result the microstrain C1 to C4 -38.65, -89.85, 71.21, 103.5. At the load 35 kN, the value of deflection on LVDT 1 to LVDT 6 are 1.535 mm, 1.535 mm, 4.505 mm, 2.45 mm, 4.19 mm, and 3.61 mm, while at value of stress 0.035 MPa results the microstrain C1 to C4 0.36, -37.68, 44.44, 43.48.
4. The results of test Multilayer Soil-Rigid-Asphalt are : the values of decrease at the maximum load on LVDT 1 to LVDT 6 are 6.98 mm, 3.2 mm, 8.25 mm, 5.75 mm, 4.38 mm, are 3.5 mm. At the maximum stress results the micro stength of asphalt course 2133.95. At the load 35 kN, the value of decrease on LVDT 1 to LVDT 6 are 1.576 mm, 0.075 mm, 3.7 mm, 1.985 mm, 2.48 mm, dan 0.986 mm, while at value of stress 0.035 Mpa results the micro stength of asphalt course 655.
5. Stress strain curve of compression test results for asphalt concrete was same with stress strain curve of the porous asphalt using Quarsite Dolomite stone and Buton Natural Asphal.Void ratio of porous asphalt tested by WU Shao-peng relatively similar to the porous asphalt using Quarsite Dolomite stone and Buton Natural Asphal, although the compressive strength according to Wu Shao-peng obtained at 3.6 Mpa while the porous asphalt using Quarsite Dolomite stone and Buton Natural Asphal gained compressive strength of 2.4 Mpa. The unconfined compressive test result of porous asphalt containing Quarsite Dolomite stone showed that the mixture with 4% Buton Natural Asphal has compressive strength value 2.4 Mpa and void ratio 19.2%, respectively

References Références Referencias

1. Alex Eduardo Alvarez Lugo, 2009, Improving Mix Design and Construction of Permeable Friction Course Mixtures. Disserttion Departmen of Civil Enginering Texas University.
2. Ali Nur, et.al, Juni 2011. "Experiment Study on Effects of Flood Puddle to Durability of Asphaltic Concrete Containing Refined Butonic Asphalt". The 9th Eastern Asia for Transportation Studies Conference, Jeju, Soulth of Korea.
3. Ali Nur, et.al, 2010, "Mechanical Properties of Asphalt Porous Containing Asbuton as Partial Replacement for Petroleum Asphalt Bitumen". 7th International Symposium on Lowland Tehnology, Saga, Japan.
4. Ali Nur, et.al, Desember 2011, "Influence of Sea Water on The Mechanical Properties of Porous Asphalt Containing Liquid Asbuton." The Sixth International Conference on Asia and Pacific Coasts. Hongkong, China.
5. Bing Zhang. 2007. Digital Test of Composite Material Using X-Ray Tomography and Finite Element Stimulation, Dissertation Submitted to the Faculty of Virginia Polytechnic Insitute and State University, Blacksburg, Virginia.
6. Environmental and Engineering Programs Materials Labolatory Pavements Division. 2005. EVERSERIES USER'S GUIDE Pavement Analysis Computer Software and Case Studies, Washington State Department of Transportation
7. Erik Sehlangen, Quantao Liu, Martin Van de Ven, Gerber Van Bochove, Jo Van Montfort, 2011. Evaluation of The Induction Healing Effect of Porous Asphalt Concrete Though Four Point Bending Fatique Test.
8. Fazleem Hanim, Ahmad Kamar and Jazlina Nor Sarif, (2009), Design of porous asphalt mixture to performance related criteria, Proceedings of 13th Conference of the Road Engineering Association of Asia and Australasia (REAAA), 9-07
9. Fenella Margaret Long, 1992. Permanent Deformation of Asphalt Concrete Pavements: A Nonlinear Viscoelastic Approach to Mix Analysys and Design, Engineering Civil and Environmental Engineering, University of California, Berkeley.
10. FirdausChairuddin, et.al. 2013. Experimental Study on Permeable Asphalt Pavement Used Quarsite Dolomite Stone (Quarsite Dolomite) as Course Aggregate for Surface Layer of Road Pavement. Volume 935 Of Advanced Materials Research. ISSN cd: 1022-6680. Conference International Green Building Technology Material (GBTM), Kualalumpur, Malaysia.
11. Firdaus Chairuddin, et.al. 2014. Climate Change Implications for Permeable Asphalt Pavement Used Quarsite Dolomite Stone (Quarsite Dolomite) on

Multilayer Test. Proceedings of theNational Conference ofCivil Engineering Graduate(KNPTS) 2014, ISSN: 2407-1021. ITB Bandung, Indonesia.

