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Pore Drainage Channel Model to Overcome Flood In Urban Area

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Abstract: Flood is always occur in Makassar in almost every rain season without exception in 2013. Flood prevention requires effective drainage design with environmental concept, to accommodate and flow water from the road body to the water absorption media to the soil layer beneath. Laboratory research is required to find out: dimension, width ratio, material and pore holes depth that effective in absorbing water from drainage tunnel body to lower soil layer. The research was conducted with experimental study using pore drainage model. The test should be performed in two stages which are static and dynamic flow. The research is the initial test which was observed with 3 variations of hole diameter, 3 variations of soil textures and 3 variation of water surface height in the tunnel. From the observation and laboratory test, it is expected to gain ideal pore holes dimension according to soil condition of the drainage tunnel.

Key words: Drainage , pore hole, tunnel, diameter, soil textures, experimental study

INTRODUCTION

Flood is always occur in Makassar in almost every rain season without exception in 2013. The mass media report the incident. Badan Nasional Penanggulangan Bencana (BNPB) of Kota Makassar had evaluated at least 1,500 people who live in Manggala Resident, mainly in Perumnas Antang.

One of the problem that often occur is flood in the city, housing area and rural area (farming area) which need technical control with huge funding perform by the government and the role of the people in the rural, urban and river flow area, wealthy or poor, academic or non academic, even all the creature that has relation with water (Sobriyah and Wignyasukarto, 2001).

From physical aspect, there are several factors that may cause flood such as: less of protected forest area as conservation land because it was converted in to city housing area, lack of catchment area, reduce of water absorption on most of soil surface due to compactness or covered with tar and other hardening material, insufficient drainage netting due to silting up, therefore, cannot function optimally and sedimentation and silting up both in the seashore and in the estuary.

Due to the flood, several main street in Makassar were overflowed for days main street in Makassar which are frequently flooded are Sungai Saddang Baru, Pelita Raya, Urip Sumoharjo, AP Pettarani, Boulevard, Abd Daeng Sirua, Toddopuli, Tidung, Tamalate, Rappocini, Jalan Landak baru and other areas. Flood that hits Makassar was suspected caused by insufficient drainage, therefore, cannot accommodate water debit and the lack of green open space as water absorption area as an examples is Lapangan Karebosi which initially allocated for water absorption area instead, it becomes an underground mall. Other reason that residents use drainage tunnel as garbage disposal, hence, the tunnel is blocked. The effort to manage flood in Makassar can not be succesed only by cleaning and sediment removing in the tunnel. It is caused by the lack of tunnel dimention to serve high city development. Drainage system in Makasar need to be total repaired because the the current drainage system is old and not suitable with city development. The concept of conventional drainage which flow water waste rapidly need to be revised to more natural flow (slow), therefore will not cause flood in down area (Kimpraswil, 2006, Sunjotos, 2011).

It is necessary to design effective drainage tunnel with environmental understanding, not only retain and flow water from the street but also function as media to absorb water to the soil beneath. One of the method can be apply to absorb water is to make pore hole or absorbing hole at the bottom along the the tunnel.

Biopore absorption hole is silindery hole made in vertical in to the ground with 10-30 cm diameter and around 100 cm depth or in case soil with shallow soil water, not more than soil water surface. Absorption hole subsequently is filled with organic waste, piled to support soil fauna, therefore, create biopore (Dinolefty, 2010). Therefore, it was planned to hold laboratory research to find out the amount, dimension, material and distance of effective pore hole for water absorption from the body of drainage tunnel to the layer beneath. Result of the research is expected to be used as input for the Government of Makassar and government of other cities which experience flood every year.

MATERIALS AND METHODS

Model drainage: For lab tests performed using porous darinase channel model in which to stage infiltration under static conditions used models with a single hole with 3 variations and depth of the hole diameter (TAPGKCOB., 2006). For impregnation on dynamic conditions used channel model with holes 4 pieces with diameters and depths were selected based on the observation of a static condition. The 3 hole spacing variation is taken to see the effect of distance on infiltration. Channel model can be seen in Fig. 1 and 2.

