

SPECIFICATION FOR DRAINAGE OF 'WIND-DRIVEN RAIN' SPACES

[Singapore Generic - Wind-Driven Rain Spaces]

1. GENERAL

This specification sets out the requirements necessary for the design, supply, installation, testing and commissioning of a rainwater drainage system for the conveyance of rainwater from 'Wind-Driven Rain Spaces'. The rainwater drainage shall be hereinafter referred to as the WDR Drainage System.

[It should be noted that the drainage of rainwater from 'Wind-Driven Rain Spaces' is not part of any prescriptive solution covered by any Building Standard or Code of Practice]

Definitions:

- *Wind-Driven Rain Spaces: are defined as being spaces which have at least one external façade wall which is unprotected from 'Wind-Driven Rain' making them susceptible to an ingress of water into that space. Such spaces typically include balconies, sky bridges, open staircases, etc.*
- *Wind-Driven Rain: is the horizontal component of flow given to rain by the winds and is an important consideration for the design of covered or partially enclosed spaces.*
- *Effective Catchment Area (A_{WDR}): is the maximum vertical opening area in any one plane of any Wind-Driven Rain Space which has an ingress of rainwater to that space.*
- *Rainfall Intensity (I): is the rate of rainfall anticipated to occur over a given return period which is selected on the balance of cost against the frequency and consequences of flooding.*
- *Factor of Risk (F_R): is directly proportional to the angle at which Wind Driven Rain is falling.*
- *Rate of Run-Off (Q_{WDR}): is the amount of water that will require to be drained from each and every Wind-Driven Rain Space.*
- *WDR Drainage System: is a rainwater drainage system which is capable of draining Wind-Driven Rain from Wind-Driven Rain Spaces located at multiple levels of a building through floor gratings/outlets into horizontal pipes which are then connected via a common vertical drainage pipe terminating at a designated discharge point at a lower level.*
- *WDR Drainage Specialist: is a specialist in the design of rainwater system for Wind-Driven Rain Spaces and meets the prerequisites as set out in section 3 below.*

The Contractor shall engage a "WDR Drainage Specialist" based on the prerequisites set out below.

2. PERFORMANCE REQUIREMENTS

- 2.1. The design and installation of the WDR Drainage System for all 'Wind-Driven Rain Spaces' derived from the tender documents must be in accordance to these Performance Requirements set out herein.
 - 2.1.1. Each and every individual Wind-Driven Rain Spaces, that is a space which is compartmentalized by a separating or dividing walls [e.g. Apartment balconies] to form its own unique space must be provided with a rainwater outlet or grating designed to provide for the Rate of Run-Off of that individual space.
 - 2.1.2. The WDR Drainage System shall be capable of draining all 'Wind-Driven Rain' from the drainage grating/outlet, through horizontal pipework and connected to a vertical stack and thereafter terminating at a suitable discharge point so identified in the tender drawings and without any **backflow or leakage**.

- 2.1.3. Where practical and within local code requirements or bye-laws the use of common stacks shall be used.
- 2.1.4. The calculation for the Rate of Run-Off to be used in the drainage of each and every wind-driven rain space will be derived from the following formula $Q_{WDR} = F_R \times A_{WDR} \times I/3600$.

3. PREREQUISITE FOR RAINWATER SPECIALIST

- 3.1. The engagement of the WDR Drainage Specialist is subject to the approval of 'X' [the Developer, the Architect, the Consultant, and the Superintending Officer]. Such approval will only be given upon the submission of the following information being made available to X.
- 3.2. The WDR Drainage Specialist shall provide documentary evidence that they have
 - 3.2.1. A minimum of 5 years' experience in the design and installation of WDR Drainage Systems for wind-driven rain spaces.
 - 3.2.2. A minimum of 2 years' knowledge of local design practices and local construction methodologies.
 - 3.2.3. Relevant experience and track record in providing rainwater solutions for the type of project being undertaken under this specification.
- 3.3. The WDR Drainage Specialist must provide full Technical Specification of his System(s) which provides information on
 - 3.3.1. Design and software systems being utilized
 - 3.3.2. Product standards to be offered on all key component parts
 - 3.3.3. System limitations
 - 3.3.4. Installation suitability
- 3.4. Any design work undertaken by the WDR Drainage Specialist should be carried out by competent personnel with relevant experience in such systems.

