



MINISTRY OF
MANPOWER



Building and Construction Authority

We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

1 March 2012

Sliding Gate
Designers, Manufacturers, Installers and Contractors and
Interested Parties (See Distribution List)

Circular on Safety Considerations in Gate Design and Operation

This circular serves as a guide to all the parties involved in the design, manufacture, installation and operation of residential and industrial gates.

2. Four accidents occurred in 2011 that involved the toppling of sliding gates at entrances to buildings. One worker was killed while four others were injured in the accidents. Details of the accidents are appended in **Appendix 1** for information.

3. Gates are common features in buildings. Gate toppling accidents could have been easily prevented if safety considerations had been made and implemented at the gate design, installation, operation and maintenance stages.

(I) Design Phase

4. All gates should be designed such that their installation, maintenance and operation can be carried out safely. The following should be considered when designing the gate:

- A. Gate structures should be structurally stable and designed in accordance to prevailing structural codes (eg. BS5950, EC3).
- B. Manually operated gates should be designed such that the force, to open or close it, is restricted to 150N for residential property gates and 260N per person for commercial/ industrial property gates.
- C. Guides and stoppers should be adequately designed and sized to ensure that the gate will not over-travel nor will it topple in the event of derailment during operation.
- D. Housings for motors of electrical gates should be standalone elements and not have dual usage as stoppers or guides for the gates. This is to ensure that the gates remain safe for use in the event the motors and housings are removed for maintenance.
- E. The gates (including door leaves, handles and fittings) should be designed such that the risk to the users having their hands crushed, cut or trapped is minimized. This could be

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done through having suitable clearances or through provision of guarding. Examples of these could be found in EN 12604:2000 Annex C.

(II) Construction, Installation and Testing

5. The following should be observed during any gate installation:

- A. Installation of gates should be carried out in accordance to the installation sequence as provided by the gate manufacturer.
- B. In the event that the gate has to be left unsecured, it should be propped to prevent toppling. Warning signs should be erected to warn workers and public not to approach the gate.
- C. Risk assessment on the installation process should be conducted to identify all potential hazards that may arise during the installation of the gate. Risk control measures should then be recommended and implemented.
- D. Testing of the gate to verify the provisions against derailment/ disengagement should be done by the installer before handover to the building owner. The recommended testing procedures (as detailed in *EN 12605:2000 Industrial, commercial and garage doors and gates – Mechanical aspects – Test methods*) are as follows:
 - a. The gate should be pushed against a cube of 400mm length placed in the travel path of the gate.
 - b. The gate should be pushed twice to their terminal position with a force of 300N and speed of 0.3 m/s.
 - c. The failure of a non-rigid suspension element (chain, rope or strap) should be simulated.
 - d. The gate should then be examined to see if they remain on track or on the guiding element and if there was any permanent deformation which would affect their function.

(III) Operation, Repair & Maintenance

6. The following measures should be taken by the owner or occupier when operating and maintaining a gate:

- A. All operation and maintenance should be carried out in accordance to the manufacturer's instruction. Where the gate is designed, fabricated and installed by a sub-contractor, the maintenance should be carried out in accordance to the sub-contractor's instruction.
- B. Risk assessment on gate operation and on the maintenance process should be conducted to identify all potential hazards that may arise during operating or maintaining the gate. Risk control measures should then be recommended and implemented.
- C. Any repair of the gate should be carried out by competent persons unless otherwise as recommended by the manufacturer- or sub-contractor.

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- D. Gates should be checked and maintained periodically according to the manufacturer's or sub-contractor's recommendation. In addition, the track for the gate should be properly upkept to prevent any accumulation of debris which could cause the derailment of the gates.
- E. All employees operating the gate should be briefed to inspect/check the gate and to ensure proper maintenance.

7. Please refer to the informative references in **Appendix 2**. While no submission on gate design/ installation/ construction is required, you are to ensure that the design takes safety of installers and operators into consideration. Should you need further information, please contact:

- MOM at 6438 5122 for information on workplace safety and health.
- BCA at 6325 7159 for issues relating to building plans

Yours faithfully,



KEVIN TEOH
for COMMISSIONER FOR WORKPLACE SAFETY AND HEALTH
MINISTRY OF MANPOWER



TEO ORH HAI
for COMMISSIONER FOR BUILDING CONTROL
BUILDING & CONSTRUCTION AUTHORITY

Encl: *Appendix 1*, Accident Case Studies
Appendix 2, Informative references on safety in gate designs and operation.