Soil texture: Media used for impregnation of soil samples have terkstur soil texture based on a 3-point location floodwaters are considered to represent the location of

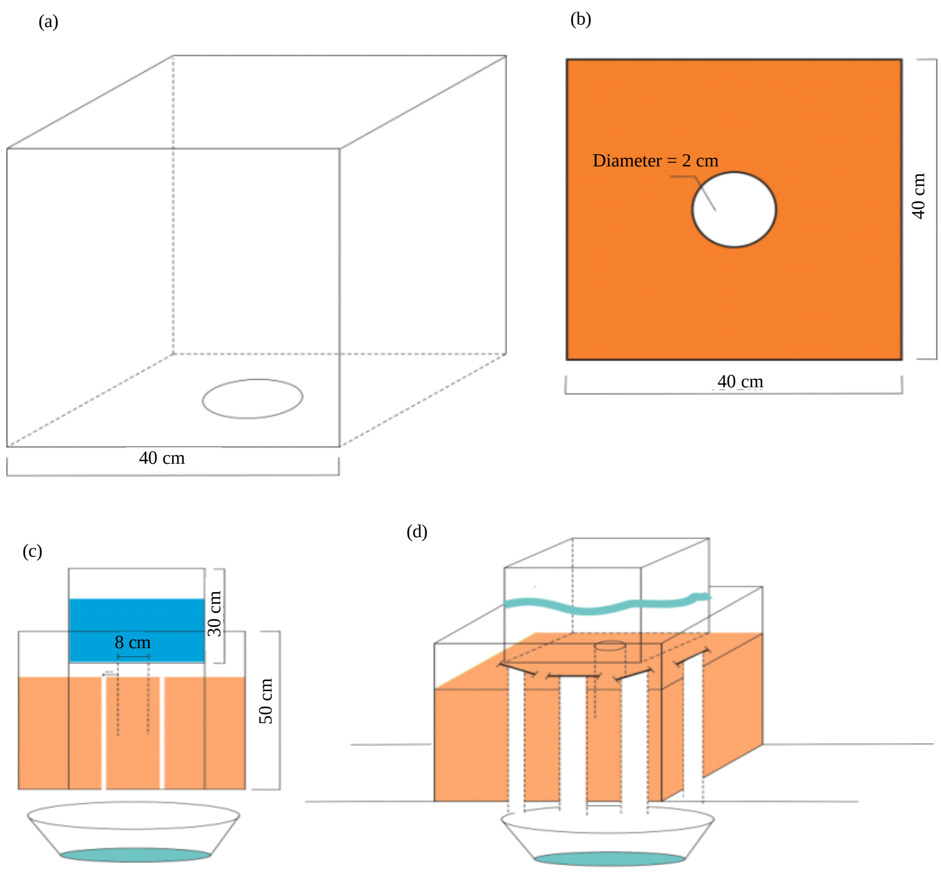

Fig. 1: a, b) Infiltration with static condition; c) Beside view and d) Persective view

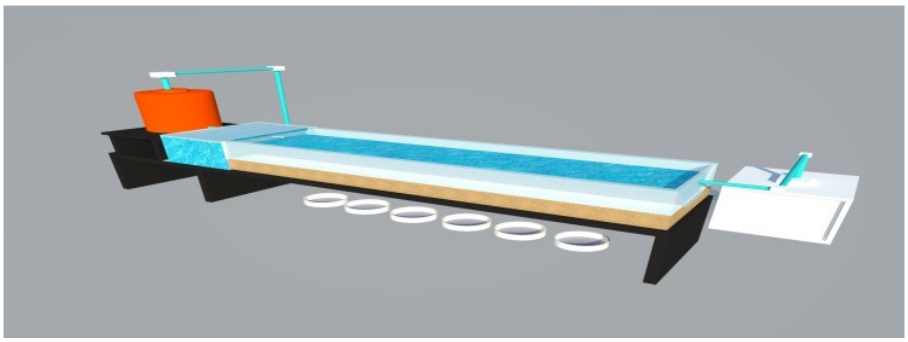

Fig. 2: Infiltration with dinamic condition

soil texture floodwaters in urban areas. Determination of soil texture through laboratory tests. To view the permeation ability test conducted initial experiments in the form of permeability and soil compacting the subgrade to determine density.

