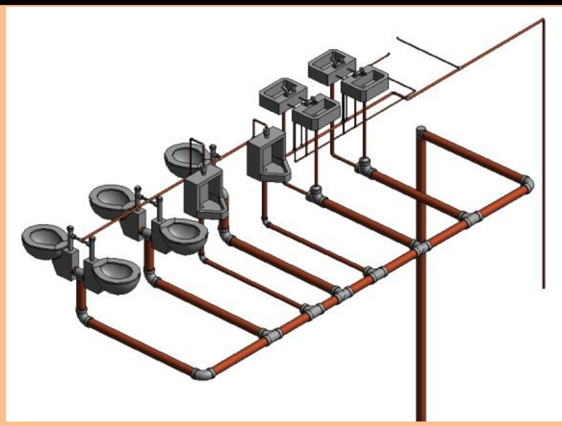
JKR 20500-0041-16

# GUIDELINES ON THE DESIGN OF SANITARY SYSTEM



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# PREFACE

The GUIDELINES ON THE DESIGN OF SANITARY SYSTEM is developed with the intention to standardize the planning and the design of sanitary plumbing system for CKM designers, in line with the current regulations, standards and guidelines.

Nevertheless, with the content and guidance of this document, it does not relieve any responsibility from any entity to exercise professional judgment, and apply engineering principles in the design, execution and completion of sanitary discharge system to meet Malaysian and International Codes of Practices and Standards.

It is hoped that the use of this guideline will lead to higher level of competency in planning and designing of sanitary system especially for the new engineers. It is also expected the standardization of the planning and design methodology of sanitary system in CKM is achieved with the wide use of the guideline.

Finally, an appreciation also goes to Senior Director of Mechanical Engineering Branch, all senior mechanical engineers, committee members, suppliers and other staffs of CKM who have directly or indirectly contributed to this publication.

## GLOSSARY OF TERMS

### General

| | | |
|---|---|---|
| Black water | : | Waste water containing faecal matter or urine. |
| Domestic waste water | : | Water which is contaminated by use and normally discharged from showers, baths, bidets, wash basins, sinks and floor gullies. |
| Drainage system | : | A system composed of drainage equipment, and other components collecting waste water and discharging by means of gravity. |
| Flood level | : | Maximum level to which waste water can rise within a drainage system. |
| Grey water | : | Waste water not containing faecal matter or urine. |
| Rainwater | : | Water resulting from natural precipitation that has not been deliberately contaminated. |
| Spillover level | : | The level at which the fluid in a receptacle will first spill over the top edge of a receptacle if the inflow of water exceeds the outflow through any outlet and any overflow pipe. |

### Pipes and fittings

| | | |
|---|---|---|
| Branch discharge pipe | : | Pipe connecting sanitary appliances to a discharge stack or drain. |
| Discharge stack | : | Main (generally vertical) pipe, conveying discharges from sanitary appliances. |
| Drain | : | Near horizontal pipe suspended within a building or buried in the ground to which stacks or ground floor appliances are connected. |
| Nominal diameter (DN) | : | Numerical designation of size which is a convenient round number approximately equal to the diameter in mm. |
| Sanitary pipework | : | Arrangement of discharge pipework, with or without ventilating pipes, connected to a drainage system. |
| Square entry | : | Equal branch junction that is more than 45 degree, or has a center line radius less than the internal pipe diameter. |
| Stack offset | : | Non-vertical part of a discharge stack. |
| Swept entry | : | Equal branch junction that is at 45 degree or less, or has a center line radius not less than the internal pipe diameter |

**Ventilating pipework**

| | | |
|---|---|---|
| Air admittance valve | : | Valve that allows air to enter the system but not to escape in order to limit pressure fluctuations within the sanitary pipework. |
| Branch ventilating pipe | : | Ventilating pipe connected to a branch discharge pipe. |
| Relief vent | : | A branch from the discharge stack, connected to stack vent, whose primary function is to provide for circulation of air between the discharge stack, the soil or waste stack. |
| Stack vent | : | Extension of a vertical discharge pipe above the highest branch discharge pipe connection that terminates in an end, open to the atmosphere. |
| Ventilating pipe | : | Pipe provided to limit the pressure fluctuations within the discharge pipe system. |
| Ventilating stack | : | Main vertical ventilating pipe, connected to a discharge stack, to limit pressure fluctuations within the discharge stack. |

**Appliances**

| | | |
|---|---|---|
| Depth of water seal (H) | : | The depth of water which would have to be removed from a fully charged trap before gases and odours at atmospheric pressure could pass through the trap. |
| Floor Trap | : | Discharge fitting intended to receive water from floors either through apertures in a grating or from pipes connected to the body of the gully. A gully may include a trap. |
| Sanitary appliances | : | Fixed appliances supplied with water and used cleaning or washing. For example: baths, showers, wash basins, bidets, WCs, urinals, sinks, dishwashers, washing machines. |
| Trap | : | Device that prevents the passage of foul air by means of water seal. |

**Calculation**

| | | |
|---|---|---|
| Discharge unit (DU) | : | A unit so chosen that the relative loading-producing effect of appliances can be expressed as multiples of that unit. The discharge unit rating on an appliance depends on its rate and duration of discharge, on the interval between discharge and on the chosen criterion of sanitary satisfactory service. It is to a simple multiple of a rate of flow. |

