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Prediction Method of Extenics Theory for Assessment of Bearing Capacity of Lateritic Soil Foundation

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***Abstract*—**Base on extenics theory, the statistical physical and mechanical properties from laboratory experiments are used to evaluate the bearing capacity of lateritic soil foundation. The properties include water content, bulk density, liquid limit, cohesion, and so on. The matter-element and the dependent function are defined. Then the synthesis dependent degree and the final grade index are calculated. The results show that predicted outcomes can be matched with the in-situ test data, and a evaluate grade associate with bearing capacity can be deduced. The results provide guidance to assess and determine the bearing capacity grade of lateritic soil foundation.

***Keywords*—**Lateritic soil; bearing capacity; extenics theory; plate loading test.

I. INTRODUCTION

HIGH natural water content, high liquid limit, high plasticity index, high void ratio are the basic physical features of lateritic soil, which is widely distributed in several southwestern provinces of P. R. China, such as Hunan, Guizhou, Yunnan, and Guangxi[1-2]. Meanwhile, lateritic soil presents a high mechanical strength and low compressibility, which is different from the general clay with similar physical properties. Assessment of bearing capacity of foundation is usually based on in-situ test data, such as plate loading test, cone penetration test (CPT) or pre-boring pressuremeter tests. Plate loading test consumes much more time, manpower and material resources. The mechanism of CPT has not been clear yet, and the drilling hole of pre-boring pressuremeter test requires high quality. Bearing capacity values of foundation are affected by many factors, such as testing tools, load type, soil parameters, and so on. And the factors always present complex nonlinear relationship. Thus, assessment of bearing capacity of foundation is a multi-variables problem. The current paper attempts to use indoor physical and mechanical properties combined with extenics theory to establish an easier and more accurate assessment model of bearing capacity of lateritic soil foundation.

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II. EXTENICS THEORY

In the objective world, there are some problems that cannot be directly solved by given conditions, but the problems may be easier or solvable through some proper transformation. All the objects or problems are recognized and classified always base on crisp set, fuzzy set [3] and extension set respectively. In the crisp set, an element either belongs to or does not belong to a set, so the range of the truth-values is [0, 1], which can be used to solve a two-valued problem. The fuzzy set concerns not only whether an element belongs to the set but also to what degree it belongs. The range of the membership function is [0, 1] in the fuzzy set. The extension set extends the fuzzy set from [0, 1] to $(-\infty, +\infty)$. This means that an element belongs to any extension set to a different degree [4]. Extenics theory was first brought up by Cai (1983) to solve contradictions and incompatibility in 1983. In extenics theory, the values of the dependent function are acquired from $(-\infty, +\infty)$. Thereby the dependent degree is able to reflect whether it belongs to a certain degree or not from positive and negative. Therefore more different information is open up from the evaluation results. Thus the extenics theory will make the evaluation results more precise [5]. Extenics were used in various disciplines [6-7], and gradually step into geotechnical engineering and geology to engineering, such as the classification of rock quality and the stability of slope [8-9].

Definitions of substances are:

$$R = (I, C, X) \tag{1}$$

where

R is the matter-element,
I is the name of the subject,
C is the characteristic,
X is the vector.

If substance I is indicated with n characters $c_1, c_2, \ldots. c_n$ and relevant $X_1, X_2, \ldots. X_n$, then the resource can be indicated as multiple resources:

$$R_i = (I_i, C, X) = \begin{bmatrix} I_i & c_1 & X_{i1} \\ & c_2 & X_{i2} \\ & \cdots & \cdots \\ & c_n & X_{in} \end{bmatrix} = \begin{bmatrix} I_1 & c_1 & (a_{i1}, b_{i1}) \\ & c_2 & (a_{i2}, b_{i2}) \\ & \cdots & \cdots \\ & c_n & (a_{in}, b_{in}) \end{bmatrix} \tag{2}$$

Express R as an n -dimensional resource, among it, $R_i = (I, c_i, X_i)(i = 1, 2, \ldots.., n)$ is called $R's$ molecular matter-element. X_{i1}、 X_{i2}、 … X_{in} , are $c_1, c_2, c_3, ...c_n$ ranges, so-called classical field,

$$X_{ij} = (a_{ij}, b_{ij}) \ (i = 1, 2, ..., m;\ j = 1, 2, ..., n).$$

For example, an ordinary box can be described as multiple matter-element to express each characteristic attribute value accurately:

$$\text{Box} \quad R_i = \begin{bmatrix} boxA & length & 297mm \\ & width & 210mm \\ & height & 25mm \\ & wight & 1.3kg \end{bmatrix} \tag{3}$$

From the concept of matter-element, it can describe individual characteristic and vector efficiently of an object, and it helps to acquaint the relationship between object and object, as well as to find the solution.