The research was conducted by the experimental method in lab testing and descriptive methods which literally meant tomake apicture of the situation, condition or event, so, it is more directed at collecting base line activity. This method is more commonly often referred to as the survey method. According to Wasrif and Friski (2010) that a study was conducted to obtain the facts of the symptoms that there are factual. To see the effect of the parameters of the infiltration, the observation is done in two stages, the condition of static and dynamic conditions.

Used for impregnation medium exture soil samples with soilt exture taken based on the 3 locations that are supposed to represent the location of the flood inundation area.

Loks is oil texture through laboratory testing research note. Soil texture samples made according to soil texture in the field and the soil samples tested permeability and compaction to see the ability of the soil permeability at the location as a material consideration in the application of porousdrainageat the site. Infiltration under static conditions was conducted to determine the effective dimensions of the hole that can absorb water.

Infiltration in dynamic conditions was to see the effect of speed and distance to the permeation pore holes.

RESULTS AND DISCUSSION

From the laboratory test result in two conditions which were static and dynamic, it is obtained as shown in Table 1 and 2.

Factors which influence infiltration debit: The value of infiltration debit is influenced by soil type, hole depth, porosity, pressure, depth, flow debit and gradient hydraulic.

Static condition

Influence of soil type to infiltration debit: As already explained in previous sstudy, one of the factor that influence infiltration debit is soil type. Result of the research using three types of soil, water surface level and hole diameter is shown on graphics.

As shown in Fig. 3-5 relation of soil type and infiltration debit with water surface level 15, 20 and 25 cm and 2 cm hole diameter in three hole depth infiltration debit at 10, 15 and 20 cm increase on soil types. Therefore, the graphics are correspond to the increase of water level, hole depth and soil types (permeability).

Table 1: Infiltration debit from laboratorium test

Hole diameter (d = cm)	Water surface heights (h = cm)	Soil type (k)	Hole depth (d = cm)	Soil height (T = cm)	T-d (cm)	h+d (cm)	((h+d))/((T-d))	q' (cm^3/det)
2	15	0.017	10	30	20	25	1.25	0.023
2	15	0.017	15	30	15	30	2.00	0.153
2	15	0.017	20	30	10	35	3.50	0.180
2	15	0.006	10	30	20	25	1.25	0.023
2	15	0.006	15	30	15	30	2.00	0.028
2	15	0.006	20	30	10	35	3.50	0.054
2	15	0.003	10	30	20	25	1.25	0.011
2	15	0.003	15	30	15	30	2.00	0.013
2	15	0.003	20	30	10	35	3.50	0.016
2	20	0.017	10	30	20	30	1.50	0.079
2	20	0.017	15	30	15	35	2.33	0.174
2	20	0.017	20	30	10	40	4.00	0.274
2	20	0.006	10	30	20	30	1.50	0.024
2	20	0.006	15	30	15	35	2.33	0.043
2	20	0.006	20	30	10	40	4.00	0.090
2	20	0.003	10	30	20	30	1.50	0.016
2	20	0.003	15	30	15	35	2.33	0.023
2	20	0.003	20	30	10	40	4.00	0.067
2	25	0.017	10	30	20	35	1.75	0.090
2	25	0.017	15	30	15	40	2.67	0.256
2	25	0.017	20	30	10	45	4.50	0.368
2	25	0.006	10	30	20	35	1.75	0.056
2	25	0.006	15	30	15	40	2.67	0.057
2	25	0.006	20	30	10	45	4.50	0.105
2	25	0.003	10	30	20	35	1.75	0.028
2	25	0.003	15	30	15	40	2.67	0.039
2	25	0.003	20	30	10	45	4.50	0.044
5	15	0.017	10	30	20	25	1.25	0.190

