

## Value Analysis Application in Material Design of Concrete

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### Abstract

concrete is the mostly used material in the world. Especially in large-scale water project. Using a hing quality kind of concrete is the key to fullfill the requirement of the project. The paper build system of synthetic tareget of appraisal(SSTA) and the model of structure at material design of concrete (MDC) .Combine fuzzy mathematics With theory and method of VE, to study characteristic numerical value(CNV)of synthetic appraisal of vague, index of symthetic target of appraisal(ISTA) and VA on MDC. study of the example is make know apply the method to do VA, provide scientific basis and ef fective method for scheme of conc rete design is decided.

#### **1. SSTA and the model of structure at MDC.**

Concrete is the mostly used material in the

world. Especially in large-scale water project, concrete is essential for and the mostly used material of dam. It is influenced directly by the scheme of MDC, that is the quatily of project, cost of project time limit for project and the length of project motin maintenance cost of project. Therefore, MDC is a item of important work in large-scale water project.

MDC relate to a lot of factors in large-scale water projec,. Especially it have also degree of difficulty to qualitative analysis the factors, therefore expect and policymake's experienee play a leading role. As a result of the experts and policymake make policy possible deviate the actual situation People beging to understand that only depend on experience and polieymaker's subjective consciousness have limita - tions, it is highly necessary to study and analysis at theory that is policy problem of the scheme of MDC. The paper build SSTA and model of structure at

MDC. Combine Vague mathematics With theory and method of VE, to synthetic appraise scheme of MDC, to probe into it with experts. MDC in large - scale water project usually relate to four categories, that is economy, technology, resource and environment, and every category subdivide a few specific item.

**1.1 Technology**

Technology condition is the first considered factor at MDC. Technology condition can be divided into productive technique, constructive technique, concrete Curing technique and managerial technique etc. once the scheme of MDC is determined, concrets of different function and quality will be produced under different technology. So it will exer agreeat influence to overall quality of project, cost of project, time limit for project and the length of project motion maintenance cost of engineering ect. So when make the MDC, must to study the scheme of MDC suit which technology condition.

**1.2 Resource**

We know that concrete is the mostly used material in large - scale water project. Concrete is made of stone, sand, cement, raw material, radue water agent, concrete curing agent, active mix materials, etc. It is a compound material. Befor scheme of MDC is difined, must to investigate resources condition of the materials of concrete. We ought to study from two aspect during resources investigation. first to investigate it in amount of material of conerete, this is the key to guarantee construction under normal conditions. Second to investigate the quality or function llevel of material of concrete, it efect directly the skeme of MDC.

**1.3 Environment**

Traditional MDC is made a target for strengh. It is often neglected, environment factor affect concrete function, during to MDC. Under harsh condition, it is in motion, reinforced concrete structure have builded or is building, along with development of science and technology and improvement of society productive forces. Since recently years, decause grin environment have effected the function of reinforced concrete structure, the symptoms begin early burst out. Result every year some countries consume many hundreds million to service it. this moment, experts

begin perception the importance, of grin environment effect.

**1.4 Economy**

**1.4.1** The one of principles MDC is problem of economy. Scheme of MDC will exer a great influence to overall quality of project, cost of porject, time limit for project and during project is in motioning mainte nanc cost of project ect. Therefore to reduce cost of project, shorten time for project, heighten quality of concrete and keep for a long time stabilize function, for cut down the cost during project is in motioning maintenanc cost of project, this is must to consider in MDC.

**1.4.2** Generally speaking, it is huge investments in bulding of water project. It has direct effect to bring about a great advance in the area economy. Because of different area economy develop imbalance, along with different area material price level is changeing. So at MDC to consider make full use of the oportune time, during bulding of water project, to accelerate economic deveeopment.

