

Design for Safety (DfS) Library


Examples of Hazards








– Architectural Design





Authors: Steve Yeung, Ng Lee Chian, Jason Oh
Reviewer: Goh Yang Miang
Contributed by: Association of Consulting Engineers Singapore (ACES)
Building & Construction Authority
CBM Pte Ltd
City Developments Limited
International Facilities Management Association (S'pore Chapter)
RSP Architects Planners & Engineers (Pte) Ltd
Workplace Safety and Health Council




Disclaimer




- i. The information presented below is for consideration only, and not an official guide for Design for Safety, as the actual needs may vary between projects.
- ii. Ultimately, the Designers need to assimilate this information with their experience and skill to develop their own approach.
- iii. The authors and Institution of Engineers, Singapore bear no responsibility whatsoever for the design that the Designers undertake.
- iv. Any unauthorised duplication and distribution is an infringement of the intellectual property rights of the authors and Institution of Engineers, Singapore.




S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
1	Roof without maintenance foothold or anchoring points.	Maintenance workers falling through fragile roof surface (e.g., skylight, corroded roof sheets).	<ol style="list-style-type: none"> 1. Design laminated glass that can take human weight. 2. Provide elevated platforms for cleaning operations. 3. Planks and supports to provide footholds. 4. Install anchors that are designed for fall arrest in accordance with SS570 and SS607. 5. Wearing appropriate PPE, e.g. harness.
2	Eye bolts installed on roof, overhead platforms and canopies as anchorage points are spaced too far apart.	Maintenance workers falling over the edge while switching anchorage from one eye bolt to another.	<ol style="list-style-type: none"> 1. Reduce intervals between anchorage points to allow use of double lanyard harnesses. 2. Provide lifeline in accordance with SS607 and 570.
3	No proper anchor points for Rope Access designed into the structure.	Maintenance workers falling over the edge as anchor's design insufficient to withstand the human load.	Design anchor points with sufficient structural strength in accordance with SS570 and SS607, with PE endorsement for Rope Access load.
4	Skylights which are difficult to access for cleaning or maintenance.	Maintenance workers losing foothold and rolled down the skylight resulting in injury.	<p>Design and build safe platform for access.</p> 




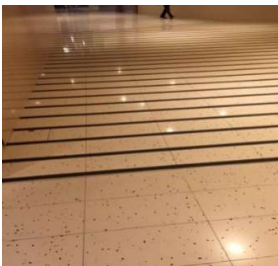
S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
5	<p>Facilities, utilities and machinery located on roof which does not have perimeter railing.</p>  	<p>Maintenance workers falling over the edge of the roof.</p>  	<ol style="list-style-type: none"> 1. Restricted access to roof. 2. Provide perimeter guardrails, cat ladders, etc. 3. Provide barricades around skylight and warning against stepping on glass. 4. Install anchors that are designed for fall arrest in accordance with SS570 and SS607. 
6	<p>Roof with steep slope</p> 	<ol style="list-style-type: none"> 1. Maintenance works falling over and rolling down the slope. 2. Dropped tools rolling down the slope and onto the ground floor. 	<ol style="list-style-type: none"> 1. Provide safety barricades at the perimeter of roof. 2. Restricted access to roof. 3. Install anchors that are designed for fall arrest in accordance with SS570 and SS607.
7	<p>Skylight at roof without appropriate barricade</p> 	<p>Workers falling through the skylight opening or edge of roof</p>	<ol style="list-style-type: none"> 1. Restricted access to roof. 2. Provide wall of at least 1.1m in height around skylight perimeter and roof edge. 3. Provide lifeline anchor points for anchorage of body harness 4. Provide night light for visibility on roof.