12. Firdaus Chairuddin,et.al.2014. Compressive Strength of Permeable Asphalt Pavement Using Quarsite Dolomite Stone and Buton Natural Asphalt (BNA) Blend. Prosiding Of 2nd International Conference on Civil and Architecture Engineering (ICCAE 2014). ISSN: 1793-8236. Bali, Indonesia.
13. F. Chairuddin, M. W. Tjaronge, M. Ramli and J. Patanduk, Experimental Study on Permeable Asphalt Pavement Used Quarsite Dolomite Stone (Quartzite Dolomite) as Course Agregate for Surface Layer of Road Pavement. ISSN print: 1022-6680. Journal of Advance Material Riset Vol. 935 (2014) pp 255-258. © (2014) Trans Tech Publication, Switzerland. Doi: 10.4028/www.scientific.net/AMR. 935.255. Index by Scopus.
14. K. Nishijima, S. Higashi and M. Ikeuchi, (2009), Development of re-paved porous asphalt pavement method for reconstructing existing dense graded asphalt pavement into porous asphalt pavement using the in-place surface recycling method, Proceeding of 13th Conference of the Road Engineering Association of Asia and Australasia(REAAA), pp.5-14
15. Lori Kathryn Schaus, 2007. Porous Asphalt Pavement Design In Proactive Design for Cold Climate Use Thesis Departmen of Eivil Enginering Waterloo University.
16. Meor Othman Hamzah, Mohammad Rosli Mohammad Hasan, Martin Van de Van, 2011. Permeability Loss In Porus Asphalt due to Binder Creep. Journal of Construction and Building Materials.
17. M.O. Hamzah, Z. F, M. Jaafar, F. Ahmad. 2013. Laboratory Simulation Of Porous Asphalt Parking Lot System and Mix Design For Storm Water Management. Journal of Engineering Science and Technology Vol 8. No. 2. Penang, Malaysia.
18. M. Miradi, A.A.A. Moleenar, M.F.C. van de Ven, (2009), Performance modeling of porous asphalt concrete using artificial intelligence, Road Materials and Pavement Design, ICAM 2009, pp.263-280
19. Suryana. A,. (2003), Inventory on Solid Bitumen Sediment using 'Outcrop Drilling' in Southern Buton region, Buton Regency, Province Southeast Sulawesi, Colloquium on Results Activities of Mineral Resources Inventory - DIM, the TA. 2003, Directorate Mineral Resources Inventory, Bandung (in Indonesian)
20. S.Starodusbsky, I Blechman and M.Livneh, (1994), Stress-strain relationship for asphalt concrete in compression, Material and Structures, Vol.27 pp.474-482
21. Tjaronge M.W, Rita Irmawaty, 2013. Influence of Water Immersion on Physical Properties of Porous Asphalt Containing Liquid Asbuton as Bituminous Binder.
22. Tjaronge M.W, 2012. Effect of Liquid Asbuton as Bituminous Asphalt Binder and CoMpaction Blows on the Porosity and Raveling Resistance of Porous Asphalt. International Symposium on Earth Science and Technology. Bandung, Indonesia.
23. Yang H. Huang, 1996. Pavement Analysis and Design, Person Prentice Hall Pearson Education Inc Upper Saddle River United States of America University of Kentucy, Inggris
24. Washington State Department of Transportation. 2005. Everseries© User's Guide, Pavement Analysis Computer Software and Case Studies, Environmental and Engineering Programs Material Laboratory – Pavements Division.
25. Wu Shao-peng, LIU Gang, MO Lian-Tong, CHEN Zheng, YE Qun-shan. 2006. Effect of fiber types on relevant properties of porous asphalt, Trans Nonferrous Met, Soc. China.
26. William G. Davids, Ph.D., P.E. 2009. EverStressFE 1.01.0 Software for 3D Finite-Element Analysis of Flexible Pavement Structures: Summary of Features and Capabilities, Research Structural Engineer, University of Maine AEWC Advanced Structures and Composites Center.
27. WU Shao-peng, LIU Gang, MO Lian-Tong, CHEN Zheng, YE Qun-Shan, Effect of Fiber types on Relevant Properties of Porous Asphalt Transaction of Nonferrous Metals Society of China 16(2006) s791-s795
28. Zhiwang zhang, Boonchai Sangpetngam, Thomas Grant. 2002. Implementation of SHRPP INDIRECT Tension Tester to Mitigate Cracking in Asphalt Pavement and Overlays. Research Center Florida Department of Transportation, University of Florida.