**SSTA and Model of Structure**

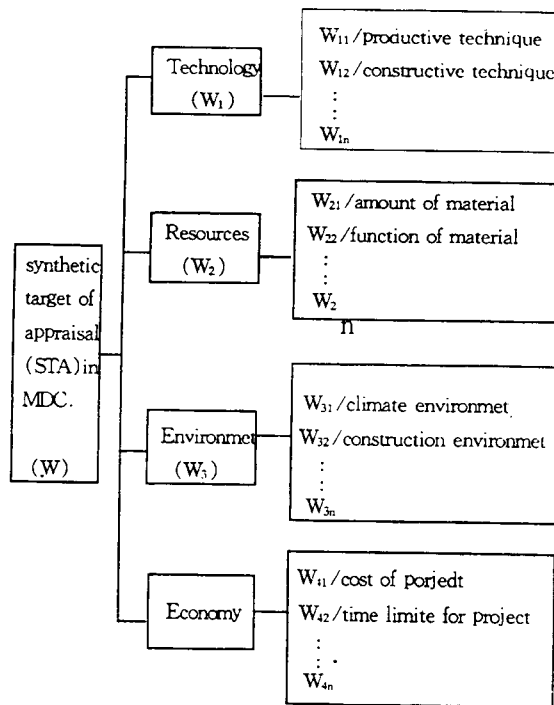


Fig · 1

**2. Model of VA and Evaluation on Scheme of MDC.**

**2.1 ISTA**

**2.1.1 Synthetic target of appraisal (STA) set.**

$$W = \begin{pmatrix} \text{technology} & W_1 = (W_{11}, W_{12}, \dots, W_{1n}) \\ \text{resources} & W_2 = (W_{21}, W_{22}, \dots, W_{2n}) \\ \text{environment} & W_3 = (W_{31}, W_{32}, \dots, W_{3n}) \\ \text{economy} & W_4 = (W_{41}, W_{42}, \dots, W_{4n}) \end{pmatrix} \quad (1)$$

**2.1.2 Weight set on No. 1 grad STA**

$$A = (a1/\text{technology}, a2/\text{resources}, a3/\text{enviroment}, a4/\text{economy}) \quad (2)$$

**2.1.3 Apply VE' function appraise method in the from of give a mark to judge obscurely each item mark on NO. 2 grade of STA.**

**obscurely mark set on NO. 2 grade of STA.**

$$A_2 = \begin{pmatrix} a_{11}, a_{12}, \dots, a_{1n} \\ a_{21}, a_{22}, \dots, a_{2n} \\ a_{31}, a_{32}, \dots, a_{3n} \\ a_{41}, a_{42}, \dots, a_{4n} \end{pmatrix} \quad (3)$$

in which  $a_n$  is obscurely mark of  $W_n$ , ect.

**2.1.4 Index set of STA**

$$P = \begin{pmatrix} p_{11}, p_{12}, \dots, p_{1n} \\ p_{21}, p_{22}, \dots, p_{2n} \\ p_{31}, p_{32}, \dots, p_{3n} \\ p_{41}, p_{42}, \dots, p_{4n} \end{pmatrix} \quad (4)$$

$$\text{in wich } p_{ij} = \frac{a_i \cdot a_{ij}}{\sum_{j=1}^n a_{ij}}$$

$$(i = 1, 2, 3, 4, \quad j = 1, 2, \dots, n)$$

**2.2 Appraisal coefficient of schemes in MDC**

**2.2.1 Schemes set in MDC**

$$U = (u_1, u_2, \dots, u_k) \quad (5)$$

in which  $u_k$  - No. k scheme  $k = 1, 2, \dots, m$ ,

Syppost there are No. m schemes of MDC and No. n TSA in the system. As if to express every apraisaly target there correspond every scheme as obscurely terget characteristic numerical value (CNV)  $X_{gk}$ . Result there are  $n \times m$  rank matrix for obscurely target (CNV) in the system.

**Obscurely target CNV matrix**

$$X_{n \cdot m} = \begin{pmatrix} X_{11}, X_{12}, \dots, X_{1m} \\ X_{21}, X_{22}, \dots, X_{2m} \\ \vdots \\ X_{n1}, X_{n2}, \dots, X_{nm} \end{pmatrix} \quad (6)$$

$$X_{n \cdot m} = X_{gk}, \quad g = 1, 2, \dots, n, \quad k = 1, 2, \dots, m.$$

**2.2.2 Appraisal coefficient set of schemes in MDC.**

$$B = (b_1, b_2, \dots, b_m) \quad (7)$$

$$b_k = \sum_{i=1}^4 \sum_{j=1}^n \sum_{g=1}^m p_{ij} \cdot X_{gk}$$

$$k = 1, 2, \dots, m,$$

**2.3 Cost of one cubic metre (COCM)**

$$C = (c_1, c_2, \dots, c_m) \quad (8)$$

$C_k$  - No. k scheme COCM.  
coefficient set of COCM.

$$H = (h_1, h_2, \dots, h_m) \quad (9)$$

$$\text{in which } h_k = \frac{C_k}{\sum_{k=1}^m C_k}$$

**2.3 VA coefficient set**

$$V = (v_1, v_2, \dots, v_m) \quad (10)$$

$$\text{in which } v_k = \frac{h_k}{h_k} \quad (k = 1, 2, \dots, m)$$

$v_k$  - No. k scheme' VA coefficient

**3 Example**

Take Xiatange water project as example. the warter project is concrete face rockfill dam (CFRD), the project is made of CFRD, diversion tunnel, flood - discharge tunnel, drain off sand tunnel and spillway. The dam top length 254m. the dam height 94m. Whole cost of project is 1.8 handred million.