III. Establish the Assessment Model of Bearing Capacity Base on Extenics Theory

A. Factors and Evaluation Criterion

As mentioned above, Lateritic soil foundation bearing capacity values are affected by many factors. The soil parameters are the most fundamental factor, which include natural water content, bulk density, void ratio, liquid limit, plasticity index, liquidity index, coefficient of compressibility, compression modulus, cohesion, internal frictional angle, and so on. According to statistical physical and mechanical tests of lateritic soil samples, a five-level hierarchical diagram is constructed as shown in Table I.

TABLE1
THE GRADE OF COMPREHENSIVE EVALUATION INDEX OF BEARING CAPACITY OF LATERITIC SOIL FOUNDATION

Evaluation Indexes	Grade of bearing capacity				
	Excellen Level I	Good Level II	Moderate Level III	Qualified Level IV	Unqualifie Level V
c_1 (%)	≤20.0	20.0~30.0	30.0~40.	40.0~50.	≥50.0
c_2	≥20.0	16.0~20.0	13.0~16.	10.0~13.	≤10.0
c_3 (%)	≤45.0	45.0~55.0	55.0~65.	65.0~75.	≥75.0
c_4	≤0.0	0.0~0.33	0.33~0.6	0.67~1.0	≥1.0
c_5 (MPa^{-1})	≤0.1	0.1~0.23	0.23~0.3	0.36~0.5	≥0.5
c_6 (kPa)	≥100.0	67.2~100.	46.6~67.	20.0~46.	≤20.0
c_7 (°)	≥30.0	21.0~30.0	12.0~21.	3.0~12.0	≤3.0

The selected evaluation indexes are as follows: c_1 natural water content w , c_2 bulk density γ , c_3 liquid limit W_L , c_4 liquidity index I_L , c_5 coefficient of compressibility α_{1-2} , c_6 cohesion c , c_7 internal frictional angle ϕ are selected as comprehensive evaluation index. The lower the level is, the higher the bearing capacity of lateritic soil foundation.

B. Classical Field Matter-Element and Joint Field Matter-Element

According to the Table I, level 1-5 are denoted by I_1, I_2, I_3, I_4, I_5, and then the classical field of the level of comprehensive evaluation index of bearing capacity of lateritic soil can be established as follows:

$$R_1 = \begin{vmatrix} I_1 & c_1 & (15.0, 20.0) \\ & c_2 & (21.0, 25.0) \\ & c_3 & (35.0, 45.0) \\ & c_4 & (-0.12, 0.1) \\ & c_5 & (0.05, 0.10) \\ & c_6 & (100.0, 110.0) \\ & c_7 & (30.0, 35.0) \end{vmatrix} R_2 = \begin{vmatrix} I_2 & c_1 & (20.0, 30.0) \\ & c_2 & (19.0, 21.0) \\ & c_3 & (45.0, 55.0) \\ & c_4 & (0.1, 0.33) \\ & c_5 & (0.1, 0.25) \\ & c_6 & (67.2, 100.0) \\ & c_7 & (21.0, 30.0) \end{vmatrix}$$

$$R_3 = \begin{vmatrix} I_3 & c_1 & (30.0, 40.0) \\ & c_2 & (16.0, 19.0) \\ & c_3 & (55.0, 65.0) \\ & c_4 & (0.33, 0.67) \\ & c_5 & (0.25, 0.4) \\ & c_6 & (46.6, 67.2) \\ & c_7 & (12.0, 21.0) \end{vmatrix} R_4 = \begin{vmatrix} I_4 & c_1 & (40.0, 50.0) \\ & c_2 & (14.0, 16.0) \\ & c_3 & (65.0, 75.0) \\ & c_4 & (0.67, 1.0) \\ & c_5 & (0.4, 0.55) \\ & c_6 & (20.0, 46.6) \\ & c_7 & (3.0, 12.0) \end{vmatrix}$$

$$R_5 = \begin{vmatrix} I_5 & c_1 & (50.0, 60.0) \\ & c_2 & (10.0, 14.0) \\ & c_3 & (75.0, 85.0) \\ & c_4 & (1.0, 1.1) \\ & c_5 & (0.55, 0.70) \\ & c_6 & (10.0, 20.0) \\ & c_7 & (0.0, 3.0) \end{vmatrix} \tag{4}$$

