RESEARCH ARTICLE

Optimum Performance-Based Design of Concrete Structure

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Abstract

The material based concrete structure designs are required to construct under different design characteristics. These design characteristics are analyzed to estimate the duration, cost and performance of concrete design. The design characteristics are also analyzed under different vectors such as environmental consideration, material based consideration and the design service consideration. The main consideration vectors defined in this paper are safety, durability and the life of concrete design. The influence of different environmental and component based vectors is discussed under the performance and life estimation of design structures.

Keywords – Structure Design, Durability, Safety, Restorability, Design Consideration

I. Introduction

The optimization of structural design is required to achieve the cost effectiveness. Lot of development is done under different structural optimization methodologies. These designs are presented by different researchers by performing the changes under different design vectors such as materialistic change, load change etc. There are number of traditional approaches defined under mathematical modeling to obtain the optimization solution. These optimization methodologies are defined under different constraints and conditions so that the seismic excitation along with non-linear structures will be obtained. The improvement to these traditional approaches is also done under different direction to improve the seismic

design as well as to improve the response towards the structure. The response structure analysis is also performed under different related events as well as the damage control mechanism so that the elasticity over the structural system will be obtained. These systems were designed under the analysis of uncertain behavior environment. There were different analytical models are presented under the non linear system with different variation over the structural designs. These performance based designs includes the rotational changes in beam column of frames. These beam columns were constructed using plastic material. The optimality criteria is defined in terms of elasticity drift over the response structure. Researcher defined the non-linear analysis under higher mode effect so that the reliable optimization over the system will be obtained[1][2][3].

Some of work is also defined for RC frame under the improvement based on design variables. In such structural design, the push over approach under the reliability optimization and robustness is defined. The work is defined under the cost and the performance optimization along with defining the beam and column sectioning. The work is also defined under the optimization in case of damage control and damage distribution. These kind of design includes the low to high frame formation under different excitation levels. Different scenarios and the components are considered to perform the modeling[4][5]
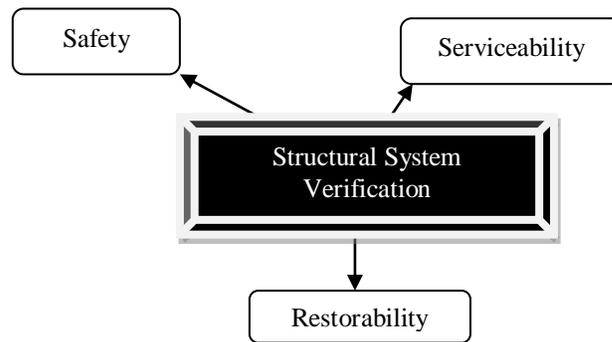
Figure 1 : Different Factors for Structural System Verification

Another component of structural design and performance analysis is the verification vector. The verification of such designs is performed under different performance requirement and under different vectors. Some of these vectors include the safety, serviceability and restorability. These verification vectors are shown in figure 1. These vectors are considered to identify the robustness of the designs under earthquake actions so that performance verification will be achieved. Different mechanical performance vectors under concrete structural definition and environmental conditions is defined and investigated so that the accurate prediction of the system will be done under the service effectiveness estimation and the future maintenance achievement. These methods also defined under constraint limit specification so that the limit state under the serviceability will be obtained and analyzed[6][7].
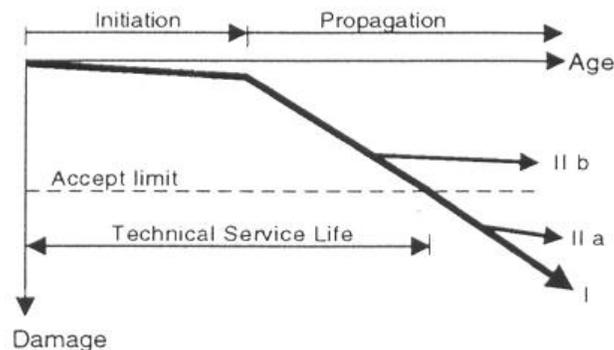
Figure 2 : Service Life of Concrete Structure

