CHAPTER 5 DETAILED INSPECTION OF EXISTING CONCRETE STRUCTURES

5.1 General

When upgrading using continuous fiber sheets, a detailed inspection of documents, records and the conditions at the site shall be conducted taking account of the mechanical properties of materials and special conditions for construction.

[Commentary]

These recommendations are to be used as reference documents when studying measures for upgrading existing concrete structures, and as specific design and construction recommendations for the use of continuous fiber sheets as the method of upgrading. The inspection and verification of performance of the existing structure and the method of selecting the upgrading techniques are not within the scope of these recommendations. They should be done based on the Recommendations for Retrofit of Concrete Structures and Recommendations for Maintenance of Concrete Structures.

Here, only the detailed inspection items deemed particularly necessary for conducting upgrading design and construction using continuous fiber sheets are described. Although continuous fiber sheets and continuous fiber strands are lightweight, they are easily damaged and are extremely weak with respect to shearing force as compared to high tensile resistance in the fiber direction. Moreover, the quality of construction with resin has a large influence on the performance after upgrading. Accordingly, a detailed inspection of these properties is needed through an inspection of documents and records in advance and an inspection at the site.

5.2 Detailed inspection using documents, records, etc.

(1) For the selection of resin and the Quality Control Plan, the meteorological conditions at the site during construction shall be studied in detail by perusing documents, records, etc.

(2) To ensure that the construction goes smoothly, the geographical conditions at the site shall be studied in detail by perusing documents, topographical maps, etc.

[Commentary]

(1) In general, the viscosity of resins is greatly affected by temperature. The use of a resin with adequate viscosity is crucial for ensuring the ease of the operation and the success of the work. In addition, the hardening time for the resin is dependent on the temperature of the resin. At low temperatures, the hardening time increases dramatically. If this happens, it affects the processes to be performed after hardening of resin. For these reasons, it is necessary to determine the climatic conditions at the site during the period in which the work is planned.

(2) Upgrading using continuous fiber sheets can be performed easily even under cramped conditions. However, a minimum space for work is required. Before drafting specific work plans, it is necessary to determine the restrictions at the site.

5.3 Detailed inspection at the site

At the site, a detailed inspection of the existing concrete structure shall be conducted in terms of the following aspects:

(1) Progress of deterioration after upgrading
(2) Bond with continuous fiber sheets
(3) Conditions for work practice
(4) Necessity for surface protection

[Commentary]

(1) The deterioration progress of the upgraded concrete structure depends on the type and degree of the causes of deterioration. Accordingly, when damaged concrete structures are upgraded, it is necessary to pre-examine the type and degree of external factors causing deterioration. Particularly when concrete damaged by alkali aggregate reaction is upgraded, volumetric expansion may occur after construction. Therefore, the quantity and area of continuous fiber

sheets for upgrading should be determined taking account of the amount of residual expansion.

(2) When upgrading using continuous fiber sheets, bond of the continuous fibers to the existing structure is crucial to obtain the desired effect of upgrading. Necessary measures should be implemented to ensure proper bond by inspecting the surface deterioration and damage of the existing structure.

(3) The completion of construction is greatly affected by irregularities in the surface of the existing structure. The irregularities tend to cause residual bubbles and impair bond and durability. Failure to remove them invites the danger that the required performance after upgrading may not be attained. For this reason, smoothing should be performed as needed and the condition of irregularities on the surface of the existing structure should be examined in advance.

Due to construction errors, existing structures may not necessarily have been completed as specified in the design documents. When using continuous fiber sheets, it is possible that there may be too much or too little material at the site. For this reason, the finished dimensions of the existing structure should be ascertained in advance.

The occurrence of bubbles or whitening while the resin is hardening may adversely influence the effectiveness of upgrading. Therefore, curing should be implemented as needed in such cases. Accordingly, it is necessary to determine the wind, sunshine, temperature changes and other conditions at the site in advance.

(4) When the continuous fibers are damaged by impacts from drifting stones, drifting wood or other sources, it is necessary to study whether surface protection should be implemented. In such cases, the material and thickness of the surface protection should be determined through consideration of the degree of damage from impacts to the existing structure. Accordingly, the potential for damage to the continuous fibers through impacts and the degree of damage to the existing structure from the impacts should be estimated.