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Geo-Technical Investigation on Black Cotton Soils

By B. Vinod, Prithanjali Shende & Md. Hyder Baba
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Abstract- Black cotton soils are predominantly available in India. Though black cotton soil plays a vital role in agriculture but it is posing many difficulties in civil engineering aspect. All the black cotton soils are not expansive soils and all the expansive soils are not black in color. These soils passed high strength in summer and decreased rapidly in winter. The soil has a swelling property due to the presence of montmorillonite mineral. Though various constructions techniques are utilized, the cracking (Minor Cracking) is seen in the buildings. For the site investigations, the behavior of soil is important. This paper gives information regarding bearing capacity and suitable foundations for different types of constructions in black cotton soils.

Keywords: *black cotton soil, cracks, swelling, strength, bearing capacity.*

GJRE-E Classification : *FOR Code: 090501*

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Geo-Technical Investigation on Black Cotton Soils

B. Vinod [α], Prithanjali Shende [σ] & Md. Hyder Baba [ρ]

Abstract- **Black cotton soils are predominantly available in India. Though black cotton soil plays a vital role in agriculture but it is posing many difficulties in civil engineering aspect. All the black cotton soils are not expansive soils and all the expansive soils are not black in color. These soils passed high strength in summer and decreased rapidly in winter. The soil has a swelling property due to the presence of montmorillonite mineral. Though various constructions techniques are utilized, the cracking (Minor Cracking) is seen in the buildings. For the site investigations, the behavior of soil is important. This paper gives information regarding bearing capacity and suitable foundations for different types of constructions in black cotton soils.**

Keywords: black cotton soil, cracks, swelling, strength, bearing capacity.

I. Introduction

In India, expansive soils are called as Black Cotton soil. The name "Black Cotton" as an agricultural origin. Most of these soils are black in color and are good for growing Cotton. All the black soils are not expansive soils and all the expansive soils are not black in color. These soils passed high strength in summer and decreased rapidly in winter. The soil has a swelling property due to the presence of montmorillonite mineral[1]. High percentage of montomorillonite renders high degree of expansiveness. These property results cracks in soil without any warning. These cracks have sometimes extent severe limit like ½" to 12" deep. Use of this type of land may suffer severe damage to the construction with the change in atmospheric conditions[2][8]. In Indiaexpansive soils cover about 20% of the total land area (Ranjan and Rao 2005, Shelke and Murthy 2010).These soils increase in volume on absorbing water during rainy seasons and decrease in volume when the water evaporates from them (Chen, 1988)[3]. Black cotton soils cover an extensive area of 300,000 km^2. The engineering properties of such soils are as follows:

- High compressibility
- Low bearing capacity
- Low shearing strength

It is a well known fact that water is the worst enemy of all structures, particularly in expansive soil areas. Water penetrates into the foundation from three sides viz. top surface, and from bottom layers due to capillary action. Therefore, specifications in expansive soil areas must take these factors into consideration. The surfacing must be impervious, sides paved and soil beneath well treated to check capillary rise of water [4].

The soilis very hard when dry, but loses its strength completely when in wet condition [5]. The wetting and drying process causes vertical movement in the soil mass which leads to failure of a pavement, in the form of settlement, heavy depression, cracking and unevenness [6].

As this black cotton soils are very important for construction many tests are performed for it's strength and bearing capacity and different methods are proposed for good construction. A sample data of black cotton soils which is available in RGUKT-Basar of Adilabad district of Telangana state has taken and examined to know the suitable foundation and its bearing capacities.

a) Objective

The primary objective of this geotechnical investigation is to examine the soil present in the top 5m zone, to determine the allowable bearing capacity of soil present in this zone and to examine the feasibility of providing shallow foundations for the upcoming structures.

II. Methodology

The trial pit method of investigation was referred as the zone of study is limited to 5m below the EGL. The salient features of the investigation program are presented below.

a) The Geo-technical Investigation Program

The location of trial pits was fixed in consultation with the DEE, RGUKT-Basar. Care was taken to see that, the location is within the area where the structure is proposed and at the same time, it do not coincide with the exact foundation location. After the excavation by mechanical excavator, the ground was further excavated manually for at least for another 30cm to avoid the influence of the excavator. Excavation of the pit up to 2m below EGL and collection of UDS-1 at this level. The thin walled tube samples were used to collect the UDS. All necessary precautions were taken to ensure quality UDS. A minimum of three cores were collected to ensure representativeness of the ground. In addition, a

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100mm diameter core was also collected, for extruding specimen for consolidation and swell pressure tests.