4. APPROVAL OF WDR DRAINAGE SYSTEM

- 4.1. The WDR Drainage Specialist shall propose his solution based on a system which has been proven through laboratory testing and has been validated by a recognised accredited certification or validating body such as TUV SUD PSB.
- 4.2. The WDR Drainage System shall consist of a vertical stack simulating water drainage from above plus minimum 2 horizontal side branches at two different level connected to drainage outlet collection points simulating the repetitive levels WDR spaces catchment source and the vertical stack shall terminate at a non free discharge point.
- 4.3. Such certification should indicate the allowable flow rates in the pipe system and provide verification that no backflow occurs through the 2 horizontal branches under in the range of flow rate from zero to the maximum flow rates so stated and not only a final maximum.

NOTES:

1. The rainwater downpipe design guidelines in Table 8 and Table 9 of SS525:2006 Codes of Practice for Roof Drainage are meant for gravity pipes without side branches and not relevant to the design of systems for drainage of Wind-Driven Rain Spaces and are strictly prohibited.
2. The use of siphonic roof drainage systems is not recommended unless the siphonic specialist can meet the criteria as set out in 4.1, 4.2 and 4.3 above.

5. DESIGN OF WDR DRAINAGE SYSTEMS

- 5.1. The WDR Drainage Specialist shall undertake and be responsible for
 - 5.1.1. The calculation of the 'Effective Catchment Areas' based on the tender drawings.
 - 5.1.2. The calculation of the Rate of Run-off which will be derived from the formula as set out in 2.1.4.
- 5.2. The WDR Drainage Specialist shall where practical position the locations of the rainwater Outlets and/or Gratings and follow the general routing of the pipe system to the designated discharge points as shown on the tender drawings.

- 5.3. In the event that the WDR Drainage Specialist identifies that the concept scheme as shown on the tender documents is impractical to implement, he shall immediately make notification of such issue.
- 5.4. The WDR Drainage Specialist may present value engineering solutions for the consideration of the Architect during any phase of the design process.
- 5.5. The WDR Drainage Specialist shall develop and coordinate his design within the constraints of the building fabric and in conjunction with the other building services all to the requirements of the Architect.
- 5.6. The WDR Drainage Specialist shall design each vertical stack system to ensure that all pipe materials and pipe system support structure as specified are capable of withstanding the forces and reactions so applied to them due to
 - 5.6.1. Changes in the dynamic flow of the system
 - 5.6.2. Thermal and Seismic effects
 - 5.6.3. Static Load
 - 5.6.4. Deflections and/or movements in the structural elements of the building directly supporting the pipework, if identified.
- 5.7. The WDR Drainage Specialist shall provide the following minimum design outputs prior to, during and upon completion of the installation. Such outputs shall include
 - 5.7.1. Flow Rates in the Pipe System
 - 5.7.2. Static calculations of bracketing and bracing support systems

6. PRODUCTS

- 6.1. Drain Gratings and/or Drain Outlets
 - 6.1.1. The specialist shall submit Technical Data Sheets of all drain gratings and/or rainwater outlets to be used in the rainwater system. Such information should include the maximum flow rate capacity of the grating/outlet.
 - 6.1.2. All data should be the result of tests which have been **certified or validated** by a recognised accredited certification or validating body. Only outlets which can demonstrate they meet the requirements of the tests will be allowed.
 - 6.1.3. All key components shall be manufactured from suitable plastics and/or from non-corrosive metallic materials such as Stainless Steel, Aluminium Alloy or equivalent.
- 6.2. Pipe Conveyance Systems
 - 6.2.1. The WDR Drainage Specialist shall at all times ensure that all pipe materials and pipe system support structure meets the provisions of Clause 5.6 above.
 - 6.2.2. The WDR Drainage Specialist shall provide a full specification of all his pipes, fittings, proprietary components, brackets and bracing required to fulfil the completion system.
 - 6.2.3. Unless otherwise specified, the Architect or the WDR Drainage Specialist shall propose the material for the pipe conveyance which he deems meets and delivers all of the technical requirements.
 - 6.2.4. The WDR Drainage Specialist shall upon request, provide calculations, data and product information supporting the design and installation of the support system to the pipe conveyance system.

