СТРОИТЕЛЬСТВО ПОДЗЕМНЫХ СООРУЖЕНИЙ И ШАХТ

UDC 622

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THE FORECAST AND ANALYSIS OF BRACE AXIS FORCE ON THE BASE HOLLOW

In the construction of the base hollow, there are many effect facts —the temperature stress, the earth pressure or so. The developing and changing of the base hollow brace structure is illegibility and unconfirmed, therefore, we can not calculate or forecast the brace axes force with a confirm model. The gray system has provided a scientific method to us. We can forecast and control the axes force with the illegibility forecast model-G(1,1) model. So that we can ensure it is safe to construct the brace structure.

1 GM(1,1)model

1·1 The generic form of GM(1,1) model

Differential equation:

$$\frac{dx^{(1)}}{dt}+ax^{(1)}=u$$

Time response:

$$\hat{x}^{(1)}(t)=(x^{(1)}(0)-\frac{u}{a})e^{-at}+\frac{u}{a}$$

Scatter response:

$$\hat{x}^{(1)}(k)=(x^{(1)}(0)-\frac{u}{a})e^{-a(k-1)}+\frac{u}{a}$$

1·2 The model of distinguishing

$$\hat{a}=[a,u]^T$$

$$\hat{a}=[(A\vdots B)^T(A\vdots B)]^{-1}(A\vdots B)^T y_N$$

$$A=\begin{bmatrix} a^{(n-1)}(x_1^{(1)},2)\cdots a^{(1)}(x_1^{(1)},2) \\ \vdots \quad\quad \vdots \\ a^{(n-1)}(x_1^{(1)},N)\cdots a^{(1)}(x_1^{(1)},N) \end{bmatrix}$$

$$B=\begin{bmatrix} -\frac{1}{2}(x_1^{(1)}(2)+x_1^{(1)}(1))\cdots x_h^{(1)}(2) \\ \vdots \quad\quad \vdots \\ -\frac{1}{2}(x_1^{(1)}(N)+x_1^{(1)}(N-1))\cdots x_h^{(1)}(N) \end{bmatrix}$$

$$y_N=\left[a^{(n)}(x_1^{(1)},2)\cdots a^{(n)}(x_1^{(1)},N)\right]^T$$

1·3 Data processing

Compared the GM(1,1) model with the GM(n,h)model, we can get:

The GM(n,h) model is:

$$\frac{d^n x_1^{(1)}}{dt^n}+\cdots+a_n x_1^{(1)}=b_1 x_2^{(1)}+\cdots+b_{h-1}x_h^{(1)},$$

$$\hat{a}=\left[a_1,\cdots,a_{n-1}\vdots a_n b_1,\cdots,b_{h-1}\right]^T;$$

The GM(1,1) model is:

$$\frac{dx_1^{(1)}}{dt}+ax_1^{(1)}=u,$$

$$\hat{a}=\left[a,u\right]^T.$$

The coefficient a of the GM(1,1) model is equal the a_n of the GM(n,h) model. The control item u is equal the $b_{h-1}x_h^{(1)}$ of the GM(n,h).

1·4 Due to a is corresponding a_n , the parameter vector $\hat{a}$ of the GM(n,h) model has been ecdysised a. Namely:

$$\hat{a}=\left[a_1,\cdots a_{n-1}\vdots a_n b_1,\cdots b_{h-1}\right]^T \Rightarrow \left[0,\cdots 0\vdots a,\cdots\right]^T.$$

1·5 Due to the parameter vector of the GM(n,h) model is that $[a_1,\ldots,a_{n-1}]^T=0$, therefore the matrix A has lost its meaning.

1·6 The control item u is equal the $b_{h-1}x_h^{(1)}$ of the GM(n,h). b_{h-1} is a parameter that it is waiting to be distinguished. In the GM(1,1) model, u is a parameter that it is waiting to be distinguished. So we can order that - $u=b_{h-1}$, $x_h^{(1)}=1$。

1·7 According to the matrix B, we can get:

$$\begin{bmatrix} x_h^{(1)}(2) \\ \vdots \\ x_h^{(1)}(N) \end{bmatrix}=\begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$$

When it is n=1 and h=1,the form of matrix B is:

$$B=\begin{bmatrix} -\frac{1}{2}(x_1^{(1)}(2)+x_1^{(1)}(1)), & 1 \\ \vdots & \vdots \\ -\frac{1}{2}(x_1^{(1)}(N)+x_1^{(1)}(N-1)), & 1 \end{bmatrix},$$

$$(A\vdots B)=B.$$

2 The observation data of the axes force

The group of puxiang in Korea South invests the yinguan building. It located in the finance and trade section of lujiazhui in the east of shanghai. Its base hollow is 120 meter long, more than 70 meter wide, the deepest is 19.6 meter. We designed the under-ground continuum wall as the support structure; it is one meter thick, and thirty-six meter deep. To insure the safety, we designed three layer concrete brace in it. In order to realize the information management, and forecast and predict the stability, the dependability and the security of the support system in construction process, we did the scene testing on the developing of the axes force in construction process. Table one is a set of data that we tested in the scene.

