Drainage Services Department Practice Note No. 1/2008

Design Guidelines for Multi-part Covers

Version No. : 1

Date of Issue : 28 January 2008

1. SCOPE

1.1 This Practice Note presents the design considerations that should be taken into account and incorporated wherever practicable, in the design of the chamber openings and procurement of multi-part covers which are subjected to traffic load. It also provides a particular specification for designers to incorporate it into the contract document as far as possible.

2. INTRODUCTION

2.1 Multi-part covers have been used in the territory for about 2 decades. These multi-part covers were installed for large drains, chambers and box culverts to facilitate inspection and maintenance. With the increasing number of multi-part covers installed, it is now appropriate to provide standard design guidelines and particular specifications taking account of the experience gained in respect of their effectiveness and performance of the covers so far installed in the territory.

2.2 In this regard, a R&D team of Land Drainage Division, together with a working group within DSD, conducted a review on types and performance of multi-part covers being used in the territory and investigated the maintenance problems encountered with a view to drawing up the requirements for standard multi-part covers. The team also conducted informal meetings with a consultant and several multi-part covers' suppliers to seek views from these outside parties. The final report of the review "RD 1044 – Standardization of Multi-part Covers" was later endorsed in R&D Steering Committee Meeting.

2.3 The design considerations are now drawn up in this Practice Note. It aims to provide guidelines to project officers or consultants in designing chamber openings and procuring multi-part covers for DSD projects. In the long term, standardization of these covers will facilitate better maintenance arrangements, minimizing duration of road closure and inconvenience to the public. Project officers or consultants shall follow all the design guidelines stipulated in this Practice Note as far as possible. However, if the design guidelines cannot be followed due to some other practical constraints, they may revise the particular specification accordingly and seek agreement from the respective maintenance office.

3. DESIGN CONSIDERATIONS

Standardization of Opening Sizes

3.1 The existing multi-part covers installed in the territory vary from place to place, resulting in substantial numbers of different types and sizes of covers to be maintained. It is considered that excessively large opening sizes for culverts/large chambers serve no particular purpose but make road closure for maintenance difficult. In this regard, there is a need to standardize and limit the opening size options.

3.2 According to the Report on RD1032 "Review of Methods of Cleansing Box Culverts", small-sized loaders or "bobcats" are now commonly used for desilting box culvert.

3.3 In consideration of the sizes of small-sized loader commonly used for desilting, the sizes for culvert/chamber openings should be limited to only two options, i.e. 2m x 3m and 3m x 4m, to avoid unnecessary excessive types of multi-part covers. These opening sizes are also considered sufficient for winching operation which is the most common desilting method currently used.

Location and Orientation of Openings

3.4 Multi-part covers are massive in size and opening of which on carriageway for maintenance work will unavoidably cause impact to the traffic. It is noted that if the cover spans across two traffic lanes, it is unlikely the traffic police can agree on closure of two traffic lanes on busy roads unless the work is under emergency. Therefore, the opening of culverts/chambers must be kept into one traffic lane, i.e. the absolute maximum width of opening should not exceed 3m. In any case, the opening should not be located at road junction so as to avoid serious traffic impact during the inspection and desilting works. Furthermore, the opening close to the signalized junction where braking of vehicles occurs frequently should be avoided to minimize the risk of cover damages.

3.5 The opening shaft should be orientated to match with the direction of the carriageway as far as possible in order to avoid unnecessary additional lane closure and hence traffic disruption. Sufficient front and rear spaces along the lane should be available for stationing of plants like grabs, backhoes or trucks. If possible, some space for temporary storage of desilted materials will be desirable.

3.6 In order to minimize traffic disruption, where space is available, preference should be given to off-road opening as access to culverts/chambers.

Loading Grades of Covers

3.7 This Practice Note sets out the design considerations for multi-part covers located within carriageways. Covers on footpaths are not included here as their designs are often determined by aesthetic consideration and not merely by loading. Also their maintenance problems and damage conditions are less significant as compared with those on carriageways.

3.8 Three loading grades are considered in this review. The Heavy grade (D400) for 400 kN test load is designed for carriageways with normal traffic loads. The Medium grade (C250) for 250 kN test load is for light traffic load and light vehicles like carparks, and on footpaths when occasional traffic is possible.

3.9 If exceptionally heavy traffic or frequent heavy wheel loads on the carriageways is expected such as docks and container terminals, the designer should consider using the Extra Heavy grade (E600) as the test load.