7. BCA GREEN MARK AND THE ENVIRONMENT

- 7.1. NRB 3-2 Sustainable Products – WDR Drainage Specialists who promote the use of environmentally friendly products that are certified by an approved local certification body and supply such 'Sustainable Products' as part of their system forming part of this specification and which will lead to the achievement of Green Mark Points for the Project will be given preferential consideration over other WDR Drainage Specialists who do not provide such 'Sustainable Products'.
- 7.2. NRB 5-1 Green Features and Innovations – Where the WDR Drainage Specialist is providing a Siphonic or WDR Drainage System in whole or as part of his overall rainwater drainage scheme such Siphonic/WDR Drainage System shall be validated to meet the requirements of Green Mark under Other Green Features.

8. INSTALLATION

8.1. System Installation

8.1.1. All WDR Drainage systems must be installed strictly in accordance to the design and installation requirements of the WDR Drainage Specialist which include

8.1.1.1. Schematics in 2D

8.1.1.2. Layout drawings and details

8.1.1.3. System Installation Manual and Installation Instructions

8.1.1.4. Technical Data Sheets

8.2. System Changes and/or Modifications

8.2.1. The WDR Drainage Specialist shall allow for minor changes due to site coordination subject to agreement with the Contractor. Notwithstanding such changes, the Architect shall be kept informed of such adhoc change on a regular basis and such changes must be incorporated into the final/as-built schematics and drawings prior to testing and handover.

8.2.2. Both the Contractor and the WDR Drainage Specialist shall ensure that significant changes in the position of the Drain Gratings or Drain Outlets or discharge points or of the routing of the pipework must at all times be approved by the WDR Drainage Specialist prior to being submitted to the Architect for acceptance into the final design, installation, testing & commissioning and handover.

8.3. System Protection

8.3.1. The WDR Drainage System shall not be used as the temporary rainwater drainage system without the express approval of the Architect.

8.3.2. The WDR Drainage Specialist shall take measures to prevent the entry of debris or foreign material likely to affect the system performance prior to handover of the system at project completion. During construction such measures may include protective covers to the rainwater outlets or temporary caps to open ended pipe systems.

8.3.3. The WDR Drainage Specialist shall if requested and upon approval of the Architect make available either part of or the whole of the siphonic installation for the use as a temporary rainwater drainage system. The responsibility for any liabilities which arise from such use of the system, will lie with the party requesting such use.

9. TESTING AND COMMISSIONING

9.1. Inspection

9.1.1. The system should be inspected for any visible defects, and where deemed necessary tested, before any insulation, boxing up, etc is installed.

9.1.2. The system should be visibly inspected to determine whether the system as installed conforms to the design. Any discrepancies should be referred back to the designer to assess whether any remedial works are required.

9.2. Concealed Works

9.2.1. The testing regime of all works that are to be concealed within a concrete structure should be identified and agreed prior to installation.

9.2.2. All works that are to be concealed other than described in 8.2.1 above should, where practical, be tested in accordance to 9.3 below, before they are finally enclosed.

9.3. Flow Testing

9.3.1. It is impractical to flow test an installed WDR Drainage System under its design conditions.

10. HANDOVER

10.1. Where systems have been sealed to prevent the ingress of debris, all seals should be removed immediately prior to handover.

10.2. Where systems have been left unprotected the system and the catchment areas feeding such systems shall be checked to ensure they are free from any debris.