

SPECIFICATION FOR SIPHONIC RAINWATER DRAINAGE OF ROOFS

[Singapore Generic - Siphonic]

1. GENERAL

This section specifies the requirements necessary for the design, supply, installation, testing and commissioning of a Siphonic Rain Water Drainage System for the conveyance of rainwater from roof areas and rainwater run-off from adjacent and/or abutting walls.

Siphonic Rain Water Drainage System are specialised in nature. The Contractor shall engage a "Siphonic Specialist" based on the prerequisites set out below.

The design of the siphonic system must meet the Performance Requirements as stipulated below.

2. PERFORMANCE REQUIREMENTS

The Performance Requirements as set out below are relevant for the drainage of all 'open to sky' areas such as roof areas, car park area, canopies all identified in the tender documents.

- 2.1. The Siphonic Rainwater System shall be capable of draining the effective catchment areas as identified in the tender drawings. The method of calculation of the effective catchment shall include allowances and considerations for sloping or curved surfaces and for adjacent vertical surfaces draining to such areas.
- 2.2. The rainwater should be conveyed through a suitable pipe conveyance system to the designated discharge point without leakage.
- 2.3. The Siphonic Rainwater System should comprise of materials which are suitable for the pressures and forces resulting from dynamic flow within the siphonic rainwater system. The material should also satisfy the following criteria for serviceability.
 - 2.3.1. Stability under uv light
 - 2.3.2. Bi-metallic corrosion
 - 2.3.3. Flexural Stiffness
 - 2.3.4. Durability
 - 2.3.5. Expansion and contraction
 - 2.3.6. Loss of strength due to above ambient temperature
- 2.4. The Siphonic Rainwater System shall be properly supported and braced throughout.
- 2.5. The Rainfall Intensity to be used in the calculation of the Rate of Run-Off is set out below.
 - 2.5.1. Examples:
 - 2.5.1.1. Rainfall Intensity to Main Roof and Canopies e.g. 330 mm/hr
 - 2.5.1.2. Rainfall Intensity to Car Park Roof e.g. 200 mm/hr

3. PREREQUISITE FOR SIPHONIC SPECIALIST

- 3.1. The engagement of the Siphonic Specialist by the Contractor is subject to the approval of 'X' [the Developer, the Architect, the Consultant, and the Superintending Officer]. Any approval will only be given upon the submission of the following information being made available to X.
- 3.2. The Siphonic Specialist shall provide documentary evidence that they have
 - 3.2.1. A minimum of 10 years' experience in the design and installation of rainwater systems.
 - 3.2.2. A minimum of 5 years' experience in the design and installation of siphonic rainwater drainage systems.
 - 3.2.3. A minimum of 2 years' knowledge of local design practices and local construction methodologies.
 - 3.2.4. Relevant experience and track record in providing siphonic rainwater solutions for the type of project being undertaken under this specification.
- 3.3. The Siphonic Specialist shall provide documentary evidence showing that

- 3.3.1. His design software is suitable for calculating, balancing and generating full design output as set out in Clause 4 below.
- 3.3.2. The software has been validated or certified by a recognised and accredited certification body such as TUV SUD PSB or BBA.
- 3.3.3. The software is complimentary to and takes into consideration all of the parameters relevant to the hardware to be used in the siphonic system. These are
 - 3.3.3.1. Pipe roughness coefficient
 - 3.3.3.2. Minor losses due to fittings
 - 3.3.3.3. Outlet resistance (k value)
- 3.4. The Siphonic Specialist must provide a full Technical Specification of his System(s) which provides information on
 - 3.4.1. Design and software systems being utilized
 - 3.4.2. Product standards to be offered on all key component parts
 - 3.4.3. System limitations
 - 3.4.4. Installation suitability
- 3.5. The Siphonic Specialist must submit upon request a list of competent personnel with relevant experience in the design of siphonic systems and such personnel are sufficient to adequately provide local support in the design and any design changes throughout the contract period.

