

Chapter 4 Load Action and Environmental action

Load action and environmental action shall be considered in accordance with the Standard Specification.

[Commentary]

In verifying the performance of existing structures and structures after retrofitting, consideration must be given to an appropriate combination of the load applied to the structure and the impact of the environment, in accordance with the performance being verified. When the changes in the performance of the structure over time during its service life are evaluated, the history of load action and environmental action on the structure must be considered. In general, permanent loads, accidental loads, variable load action and environmental action should be considered. When the performance of the structure at the time of verification is evaluated, appropriate values from among those for the assumed load action and effect of environment at that point in time should be selected in accordance with the performance to be verified. In these (draft) guidelines, the values are generally combined as shown in **Table C4.1.1** for the performance being verified.

Table C4.1.1 Combination of load action and environmental action

Performance	Actions that must be considered when evaluating changes in performance over time up to verification	Actions that should be considered at the time of verification
Safety	History of permanent load + accidental load + variable load + environmental action	Permanent load + primary variable load + secondary variable load
		Permanent load + accidental load + secondary variable load
		Permanent load + accidental load
		Permanent load + variable load
Serviceability		Permanent load + variable load
Restorability		Permanent load + accidental load + secondary variable load

Permanent loads, variable loads and accidental loads should be considered in accordance with the Standard Specification (Design). Of the accidental loads, seismic action should be considered in accordance with the Standard Specification (Seismic Design). Characteristic values for load and load factors should be determined in accordance with the Standard Specification (Design) (Seismic Design), based on the values shown in **Table C4.1.2**.

Table C4.1.2 Load characteristic values and load factors

Load characteristic values and load coefficients used for safety verification	Load characteristic values and load factors used for study of ultimate limit state
	Load characteristic values and load factors used for study of fatigue limit state
	Load characteristic values and load factors used for seismic performance 2 and 3 verification
Load characteristic values and load coefficients used for serviceability verification	Load characteristic values and load factors used for study of service limit state
Load characteristic values and load coefficients used for restorability verification	Load characteristic values and load factors used for seismic performance 1 and 2 verification

The effect of the environment on a structure includes ambient temperature, humidity, concentration of salts and other substances, the action of wetness and dryness, sunlight, ultraviolet light and so on. Environmental

action is applied continuously to the structure during its service life and is a primary cause of deterioration of, and changes in, the materials in the structure over time.

The environmental action that affects changes in performance over time is not uniform and depends on the type of structure, the site environment and other factors. In contrast to load action, general methods of expressing the size of the impact and fluctuations over time have not yet been established for many types of environmental action. Appropriate models of the history of the environmental action that match the construction method being used to predict changes over time must be created to consider these factors.

Environmental action relating to corrosion of the steel in the structure and freezing damage suffered to the concrete should be considered through reference to the Standard Specification (Design) and the Guidelines for Durability Design of Concrete Structures (draft). The Maintenance Guidelines (draft) cover methods for considering environmental action in accordance with a variety of structure deterioration phenomena.