If P is the number of evaluation index, and relevant X_{p1}、 X_{p2}、 … X_{pn} are c_1, c_2, $c_3, ..., c_n$ ranges, the joint field as follows:

$$R_p = (P, C, X_p) = \begin{bmatrix} P & c_1 & X_{p1} \\ & c_2 & X_{p2} \\ & \cdots & \cdots \\ & c_n & X_{pn} \end{bmatrix} = \begin{bmatrix} P & c_1 & (a_{p1}, b_{p1}) \\ & c_2 & (a_{p2}, b_{p2}) \\ & \cdots & \cdots \\ & c_n & (a_{pn}, b_{pn}) \end{bmatrix} \tag{5}$$

And then the joint field matter-element is

$$R_p = \begin{vmatrix} P & c_1 & (15.0, 60.0) \\ & c_2 & (10.0, 25.0) \\ & c_3 & (35.0, 85.0) \\ & c_4 & (-0.12, 1.1) \\ & c_5 & (0.05, 0.70) \\ & c_6 & (10.0, 110.0) \\ & c_7 & (0, 35.0) \end{vmatrix} \tag{6}$$

C. Establish Measurement-Needed Matter-Element

Measurement-needed matter-element R_x can be established by(7). There are five measurement-needed matter-elements the lateritic soil bearing capacity can be obtained (R_{x1}、 R_{x2}、 R_{x3} 、 R_{x4} 、 R_{x5}) from the data of laboratory experiments of lateritic soil. The lateritic soil samples (depth 0.8~1.5m) are taken from Xia-Chen highway of the Chenzhou section, Hunan province (milestone: K166+520, K166+495, K166+420, K166+380, K166+460). For example, R_{x1}, R_{x3}, R_{x5} are shown in (8)

$$R_x = (P, C, X) = \begin{vmatrix} P_x & c_1 & x_1 \\ & c_2 & x_2 \\ & c_3 & x_3 \\ & c_4 & x_4 \\ & c_5 & x_5 \\ & c_6 & x_6 \\ & c_7 & x_7 \end{vmatrix} \tag{7}$$

$$R_{x1} = \begin{vmatrix} P_{x1} & c_1 & 29.2 \\ & c_2 & 16.8 \\ & c_3 & 61.3 \\ & c_4 & -0.16 \\ & c_5 & 0.75 \\ & c_6 & 67.0 \\ & c_7 & 21.1 \end{vmatrix} R_{x3} = \begin{vmatrix} P_{x2} & c_1 & 25.8 \\ & c_2 & 16.8 \\ & c_3 & 57.7 \\ & c_4 & -0.09 \\ & c_5 & 0.71 \\ & c_6 & 79.3 \\ & c_7 & 14.3 \end{vmatrix} R_{x5} = \begin{vmatrix} P_{x3} & c_1 & 28.9 \\ & c_2 & 17.5 \\ & c_3 & 75.2 \\ & c_4 & -0.24 \\ & c_5 & 0.17 \\ & c_6 & 38.6 \\ & c_7 & 34.1 \end{vmatrix} \tag{8}$$

D. Calculate the Dependent Degree

The dependent function about the matter-element analysis for the lateritic soil foundation bearing capacity assessment is defined as follows:

$$K_i(x_j) = \begin{cases} \dfrac{-\rho(x_j, X_{ij})}{\left|X_{ij}\right|}, (x_j \in X_{ij}) \\ \dfrac{\rho(x_j, X_{ij})}{\rho(x_j, X_{pj}) - \rho(x_j, X_{ij})}, (x_j \notin X_{ij}) \end{cases} \tag{9}$$

$$\rho(x_j, X_{ij}) = \left| x_j - \frac{(a_{ij} + b_{ij})}{2} \right| - \frac{(b_{ij} - a_{ij})}{2} \tag{10}$$

$$\rho(x_j, X_{pj}) = \left| x_j - \frac{(a_{pj} + b_{pj})}{2} \right| - \frac{(b_{pj} - a_{pj})}{2} \tag{11}$$

where $K_i(x_j)$ is the dependent degree of No. j index value x_j, X_{ij} refers to the value field of No. j index subjected to No. i rank, $X_{ij} = (a_{ij}, b_{ij})$ is the distance between No. j index value x_j and the classical field of No. i grade.