- The Excavation was taken to a level of 4.50 m to 4.80 m below EGL and UDS-2 was collected.
- Laboratory tests on UDS and DS as per relevant provisions of IS:2720.
- Interpretation and analysis of the laboratory data to arrive at the allowable bearing capacity at various levels.
- Preparation of report together with necessary recommendations.

b) Site Condition

The site selected for the test is mainly of Black cotton soil. The soil on the surface was indicating shrinkage cracks of around 40mm width. The light weight structures with load bearing type of walls having foundations laid at shallow depth on the in-situ soil have developed cracks, indicating the typical features of expansive clays such as Black cotton soils. So a shallow foundation is usually provided when the soil at a shallow depth has adequate capacity to support the load of the structure. However, in situation where the soil at shallow depth is poor, in order to transmit the load safely, the depth of foundation has to be increased till a suitable soil stratum is met. In view of increased depth, such foundations are called deep foundations. Piles, piers and wells are examples of deep foundations [7].

Figure 1 : Cracks, Swelling in Black cotton soil

III. Results and Discussion

All necessary laboratory tests are proposed to determine in the index and engineering properties as per IS: 2720. The test results are summarized in Table-1.

Table 1 : Test Results

Sample code	Uds -1	Uds– 2
Depth of collection (m)	2.00	4.80
Specific Gravity of solids (G)	2.64	2.66
Natural density ,g/cc	1.96	2.06
Natural moisture content (%)	28.17	28.31
Dry density (g/cc)	1.53	1.61
Natural void ratio	0.73	0.65
Water content at saturation (%)	27.65	24.43
Grain size distribution		
Gravel size (%)	0.00	5.60
Coarse sand size (%)	3.60	2.50
Medium sand size (%)	4.40	1.80
Fine sand size (%)	3.20	2.96
Slit size (%)	4.20	7.10
Clay size (%)	84.60	80.10
Consistency limits		
Liquid limit (%)	74.80	69.40
Plastic limit (%)	30.30	32.30
Plastic index	44.50	37.10
Differential free swell index (%)	72.70	45.70

a) Swell Pressure test

The swell pressure test is performed as per IS:2720, Part-41, Section-2, on the specimen extruded from UDS and the average swell pressure observed was 214kN/sqm for the BC Soil layer present from GL to a depth of 0.60m to 2.40m at its in-situ density and moisture content as on 18.11.2013. Keeping in view of the seasonal moisture variations, similar test was performed at the in-situ density with moisture content at shrinkage limit. The swell pressure was observed to be 286kN/sqm.

b) Hydrometer Test

The particle size distribution was determined using hydrometer method as per IS:2720, Part-4. Double jar system was used to eliminate correction for temperature.

c) Computation of Net Allowable Bearing Capacities

Based on the laboratory test results, the feasibility of providing shallow foundations has been examined by computing the net allowable bearing capacities for a

- 2m wide square footing and
- 8m wide raft foundation.

The calculations are provided. The outcomes of the calculation are summarized in Table 2.

IV. Conclusion

Based on investigations made on Black cotton soil, different conditions are examined and the strength of the soil is found by consolidation method, swell pressure method, Hydrometer analysis, consistency index tests. Moreover the bearing capacity and suitable foundations for different constructions was known appropriately. In view of the above, based on the observation of the ground during field visit and based on the analysis of the laboratory test results, the end bearing type of cast-in-situ pile foundations are found to be more appropriate, In view of the expansive nature of the top soil necessary precautions may be taken in all those lightly loaded structural components that need to be rested on the in-situ expansive clay

Table 2 : Bearing capacities

TP location	2m wide square footing		8m wide raft foundation	
	Net Safe Bearing Capacity (kPa)	Net Bearing Capacity for an Allowable Settlement of 50mm	Net Safe Bearing Capacity (kPa)	Net Bearing Capacity for an Allowable Settlement of 100mm
TP-1	50.6	28	109.8	21
TP-3	90.7	27	119.4	20

V. Acknowledgements

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References Références Referencias

1. Arora K R., "Soil mechanics and Foundation En- gineering "2005.
2. Gudaliya, P.J., "Study of black cotton soil characteristics with cement waste dust and lime", Non-Circuit Branches of the 3rdNirma University International Conference on Engineerin, 51,2013,pp 110-118.
3. Aparna., Jain, P.K., and Rakesh kumar., "Study Of Swelling Behaviour of Black cotton soil Improved with Sand column", International Journal of Advances in Engineering &Technology, July, 2014, Vol. 7, Issue 3, pp. 905-910.
4. Balasubramaniam, A. S., Bergado, D. T., Buensuceso Jr, B. Rand Yong, W. C. (1989). Strength and deformation characteristics of lime-treated soft clays. Geotech. Eng., 20, 49-65.