S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
8	Corroded metal roof. 	<ol style="list-style-type: none"> 1. Workers stepping on damaged / corroded roof sheet and falling through. 2. Workers falling over edge of roof. 3. Workers' tools falling off roof and hit the pedestrians. 	<ol style="list-style-type: none"> 1. Provide lifeline anchor points for anchorage of body harness. 2. Select durable materials and appropriate slope to prevent ponding, hence corrosion.
9	Sloped cantilever ledge connected to parapet walls along the corridor. 	<ol style="list-style-type: none"> 1. Workers falling over ledge while working on it. 2. Workers falling from height while accessing the cantilever ledge. 3. Workers' tools falling from ledge and hit the pedestrians. 4. Person retrieving dropped valuable items. 	<ol style="list-style-type: none"> 1. Standalone canopy as rain shield, i.e. not connected to corridors to reduce the likelihood of people climbing on top. 2. Provide anchors to support safety net for workers working on ledge. 3. Provide lifeline anchors points for anchorage of body harness, covering the full ledge length.
10	Trap door located at the edge of the roof. 	Maintenance workers falling over the edge of roof as they climb up through the trap door.	<ol style="list-style-type: none"> 1. Position trap door away from edge of roof. 2. Provide wall / guardrails of at least 1.1m in height around roof edge. 3. Provide lifeline anchor points for anchorage of body harness. 4. At all times workers anchor to lifeline while working on the roof.
11	Absence of fall arrestor system at roof top for maintenance purposes. 	Maintenance workers falling over the edge.	Install fall arrestor system with lifeline anchors for maintenance safety.




S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
12	<p>Absence of sturdy safety barriers along the edge of roof.</p> 	Maintenance workers falling over the edge.	<ol style="list-style-type: none"> 1. Provide wall / guardrails of at least 1.1m in height around roof edge. 2. Provide warning signages.
13	<p>Facades difficult to access for cleaning, repair or replacement.</p> 	Require temporary scaffolding and risk of workers falling from height.	Provide designated anchorage points for rope access or BMU system.
14	<p>Tiles on exteriors of columns or walls.</p> 	Fall off if not secured properly, resulting in personnel injuries.	<ol style="list-style-type: none"> 1. Use mechanical connection such as hooks or anchor to prevent tiles from falling. 2. Use “lips” that prevent falling. 3. Adhere to appropriate quality control procedure to ensure proper anchorage.
15	No safety markings on glass panels.	Personnel walking into the glass panel, resulting in injuries.	Provide eye level safety marking.
16	Bollards along driveway with no reflective stickers.	Cars or personnel crashing with the bollards.	<ol style="list-style-type: none"> 1. Provide bollards at appropriate locations to protect personnel or facilities. 2. Provide reflective stickers on bollards.






S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
17	Metal grating flooring for AHU room, catwalk, etc.	Dropped objects through grating from upper level, resulting in personnel injuries below.	<ol style="list-style-type: none"> 1. Do not use grating. 2. Select grating with load bars of closer spacing.
18	Confined space without the necessary provisions for safe entry. 	Personnel trapped inside and not evacuated quickly during incidents.	Provide ventilation, gas detection systems as per WSH requirements.
19	Roof and outdoor areas exposed to rain. 	Stagnant water become mosquitoes breeding ground.	Design and construct surfaces to prevent stagnant water.
20	Sudden drop of floor level upon entering plant room.	Trip and fall or ankle injuries.	<ol style="list-style-type: none"> 1. Avoid different levels for plant room. 2. Provide sufficient lighting. 3. Provide different color floor finishes, warning signages or paint yellow strips.
21	Fire hose reel compartment floor with lower floor level than the corridor. 	Falling hazard for the person using fire hose reel or maintaining the riser.	Avoid different level for fire hose reel compartment.

S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
22	<p>No bollard / no kerb to demarcate driveway and pedestrian walkway.</p> 	Cars accidentally driving onto pedestrian walkway or shop fronts, resulting in personnel injuries.	<ol style="list-style-type: none"> 1. Provide kerb. 2. Provide bollards to prevent cars from driving onto walkway. 3. Provide pot plants and yellow warning strips.
23	<p>Raised platform without guardrails.</p> 	Personnal falling over the edge.	Install guardrails.
24	<p>Rainwater flows into carpark from open ramp.</p>	Carpark flooded, resulting in drowning and mosquitoes breeding.	<ol style="list-style-type: none"> 1. Provide ramp with sufficient height at entrance to prevent water flowing in from the surrounding streets. 2. Provide water flows over cut-off drain. 3. Paving two cut-off drains along the ramp to improve drainage.
25	<p>Fixed ladders over 4m high.</p>	Falling from height while climbing up/down the ladder.	<p>Provide fall prevention system, e.g. cage.</p> 