Table 1: Continue

Hole diameter (d = cm)	Water surface heights (h = cm)	Soil type (k)	Hole depth (d = cm)	Soil height (T = cm)	T-d (cm)	h+d (cm)	((h+d))/((T-d))	q' (cm^3/det)
5	15	0.017	15	30	15	30	2.00	0.407
5	15	0.017	20	30	10	35	3.50	0.589
5	15	0.006	10	30	20	25	1.25	0.036
5	15	0.006	15	30	15	30	2.00	0.099
5	15	0.006	20	30	10	35	3.50	0.203
5	15	0.003	10	30	20	25	1.25	0.056
5	15	0.003	15	30	15	30	2.00	0.080
5	15	0.003	20	30	10	35	3.50	0.117
5	20	0.017	10	30	20	30	1.50	0.211
5	20	0.017	15	30	15	35	2.33	0.433
5	20	0.017	20	30	10	40	4.00	0.727
5	20	0.006	10	30	20	30	1.50	0.081
5	20	0.006	15	30	15	35	2.33	0.144
5	20	0.006	20	30	10	40	4.00	0.268
5	20	0.003	10	30	20	30	1.50	0.070
5	20	0.003	15	30	15	35	2.33	0.101
5	20	0.003	20	30	10	40	4.00	0.211
5	25	0.017	10	30	20	35	1.75	0.210
5	25	0.017	15	30	15	40	2.67	0.456
5	25	0.017	20	30	10	45	4.50	0.900
5	25	0.006	10	30	20	35	1.75	0.136
5	25	0.006	15	30	15	40	2.67	0.202
5	25	0.006	20	30	10	45	4.50	0.326
5	25	0.003	10	30	20	35	1.75	0.104
5	25	0.003	15	30	15	40	2.67	0.115
5	25	0.003	20	30	10	45	4.50	0.239

Table 2: Data of infiltration debit from laboratory test result in static dynamic condition

Hole space (x = cm)	Soil type (k)	Soil depth (T = cm)	T-d (cm)	Flow debit (Q = dm^3/det)	Flow rate (V = dm^2/det)	Water surface height (h = cm)	h+d (cm)	((h+d))/((T-d))	Infiltration debit (cm^3/det q)
30	0.017	30	20	0.8	0.10	1.13	11.13	0.56	0.112
30	0.017	30	20	1.5	0.13	1.63	11.63	0.58	0.180
30	0.017	30	20	2.5	0.17	2.25	12.25	0.61	0.295
30	0.006	30	20	0.8	0.17	1.13	11.13	0.56	0.088
30	0.006	30	20	1.5	0.23	1.63	11.63	0.58	0.144
30	0.006	30	20	2.5	0.23	2.25	12.25	0.61	0.227
30	0.003	30	20	0.8	0.13	1.13	11.13	0.56	0.015
30	0.003	30	20	1.5	0.30	1.63	11.63	0.58	0.016
30	0.003	30	20	2.5	0.40	2.25	12.25	0.61	0.026
60	0.017	30	20	0.8	0.10	1.83	11.83	0.59	0.628
60	0.017	30	20	1.5	0.13	2.00	12.00	0.60	1.004
60	0.017	30	20	2.5	0.20	2.50	12.50	0.63	1.228
60	0.006	30	20	0.8	0.13	1.83	11.83	0.59	0.143
60	0.006	30	20	1.5	0.27	2.00	12.00	0.60	0.202
60	0.006	30	20	2.5	0.40	2.50	12.50	0.63	0.271
60	0.003	30	20	0.8	0.20	1.83	11.83	0.59	0.066
60	0.003	30	20	1.5	0.27	2.00	12.00	0.60	0.049
60	0.003	30	20	2.5	0.37	2.50	12.50	0.63	0.035
90	0.017	30	20	0.8	0.10	1.88	11.88	0.59	0.081
90	0.017	30	20	1.5	0.13	2.50	12.50	0.63	0.131
90	0.017	30	20	2.5	0.17	3.00	13.00	0.65	0.236
90	0.006	30	20	0.8	0.17	1.88	11.88	0.59	0.080
90	0.006	30	20	1.5	0.27	2.50	12.50	0.63	0.088
90	0.006	30	20	2.5	0.33	3.00	13.00	0.65	0.170
90	0.003	30	20	0.8	0.13	1.88	11.88	0.59	0.054
90	0.003	30	20	1.5	0.27	2.50	12.50	0.63	0.054
90	0.003	30	20	2.5	0.42	3.00	13.00	0.65	0.093
30	0.017	30	15	0.8	0.10	1.13	16.13	1.08	0.079
30	0.017	30	15	1.5	0.17	1.63	16.63	1.11	0.169
30	0.017	30	15	2.5	0.17	2.25	17.25	1.15	0.501
30	0.006	30	15	0.8	0.13	1.13	16.13	1.08	0.049
30	0.006	30	15	1.5	0.30	1.63	16.63	1.11	0.082
30	0.006	30	15	2.5	0.37	2.25	17.25	1.15	0.113
30	0.003	30	15	0.8	0.17	1.13	16.13	1.08	0.023
30	0.003	30	15	1.5	0.20	1.63	16.63	1.11	0.044
30	0.003	30	15	2.5	0.27	2.25	17.25	1.15	0.065