And then, K_{x1}, K_{x2}, K_{x3}, K_{x4}, K_{x5} can be calculated. There is no space here to list all of them, but the K_{x1}, K_{x3}, K_{x5} are shown as follows.

$$K_{x1} = \begin{vmatrix} K_1(x_1) & K_1(x_2) & \dots & K_1(x_7) \\ K_2(x_1) & K_2(x_2) & \dots & K_2(x_7) \\ K_3(x_1) & K_2(x_2) & \dots & K_3(x_7) \\ K_4(x_1) & K_2(x_2) & \dots & K_4(x_7) \\ K_5(x_1) & K_2(x_2) & \dots & K_5(x_7) \end{vmatrix}$$

$$= \begin{vmatrix} -0.393 & -0.382 & -0.408 & -0.182 & -1.083 & -0.434 & -0.390 \\ 0.080 & -0.244 & -0.210 & -1.182 & -1.111 & -0.005 & 0.011 \\ -0.053 & 0.267 & 0.370 & -1.089 & -1.167 & 0.010 & -0.007 \\ -0.432 & -0.105 & -0.135 & -1.051 & -1.333 & -0.322 & -0.396 \\ -0.594 & -0.292 & -0.366 & -1.036 & -0.333 & -0.522 & -0.566 \end{vmatrix}$$

$$K_{x3} = \begin{vmatrix} -0.349 & -0.382 & -0.359 & 0.136 & -1.017 & -0.403 & -0.523 \\ 0.420 & -0.244 & -0.106 & -0.864 & -1.022 & 0.369 & -0.319 \\ -0.280 & 0.267 & 0.270 & -0.933 & -1.033 & -0.283 & 0.256 \\ -0.568 & -0.105 & -0.243 & -0.962 & -1.067 & -0.516 & -0.232 \\ -0.691 & -0.292 & -0.433 & -0.973 & -0.067 & -0.659 & -0.926 \end{vmatrix}$$

$$K_{x5} = \begin{vmatrix} -0.390 & -0.318 & -0.755 & -0.545 & -0.368 & -0.682 & 0.180 \\ 0.110 & -0.750 & -0.673 & -1.545 & 0.467 & -0.500 & -0.820 \\ -0.073 & 0.250 & -0.510 & -1.267 & -0.400 & -0.219 & -0.936 \\ -0.444 & -0.167 & -0.020 & -1.152 & -0.657 & 0.301 & -0.961 \\ -0.603 & -0.318 & 0.020 & -1.107 & -0.760 & -0.394 & -0.972 \end{vmatrix} \tag{12}$$

In the extenics theory, the dependent degree is able to reflect whether it belongs to a certain degree or not from positive and negative, which greatly enlarges its research scope and opens out more different information. It makes the results more precise. Therefore the meaning which is expressed by the dependent degree is more profound [10].

E. Determine the Weights of the Factors

The weights of the factors of the assessed object can be calculated as follows;

$$\lambda_{ij} = \frac{x_j}{b_{ij}} \bigg/ \sum_{j=1}^{n} \frac{x_j}{b_{ij}} \tag{13}$$

And then, $\lambda_{ij}, (i = 1, 2, ..., 5; j = 1, 2, ..., 7)$ can be calculated, λ_{x1} 、 λ_{x3} 、 λ_{x5} are shown as follows:

$$\lambda_{x1} = \begin{vmatrix} \lambda_1(x_1) & \lambda_1(x_2) & \dots & \lambda_1(x_7) \\ \lambda_2(x_1) & \lambda_2(x_2) & \dots & \lambda_2(x_7) \\ \lambda_3(x_1) & \lambda_2(x_2) & \dots & \lambda_3(x_7) \\ \lambda_4(x_1) & \lambda_2(x_2) & \dots & \lambda_4(x_7) \\ \lambda_5(x_1) & \lambda_2(x_2) & \dots & \lambda_5(x_7) \end{vmatrix}$$

$$= \begin{vmatrix} 0.109 & 0.050 & 0.131 & 0.057 & 0.561 & 0.046 & 0.045 \\ 0.120 & 0.098 & 0.167 & 0.078 & 0.369 & 0.082 & 0.086 \\ 0.103 & 0.124 & 0.157 & 0.071 & 0.264 & 0.140 & 0.141 \\ 0.077 & 0.139 & 0.125 & 0.056 & 0.180 & 0.190 & 0.233 \\ 0.034 & 0.084 & 0.057 & 0.028 & 0.075 & 0.233 & 0.490 \end{vmatrix}$$