Table 1

The tested data

	1	2	3	4	5	6	7
x^0(i)	6040	6271	6434	6877	7189	7939	8466

3 Establish the GM(1,1) model about the displacement forecast

3·1 Calculation (AB)

We have been informed that:

$$\bar{x}^{(0)} = \left\{x^{(0)}(1), x^{(0)}(2), \cdots x^{(0)}(10)\right\}$$

According to the data, we can get:

$$x^{(1)}_{(1)} = \sum_{1}^{I} x^{0}_{I} = x^{(0)}_{(1)} = 6040$$

$$x^{(1)}_{(2)} = x^{(0)}_{(1)} + x^{(0)}_{(2)} = 12311$$

$$x^{(1)}_{(3)} = 18745 \qquad x^{(1)}_{(4)} = 25622 \qquad x^{(1)}_{(5)} = 32811$$

$$x^{(1)}_{(6)} = 40750 \qquad x^{(1)}_{(7)} = 49236$$

$$\frac{1}{2}(x^{(1)}_{(1)} + x^{(!)}_{(2)}) = \frac{1}{2}(6040 + 12311) = 9175.5$$

$$\frac{1}{2}(x^{(1)}_{(2)} + x^{(1)}_{(3)}) = 15528$$

$$\frac{1}{2}(x^{(1)}_{(3)} + x^{(1)}_{(4)}) = 22183.5 \quad \frac{1}{2}(x^{(!)}_{(4)} + x^{(1)}_{(5)}) = 29216.5$$

$$\frac{1}{2}(x^{(!)}_{(5)} + x^{(1)}_{(6)}) = 36780.5 \qquad \frac{1}{2}(x^{(1)}_{(6)} + x^{(1)}_{(7)}) = 44993$$

So:

$$(A \vdots B) = B = \begin{bmatrix} -9175.50 & 1 \\ -15528.0 & 1 \\ -22183.5 & 1 \\ -29216.5 & 1 \\ -36780.5 & 1 \\ -44993.0 & 1 \end{bmatrix}$$

$Y_N=[a^{(n)}(x_1^{(1)},2),a^{(n)}(x_1^{(1)},3),\cdots a^{(n)}(x_1^{(1)},N)]$

Because it is n=1,therefore it is:

$Y_N=[a^{(1)}(x_1^{(1)},2),a^{(1)}(x_1^{(1)},3),\cdots a^{(1)}(x_1^{(1)},N)]$

Because it is $a^{(1)}(x_K^{(1)},I)=x_K^{(0)}(I)$,therefore it is:

$a^{(1)}(x_1^{(1)},2)=x_1^{(0)}(2)$

$a^{(1)}(x_1^{(1)},3)=x_1^{(0)}(3)$

$a^{(1)}(x_1^{(1)},N)=x_1^{(0)}(N)$

Duo to it is $N = 7$,so it is :

$Y_N=[6271,6434,6877,7189,7939,8486]^T$

3·2 Calculation $\hat{a}$

$$\hat{a} = \begin{Bmatrix} a \\ u \end{Bmatrix} = [(A \vdots B)^T (A \vdots B)]^{-1} (A \vdots B)^T Y_N$$

$$= \left\{ \begin{bmatrix} -9175.50 & 1 \\ -15528.0 & 1 \\ -22183.5 & 1 \\ -29216.5 & 1 \\ -36780.5 & 1 \\ -44993.0 & 1 \end{bmatrix}^T \begin{bmatrix} -9175.50 & 1 \\ -15528.0 & 1 \\ -22183.5 & 1 \\ -29216.5 & 1 \\ -36780.5 & 1 \\ -44993.0 & 1 \end{bmatrix} \right\}^{-1} \times$$

$$\times \begin{bmatrix} -9175.50 & 1 \\ -15528.0 & 1 \\ -22183.5 & 1 \\ -29216.5 & 1 \\ -36780.5 & 1 \\ -44993.0 & 1 \end{bmatrix}^T \begin{Bmatrix} 6271 \\ 6434 \\ 6877 \\ 7189 \\ 7939 \\ 8486 \end{Bmatrix} = \begin{bmatrix} -0.057 \\ 5660 \end{bmatrix}$$