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ACCIDENT CASE STUDIES

Case 1 – 15 March 2011

The Deceased, a security officer, was in the process of manually shutting a steel sliding gate leaf when the gate leaf toppled on him, fatally pinning him to the ground. The incident gate leaf was almost 9.7m wide and 2.5m high and weighed about 900kg. The gate was designed to be mechanically operated by remote but the motor which was meant to operate the gate leaf had been removed for maintenance prior to the accident. As a result, the gate had to be manually pushed.

Due to the removal of the motor housing which was also used as a rear stopper, the gate had over travelled. The gate had rollers installed to guide the gate leaf along the rail while outriggers were mounted to prop the travelling gate but both fittings did not serve to prevent the gate from toppling during the accident.

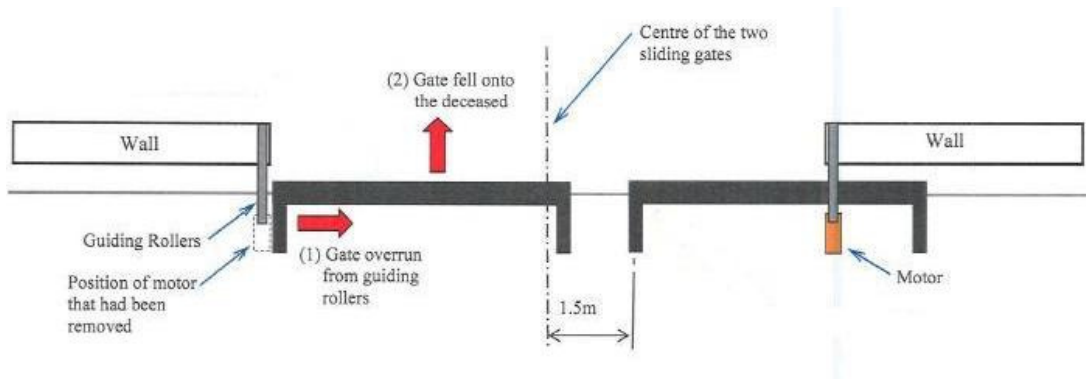
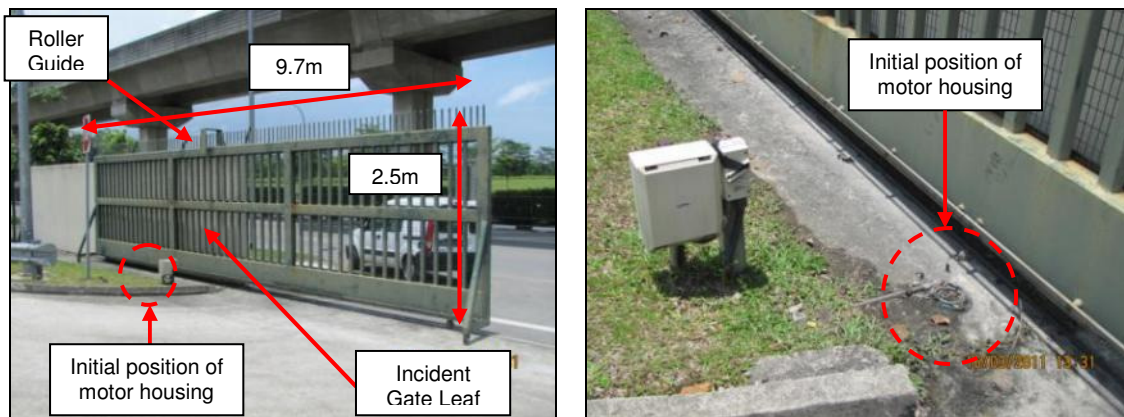


Photo showing the plan view of the incident gate



Photos showing the initial location of the rear stopper (Motor housing)

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Case 2 – 29 April 2011

Two technicians were injured when a wooden sliding gate under installation toppled on them. The technicians were surveying the utilities distribution board of a private residential unit when the accident occurred. In order to access the distribution board, the technicians had moved the gate and it toppled on them.

