

Appendix 9

Cantilevered Canopy and Balcony

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1 Introduction

- 1.1** Cantilevered canopies and balconies could pose a high risk on the safety of the building occupants and the public. The building owners and management agents must pay particular attention in the monitoring, maintenance and repair of such structures.

2 Reasons for the High Risk

- 2.1** Cantilevered structures are supported at one end only. All the loading acting on the cantilevered structures will be transferred to the main building structures through this point. Therefore, when failure occurs at this point, the whole structures will fall down, usually without any signs of warning.
- 2.2** Canopies and balconies can easily be overloaded. The reasons are:
- They can easily be erected with unauthorized building works.
 - They can easily be misused (e.g. for storage purpose).
 - They can easily be altered or affected by improper repairs (e.g. addition of parapet walls, excessive screeding thickness, surface cross fall in the wrong direction, etc.).
 - The drains could easily be blocked resulting in the structures having to resist additional loads due to ponding of water.
- 2.3** Canopies and balconies are susceptible to deterioration or corrosion. The reasons are:
- They are usually exposed to weathering.
 - They can easily be misused or occupied by unauthorized building works, causing wet and humid condition, or blockage of drains.
 - The main steel bars of cantilevered structures are near the top surface of the structure, which is more vulnerable to corrosion.
 - The tension zone of cantilevered structures is in the top. Cracks will be developed in the tension zone. When the cracks are wide enough for water penetrating to the main steel bars, corrosion of the main steel bars will occur.

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2.4 Cantilevered structures are susceptible to faulty construction. The reasons are:

- Construction of cantilevered structures requires an accurate positioning of the main steel bars near the top surface of the structures. Furthermore, their position could easily be affected (e.g. by workers stepping on them) during construction or during pouring of concrete.
- Cantilevered structures are usually cast separately from the main building structures. The construction joint, if not properly treated, could be the source of future problems.
- The main steel bars of cantilevered structures are anchored in the main building structure. If the anchorage is not properly constructed (e.g. anchorage lengths of the steel bars not adequate), failure of the anchorage could occur.

3 Signs of Warning

3.1 Cantilevered structures usually collapse without any signs of warning. Such signs could only be noticed in some particular cases:

- **Downward deflection of the structure.** Usually this could not be observed by naked eyes. It could only be noticed in some particular situations. For example, a canopy or balcony has a railing or parapet that connects to the building structure, and the deflection of the canopy/balcony has opened a gap or caused a separation or cracking between the railing/parapet and the building structure. In such case, an registered building professionals may be able to predict a possible imminent collapse of the canopy/balcony.
- **Rust staining surface.** This is a sign of corrosion of the steel bars. However, in some canopies/balconies, rust staining may not be easily observed even when the steel bars have seriously corroded. This is particularly common in canopies and balconies constructed with small diameter steel bars. Furthermore, in some canopies/balconies, the surfaces may have been concealed or covered up. In such case, the building owners or management agents should at suitable timing remove the covering materials and inspect the surfaces of the canopies/balconies.
- **Cracks in the structures.** Cracks are usually developed before a structure collapses. They are developed in the tension zone of the structure. For cantilevered structures, the tension zone is on the top. In many cases, cracks in such location are difficult to be observed due to access problems or covering up of the surface by waterproofing materials or screeding. Purposely made inspection or investigation is usually required to detect cracks in cantilevered canopies or balconies.

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4 Method of Investigation

- 4.1** Canopies and balconies are difficult to be inspected with naked eyes. Coring of concrete samples from the structures for testing is usually required. The investigation should be carried out by an registered building professionals.
- 4.2** The scope of investigation should include:
- the thickness and strength of the concrete,
 - the thickness of screeding and any other surfacing materials,
 - the size, spacing and position of the steel bars,
 - evidence of any faulty construction,
 - the extent of corrosion and deterioration in concrete and steel bars,
 - the drainage condition,
 - the loading condition, etc.
- 4.3** Based on the results of the investigation, the structural engineer should assess the load carrying capacities of the canopies/balconies, any repair works required, and the remaining service lives of the structures after repair.
- 4.4** Before carrying out the investigation, the structural engineer must decide whether it is necessary to install temporary supports for the canopies or balconies.
- 4.5** Before carrying out the investigation, any unauthorized building works erected on, below or otherwise attached to the canopies or balconies, and any materials placed or stored in the canopies or balconies must be removed.

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5 Maintenance and Repair

- 5.1** Canopies or balconies must be free of any unauthorized structures. Any unauthorized structure, whether above, below, or otherwise attached to the canopies/balconies must be removed immediately.
- 5.2** Any misuse of canopies or balconies, such as storage of materials, must not be allowed.
- 5.3** Any means that could overload the canopies or balconies must be avoided.
- 5.4** The drainage system and waterproofing system of the canopies/balconies must be well maintained to ensure they are properly functioned.
- 5.5** Ponding of water on canopies or balconies must be avoided.
- 5.6** Any means that could aggravate the conditions of the canopies or balconies, leading to a faster rate of corrosion or deterioration of concrete or steel bars must be avoided. Canopies and balconies must always be maintained in a clean and dry condition.
- 5.7** If necessary, the owners should engage an registered building professionals to carry out investigation on the structural condition of the canopies or balconies.
- 5.8** Where strengthening of canopies or balconies is required, prior approval of the strengthening proposal and consent to the commencement and carrying out of the works must be obtained from the Buildings Department.
- 5.9** Where a canopy is no longer required, the owner may seek approval from the Buildings Department for the removal of the canopy.