The main aim of structure design is to improve the probability vector for acceptability of the life of the structural design. The reliable concrete structure is designed under the durability and the service life analysis. The load and capacity based analysis is performed for the structure design. The function based checks are performed under the normal and heavy load conditions to identify the durability and the service life time of concrete design. It is one of the fundamental properties that

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is required to estimate during each phase of the design. It is also analyzed during the requirement phase to estimate the target time under week serviceability of a structure. Here figure 2 is showing the service life of concrete structure[8].

As we can see in the figure, the life and performance of concrete structure depends on two main components called mechanical and the structural performance components. These components are serviceability and aesthetics. The life of the concrete structure is estimated over two different phases of deterioration. These phases are initial phase and the propagation phase. During the initial phase, the standard estimation is performed without considering any weak property. During the propagation phase, the potential damages and acceleration periods are also considered. During this period effective estimation of life, cost and performance of structure design can be done under different vectors[9][10].

In this paper, a study of the existing prediction and classification approaches is defined along with a fuzzy based model representation. In this section, a study to the prediction system is defined along with relative prediction based approach. In section II, the work done by earlier author in this area is discussed. In section III, a fuzzy based model is represented to perform the prediction for the autistic patients. In section IV, the conclusion relative to the predictive analysis is defined.

II. DESIGN CONSIDERATIONS

Main aim of the concrete structure design is to achieve the serviceability or the durability. To achieve this, the quality of the material and component elements used in the design structure having the effective importance. These all materials are defined with their property and quality factors. Some of these quality vectors include the elasticity, thermal support, durability, water tightness etc. These all characteristics are analyzed and tested under different constraints and conditions so that the variation analysis over the values will be performed. The design strength of this material is also analyzed under the material strength and material factor. Based on these two characteristics, the independent material vector value is obtained[11]. The design consideration vectors are shown in table 1

Table 1 : Factors for Concrete Design

Factor	Symbol
Design Strength of Material	Fd
Material Factor	γd
Characteristic Value of Material	fk
Material Modification Factor	ρm

While designing the concrete structure, different kind of concrete material can be used. These all materials are different according to the type, quality and the characteristics. Each kind of material is analyzed and tested under different consideration. These consideration vectors include the construction life, design like, robustness, environmental effectiveness, safety vector etc. The mechanical characteristics of these concrete materials includes the prestressing steel, reinforcing bars and the rolled sections of the concrete structures. Based on these all vectors, the concrete performance verification and the quality vectors are defined and analyzed. These all vectors are described under different material based characteristics and the material based properties. The mechanical strength and deformation characteristics under the physical properties are described. These characteristics are defined under different load factors such as normal load and heavy load factors. These load factors are described under tension, compression and bond analysis. These all vectors are defined under time effective quantities and the elasticity vectors so that the quality analysis under different coefficient vectors are described[12].

Another time resistance vector for concrete design is durability vector. Durability depends on the material properties, external variables as well as environmental vectors. These vectors include the weather based analysis, chemical effect analysis and the resistance analysis. The impact of these vectors includes the performance analysis. This analysis is described as the verification vector based on which the resistance analysis is carried out. While designing the concrete structure, the important vector is the safety analysis. This analysis is performed under some constraints and assumptions. This verification is defined as propagation and occurrence vectors so that the relational analysis will be performed. This analysis is also under the elasticity analysis and the crack analysis under different zones. To analyze the crack based

analysis, the stress and energy based vectors are modified over the concrete material. The analysis is also done under the fracture energy analysis under the defined area. The analysis vector includes the crack type analysis and the crack width analysis. The property based analysis is performed under size effect so that material area propagation will be estimated and the material strength will be obtained[13].

