

Kumagai Gumi Co., Ltd. (Hong Kong Branch), March 2003

Title: Environmental construction engineering and management during station interchange works at Mei Foo Sun Chuen Mass Transit Railway Station – Hong Kong

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Brief

Understanding and managing environmental issues in large engineering projects is a challenging task. Works must be studied for impacts likely to be imparted as noise, dust, fumes, water discharges, resource consumption, material reuse and recycling, waste management before mobilising on site. The issues and measures adopted and results achieved for a large civil engineering project in Hong Kong are outlined.

Introduction

Contract 506A, Mei Foo Station Interchange started on 8th December 2000 with a 2.7-year programme and was about 80% complete at the time of issuing this paper. Mei Foo contained strict environmental requirements from the Client (Mass Transit Railway Corporation Limited), statutory law and Kumagai Gumi's own ISO 14001:1996 management system requirements. This paper outlines the measures taken to protect the environment under the following three categories: 1) Engineering and Construction, 2) Environmental Management and 3) Results.

1) Engineering and Construction

Mei Foo Station Interchange works were divided into two main areas: External Works and Internal Station Works.

External Works:

Noise was a primary concern since residential tower blocks surrounded the construction site. Diaphragm wall plant noise was reduced by over 12dB using a steel framed noise barrier and high tech noise absorbing Kyowa fabric sheets from Japan. Excavation and breaking works to the station box were completely covered by a durable noise enclosure constructed from structural steel, pre-cast concrete panels and joints filled with 60 MPa non-shrink grout providing noise reduction of over 27.7dB. Noise was further reduced by planning works sequences to avoid placing items of plant close together that could cause sound power levels to increase. During the demolition of the noise enclosure, hydraulic jacks replaced pneumatic breakers to break grout joints between the pre-cast concrete deck panels and significantly reduce noise and dust.

Mei Foo's new basement works required heavy steel members for lateral support during the excavation stage. Rather than buy new steel, more than 75% or 122.3 tonnes of second hand steel was procured saving natural resources. The programme called for the construction of a temporary emergency vehicular access (EVA) at grade level inside Mount Sterling Mall. Material consumption for the EVA was reduced since careful demolition of the noise enclosure provided a ready supply of reinforced concrete pre-cast panels suitable for constructing the base of the EVA. Control of material and waste leaving the construction site was enabled by using a *Trip-Ticket System* that ensured only valid wastes were sent to Landfill.

Construction water required treatment before transfer to public drainage systems. Diaphragm Wall construction wastewater used a non-toxic chemical flocculant agent #26 in a pre-sediment tank to ensure water was clear before traveling to the final settlement tank. Since the flocculant was non-toxic, sediment could go to public fill instead of a chemical waste plant. All other construction waters were directed to sediment tanks. Discharges were subject to quantity and chemical analysis checks under the government license issued for the project.

Internal Station Works:

Internal noise was reduced by using portable noise barriers while breaking concrete. Electric hand-held breakers replaced pneumatic breakers reducing noise generation from the source. Large sections of reinforced concrete slab thickness ranging from (800mm - 1000mm thick) were removed using a combination of sawing, wire cutting and / or coring techniques instead of using pneumatic concrete breakers resulting in less noise, vibration and dust.

To improve progress, mini breakers were used to demolish the Station Entrance C2 staircase. However, to reduce the effects of diesel exhaust inside the station, extended exhausts with noise absorption chambers were used to control emissions by directing them from the internal staircase area to the outdoors.

Waste reduction was achieved using the following 3 methods.

1. Ordinary Portland Cement (OPC) consumption reduction by using 30% power industry by products Pulverised Fuel Ash (PFA) in the concrete mix.
2. Plywood consumption reduction by monitoring re-use of timber formwork and plywood.
3. Design change to a ramp design by reducing concrete and steel reduction by achieving ramp functionality with using solid elements. By using a void ramp with a non-load bearing fire resistant void former cost savings of about HK\$250,000 were realised.

General:

Some general measures to protect the environment were achieved by:

- Implementation of construction waste segregation to enable maximum reuse and recycling of materials and ensure minimal waste sent to public landfill.
- Purchase 100% recycled paper for use in the site office Fax machine to help stimulate the market for recycled products.
- Promote saving of electricity by switching off lights and equipment when not in use and measuring electricity consumption.

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- Distinguishing between office A3/A4 paper and other types of paper for effective paper reuse and recycling.
- Recycling of printer toner cartridges.
- Licensed chemical waste collectors were employed to collection waste lubricating oils and batteries used in temporary traffic measure.
- Direct labour was hired to keep the construction site clean and tidy at all times.
- Maintaining scenic landscapes by use of decorative hoarding and involving the public in a hoarding poster competition

Some detailed waste reduction statistics were:

- Environmental conservation was demonstrated by reducing wastage
- Steel rebar wastage was kept below 0.7%¹
- Concrete wastage was kept below 1.5%²
- Printer toner cartridge recycling was 100%

2) Environmental management

Kumagai required advance planning and preparation of all environmental licenses, permits, registrations for this project as required by our ISO14001 compliant procedures. This included:

- Weekly noise and dust monitoring at locations agreed with the Government.
- Internal noise monitoring
- Wastewater sampling and testing on effluent discharges (e.g. SS, COD, pH value)
- Monthly site environmental inspections
- Weekly site environmental inspections every Monday.
- Ad-hoc site environmental inspections with photos
- Quarterly internal audits by trained auditors from other projects
- Six monthly client audits by environmental engineers against the Environmental Management Plan and contract specification
- Six monthly third party audits by BSi against internal procedures.
- Environmental induction and awareness training to all site staff and subcontractors' staff
- Tool-box talk training to supervisory staff and subcontractors about work specific environmental issues.
- Arrange special environmental seminars delivered by the Hong Kong Government's Environmental Protection Department
- Sending a senior site representative to attend the monthly meetings of the Mei Foo Sun Chuen residents association meetings to hear first person their concerns and communicate this back to the project team.
- Arrange site walks with the Hong Kong Government's Environmental Protection Department Local Control Officers to view the environmental measures being taken by Kumagai Gumi to promote good communication
- Join the Hong Kong Government Works Bureau's Considerate Contractor Scheme to demonstrate commitment to safety and environmental measures and allow for objective feedback about the site's performance.
- Monthly reporting to the client on all environmental measures and issues.

3) Results

The Mei Foo Station Improvement works project has been a success for both the Client and the Contractor. Now programmed to finish almost 4 months ahead of schedule and on budget, the project can cite the following 4 examples of its environmental success:

1. Zero prosecutions against the Noise Control Ordinance, Water Pollution Control Ordinance, Environmental Impact Assessment Ordinance, and Waste Disposal Ordinance.
2. Received the Hong Kong Government Works Bureau Considerate Contractor Scheme's highest award of '**Excellent**' after one year of quarterly assessments.
3. Received the Hong Kong Government Environmental Protection Department Wastewise Scheme's highest award of the '**Gold Wastewise Logo**'.
4. Received the Client's Environmental Award and a Cheque for HK\$5,000 out of a possible 12 contractors that were working on the MTRCL's LAR Station Improvement projects.

4) Key Words: Environmental Protection Department, noise barrier, noise enclosure, settlement tank, trip-ticket system, waste reduction

¹ Includes rebar used in permanent and temporary works.

² Includes concrete used in permanent and temporary works.