4. DESIGN

- 4.1. The Siphonic Specialist shall undertake and be responsible for
 - 4.1.1. The calculation of the 'Effective Catchment Areas' based on the tender drawings. Such calculation shall be made based on SS 525:2006. Clause 7.1. parts 7.1.1.1 through 7.1.1.4.
 - 4.1.2. The calculation of the Rate of Run-off which will be derived from the Effective Catchment Areas and the Rainfall Intensity as stated in Clause 2.5 above.
- 4.2. The Siphonic Specialist shall where practical position the locations of the siphonic rainwater outlets and follow the general routing of the pipe system to the designated discharge points as shown on the tender drawings.
- 4.3. In the event that the Siphonic Specialist identifies that the compliant scheme as shown on the tender documents is impractical to implement he shall immediately make notification of such issue.
- 4.4. The Siphonic Specialist may present value engineering solutions for the consideration of X during any phase of the design process.
- 4.5. The design of all siphonic systems must be carried out by competent personnel with relevant experience in such systems.
- 4.6. The Siphonic 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 X.
- 4.7. The Siphonic Specialist shall design each siphonic system to
 - 4.7.1. 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
 - 4.7.1.1. Changes in the dynamic flow of the system
 - 4.7.1.2. Thermal and Seismic effects
 - 4.7.1.3. Static Load
 - 4.7.1.4. Hydrostatic Pressure
 - 4.7.1.5. Deflections in the structural elements of the building directly supporting the pipework, if identified.
- 4.8. The Siphonic Rainwater Specialist shall provide the following minimum design outputs prior to, during and upon completion of the installation. Such outputs shall include
 - 4.8.1. Hydraulic calculation showing frictional losses, local losses, head loss, flow rates, flow velocities and pressure profile together with resultant pipe sizing.
 - 4.8.2. Static calculations of bracketing and bracing support systems.
- 4.9. The Siphonic Rainwater Specialist shall provide design input or expert knowledge or advice on the size of any gutters for which a siphonic system provided by them is being drained by that system.

5. PRODUCTS

5.1. Siphonic Rainwater Outlets

- 5.1.1. All key components shall be manufactured from non-corrosive metallic materials such as Stainless Steel, Aluminium Alloy or equivalent.
- 5.1.2. The specialist should submit Technical Data Sheets of all outlets to be used in the system which provide key information including, but not restricted to
 - 5.1.2.1. The vertical height of the air baffle located above the spigot orifice and the horizontal distance between the air baffle and the spigot wall.
 - 5.1.2.2. The radius of spigot at its interface with the base plate.
 - 5.1.2.3. The flow rate capacity of the outlet and the water depth around the outlet.
- 5.1.3. All such 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. Outlets without fixed Air Baffles are excluded unless they can demonstrate they work at all dimensional positions.
- 5.1.4. The siphonic specialist shall provide details showing interface between the outlet and
 - 5.1.4.1. Pipe network
 - 5.1.4.2. Roof membrane/Roof Finishes
 - 5.1.4.3. Gutters
- 5.1.5. The siphonic outlet should be protected by a leaf guard or be structured to minimise blockage from leaves, debris and the like.

5.2. Pipe Conveyance Systems

- 5.2.1. Generally
 - 5.2.1.1. The Siphonic Specialist shall at all times ensure that all pipe materials and pipe system support structure meets the provisions of Clause 4.7 above.
 - 5.2.1.2. The Specialist shall provide a full specification of all his pipes, fittings, brackets and bracing required to fulfil the completion of the installation.
- 5.2.2. Pipe Material & Pipe Support Systems
 - 5.2.2.1. Unless otherwise specified by X, the Siphonic Specialist shall propose the material for the pipe conveyance which he deems meets all of the technical requirements stated or specified herein to this **Specification for Siphonic Rainwater Drainage of Roofs**.
 - 5.2.2.2. The Siphonic Specialist shall
 - 5.2.2.2.1. Identify the maximum positive and negative pressure within the Specialist's pipe conveyance system based on the hydraulic calculations and shall provide adequate test data in support of the adequacy of pipe system intended to be installed. Such test data must include the pressure ratings (both positive and negative) of the pipe material, the pipe fittings and any other pipe jointing system being utilised within the pipe conveyance system.
 - 5.2.2.2.2. Upon request, provide calculations, data and product information supporting the design and installation of the support system to the pipe conveyance system.
- 5.2.3. Pipe Material for Hydrostatic Pressure
 - 5.2.3.1. Where a potential blockage can occur in a rainwater drainage system, the pipe system must be capable of resisting the hydrostatic forces from such blockage. Where this pressure exceeds the pressure rating of the pipe system designed for dynamic pressure under siphonic full-bore flow the specification of the pipe system under hydrostatic should be made from a suitable metallic pipe material.