5. Kavish S. et.al., "Analysis of Engineering Properties of Black Cotton Soil & Stabilization Using By Lime", Int. Journal of Engineering Research and Applications,4, May 2014, pp.25-32.
6. Nadgouda, K.A. Hegde, R.A., "The Effect of Lime Stabilization on Properties of Black Cotton Soil"., Indian Geotechnical Conference–2010, GEO trendz December 16–18, 2010,IGS Mumbai Chapter & IIT Bombay.
7. Gopal Ranjan, Rao A S R., "Basic and applied soil Mechanics"., Revised second Edition 2007.
8. Chen, F.H. (1988). "Foundations on Expansive Soils."Elsevier Scientific Publishing Co., Amsterdam
9. IS 2720-15., Methods of test for soil part-15., IS 2720-41 (1977)., Methods of test of soil part-41., IS 2720-4 (1985)., Hydrometer test.

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Propertis Porous Asphalt used Quarsite Dolomite Stone with Buton Natural Asphalt After Loading

By Firdaus Chairuddin
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Abstract- The lot deposit of Quarsite Dolomite Stone as local material from sea location in Banggai island in half Sulawesi of Indonesia. Was still not be exploited better. Some reseaarch in the field of road construction showed that Quarsite Dolomite Stone was powefull enough when mixtured asphalt structure. Permeable asphalt pavement or porous friction course is commonly knows as porous asphalt. The porous pavement used in japanes and europe. The pavement consists in a porous overlay allowing rainwater to flow down to the botton the overlay and then to drain on the edges of the pavement. Quality of porous asphalt was developed to drain pavement surface flow through it's pores, because of is specific propertis to mesure it's ability to drain the water. Indirect Tensile Strength 0.0673 for asphalt quality 3% and Indirect Tensile Strength 0.2370 for asphalt quality 5%. Cantabro test, loss weight 77.10 for asphalt quality 3% and loss weight 9.70 for asphalt quality 5%.

Keywords: quarsite dolomite stone, cantabro loss, indirect tensile strength, unconfined compresship strenght.

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Firdaus Chairuddin

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Keywords: quarsite dolomite stone, cantabro loss, indirect tensile strength, unconfined compresship strenght.

I. Introduction

Permeable asphalt pavement or porus friction course is commonly knews as porous asphalt. The porous pavement is commonly used in Europe and Japan. The pavement cousist in a porous overlay and then to drain on he edges to the pavement (*Michael. E Barret. Ph.D*). The lot deposit of Quarsite Dolomite Stone in Indonesia was still not be exploited better. Among the exiting utilization of it most of it was exploited for traditional needs fireplace material, some last rasearch in the field of road construction showed that Quarsite Dolomite Stone was powerfull enough when mixtured material for pavemen stabilization. Quarsite Dolomite Stone is local material from sea location in the island of banggai half Sulawesi Indonesia. Its was kwarsit Dolomitan material Celebes (*Car Donald*, 1985). This Experimental be done for mesuring propertis permeability asphalt pavement with using Quarsite Dolomite Stone as Local material who was come from sea location at the Banggai Island half Celebes Indonesia with used Rice Hash as Filler.

As course agregate on the surface layer Road Pavement. Capasity drain porous Asphalt were connecting correlasion with spacing hight and small porousity in structure Asphalt. Stability and Durability and Hydrolic conductivity its must be hight test than 20% (*Ruz. et. al,* 1990). Asphalt porous is open graded course Aggregate. Porousity asphalt porous (10%-15%) the structure made drain for flow water (*Nur Ali, et al.* 2005).

Figure 1 : Permeable Friction Course

Aggregate was specimen mineral who was done for mixture road konstruktion in the asphalt pavement it's mush be 90%-95% for the total weight strukture or 77%-85% for all volume (*Alkin, et. al* 1997).

Clasification agregate be measured by spacing at all : course aggregate it must be lost for filter No.8 it is higher than 2,36 mm. Fine aggregate it must be lostfor filter No.8 and stoped to No. 200 or it is 2,36 mm and 75 μm. Filler it must be smaller than 75 μm and lost filter No. 200

Figure 2 : Quarsite Dolomite Stone (Local Containe of Banggai island in half celebes)

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II. Literature Review

Two different test, the indirect tensile test (IDT) and the semi-circular bending test (SCB) were performed on a Permeable asphalt pavement. The mixture was a 10 mm nominal maximum size produced with limestone and marly limestone, calcarenite, and fine and coarse sand. It has 6.5% (±0.5%) air void and 5.4% design asphalt content, produced with 60/70 PEN virgin bitumen. Specimens were compacted using a Superpave Gyratory compactor at $N = 109$ revolutions to produce a 6500 g, 150 mm diameter Gyratory-compacted specimen. Specimens 150 mm diameter by 25 mm thick were used to perform Superpave IDT test with the *system developed* by Roque and Buttlar [9,10]. Some of these thin specimens were sliced to obtain 75 mm height semi circular specimens in order to conduct SCB test.

