

Re-construction of Catchwater

Introduction

The 93 km of catchwater channels and 9 km of catchwater tunnels on Hong Kong Island, Lantau Island and in Tai Lam Chung have been in service for many decades ranging from 40 to more than 100 years. Many sections of the catchwater channels and tunnels are showing signs of ageing. The deteriorating condition of the catchwater channels and tunnels may lead to leakage (Figure 1). Breaking of the catchwater channels during rainstorms may result in flooding and slope failures.



Figure 1 : Deteriorated condition of existing catchwater channel

Moreover, many slopes formed along both sides of the catchwater channels are not up to current geotechnical standards. Some of these substandard slopes (Figure 2) could pose risk to lives, roads and developments nearby.



Figure 2 : Substandard slope

To ensure the continued stability of the catchwater channels and tunnels, Water Supplies Department (WSD) has commissioned projects to carry out repair and reconstruction works, as appropriate, for the defective sections of the catchwater channels and

tunnels on Hong Kong Island, Lantau Island and in Tai Lam Chung. The projects also upgrade some priority slopes adjoining the catchwater channels in conjunction with the reconstruction and repair of catchwater channels.

The scope of the works of the projects comprises:

- i) the reconstruction / repair of about 24 km of defective sections of catchwater channels and upgrading of 10 priority slopes adjoining the catchwater channels on Hong Kong Island
- ii) the reconstruction / repair of about 3 km of defective sections of catchwater channels and upgrading of 10 priority slopes adjoining the catchwater channels on Lantau Island
- iii) the reconstruction / repair of about 9 km of defective sections of catchwater channels and repair of about 1 km of defective sections of catchwater tunnels, and the upgrading of 16 priority slopes adjoining the catchwater channels in Tai Lam Chung

Reconstruction and Repair Works of Catchwater Channels and Tunnels

The methods that are used for reconstruction / repair of the catchwater channels and tunnels are as follows:

1. Reconstruction

Repair of the catchwater channels is to be carried out wherever practical. For those sections with deteriorated condition beyond repair, reconstruction is to be carried out. These sections are typically those with severe or multiple cracks on structures and significantly dislocated joints between structures of the catchwater channels. The defective section of the catchwater channel is completely demolished and reconstructed with reinforced concrete structure of the same profile of the existing catchwater channel.

2. Concrete Repair

Unsound concrete are removed by water jetting and wire brush or other approved methods. Bonding agent is applied to the freshly exposed substrate for development of a good bond. Proprietary materials are then applied to reinstate to the original surface.

3. Render-based Repair

This method is applied to catchwater channels with weak substrate; for example, catchwater channels constructed of low quality concrete. Unsound materials are removed by water jetting,

wire brush, abrasive blasting or other approved methods. Layers of render-based material including bonding agent, undercoats and final coat are then applied to reinstate to the original surface.

4. Joint Restoration

Dirt, deteriorated seals and loose material are removed from the groove. The groove is then cleaned by water jetting and roughened by wire brush or other approved methods. At joints where poor concrete is found, they will be repaired as detailed above before the application of the joint sealant material.

5. Crack Repair

Cracks are to be fully exposed prior to the repair work. Cracks are thoroughly cleaned and sealed to eliminate the risk of water leakage from the catchwater channels.

6. Waterproofing

Surface of the catchwater channel is treated by applying a layer of low viscosity resin for impregnation of the concrete surface to improve the abrasion resistance and reduce permeability of the concrete. Waterproofing is carried out for catchwater channels in the vicinity of roads and developments.

The general view of the catchwater channel after repair is depicted below (Figure 3).



Figure 3 : Catchwater channel after repair

Upgrading Works for Priority Slopes

The priority cut slopes to be upgraded under the projects are uphill of the catchwater channels. They generally have a gradient ranges from 50 to 65 degree to

horizontal. Most of them are protected by rigid concrete cover and some have experienced local landslides. Geotechnical investigation reveals that the stability of these cut slopes fails to meet the minimum required factor of safety.

The priority fill slopes to be upgraded under the projects are downhill of the catchwater channels. They generally have a gradient ranges from 30 to 40 degree to horizontal and some of them are supported by masonry wall at the slope toe. They are generally covered with heavy vegetation. Geotechnical investigation reveals that the existing filling material was not properly compacted and could cause liquefaction.

The methods of upgrading works for the cut slopes include soil nailing, provision of raking drains and surface drainage channel. These upgrading works, as compared to slope re-profiling, could minimize the volume of spoil for disposal, disturbance to vegetations and felling of trees beyond the crest of the slope.

The methods of upgrading works for the fill slopes include replacement and re-compaction of the existing fill material, thickening of the existing masonry wall, construction of concrete toe wall, soil nailing, provision of raking drains and surface drainage channel. Careful consideration has been given to the extent of replacement and re-compaction zones of existing fill with a view to maximize tree preservation. The stabilizing effect of the tree roots has been considered in the geotechnical design for areas with large number of trees and it results in avoiding felling of large number of trees.

To improve the visual impact and to blend with the natural environment after slope upgrading works, the fill slope surface is to be landscaped by treatment of grass hydroseeding and planting of shrub and tree seedlings. For cut slopes, hydroseeding and mulch matting system with shrub seedling planting are to be provided (Figure 4).



Figure 4 : Upgraded priority slope with landscape



Site Constraints and Specific Mitigation Measures

The catchwater channels and priority slopes are located in remote areas. Some of the catchwater channels, in particular on Hong Kong Island, do not have vehicular access. This site constraint poses great difficulties in the delivery of materials and plant. Special construction method with intensive labour force is adopted to overcome the shortage of plant in these areas. Delivery of materials is achieved by helicopter services and installation of conveying chutes to these remote sites.

Some rare or protected plants and animals are known to exist in the vicinity of the catchwater channels and catchwater tunnels. For examples, bats inhabited inside catchwater tunnels and pitcher plants alongside the catchwater channels are to be protected. Qualified ecologists are engaged to visit the sites regularly throughout the course of the rehabilitation works to ensure minimum disturbance to the surrounding habitats.

Since the works areas are located within the water gathering ground and country parks, special measures in compliance with the conditions and requirements of Agriculture Fisheries and Conservation Department (AFCD) and WSD are implemented.

All works carried out must not impose any potential risk of contaminating the raw water being conveyed to the reservoirs via the catchwater channels and tunnels. Because the rehabilitation works are in close vicinity of the hiking trails, site tidiness and cleanliness are tightly controlled to alleviate nuisance to the hikers. No works are allowed to carry out during Sundays and public holidays.

Contract and Works Programme

Two contracts have been awarded for execution of the catchwater channel and tunnel reconstruction / repair works and slope upgrading works on Kong Hong Island, Lantau Island and in Tai Lam Chung.

One of the contracts, involving rehabilitation works on Hong Kong Island and Lantua Island, commenced in September 2002 for substantial completion by mid 2005. The contract sum is about \$162 million.

The other contract, involving rehabilitation works in Tai Lam Chung, commenced in April 2003 for substantial completion by early 2006. The contract sum is about \$89 million.