Specification

3.10 A Particular Specification, as shown in **Annex A**, detailing all the particular requirements, such as construction details, tolerance, spare parts, training, and operation manual for the multi-part covers is prepared. It should form the basis for incorporation into contract document appropriately.

4. PROVISION OF SPARE PARTS

4.1 It is noted that multi-part covers are often made to order and the manufacturer may not

have stocks. Immediate replacement of damaged covers may not be possible. The Engineer should request the Contractor for spare parts of the covers and the associated accessories to facilitate future maintenance or replacement.

4.2 The provision of spare parts should be on project basis and applicable for projects in the design stage, i.e. with contracts tendered after issue of this Practice Note. The requirements on spare parts can be relaxed or waived in future when sufficient quantities of spare parts are kept in stock. Also, for very large projects where there are many multi-part covers of same size, the percentage of spare parts can be lowered if the maintenance office considers acceptable.

5. MULTI-PART COVER DATABASE

5.1 Over 900 number of existing multi-part covers installed all over the territory are supplied by different suppliers. Their types, dimensions and designs vary from place to place. A centralized database with sufficient as-built information will be set up for retrieval when the need of maintenance or replacement of the multi-part cover arises.

5.2 The database shall be kept under the DSD portal, that can be easily accessed by all DSD staff. For the sake of easy reference and updating, three separate sets of database would be prepared for three Operations and Maintenance Divisions respectively. The project officer should be responsible for uploading all the required information to the database should there be new multi-part covers installed. The maintenance office should also make endeavour to fill in all required information as shown in **Annex B**.

6. REFERENCE DOCUMENTS

i) British Standard BS EN 124:1994, Gully tops and manhole tops for vehicular and pedestrian areas – Design requirements, type testing, marking, quality control, British Standards Institution, Oct. 1994

ii) R&D Final Report No. RD1044 – Standardization of Multi-part Cover

iii) R&D Final Report No. RD1032 - Review of Methods of Cleansing Box Culverts

iv) General Specification for Civil Engineering Works (2006 Edition)

7. ANNEX

ANNEX A – Particular Specification for Multi-part Cover

ANNEX B – Multi-part Cover Database

(F K LAI)
Deputy Director of Drainage Services

Annex A

Particular Specification for Multi-part Cover

Multi-part covers shall comply with requirements set out below:

General Requirements	(1)	Multiple part, or multi-part, covers shall be of a ribbed plate design. The supporting frames shall incorporate an "I" beam design profile to provide a robust and rigid frame which will withstand the specified test loads, without any concrete infill or backfill. The frames shall be assembled from separate machined sections bolted and sealed at the joints. Where frames are required to support covers across the pits, each frame section shall be permanently fixed to the removable steel beam, which spans the opening of the pit. The ends of the removable beams shall be supported and accurately located by beam housing boxes which shall be an integral part of the frame.
	(2)	All products shall be manufactured and assembled in a facility quality assured to ISO 9001.
	(3)	The individual cover parts shall be of one equal size to give a symmetrical appearance about the center line and simplify the stocking of spare parts. For clear opening sizes 2m x 3m and 3m x 4m, the covers shall be made up from 12 parts and 20 parts of covers respectively.
	(4)	Concrete filling for covers and frames shall be Grade 45/10 or the grade recommended by the manufacturers and approved by the Engineer. Thoroughly tamped to provide good compaction. The concrete surface shall be textured by brushing in accordance with Clause 10.44, 10.57 (1) & (3) and 10.58 of the General Specification for Civil Engineering Works (2006 Edition).
	(5)	All cast units shall be cleanly cast and free from air holes, sand holes, loose rust and any surface defects.
	(6)	The Contractor shall demonstrate the cover can be opened and closed manually.
Seating and seating of covers	(1)	The seating faces of covers and frames shall be machined so that when positioned together metal to metal contact achieved shall be within a 0.25 mm tolerance. Appropriate markings shall be deeply engraved across the outside edges of the covers and the frames to indicate the correct positions of the covers inside the frame, so as to prevent incorrect placement after opening.
	(2)	The design and fabrication of the covers shall ensure permanent non-rocking operation and sealing against the ingress of detritus. The design and fabrication of these matching seating faces shall eliminate the possibility of movement due to traffic.
	(3)	All covers shall be watertight. The interposition of a film of graphite grease between the contacting seating faces of covers and frames will provide a gas and watertight joint under normal

rainwater conditions. Provision may be made for a horizontal seating under cover to cover joints to ensure a watertight seal. The Contractor shall demonstrate to the Engineer's satisfaction that an independently witnessed test has been performed to confirm that the design of the covers and frames is proven to be watertight.

