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# An experimental analysis on structural beam with Taguchi orthogonal array

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## Abstract

Taguchi optimization method is a statistical technique to optimize the selected factors and will improve the quality of compositions. The aim of this paper is to define effective optimization techniques to identify the effective orthogonal array combination using experiments in the beam structure. The Taguchi L9 array has experimented in this study with three different levels and four parameters. After the completion of the experiments, the results are compared with fully factorial methods. The output will be in the form of S/N ratio and graphs. The best-optimized combination is found for minimizing the number of experiments. The size of the beam structure is 1250 mm \* 150 mm \* 150 mm.

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## Introduction

Taguchi and Konishi developed the method called Taguchi optimization method [1]. It was initially developed for agricultural field and goods manufacture and later its application was expanded for all other engineering fields like biomedical, mechanical ..., etc. The key success of this optimization is based on careful selection of parameters on each level. The concrete cube should be properly cast and the compaction should be done properly so that no air bubbles will not be present inside the concrete cube. After the concrete cube is cast, the cube is cured and they are tested for 7 days, 14 days and 28-

day compression test [4]. This test is done in a compression machine. The outcome of an investigation study used out to optimize the concrete mixing size by the Taguchi method. The compression values that are conventional concrete and special concrete compression value are compared with the conventional concrete so that we will get a compression graph and S/N value is taken from the compression mean value. The mean value and the S/N values are plotted in the graph so the graphs are compared and we can get a final value.

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## Section snippets

### Cement

Cement is a finely milled mineral powder, usually gray in color [5]. The most important raw materials for the production of cement are limestone, clay, and marl. Mixed with water, cement serves as an adhesive to bind sand, gravel, and hard rock in concrete [6]. The cement hardens both in the air and underwater and remains in its hardened state once reached. Cement is usually available in the form of a homogeneous bulk dry good. Its characteristics are standardized in order to ensure the...

### Methodology

Taguchi technique is an appliance for optimizing the recital quality of a process. The intent of the research is to spot and design the method parameter that optimizes the preferred quality attribute and they are least to noise factors. In the current learning, the objective of the job is to see the special effects of the method parameters on the concert and the best blend of control factors that would increase the compressive force of the concrete which is elected as the quality attributes [7]...

### Importance of Taguchi methods

An advantage of the Taguchi method is that it emphasizes a mean performance characteristic value close to the target value rather than a value within certain specific limits, thus improving the product quality [1]. Additionally, Taguchi's method for experimental design is straightforward and easy to apply to many engineering situations, making it a powerful yet simple tool. It can be used to quickly narrow the scope of a research project or to identify problems in a manufacturing process from...

### Result and discussion

The universal testing machine is used to evaluate the compressive strength of the concrete cubes [3]. The three compression readings are record for every combination as shown in Table 6. These parameters are taken from a designed trial to analyze the mean function.

The Table 1 shown below explain the three levels (level 1, level 2 and level 3) of four factors (W/C ratio, fly ash, M-sand and sisal fibre) which will be shuffled during different levels of combinations.

Generally, there are three...

## Conclusion

This paper illustrates the application of the parameter design (Taguchi method) in the optimization. The following conclusions can be drawn based on the above experimental results of this study

- The optimum combination of the experiments is identified (SNO: 4)...
- The S/N ratio of the individual control factors is calculated to identify the effect of each parameter in the optimization level, please refer Table 6...
- Taguchi process of parameter can be performing with lesser number of experimentations as...

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None....

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper....

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...The philosophy of this method is aimed at the robust design of a process, thus achieving the reduction of response variability around a target value (Taguchi, 1986; Phadke, 1989). The interest in using this method lies in its effectiveness to design complex systems with multiple variables and laborious implementations (see Gunay and Hınıslıođlu, 2011; Yazdani et al., 2013; Hsia, 2013; Sabarish and Pratheeba, 2020; Gisbert et al., 2020). The paper is structured as follows:...

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...With the use of orthogonal arrays in designs of experiment [68–71], Taguchi optimization eliminates uncontrollable noise factors with reduced experimental runs and hence strikes a balance among product quality, engineering quality and production costs. The advantages of Taguchi optimization are improved product design, timely cost-effective product development and enhanced customer satisfaction [70,71]. Since its adoption by Boeing, Ford, Toyota and Xerox in the 1980s, it has found several industrial/construction applications in optimization of sandwich structures, concrete and pavement designs [68,69,71–73]...

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