S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
26	<p>Insufficient illumination at certain basement areas</p> 	Trip and fall.	Design and install sufficient lights.
27	<p>Slopes and uneven surfaces where services require to be maintained.</p> 	Difficult to erect scaffolds or mobilisation of scissor lifts for maintaining the service.	Design the floor to be level or have a gentle gradient for scaffolds or scissor lifts operations.
28	<p>Door swing zones located in carpark driveway.</p> 	<p>Blind spots for pedestrian coming into the carpark.</p> <p>Doors swinging into the way of passing by cars.</p>	<ol style="list-style-type: none"> 1. Recess doors to become set-in, and don't open into vehicle path. 2. Mark out and / or label danger areas with prominent markings.
29	<p>Slips and falls in common areas.</p> 	Personnel injuries.	Use non-slip floor materials, especially areas with slopes or ramps.

S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
30	<p>Heavy swing doors</p> 	Difficult for those who are not strong enough to push it open.	Design and install automatic sliding doors instead of swing type.
31	<p>Absence of handrails on sides of staircases.</p> 	Slip and fall for users on the side without handrail.	Design and install handrails along both sides of staircases, where practicable.
32	<p>Rainwater seep in through the louvres on the facade of buildings.</p>	Water on the floor surface causing slip and fall.	Design and install effective rain cover to prevent seepage.
33	<p>Cars exiting carpark with poor visibility of other road users, especially those with steep ramp.</p>	Cars colliding with passers-by.	<ol style="list-style-type: none"> 1. Allow better visibility of all users at this intersection point. 2. Provide "white lines" at the point of intersection between the vehicles and pedestrians. 3. Restrict the speed of cyclists, e-scooters and vehicles by installing humps, bollard, signs, illuminations, etc.
34	<p>Door swing into blind spot.</p>  	People standing in front of door get hit by the door.	Install louvres on solid door that swing open and it should be high enough to give a good view of any person standing on the other side. The louvres should be slope downwards in the direction of the door opening.

S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
35	<p>Fire access panel obstructed by furniture.</p> 	Impede the fire evacuation operations.	Install simple signage to remind staff and visitors not to block the fire access panel.
36	Sloping traveller surface gets wet.	User slips & falls due to the slippery surface.	<ol style="list-style-type: none"> 1. Provide roof over outdoor sloping traveller to keep it dry and non-slippery. 2. Roughen the traveller with serrated surface.
37	<p>Automatic Storage Retrieval System (ASRS) with no access platform for maintenance such as changing light bulbs, air-cond maintenances, sprinkler pipe repair, etc.</p> 	Workers falling from height.	<ol style="list-style-type: none"> 1. Provide working platform for accessing the top of the ASRS rack. 2. Maintenance staff to be trained for working at height. 3. Indicate the ASRS loading clearly (kN/m²).
38	<p>Speed limit signs not provided in carparks and loading/unloading areas</p> 	Car accidents which may involve pedestrians.	<ol style="list-style-type: none"> 1. Impose traffic speed limit and display it at prominent places. 2. Provide speed humps at appropriate places to protect pedestrians.

S/No	Hazard	Risk	Proposed DfS Control Measure(s), where applicable.
39	<p>Birds flying into the water tank area.</p> 	<p>Risk of workman falling sick caused by birds droppings.</p> 	<ol style="list-style-type: none"> 1. Provide covers for the water tanks. closed at all times 2. Close up all openings to prevent birds access. 3. Provide net at opening to prevent bird access.
40	<p>No proper storage area for hazardous chemicals.</p> 	<p>Personnel come in contact with hazardous chemicals.</p> 	<ol style="list-style-type: none"> 1. Install emergency eye wash and shower at chemical storage areas. 2. Ensure Chemical Safety Data Sheet (SDS) are available at chemical storage areas and workers are aware of emergency procedures. 3. Provide designated storage area with allowable quantity, clear label and SDS displayed. 4. Find out chemicals / quantities to be stored during operations and design space for them.
41	<p>Wheel chairs and prams placed in front of gas panel.</p> 	<p>In the event of fire, staff have difficulty in shutting down gas supply.</p>	<ol style="list-style-type: none"> 1. Provide designated area for such items. 2. Install CCTV for enforcement. 3. Provide signages to inform not to place items near the gas panel.