Structural Sustainability, Quality Control, Durability and Robustness of Underground Metro Structures

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Summary

Underground Metro Rail forms an integral and essential part of infrastructure in any rapidly developing country. Sustainability of these structures depends on durability of the components, which, in turn, is related to factors like quality of the design considered, material used, construction procedure etc. Different chemical agents react with concrete and impair their durability. With the exception of design, these requirements for durability are difficult to characterize with certainty because most of these depend on human factors and environmental uncertainties. Robustness is another important factor contributing to sustainability. It enables the structure to survive unforeseen or unusual events without excessive damage or loss of function. This paper represents various criteria which are essentially being followed during design, construction and maintenance phases to attain the durability, quality and robustness of an underground metro structure.

Keywords: Underground, Structure, Sustainability

1. Introduction

A durable structure, as defined in the Euro Codes[1],shall meet the requirements of serviceability, strength and stability throughout its design working life, without significant loss of utility or excessive unforeseen maintenance. Similarly, robustness can be explained as an inherent property of systems that enables them to survive unforeseen or unusual events without excessive damage or loss of function[2]. A structure may still be made serviceable beyond the design life with a reasonable amount of retrofitting measure. It does not, however, mean that the structure will no longer serve its purpose after that particular time frame. It is evident that both durability and robustness assume paramount importance in enhancing the design life of major structures. Now, both durability and robustness are qualitative terms which cannot be quantified easily. However, they can be ensured by adapting a series of quality control measures in design, planning, construction and maintenance of the structure. These factors have been discussed in detail in the following sections of the article.The topic assumes greater relevance in underground metro structures, where a longer design life is essential considering the public benefits of the project and the high financial investments required in building such a facility. The significance of an underground metro structure as a safe, affordable, quick, comfortable, reliable and sustainable access for growing number of city dwellers is of common knowledge. As such, all underground metro structures being built across the globe are targeted to have 120 years of design life with a very minimum maintenance.

There are typical challenges in ensuring durability and robustness of an underground structure. Unlike an elevated facility, most parts of the underground structures are exposed to several uncertainties, viz. ground conditions, quality of construction etc. Physical inspection and identification of defects is only possible after most of the structure is built and the earth within the station box is excavated.

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