The tests were performed on three replicates at 10 °C using an MTS closed-loop servo-hydraulic loading system. The experimental set-up of each test is shown in Fig. 1.

a) The indirect tensile test (IDT)

The IDT loads monotonieally a 152 mm diameter circular specimen to failure applying a constant stroke of 0.084 mm/s. Two strain gauges with a length of 38.1 mm are placed at the centre of the specimen to measure vertical and horizontal deformations during loading. The horizontal stress occurring at the centre of the specimen is computed using the following IDT plane stress equation, according to the superpave indirect tension test procedure [9,10]:

$$\sigma h = 2P/\pi Dt$$

where:

σh tensile stress at the centre of the specimens,
P load of the specimen,
D diameter of the specimen,
t thickness of the specimen.

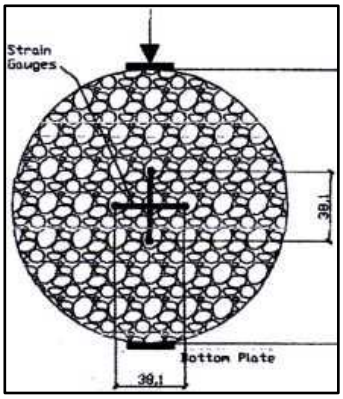
In addition, the procedure developed by Roque and Buttlar [9,10] was used to calculate horizontal and vertical strains at the center of the specimen from horizontal and vertical train gauge measurements.

III. Materials and Methods

a) Indirect Testing

Permeable asphalt pavement was produced with used Quarsite Dolomite Stone as course aggregate. The Quarsite Dolomite Stone broked in the spacing ∅ 3/8" ½"-¾" with the BNA Blend Pertamina penetration 60/70. Briket at the Bitumen be done as the standard variation asphalt 3%, 3,5%, 4%, and 5% for testing experimental Indirect Tensile Strength (ITS) and Catambro Lost. We was controlling testing for composition asphalt permeable pavement with Standar National Indonesia (SNI) and American Association for Testing and Material (ASTM), Permeability and Marshal

Test with asphalt variation 4-7% integral spacing 1% who use variation open gradation. Asphalt optimum standar is 4% be used to controlling variation asphalt. For optimum asphalt test be use variation asphalt 3% - 5% with spacing 5%.



For open gradation we use lost aggregate ¾", ½" and lost filter by comparative 50 : 50. Fine aggregate we use filter number 4, finally number 200, we used 10%. BNA Blend Pertamina we use all variation asphalt category: 3%, 3.5%, 4%, 4.5% and 5%. Test Indirect Tensil Strength (ITS) be controlling by ASTM D6931-07.

Figure 6 : Test Indirect Tensile Strength

b) Mix Design Permeable Asphalt Pavement Testing

Mix design permeable asphalt pavement the used composition open graded sistem. Who was Mix Trial Gradation lost of material ¾", 1/2 " be stoped filter ½" and lost of material ½" be stoped filter 3/8" with composition comparative 50-50 to course aggregate. The used fine aggregate lost filter number 4, and stoped filter number 200 all of 10% for mould capacity. Asphalt Blend Pertamina the use variation standard 3%, 3.5%, 4%, 4.5% and 5%. Briket make in for ∅ 10 cm and depth + 6.5cm and Briket make in ∅40x40 cm, depth + 6.5cm.

Figure 9 : Permeable asphalt pavement

Table 1 : Total briket test indirect tensile strength and Cantabro

Item Testing	BNA Blend Pertamina *(%)*	Planning Briket (unit)
Indirect tensile strength	3	5
	3,5	5
	4	5
	4,5	3
	5	5
Cantabro	3	5
	3,5	5
	4	5
	4,5	5
	5	5
Total briket		50

Before briket test in cantabro, briket was plum to Los Angeles machine drum, speed (V) 30-33 rpm for rotation.