3·3 Calculation time respond model

$$\hat{x}^{(1)}(t) = (x^{(1)}(0) - \frac{u}{a})e^{-at} + \frac{u}{a}$$

Let:

$x^{(1)}(0)=x^{(0)}(1)=6040$ $\qquad$ u/a=-5660/0.057=-99300

Then:

$$\hat{x}(t) = (6040 + 99300)e^{0.057t} - 99300 =$$

$$= 105300e^{0057t} - 99300$$

$$\hat{x}^{(1)}(K+1) = 105300e^{0057k} - 99300$$

$$K = 1 \qquad \hat{x}^1_2 = 105300e^{0057} - 99300 = 12176$$

$$K = 2 \qquad \hat{x}^1_3 = 105300e^{0057\times 2} - 99300 = 18715$$

$$K = 3 \qquad \hat{x}^1_4 = 105300e^{0057\times 3} - 99300 = 25637$$

$$K = 4 \qquad \hat{x}^1_5 = 105300e^{0057\times 4} - 99300 = 32966$$

$$K = 5 \qquad \hat{x}^1_6 = 105300e^{0057\times 5} - 99300 = 40724$$

$$K = 6 \qquad \hat{x}^1_7 = 105300e^{0057\times 6} - 99300 = 48937$$

3·4 Compare with the tested data

Table 2

The table of data compares

Tested data	Forecasted data
12311	12176
18745	18715
25622	25637
32811	32966
40750	40724
49236	48937

Through the data compare, we know that the forecasted data is anastomosed with the tested data, so the model can be used in the construction.

4 Conclusions

According to the calculation and analyses that we have done, the gray system forecast model GM (1, 1) can be used in the fore-cast and control the brace axes force of the base hollow in construction process. It can reflect well the engineering fact. It has guidance and practicality value to the information construction of the base hollow.

CONSULTING LITERATURE

1. Dengjulong // Gray control system, the publishing company of the Huazhong science and technology university, 1985.

2. Dengjulong // Gray system engineering, the publishing company of the Huazhong science and technology university, 1990.

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UDC 622

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INVESTMENT EVALUATION OF CIVIL ENGINEERING PROJECT

1 Civil building scale investment normal technical and economic result quota evaluation .

Technical and economic evaluation is the most important part of the project feasibility evaluation. In order to make the policy-making correct and scientific, bearing capacity of investment plan varying with various of external condition changes and relevant probability distribution should be known about. The correct policy-making rules and methods under risk should be mastered. Therefore, a series of contingent analysis will be made in terms of technology and economy to ensure the reasonableness and correctness of evaluation.

1.1 Static quota appraisal

1.1.1 Investment payback period

$$\sum_{t=0}^{T_P} NB_t = \sum_{t=0}^{T_P} (B - C)_t = K$$

where: K-civil building investment total

B_t-income of the tth year

C_t-expenditure of the tth year(mainly include maintenance cost and tendance cost)

NB_t-net income of the tth year

$NB_t = B_t - C_t$

T_p-investment payback period or T_p is expressed by the typical formula:

$$T_P = T - 1 + \frac{\text{The absolute value of the accumulative net present cost of the (T - 1)year}}{\text{Net present cost of the Tth year}}$$

Where: T-the total years that the accumulative net present cost are greater than or equal zero

Appraisal Criterion:

Suppose T_b is the standard investment payback period:

If $T_p \leq T_b$, then the scale investment is feasible,

If $T_p > T_b$, then the scale investment is unfeasible

1.1.2 Investment profit rate

$$R = \frac{NB}{K}$$

Where, K-total scale investment cost, $K = \sum_{t=0}^{m} K_t$

K_t-Investment cost of the tth year

m-the total years of investment

NB-profit of the normal year

R-investment profit rate

Appraisal Criterion:

Suppose R_b is the investment revenue rate

If $R \geq R_b$, then the investment is acceptable

If $R < R_b$, then the investment is denied.

1.2 Dynamic quota appraisal

1.2.1 Net present value

$$NPV = \sum_{t=0}^{n} (CI - CO)t (1 + i_o)^{-t}$$

$$= \sum_{t=0}^{n} (CI - K - CO')t (1 + i_o)^{-t}$$

where, Co_t-cash expenditure of the tth year