Table 2: Continue

Hole space (x = cm)	Soil type (k)	Soil depth (T = cm)	T-d (cm)	Flow debit (Q = dm^3/det)	Flow rate (V = dm^2/det)	Water surface height (h = cm)	h+d (cm)	((h+d))/((T-d))	Infiltration debit (cm^3/det q)
60	0.017	30	15	0.8	0.10	1.83	16.83	1.12	0.143
60	0.017	30	15	1.5	0.13	2.00	17.00	1.13	0.196
60	0.017	30	15	2.5	0.17	2.50	17.50	1.17	0.319
60	0.006	30	15	0.8	0.13	1.83	16.83	1.12	0.059
60	0.006	30	15	1.5	0.33	2.00	17.00	1.13	0.196
60	0.006	30	15	2.5	0.50	2.50	17.50	1.17	0.198
60	0.003	30	15	0.8	0.17	1.83	16.83	1.12	0.036
60	0.003	30	15	1.5	0.17	2.00	17.00	1.13	0.040
60	0.003	30	15	2.5	0.17	2.50	17.50	1.17	0.077
90	0.017	30	15	0.8	0.10	1.88	16.88	1.13	0.074
90	0.017	30	15	1.5	0.17	2.50	17.50	1.17	0.166
90	0.017	30	15	2.5	0.30	3.00	18.00	1.20	0.700
90	0.006	30	15	0.8	0.13	1.88	16.88	1.13	0.071
90	0.006	30	15	1.5	0.23	2.50	17.50	1.17	0.118
90	0.006	30	15	2.5	0.43	3.00	18.00	1.20	0.237
90	0.003	30	15	0.8	0.13	1.88	16.88	1.13	0.025
90	0.003	30	15	1.5	0.20	2.50	17.50	1.17	0.045
90	0.003	30	15	2.5	0.17	3.00	18.00	1.20	0.090
30	0.017	30	10	0.8	0.10	1.13	21.13	2.11	0.298
30	0.017	30	10	1.5	0.27	1.63	21.63	2.16	0.383
30	0.017	30	10	2.5	0.17	2.25	22.25	2.23	0.461
30	0.006	30	10	0.8	0.13	1.13	21.13	2.11	0.154
30	0.006	30	10	1.5	0.30	1.63	21.63	2.16	0.294
30	0.006	30	10	2.5	0.33	2.25	22.25	2.23	0.301
30	0.003	30	10	0.8	0.17	1.13	21.13	2.11	0.050
30	0.003	30	10	1.5	0.27	1.63	21.63	2.16	0.052
30	0.003	30	10	2.5	0.13	2.25	22.25	2.23	0.167
60	0.017	30	10	0.8	0.17	1.83	21.83	2.18	0.520
60	0.017	30	10	1.5	0.20	2.00	22.00	2.20	0.457
60	0.017	30	10	2.5	0.27	2.50	22.50	2.25	0.354
60	0.006	30	10	0.8	0.13	1.83	21.83	2.18	0.123
60	0.006	30	10	1.5	0.23	2.00	22.00	2.20	0.337
60	0.006	30	10	2.5	0.47	2.50	22.50	2.25	0.319
60	0.003	30	10	0.8	0.13	1.83	21.83	2.18	0.063
60	0.003	30	10	1.5	0.13	2.00	22.00	2.20	0.079
60	0.003	30	10	2.5	0.17	2.50	22.50	2.25	0.089
90	0.017	30	10	0.8	0.10	1.88	21.88	2.19	0.228
90	0.017	30	10	1.5	0.27	2.50	22.50	2.25	0.460
90	0.017	30	10	2.5	0.10	3.00	23.00	2.30	0.567
90	0.006	30	10	0.8	0.10	1.88	21.88	2.19	0.133
90	0.006	30	10	1.5	0.27	2.50	22.50	2.25	0.170
90	0.006	30	10	2.5	0.37	3.00	23.00	2.30	0.290
90	0.003	30	10	0.8	0.13	1.88	21.88	2.19	0.085
90	0.003	30	10	1.5	0.13	2.50	22.50	2.25	0.099
90	0.003	30	10	2.5	0.27	3	23.00	2.30	0.179

