QFD Design of Machine-made Sand Based on Independent/Decomposition Axiom

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Abstract

Quality Function Deployment (QFD) and Axiomatic Design (Axiomatic Design, referred to as AD) as two kinds to meet customer needs and the exact needs of customers into the design of the product approach. However, both approaches have their own limitations. Based on the original QFD quality development, the axiomatic design is used to optimize the quality house, to ensure the independence of the parameters, to construct the axiomatic quality house, and to make the quality house more clearly the correlation between the reaction function demand and the design parameters. Based on the parameter correlation of axiomatic design, QFD2000 is used to plan the production of machine-made sand.

Keywords: Axiomatic design; Quality Function Deployment; Machine-made Sand; QFD2000;

1. Introduction

Machine-made sand is different from the natural sand, it is made by making machines and other specific equipments. In recent years, sand and gravel market demand shows an increasing trend year by year. According to the data show that China's aggregate annual production reached 10 billion tons. Because of the influence of environment and national policy, the production of mechanism sand and gravel becomes the key to substitute natural sand in sand and gravel industry, and the improvement of machine-made sand production process becomes the key of high quality mechanism sand.

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2. Customer demands mapping

In order to obtain the customer's demand for machine-made sand, this research mainly takes the market research as the main method, uses the brainstorm method, and utilizes the customer feedback information in the product forum to carry on the full excavation to the demand information.

Through the above work, we can obtain a more comprehensive customer demand for sand. Customers have two main needs for sand sold in the market: First, to meet the characteristics of daily demand for construction; Second, high-quality characteristics of machine-made sand. Changing customers' vague demand to a description of the specific functional requirements. FR1: General function of machine-made sand, FR2: High quality performance of machine-made sand. According to customer needs, and to meet the axiom of independence, one by one mapping, DP1: manufacturing ordinary sand, DP2: manufacturing high-quality machine-made sand. Through the market survey to obtain the corresponding needs of customer demand for the importance of 1-3-5-7-9 evaluation. Definition to FR1: The routine function of the sand is evaluated as 7, FR2: The important evaluation of the high quality performance of the machine-made sand is 9.

When the functional requirements are mapped as design parameters, mapping is performed according to the independent axiom requirement. First use QFD2000 to design quality housing, as shown in Figure 1. Set the left function requirement to FR1: Machine-made sand daily function, FR2: Machine-made sand high quality performance. The upper part of the design parameters set to DP1: making ordinary machine-made sand, DP2: making high-quality machine-made sand. In the correlation matrix, the correlation between the parameters is set by using the strong correlation symbol ●, the weak correlation Δ. This correlation provides a basis for the matrix design of multi-level decomposition.

![Fig. 1. First level axiomatic quality house.](image)

3. Multistage Expansion Based on Decomposition Control

3.1. First and second level axiomatic quality house

According to the establishment of one level axiomatic quality house, write the design matrix:

$$
\begin{bmatrix}
FR_1 \\
FR_2
\end{bmatrix} =
\begin{bmatrix}
0 \\
0
\end{bmatrix}
\times
\begin{bmatrix}
DP_1 \\
DP_2
\end{bmatrix}
$$

In order to facilitate the research, we continue to weaken the weak correlation, so that the parameters in the theoretical calculation for the non-correlation, the design matrix, which is diagonal matrix, to meet the independent axiom. After satisfying the axiom of independence, it is clear that DP1: Manufacture of ordinary machine-made sand, DP2: Manufacturing of high-quality machine-made sand is incomplete.

According to the "Z" glyph mapping principle, to re-expand the functional requirements. The basic performance of ordinary sand mainly include: strength, viscosity, water retention. High quality gravel contains a workability. The design proceeds from four performance optimizations[11].
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