The area is typical continental climate. Winter continued 4 - 5 months, the lowest air temperature arrive at  $-55^\circ\text{C}$ . summer and autumn is opportune season of construction.

The arid climate and burning hot in summer and autumn, the highest temperature arrive at  $45^\circ\text{C}$ , the difference in temperature more, than  $25^\circ\text{C}$  in day night.

The area economy level low. There is only a small cement works, about 100km distance from the

project. There is a small cement works in near area, about 250km between two areas. Other some big - sized cement factories are more than 500km from the project. Besides stone and sand in the area, other raw material, radue water agent, concrete curing agent, active mix materias, cement etc, were need transport- ed from more than hundreds km.

**3.2 SSTA and Model of Structure**

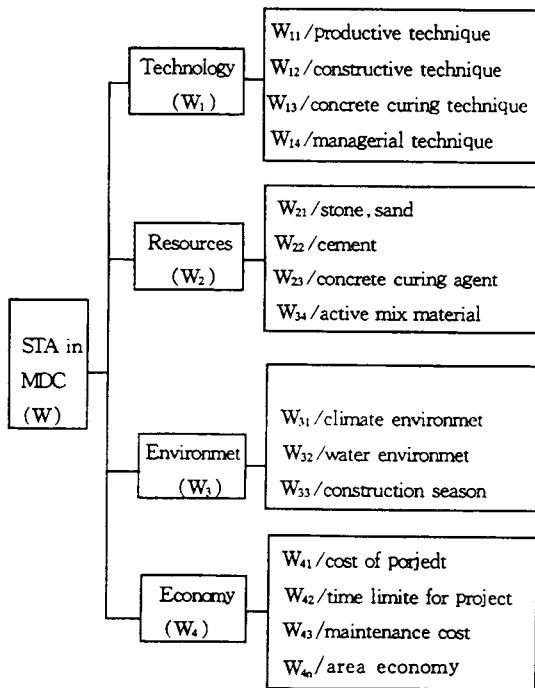


Fig. 2

**3.3 VA in scheme of MDC.**

**3.3.1 From Fig. 2 STA set**

$$W = \begin{pmatrix} \text{technology} & W_1 = (W_{11}, W_{12}, W_{13}, W_{14}) \\ \text{resources} & W_2 = (W_{21}, W_{22}, W_{23}, W_{24}) \\ \text{environment} & W_3 = (W_{31}, W_{32}, W_{33}, W_{34}) \\ \text{economy} & W_4 = (W_{41}, W_{42}, W_{43}, W_{44}) \end{pmatrix} \quad (11)$$

**3.3.2 From Ep. (2) weight set on No. 1 grad**

STA

$$A_1 = (a_1/\text{technologt}, a_2/\text{resources}, a_3/\text{environment}, a_4/\text{economy})$$

$$= (0.27/, 0.25/, 0.2/, 0.28) \quad (12)$$

**3.3.3 From Eq. (3) obscurely mark set on No. 2 grade of STA.**

$$A_2 = \begin{pmatrix} 3.5 & 2.2 & 1.5 & 2.8 \\ 2 & 4.5 & 1.2 & 2.8 \\ 3.5 & 2 & 4.5 & 0 \\ 2.3 & 2 & 3.5 & 2.2 \end{pmatrix} \quad (13)$$

**3.3.4 From Eq. (4) Index set of STA**

$$P = \begin{pmatrix} 0.945 & 0.549 & 0.405 & 0.756 \\ 0.500 & 1.125 & 0.300 & 0.700 \\ 0.700 & 0.400 & 0.900 & 0 \\ 0.644 & 0.560 & 0.980 & 0.616 \end{pmatrix} \quad (14)$$

**3.3.5 From Eq. (5) Scheme ste of MDC**

$$U = (u_1, u_2, u_3, u_4, u_5, u_6) \quad (15)$$

**3.3.6 From Eq. (6) (7) Appraisal coefficient set of schemes in MDC.**

$$B = (b_1, b_2, b_3, b_4, b_5, b_6) \\ = (2.3368, 1.4280, 1.8230, 1.9180, 1.8030, 0.7130) \quad (16)$$

**3.3.7 From Eq. (8)(9)(10) VA coefficient**

$$V_i = \frac{b_i}{c_i} \\ V = (v_1, v_2, v_3, v_4, v_5, v_6) \\ = (1.232, 0.827, 1.048, 1.380, 1.093, 0.410)$$

According to VA' appraise principle, recommend to adopt No.1 scheme( $v_1 = 1.232$ ) and No.4 scheme( $v_2 = 1.380$ ). In practice apply, So intex number will be very much and obscurely target CNV work quality of compute will be very much. Therefore have the aid of computer work into apprais indes and compute CNV.