Graphic on Fig. 3 and 4 show the relation of soil type and infiltration debit with water surface level 15 and 20 cm and 2 cm diameter hole in various hole depth. The result show almost similar in both graphics which is the increase of infiltration debit in the three soil types in different hole depth. In soil type 0.003, 0.005 and 0.017 k the infiltration debit increase, although, the increase was not high which were 0.016, 0.024, 0.079 cm^3/det while in hole depth 15 and 20 cm on three soil types the number were 0.023, 0.0043, 0.174, 0.067, 0.090, 0.274 cm^3/det.

Graphic on Fig. 6-8 show the relation of soil type and infiltration debit with water surface level 15, 20 and 25 cm and 5 cm diameter hole in various hole depth show the increase of infiltration debit to 0.774 as shown on graphin

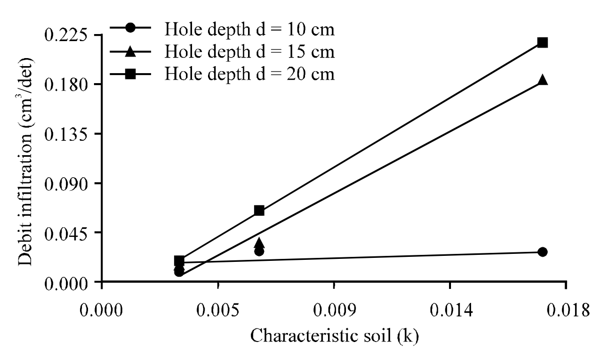

Fig. 3: Graphic of relation of soil type and infiltration debit with water surface level of 15 cm and hole diameter d = 2 in various hole depth

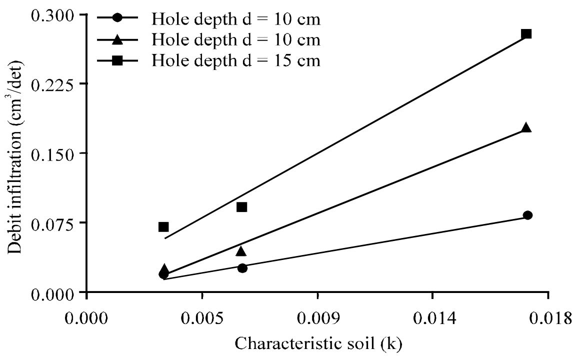

Fig. 4: Graphic of relation of soil type and infiltration debit with water surface level of 20 cm and hole diameter d = 2 in various hole depth