It was found that there were no informative or warning signs displayed near the gate to caution persons that the gate was still being installed. The gate was also not propped to prevent toppling.



Photo showing the toppled incident gate



Photo showing the toppled incident gate

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Case 3 – 10 June 2011

The manager of a condominium was struck by a toppling gate while trying to dislodge the gate which had derailed and was partially embedded in the ground.

Investigations revealed that poor maintenance of the gate caused debris to accumulate on the track, which in turn caused the gate to derail and its wheels were stuck in the soft ground. In a bid to release the gate, the injured pulled hard on the gate, causing the gate leaf to unhinge and subsequently topple on him.



Photo showing the wheels of the incident gate not resting on the track



Photo showing one the wheels of the incident stuck in soft ground

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Case 4 – 28 October 2011

The Injured, a security officer had manually opened a sliding boundary gate when the gate leaf suddenly derailed and toppled, pinning him to the ground. The incident gate leaf was 8.6m wide and 1.9m high. The gate was operated manually and the gate leaf was mounted on two wheels travelling on a rail constructed from a right angle bracket.

Investigations revealed that the cause of the derailment was due to poor maintenance and a visibly crooked track. The track was littered with concrete debris and litter which contributed to the derailment of the gate.

The gate was installed with guide rollers and stoppers to prevent the toppling and over traveling. However, the track on which the gate leaf travelled was mounted 70 mm above the ground while the guide rollers which guide the traveling gate only overlapped the gate leaf by 25 mm. Hence, it was inadequate to prevent the gate from toppling once it derailed.

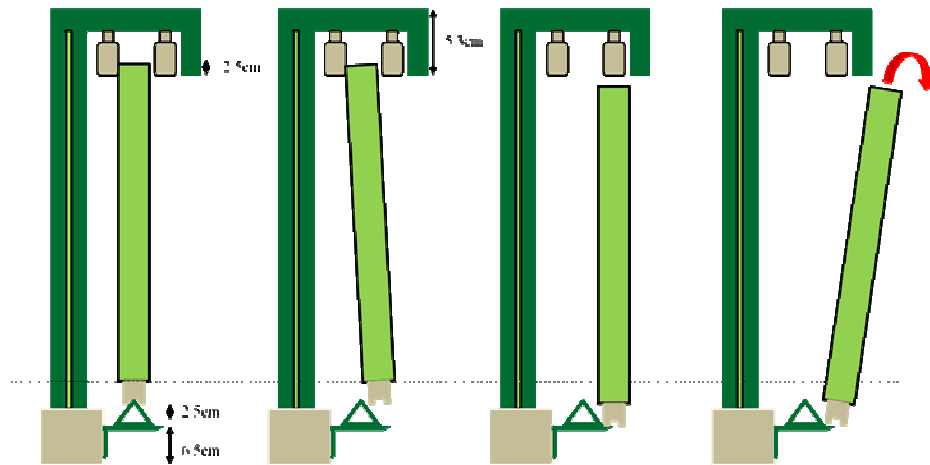


Photo showing the inadequacy of the gate design which failed to prevent the gate toppling



Photos showing the gap between concrete kerb on the track littered with debris and litters

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INFORMATIVE REFERENCES

- A. **BS EN 12445:2001**: Industrial commercial and garage doors and gates. Safety in use of power operated doors. Test methods.
- B. **BS EN 12453:2001** (Industrial, commercial and garage doors and gates – Safety in use of power operated doors – Requirement)
- C. **BS EN 12604: 2000** (Industrial, commercial and garage doors and gates – Mechanical aspects – Requirements)
- D. **BS EN 12605: 2000** (Industrial, commercial and garage doors and gates – Mechanical aspects – Test Methods)
- E. **BS EN 13857:2008** (Safety of machinery – Safety distance to prevent hazard zones being reach by upper and lower limbs)
- F. **BS EN 12635 :2002 + A1: 2008** (Industrial, commercial and garage doors and gates – Installation and Use)

Further information can be found at:

- A. **Workplace Safety & Health Council (WSHC)**

<https://www.wshc.sg/>

- B. **Ministry of Manpower (MOM) – Occupational Safety & Health Division (OSHD)**

<http://www.mom.gov.sg/workplace-safety-health/Pages/default.aspx>

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