$$L = \frac{Mo - Mi}{Mo} \times 100$$

Figure 10 : Test Cantabro Machine

IV. Result and Discussion

a) *Analysis Indirect Tensile Strength*

Table 2 : Outcome Indirect Tensile Strength test

Sam pel	Percen tage asphalt quality (%)	Diameter briket	High Briket	Load Value (P)	ITS Value
		mm	mm	kgf	Mpa
		D	H		
I		102.3	66.9		0
II		102.22	69.3	75.00	0.066134591
III		102	68.5	100.00	0.089401701
IV	3.0	102.4	67.7	75.00	0.067578595
V		102.4	67	125.00	0.113807734
Average					0.067384524
I	3.5	102.5	67.5	275.00	0.24827991
II		101.8	67.2	225.00	0.205448034
III		102.4	68.4	250.00	0.222956672
IV		102.1	68.8	200.00	0.177849373
V		102	68	275.00	0.247662431
Average					0.220439284
I	4.0	102.8	69	350.00	0.308221097
II		102.5	68.2	400.00	0.357427756
III		102.2	68.9	350.00	0.310480586
IV		102	69	375.00	0.332826983
V		102.3	67.4	350.00	0.317080137
Average					0.325207312
I	4.5	102.3	68.4	300.00	0.267809539
II		102.4	68.3	250.00	0.223283109
III		102.5	69.5	275.00	0.241135164
IV		102.6	67.6	325.00	0.292702092
V		102.2	68	275.00	0.247177769
Average					0.254421535
I	5.0	102.2	61.7	275.00	0.272416342
II		102.5	68	225.00	0.201644445
III		102.4	65	250.00	0.234619021
IV		102.4	66.1	225.00	0.207643158
V		102.2	68.2	300.00	0.268857717
Average					0.237036137

Figure 12 : Correlation quality asphalt with Indirect Tensile Strength

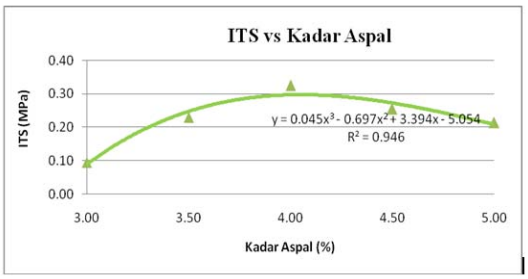


Figure 13 : Briket after Indirect Tensile Strength Test

Tabel 3 : Recapitulation R_{maks} value

No.	Quality asphalt	Maximum Loading (Kgf)	ITS Value (MPa)	RMaks
1	3,00	125	0,1140	0,0180
2	3,50	275	0,2483	0,0234
3	4,00	400	0,3574	0,0283
4	4,50	325	0,2927	0,0253
5	5,00	250	0,2346	0,0225