$$\lambda_{x3} = \begin{vmatrix} 0.102 & 0.053 & 0.130 & 0.065 & 0.560 & 0.057 & 0.032 \\ 0.111 & 0.103 & 0.166 & 0.088 & 0.367 & 0.103 & 0.062 \\ 0.095 & 0.131 & 0.155 & 0.081 & 0.263 & 0.175 & 0.101 \\ 0.073 & 0.148 & 0.125 & 0.064 & 0.182 & 0.240 & 0.168 \\ 0.034 & 0.095 & 0.061 & 0.034 & 0.081 & 0.315 & 0.379 \end{vmatrix}$$

$$\lambda_{x5} = \begin{vmatrix} 0.180 & 0.087 & 0.268 & 0.086 & 0.212 & 0.044 & 0.122 \\ 0.154 & 0.134 & 0.268 & 0.092 & 0.109 & 0.062 & 0.182 \\ 0.119 & 0.151 & 0.225 & 0.075 & 0.070 & 0.094 & 0.267 \\ 0.080 & 0.152 & 0.161 & 0.053 & 0.043 & 0.115 & 0.395 \\ 0.029 & 0.075 & 0.060 & 0.022 & 0.015 & 0.116 & 0.683 \end{vmatrix} \tag{14}$$

F. Calculate the Synthesis Dependent Degree and the Predicting Results

According to the weight of each factor in the same hierarchy within the same above factor and the dependent function based on the extenics mathematics, the dependent degree about No. i rank of the assessed object P_x can be calculated as follows;

$$K_i(P_x)=\sum_{j=1}^{n}\lambda_{ij}K_i(x_j) \tag{15}$$

And then, $K(P_{x1})$、$K(P_{x2})$、$K(P_{x3})$、$K(P_{x4})$、$K(P_{x5})$ can be calculated. There is no space here to list all of them, but the $K(P_{x1}),K(P_{x3}),K(P_{x5})$ are shown as follows;

$$\begin{aligned} K(P_{x1}) &= [K_1(P_{x1}),K_2(P_{x1}),K_3(P_{x1}),K_4(P_{x1}),K_5(P_{x1})] \\ &= [-0.772,-0.550,-0.299,-0.517,-0.518\ ] \\ K(P_{x3}) &= [K_1(P_{x3}),K_2(P_{x3}),K_3(P_{x3}),K_4(P_{x3}),K_5(P_{x3})] \\ &= [-0.703,-0.430,-0.320,-0.506,-0.676] \\ K(P_{x5}) &= [K_1(P_{x5}),K_2(P_{x5}),K_3(P_{x5}),K_4(P_{x5}),K_5(P_{x5})] \\ &= [-0.434,-0.534,-0.478,-0.499,-0.785] \end{aligned} \tag{16}$$

The grade number, which is the maximum element of No. i vector, is regarded as the grade of the bearing capacity of lateritic soil foundation. In other words, when the element of No. i vector is the maximum, the bearing capacity grade is i. The grades and the predicted results were shown in Table II.

TABLE II
THE DEGREES AND THE PREDICTED RESULTS

No.	1	2	3	4	5
Milestone (K166)	+520	+495	+420	+380	+460
$K_1(P_x)$	-0.722	-0.41	-0.703	-1.177	-0.434
$K_2(P_x)$	-0.55	-0.315	-0.43	-0.917	-0.534
$K_3(P_x)$	-0.299	-0.131	-0.320	-1.144	-0.478
$K_4(P_x)$	-0.517	-0.136	-0.506	-1.528	-0.499
$K_5(P_x)$	-0.518	-0.35	-0.676	-0.728	-0.785
max $K_i(P_x)$	-0.299	-0.131	-0.32	-0.728	-0.434
Predicted results	III	III	III	V	I

IV. IN-SITU TEST VERIFICATION AND DISCUSSION

In order to verify the predicted results of the assessment model, plate loading tests are used to obtain the bearing capacity characteristics and deformation modulus of lateritic soil foundation. Fig. 1 shows the arrangement of the plate load test. The apparatuses are mainly constituted by three parts: rigid plate, load equivalent and dial gauge. A steel rigid plate is prepared (0.55m width, 0.55m length and 0.03m height). Hydraulic jack (max load 30T) for applying the load, and screw anchors as the reaction load. Four dial gauges (displacement range: 0-10mm, accuracy: 0.01mm) and reference beams are used to measure the settlement. Average of the four dial readings is taken as the settlement of the plate corresponding to the applied load. When the rate of average settlement is less than 0.01 mm per two hours, load is then increased to further preset load, and the load and average settlement readings are noted as before.

