

Chapter 9 Environmental Actions

[Public Notice] (Environmental Actions)

Article 19

The effects of environmental actions shall be assessed with appropriate methods in consideration of the conditions to which the facilities are subjected such as the design service life, the material characteristics, the environmental conditions, the maintenance methods.

[Interpretation]

7. Setting of Environmental Conditions

(8) **Other Matters** (Article 6 of the Ministerial Ordinance and the interpretation related to Article 19 and 20 of the Public Notice)

① Environmental actions

When evaluating the effects of environmental actions, it is necessary to appropriately consider factors that cause the deterioration or change of properties of materials in structures by taking into account the design working life of the facility concerned, the material characteristics, the environmental conditions, the maintenance methods, and other conditions to which the facility is subjected. Considering that there are cases wherein multiple factors act together, it is also necessary to simultaneously consider multiple environmental actions depending on the circumstances.

If there is a possibility that environmental actions may cause the deterioration or a change in the properties of materials in a structure and make it difficult for the structure to achieve the required performance during its design working life, it is necessary to appropriately consider the effects of the environmental actions according to the circumstances. (Refer to **Part I, Chapter 2, 4 Maintenance of Facilities Subject to the Technical Standards.**) When evaluating the effects of environmental actions, it is necessary to appropriately consider the material characteristics, installation state of the facility, and other factors.

For the evaluation of environmental actions on steel, refer to **Part II, Chapter 11, 2.4 Corrosion Control of Steel** and **Part III, Chapter 2, 1.3.5 Corrosion Control Design of Steel**. For the evaluation of environmental actions on concrete, refer to **Part II, Chapter 11, 3.2 Concrete Quality and Performance Characteristics** and **Part III, Chapter 2, 1.2 Concrete**. For the evaluation of environmental actions on other materials, refer to **Part II, Chapter 11, 8 Other Materials**.

The main environmental actions include temperatures; moisture; substances that affect the progress of deterioration, such as chloride ions; and ultraviolet rays.

(1) Effects of environmental actions on reinforced concrete

① Overview

Regarding environmental actions on reinforced concrete, it is necessary to consider the factors that affect the change in the properties of concrete and the corrosion of internal steel members. Carbon dioxide and chloride ions affect steel corrosion, low temperatures affect frost damage, and sulfate ions affect chemical deterioration. Furthermore, temperature changes, water supply, and drying affect not only the abovementioned deterioration but also the temperature stress, cracking, shrinkage, alkali-aggregate reaction, and other phenomena of concrete.

② Evaluation of the effects of environmental actions on reinforced concrete

A deterioration phenomenon of concrete may be caused by not only a single factor but also combined factors. Therefore, when evaluating the effects of environmental actions on reinforced concrete, it is necessary to simultaneously consider two or more environmental actions depending on the circumstances.

For concrete port structures located in the ocean, it is common to consider the effects of chloride ions on steel corrosion in terms of the concentration of chloride ions on concrete surfaces (refer to **Part III, Chapter 2, 1.2.4 Examination of Change in Performance Over Time**).

(2) Effects of environmental actions on steel and its corrosion protection methods

① Overview

Regarding environmental actions on steel, it is necessary to consider factors that affect steel corrosion. The main factors include temperatures, flow velocities, waves, and water quality.

Steel corrosion protection methods include the cathodic protection method and coating method. Environmental actions on the cathodic protection method include temperatures, flow velocities, waves, and water quality, and those on the coating method include water quality, temperatures, and ultraviolet rays.

② Evaluation of the effects of environmental actions on steel and its corrosion protection methods

When evaluating the effects of environmental actions on steel, it is generally necessary to divide a steel corrosion environment into the part in the air over the sea, the splash zone, the tidal zone, the part in the seawater, and the part in the sea bottom soil depending on the installation state of the steel.

When evaluating environmental actions on the cathodic protection method, it is common to mainly consider the water quality and flow velocities. When evaluating environmental actions on the coating method, it is necessary to mainly consider the water quality, temperature, and ultraviolet ray intensity.

(3) Others

When evaluating the effects of environmental actions on materials other than concrete and steel, it is advisable to fully consider the special characteristics of facilities located in the ocean or in ports.