6. BCA GREEN MARK AND THE ENVIRONMENT

- 6.1. NRB 3-2 Sustainable Products – Siphonic 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 Siphonic Specialists who do not provide such 'Sustainable Products'.

- 6.2. NRB 5-1 Green Features and Innovations – Where the Siphonic Specialist is providing a Siphonic System in whole or as part of his overall rainwater drainage scheme, such Siphonic System shall be validated to meet the requirements of Green Mark under Other Green Features.

7. INSTALLATION

7.1. System Installation

- 7.1.1. All Siphonic Rainwater Drainage systems must be installed strictly in accordance to the design and installation requirements of the Siphonic Specialist which include
- 7.1.1.1. Schematics in 3D
 - 7.1.1.2. Layout drawings and details
 - 7.1.1.3. System Installation Manual and Installation Instructions
 - 7.1.1.4. Technical Data Sheets

7.2. System Changes and/or Modifications

- 7.2.1. The Specialist shall allow for minor changes due to site coordination subject to agreement with the Contractor. Notwithstanding such changes, X 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.
- 7.2.2. Both the Contractor and the Siphonic Specialist shall ensure that significant changes in the position of the siphonic rainwater outlets or discharge points or of the routing of the pipework must at all times be approved by the Siphonic Specialist prior to being submitted to X for acceptance into the final design, installation, testing and commissioning, and handover.

7.3. System Protection

- 7.3.1. The Siphonic Rainwater Drainage System shall not be used as the temporary rainwater drainage system without the express approval of X.
- 7.3.2. The Siphonic 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.
- 7.3.3. The Siphonic Specialist shall if requested and upon approval of X 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.

8. TESTING AND COMMISSIONING

8.1. Inspection

- 8.1.1. The system should be inspected for any visible defects, and where deemed necessary tested, before any insulation, boxing up, etc is installed.
- 8.1.2. 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.

8.2. Concealed Works

- 8.2.1. The testing regime of all works that are to be concealed within a concrete structure should be identified and agreed prior to installation.
- 8.2.2. All works that are to be concealed other than described in 7.2.1 above should, where practical, be tested in accordance to 8.3 below, before they are finally enclosed.

8.3. Positive Pressure Testing

- 8.3.1. The system should be tested (see 8.3.2 and 8.3.3) either in parts or as a whole, to check its integrity against positive pressure. Where the integrity of the pipe system (see 5.2.2.2.1) has been tested and validated by a recognised and accredited certification body such as TUV SUD PSB or BBA, such systems shall be exempt from 8.3.2 below.

- 8.3.2. Internal rainwater pipes should be tested with water to whatever pressure is likely to be exerted within the pipe in the event of a blockage occurring.
- 8.3.3. Internal rainwater pipes should be capable of withstanding a constant air pressure of 38 mm water gauge for a period of 3 minutes, after equilibrium has been established. Any drop in pressure should be investigated, remedial works undertaken and the system retested until no pressure drop is observed.
- 8.4. Negative Pressure Testing
 - 8.4.1. Negative pressure testing is considered impractical. In the absence of any practical test regime, special attention should be made during all visual inspections to the method of jointing of the pipe system to ensure that it meets the design criteria for negative pressure.
- 8.5. Flow Testing
 - 8.5.1. It is impractical to flow test an installed siphonic roof drainage system under its design conditions. Where testing is to be carried out to ensure the integrity of
 - 8.5.1.1. Roof membranes and their interface with rainwater outlets and/or
 - 8.5.1.2. Gutters and their interface with rainwater outletsThen this should be carried out through ponding on the membrane roof or filling of gutters (not covered under this specification) then upon completion of such testing a simple flow test can be observed which will demonstrate that the system is free flowing.

9. HANDOVER

- 9.1. Where systems have been sealed to prevent the ingress of debris, all seals should be removed immediately prior to handover.
- 9.2. 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.