Fig. 1 The arrangement of the plate load test

The procedure is repeated till the settlement cannot maintain stability or the cracks caused by the load keep spreading as the applying load maintains a constant. The measured and revised (least-squares method) pressure settlement curves are shown in Fig. 2. The values of bearing capacity characteristics and deformation modulus are shown in Table III.

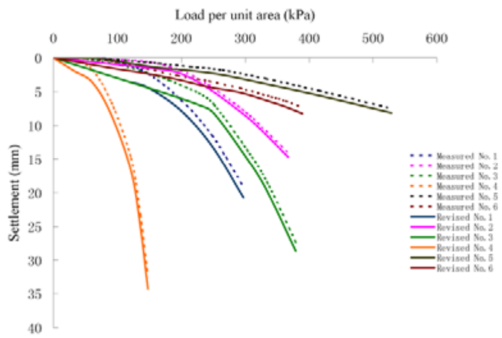

Fig. 2 The measured and revised pressure-settlement curves

TABLE III
BEARING CAPACITY CHARACTERISTICS AND DEFORMATION MODULUS OF LATERITIC SOIL FOUNDATION

No	Milestone	plate loading tests	
		Bearing capacity characteristics (kPa)	deformation modulus (MPa)
1	K166+520	204.2	9.98
2	K166+495	296.2	14.48
3	K166+420	251.9	12.31
4	K166+380	97.1	4.76
5	K166+460	416.5	20.36

Table II illustrates that, the assessment grades of bearing capacity foundation at milestone K166+520, K166+495, K170+420 are level III, and the grade of K170+380 is level V, the grade of K170+460 is level I. The predicted results of this method can be matched with the In-situ test results in the Table 3. Therefore, the relationships between the assessed grades and the values of bearing capacity characteristics can be described as Table IV shows.

TABLE IV
RELATIONSHIPS BETWEEN ASSESSED GRADES AND VALUES OF BEARING CAPACITY CHARACTERISTICS

Grade of bearing capacity		value of bearing capacity characteristics
Excellent	Level I	≥300kPa
Good	Level II	
Moderate	Level III	200~300 kPa
Qualified	Level IV	100~200 kPa
Unqualified	Level V	≤100 kPa

And then the physical and mechanical property index data of other lateritic regions[11-12] are used in the prediction model. The forecasted results are also consistent with the described relationships above, shown in Table V.

The dependent degree has introduced the negative number. The negative could completely reflect the comprehensive quality level of things for it guaranteed the integrity of information. Therefore, the assessment result is more objective and accurate, and more reliable and feasible. The extension comprehensive prediction method presented a new feasible path for the evaluation of bearing capacity of foundation of lateritic soil by using physical and mechanical properties from laboratory experiments.

TABLE V
PHYSICAL AND MECHANICAL PROPERTIES OF THE OTHER LATERITIC REGIONS AND PREDICTED RESULTS

Region		Wu-Guang passenger dedicated line (DK1784+889)	Yi-xin airport region I
Physical and mechanical properties	c_1 (%)	21.4	42.25
	c_2 (kN.m^{-3})	18.2	16.8
	c_3 (%)	55.8	70
	c_4	0.84	0.01
	c_5 (MPa^{-1})	0.12	0.41
	c_6 (kPa)	55.4	60.6
	c_7 (°)	24.4	13.9
Extension comprehensive prediction	$K_1(P_x)$	-0.281	-0.538
	$K_2(P_x)$	-0.138	-0.37
	$K_3(P_x)$	-0.121	0.024
	$K_4(P_x)$	-0.477	-0.034
	$K_5(P_x)$	-0.602	-0.397
	predicted results	III	III
Bearing capacity characteristics (kPa)		260	240

V. CONCLUSION

In this study, the statistical physical and mechanical properties from laboratory experiments are used to evaluate the bearing capacity of lateritic soil foundation base on extenics theory. The matter-element and the dependent function are defined. Then the synthesis dependent degree and the final grade index are calculated. The results show that predicted outcomes can be matched with the in-situ test data, and a evaluate grade associate with bearing capacity can be deduced.

The presented prediction method is rigorous in the mathematical logic. The advantages of that are: a large number of factors can be considered, and the predicted results are more accurate. However, it is required to improve in some aspects, such as the supplement and development of the assessment indexes. These have yet to be explored further.

This methodology, combining the extenics theory, provides a new scientific method for assessment of bearing capacity of foundation and makes the assessment results more reasonable and comprehensive. Thus, the method may be very interesting to designers and constructors involved in civil engineering.

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