

# Construction Defects and Durability of Concrete Structures

Dr. Taketo Uomoto

Professor Emeritus, the University of Tokyo  
Chief Executive, Public Works Research Institute

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When I was a student, I learned that if concrete with proper materials and proportions is sufficiently mixed and correctly casted, concrete structures can be used semi-permanently. Therefore, I learned that it is important to select the materials, design the mix, and carry out correct transport, compaction, and curing. In fact there were many old concrete structures without any problem even after several tens of years. However, there were many cases where construction defects were found in actual concrete structures, such as cold joints, honeycombs, etc.

Later at university, I carried out various researches on methods of producing and casting good quality concrete, but I often think that it is important to study more on the problem of "how to deal with cases where the incorrect method was adopted, etc." I became aware of this, soon after becoming a chairperson of the Concrete Committee of JSCE with the occurrence of the spalling accident of concrete block from the lining concrete in June 1999 in the (shinkansen) Fukuoka Tunnel. The spalled concrete block fell on the shinkansen roof, but fortunately no major damage was caused, such as overturning of the train, etc.

Various studies were carried out to investigate the cause of this accident. Examining photographs after spraying with phenolphthalein, etc., it was found that most of the spalled concrete had been carbonated, and that, until immediately before it fell, it was attached to the wall surface over a very small area. It was considered that most of the cracking and spalling occurred prior to the accident, and it fell off when it was no longer able to withstand the stresses generated in the concrete due to the shinkansen vibrations or the reduction in air pressure caused by the train, etc. Cold joints had occurred at the top surface of these carbonated locations, and the surface was completely carbonated. In other words, the cold joint had allowed air, carbon dioxide or oxygen to penetrate inside the concrete. As a result, the cement hydration on the surface layer stopped, thereby causing a problem of durability.

Cold joints are one type of construction defect produced when time elapsed by some reasons after casting one layer of concrete, and then the top layer of concrete is cast without taking into consideration the time that has passed. As a result, the cold joint becomes a portion not only can it not transfer force, but also it forms a pathway for air or liquid. Therefore if this situation occurs, there is a possibility that the transmission of force will be obstructed, and taking durability into consideration, it is necessary to repair the cold joint immediately with resin or similar material, to produce a sealed structure through which air and liquid do not penetrate.

From the above it is clear that construction defects that are frequently seen in Japan hold major problems for the future. It is important to promptly take measures against these problems. Considering the future, in order to enable the concrete structures of important social infrastructure to be used for a long period of time, concrete engineers must ensure not only that construction defects do not occur, but also when incorrect construction does occur, it is important to investigate how to deal with this problem immediately by repair or strengthening, etc.

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