(4) The machined underside seating face of covers shall facilitate a slide-out technique of removal and replacement. The cover parts shall be installed with the "I" beams running along the line of traffic and the direction of sliding out going with the traffic flow.

Structural requirements

(1) All covers shall be capable of withstanding the test load, deflection and maximum deformation criteria specified in BS EN 124, in their as service condition, for the loading specified on the Drawings.

(2) Supporting frames shall incorporate an "I" Beam design profile to provide a robust and rigid frame which will withstand the specified test loads, without any concrete infill or backfill.

(3) Supporting beams in multi-span units shall be easy to remove with appropriate lifting equipment to facilitate access to the total chamber area. The level of the supporting beam shall be finely adjustable during installation, such that the multiple unit can match with the adjacent road surface level. Beam wallboxes shall not project into the chamber opening.

Materials for covers and frames

(1) Covers and frames shall be manufactured from ductile iron to ISO 1083 / BS EN 1563:1997. Steel components shall comply with BS EN 10083 / ISO 630.

Protection coatings

(1) Removable supporting steelwork shall be galvanized to BS EN ISO 1461:1999.

Submissions and Specialist supervision

(1) The installation of covers and frames shall be in accordance with the manufacturer's recommendation.

(2) Full particulars of the proposed covers and frames shall be submitted to the Engineer for approval.

(3) Specialist supervision shall be provided for the installation of the covers and frames. The contractor shall submit for the Engineer's approval the name of the specialist supervisor he proposes to use for the installation together with details of his previous experience.

(4) The Contractor shall submit structural design calculation checked and certified by the independent checking engineer and materials information for approval by the Engineer.

Keyways and locking screws

(1) Covers shall be fitted with keyways to facilitate removal using the recommended lifting key(s). The lifting key(s) shall be of a type that locks into the keyways and shall incorporate a jacking device that will break the inherent seal between the cover and frame.

(2) For covers with locking screws, each cover shall be secured by vandal-proof stainless steel locking screws located in each of the corner keyways. Plastic plugs shall be provided for keyways/bolt

holes to prevent ingress of debris.

Spare Parts

(1) The Contractor shall provide spare part of the cover parts and the associated accessories including lifting keys, shifting spanner, water pipes and tins of grease. The number of spare cover parts shall be 10% of the total number of parts installed under the project or determined by the Engineer.

(2) The Contractor shall also provide three sets of lifting keys, or the number as instructed by the Engineer, to the maintenance authority of the multi-part covers.

Training

(1) The Contractor shall provide sufficient copies of operation manual of the multi-part covers as directed by the Engineer and provide training sessions to all technical staff/ labourers either in the project office or the maintenance authority as agreed by the Engineer. The operation manual shall include detailed workshop drawings and information of the cover, and requirements on operation and maintenance of the cover.

Test Loads

(1) The test loads that covers are required to withstand shall be as stated in the Table below

Details of multi-part cover and frame test requirements

Grade (Class)	**Test Requirement (BS EN 124)**	
	Diameter of block (mm)	**Test load (kN)**
Medium (C250)	250	250
Heavy (D400)	250	400
Extra Heavy (E600)	250	600

Annex B

Multi-part Cover Database

The following data are included in the centralized database that have been posted in the DSD portal. For all new multi-part covers to be handed over for maintenance, these information shall be provided by the project office together with the operation manual.

Location

- Region (MS,MN or HK&I)
- Identified locations
- Multi-part cover ID No.
- Corresponding traffic condition (heavy, medium, low)

Dimension

- Number of cover parts per opening
- Overall dimensions of cover
- Size of clear opening
- Dimensions of cover parts

Manufacturing Details

- Brand name and suppliers
- Loading classification (e.g. Class D400 in BS EN124)
- Wheel Load/ Test Load (kN)

Maintenance

- Particular requirement for maintenance, accessibility and associated cost
- Availability of spare parts and storage location
- Inspection frequency
- Last inspection/ maintenance date/ works details
- Suppliers' details (telephone, address, contact persons, etc)