III. LIFE AND DURABILITY ANALYSIS OVER STRUCTURAL DESIGN

In this section, concrete structure design is been analyzed under the life and durability factors. The structure design performance is analyzed under different vectors such as mechanical vector, financial factor, reliability etc. To perform this analysis, the duration based analysis is performed. The stress analysis along with carbonation of concrete is analyzed. The material analysis is also performed under type of material under durability. This analysis of analysis is performed short term and long term design considerations. The service life of concrete design is analyzed under two main aspects called performance based analysis and deem to satisfy rule analysis. Deem-to-satisfy rule is basically defined for the conrete definition and composition so that the service life of the concrete design is specified and estimated. This kind of performance design is defined under performance vector with durability specification. The service life is defined under the limit states so that the load based resistance will be analyzed[7][8]. The load vectors is specified to analyze the strength of the design. These all vectors are collectively shown in figure 3.
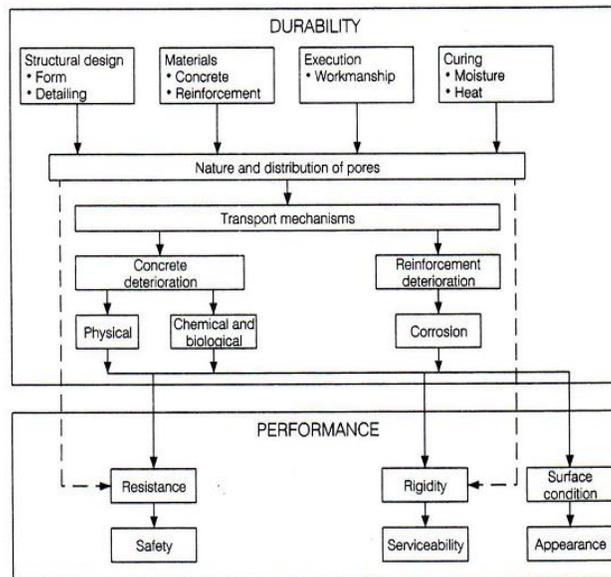

Figure 3 : Factors for Life and Durability Analysis

The design consideration of structure design includes the environmental impact analysis under the structure ability analysis. The vectors considered during this study and analysis includes its impose analysis for environmental vectors. Based on these all factors structure design durability is analyzed. This design analysis also depends on the mixture proportioning, construction approach, maintenance approach analysis, production and placement methodology analysis. This also includes the involvement of concrete degradation with the inclusion of water or some other fluid. The stress vectors are also analyzed. Uncertain situation based prediction analysis is also performed under environmental and chemical combination analysis. These vectors are also analyzed over the surrounding elements so that the durability over the design system will be obtained[10][11]. The elements of design and execution of the concrete structure is shown in figure 3.

Another vector durability theory design is the safety or the reliability vector. The reliability is analyzed under the failure estimation over the system so that the probabilistic decision can be drawn from the procedure. Some of key factors considered during this procedural construction is shown here under

- Property based consideration respective to design actions.
- Material selection choice for initial cost definition.
- Design procedure and maintenance procedure specification
- Consideration of stress components.

- Consideration of environmental vectors.
- Consideration of water, heat situations

Another theory behind the effective design consideration under effective durable design consideration is the deterministic estimation and design. This design estimation is based on different characteristic definition under the environmental and parametric elements so that the age of the structure design will be performed. The design modeling is performed under the service life specification and reliability estimation[12][13]. The effective consideration taken here are

- Service Life Estimation
- Specification of Target Life
- Environmental Effect Analysis
- Durability estimation
- Parametric model specification under mathematical model
- Mechanical Design Consideration

Based on these vector classes, the life and durability of the concrete design structure is defined and analyzed. Different consideration under different kind of vectors is analyzed so that probabilistic estimation of structure design will be performed.

IV. CONCLUSION

In this paper, the performance and cost estimation approaches for concrete structure design are defined. The design consideration is here analyzed under three main vectors called safety, durability and Restorability. The influence of different environmental, material based and external vectors are explored.

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