HIGHWAYS
DEPARTMENT

PRACTICE NOTES

Control of Mould Growth on Concrete Parapets

Bridges and Structures Division

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1. Background

Mould growth creating a blackening appearance is common for most concrete bridges in Hong Kong. Due to the lack of permeability and surface absorption specification, some engineers adopted a concrete mix of relatively high permeability and water absorption for bridge parapets. There is also no specific effort in design detailing to prevent sustained rainwater flowing down the external parapet faces. All these lead to the staining problem on the concrete parapet surface. A study has been conveyed in April 1999 to investigate the problem and measures to control/eliminate the mould growth on concrete structures. This practice notes is issued to introduce some measures which aim to minimize mould growth on concrete bridge parapets.

2. Problem

The blackening and mould growth on concrete bridge surfaces is widespread in Hong Kong. Depending on the concrete mix and detailing, the mould growth varies to different extent. For some bridges, mould growth has been very serious within a year of completion.

This is aesthetically unacceptable and creates a very poor public image for the Department. This also leads to a continuing maintenance problem for the life of the structure. Although the mould could be removed to some extent with high pressure water jetting, mould will come back within a short period of time and it will be very costly to upkeep the cleanliness of the bridges structures. Measures are therefore required to minimize mould growth for all bridge designs.

3. Measures to be Implemented

With immediate effects, the following measures are to be implemented.

3.1 Detailing

The detailing of the parapet profile should be such that the rainwater will flow rapidly away from external parapet surface. Parapet top shall be cambered to fall towards the inner face of parapet at an angle of not less than 1 in 10. The rainwater may flow down the internal face of parapet, or be properly collected.

3.2 Water/Cement Ratio

The water absorption of concrete will be lower for concrete with smaller water/cement ratio. The water/cement ratio for concrete parapet shall not exceed 0.4.

3.3 Initial Surface Absorption Test

The 10 minutes Initial Surface Absorption Test (ISAT) to BS 1881: Part 208 : 1996 for concrete parapet shall not exceed 0.25 $ml/m^2/s$.

Explanatory Notes

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1. Investigation Study

In April 1999, a consultant was employed by this Department to look into the cause of blackening and mould growth on concrete structures. The factors that apparently causing the mould growth and consequent staining problem are:

- Presence of persistent moisture
- Availability of nutrients
- Reduced alkalinity

1.1 Presence of Moisture

When water comes into contact with dry concrete it is initially absorbed into concrete by capillary suction. The rate of surface absorption depends on the porosity and permeability of concrete at the surface zone. Concrete surfaces with high surface absorption would maintain a damper surface for longer periods which will support mould growth. The water/cement ratio in concrete mix, type of formwork lining and effectiveness of curing have the most significant influence on surface absorption.

1.2 Availability of Nutrients

Mould growth requires nutrients. Mould oils or mould releasing agents with organic components and organic particles in the atmosphere are major source of nutrients. There is yet no effective solution to control mould growth by cutting off nutrient supply.

1.3 Reduction in Alkalinity

Mould growth is affected by alkalinity of concrete. A high alkalinity is less favourable for mould growth. Carbonation of concrete would cause the reduction of alkalinity of concrete and thus favours mould growth. This is one of the reasons why structures with carbonated surface will have more serious mould growth problem.

2. Measures to Minimize Staining Problem in New Construction

There are several measures identified by the consultant to control the mould growth on concrete structures which in brief are to provide a dense concrete and reduce the moisture retention on concrete surface. These measures include:

(i) Water/cement ratio of concrete
(ii) Workmanship in concrete compaction
(iii) Effective curing
(iv) Formwork type
(v) Structures detailing
(vi) Surface coating
(vii) Integral biocides

The above options would be expected to have a positive effect on reducing the potential for mould growth on concrete surfaces. The Engineer is required to take necessary action on points (i) to (iv) for achieving the required concrete surface absorption of 10 minutes Initial Surface Absorption Test (ISAT) value of 0.25ml/m^2/s. In particular, an upper limit of water/cement ratio at 0.4 is imposed. Use of surface coating involves substantial cost and has to be justified on individual cases. At present, there is not much information available on the effectiveness of integral biocide and use of this measure is still being explored.

According to the investigation study in 1999, a surface absorption value of 10 minutes ISAT of 0.25 ml/m^2/s is recommended.