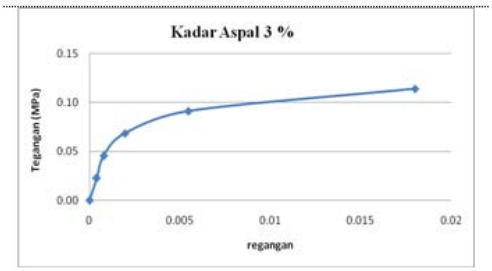


Figure 14 : Corelation ITS Value and R value 3%

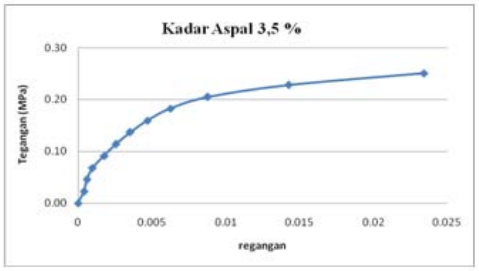


Figure 15 : Corelation ITS Value and R value 3.5%

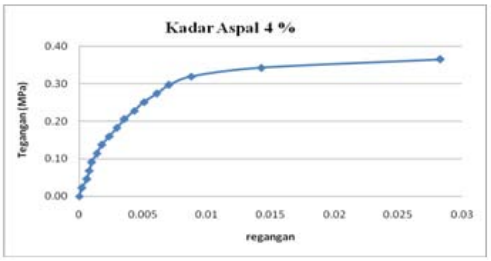


Figure 16 : Corelation ITS Value and R value 4%

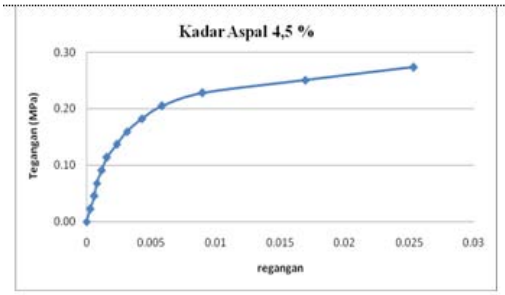


Figure 17 : Corelation ITS Value and R value 4.5%

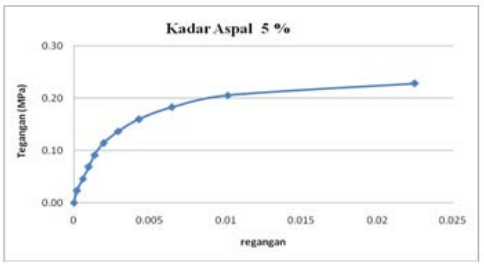


Figure 18 : Corelation ITS Value and R value 5%

b) Analysis Cantabro

Table 4 : Outcome Cantabro test

Sampel	Percentage quality asphal	Weight before test (Gram) Mo	Weight after test (Gram) Mi	Loss Weight (Gram)	Loss Weight (%) L
I	3.0	1081	244	837.00	77.43
II		1083	248	835.00	77.10
III		1090	281	809.00	74.22
IV		1091	226	865.00	79.29
V		1070	241	829.00	77.48
Average					**77.10**
I	3.5	1085	731	354.00	32.63
II		1089	760	329.00	30.21
III		1071	748	323.00	30.16
IV		1069	711	358.00	33.49
V		1088	705	383.00	35.20
Average					**32.34**
I	4.0	1081	913	168.00	15.54
II		1082	936	146.00	13.49
III		1088	931	157.00	14.43
IV		1086	944	162.00	13.09
V		1090	913	177.00	16.24
Average					**14.56**
I	4.5	1084	959	125.00	11.53
II		1082	952	130.00	12.01
III		1086	940	146.00	13.44
IV		1088	961	127.00	11.67
V		1084	948	136.00	12.55
Average					**12.24**
I	5.0	1075	956	119.00	11.07
II		1084	968	116.00	10.70
III		1090	984	106.00	9.72
IV		1078	994	84.00	7.79
V		1105	1003	102.00	9.23
Average					**9.70**

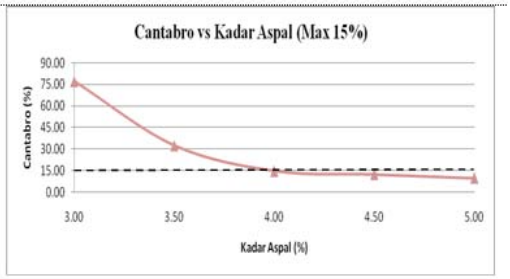


Figure 19 : Corelation quality asphalt with value cantabro loss

1. Indirect tensile strength 0,1140 MPa for total load 125 Kgf, for the quality asphalt 3% R_{maks} 0,0180. Indirect tensile strength 0, 2483 MPa for total load 275 Kgf, for the quality asphalt 3.5% R_{maks} 0,0234. Indirect tensile strength 0, 3574 MPa for total load 400 Kgf, for the quality asphalt 4% R_{maks} 0, 0283. Indirect tensile strength 0, 2927 MPa for total load 325 Kgf, for the quality asphalt 4.5% R_{maks} 0,0253. Indirect tensile strength 0,2346 MPa for total load 250 Kgf, for the quality asphalt 5% R_{maks} 0,0225.

2. Permeable asphalt pavement mixture for Cantabro test we can see that optimum BNA Blend Pertamina for the coarse agregate Quarsite Dolomite Stone it was bigger porous when quality asphalt 3%. Loss weight Cantabro 77.10% correlation with quality asphalt 3%, loss weight Cantabro 32,34% correlation with quality asphalt 3.5%, loss weight Cantabro 14,56% correlation with quality asphalt 4%, Loss weight Cantabro 12,24% correlation with quality asphalt 4.5% and loss weight Cantabro 9,70% correlation with quality asphalt 5%.

References Références Referencias

1. Allex Eduardo Alvarez Lugo, 2009, *Improving Mix Design and Construction of Permeable Friction Course Mixtures*. Disserttion Departmen of Civil Enginering Texas University.
2. He Gui Ping, Wong Wing Gun, 2006. *Effects of Moisture On Strength and Permanent Deformation of Foamed Asphalt Mix Incorporating Rap Materials.* Journal of Constraction and Building Materials.
3. Hao Ying, 2008, *Using X-Ray Computed Tomography to Quantity Damage of Hot-Mix Asphalt in The Dynamic Complex Modulus and Flow Number.*
4. Nur Ali, M. Wahid Tjaronge, Lawalenna Samang and Muhammad Isran Ramli, Juni 2011. *"Experimental Study on Effects of Flood Puddle to Durability of Asphaltic Concrete Containing Refined Butonic Asphalt"*. The 9th Eastern Asia for Transportation Studies Coference, Jeju, South of Korea.
5. Nielsen, C. B, E. Nielsen, J. B. Andersen and J. Rasberg, 2004, *"Develpment of Durabel Porous Asphalt Mixes from Laboratory Experiment"*, Proceeding of The 3rd Euroasphalt and Eurobitume Congress, Vienna.
6. Verhelst, F.A.D.B, Vervoort and G Marchal (1995). *X-Ray Computerized Determination of Heterogeneties in Rock Samples.*
7. Phill Herrington, Sheryn Relly and Show Cook, 1997, *"Porus Asphalt Durability Test"*, Transport New Zealand Research Report No. 265, 32 pp, ISBN 0-478-25376-1, ISSN 1174-0574.

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4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

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Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

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(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

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It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

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Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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Abstract, used in Original Papers and Reviews:

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Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

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15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

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Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

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This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

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- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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