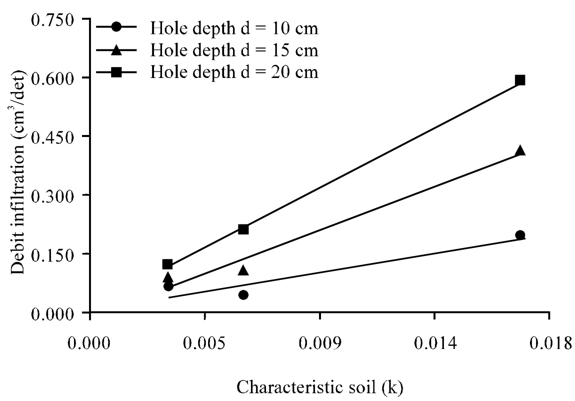

Fig. 5: Graphic of relation of soil type and infiltration debit with water surface level of 25 cm and hole diameter d = 2 in various hole depth

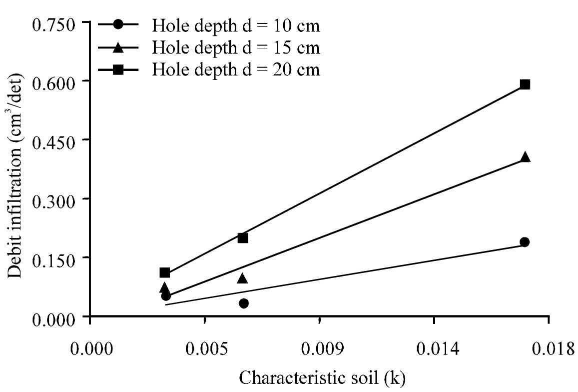

Fig. 6: Graphic of relation of soil type and infiltration debit with water surface level of 15 cm and hole diameter d = 5 in various hole depth

in Fig. 8. The increase of the infiltration debit was correspond to the increase of soil type permeability which were 0.003, 0.005 and 0.017 k with three hole depth and three water surface levels.

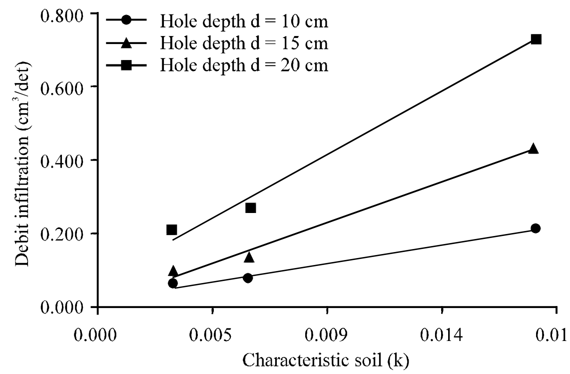

Fig. 7: Graphic of relation of soil type and infiltration debit with water surface level of 20 cm and hole diameter d = 5 in various hole depth

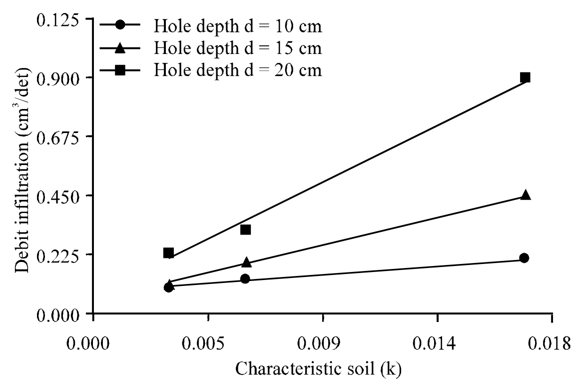

Fig. 8: Graphic of relation of soil type and infiltration debit with water surface level of 25 cm and hole diameter d = 5 in various hole depth

CONCLUSION

The research is the initial test which was observed with 3 variations of hole diameter, 3 variations of soil textures and 3 variation of water surface height in the tunnel. From the observation and laboratory test, it is expected to gain ideal pore holes dimension according to soil condition of the drainage tunnel.

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