**NOMENCLATURE**

| | |
|---|---|
| AWC | Asian Water Closet |
| B | Basin |
| BD | Bidet |
| BS | British Standard |
| FRP | Fibre Reinforced Plastic |
| FT | Floor Trap |
| FV | Flush Valve |
| G.I. | Galvanized Iron |
| GRC | Glass Reinforced Concrete |
| GRP | Glass Reinforced Plastic |
| HDPE | High-Density Polyethylene |
| I.C | Inspection Chamber |
| LB | Long Bath |
| MS | Malaysian Standards |
| PP | Polypropylene |
| PP-R | Polypropylene Random Copolymer |
| PVC | Polyvinylchloride |
| PWC | Pedestal Water Closet |
| SPAN | Suruhanjaya Perkhidmatan Air Negara |
| SS | Stainless Steel |
| T | Tap |
| UPVC | Unplasticized Polyvinyl Chloride |
| WB | Wash Basin |
| WC | Water Closet |
| WCT | Water Closet Tap |

## 1.0 INTRODUCTION

This guideline deals solely on soil and domestic waste water (waste water) sanitary plumbing system. Hence, any reference to "plumbing" or "soil and waste water sanitary plumbing" mentioned in this guideline refers to the sanitary plumbing of a building. It is important to note that *MS 1402: PART 1:2006 - Code Of Practice For Sanitary System In Buildings – Part 1 : Design* stands as the main reference of this guideline.

The purpose of the sanitary system is to remove effluent discharged from plumbing fixtures and other equipment to an approved point of disposal.

To avoid confusion, some knowledge of the terms relating to sanitary pipework is necessary. The terms "stack" relates to a vertical pipe. The portion of which carries waste water is referred to as the "discharge stack", and the part which does not carry waste is called the "ventilation stack". A pipe carrying waste water from a fitting or group of fittings to the main discharge pipe is called a "branch discharge pipe". These terms are important and are clearly shown in **FIGURE 1**.

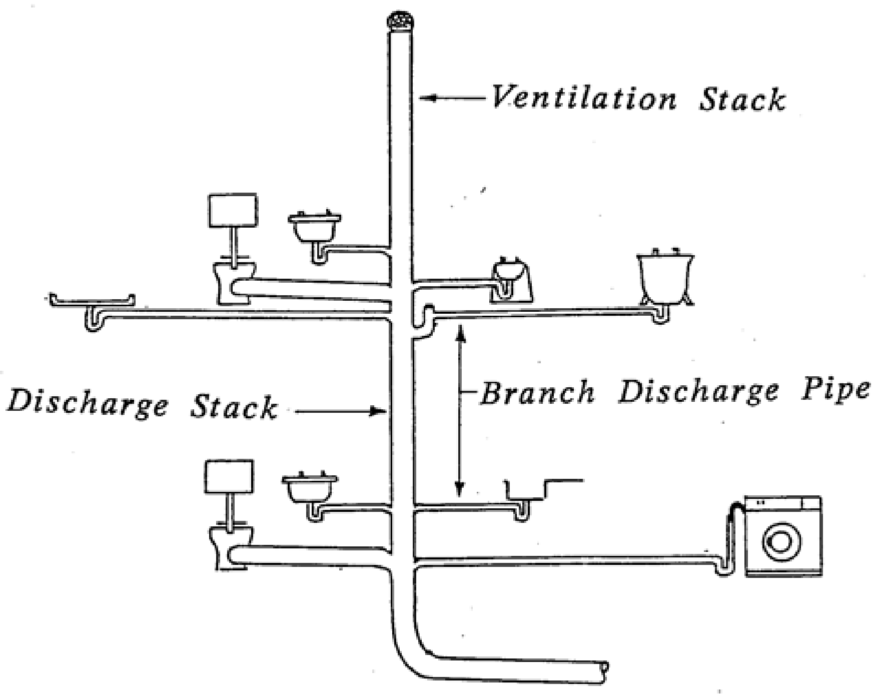



**FIGURE 1: Terms relating to Sanitary Pipework (Single Stack System)**

### 1.1 Objectives

A good sanitary pipework system should be designed and installed to provide the following attributes:

i. Prevent the transmission of foul air into the building.
ii. Minimise the frequency of any blockage, and provide adequate pipe access to enable the effective clearance of any such blockage.
iii. Provide efficient conveyance of discharge from sanitary, kitchen, laundry and wash-down facilities, to enable the correct function of each appliance.
iv. Avoid flooding to any part of a building where the floor level is located below normal ground level.

To ensure that the objectives given above can be achieved, it is important that the design of sanitary plumbing systems should follow the steps given below:

i. Study the architectural drawings and the project brief.
ii. Draw out pipework layout based on the architectural plans.
iii. Decide on the piping materials and carry out a detailed design on the pipe sizing.

### 1.2 Limit of Mechanical Scope of Design (Mechanical and Civil)

Scope of design for mechanical can be identified as below:

i. Design of sanitary pipework in the building.
ii. Pipework to the inspection chamber or nearest manhole (if no inspection chamber).
iii. Location and number of inspection chamber.

It is very critical to emphasize that the sanitary system is meant for the waste water from the building only. Piping system from other sources, such as rainwater, shall not be connected to the sanitary system.

The actual location of inspection chamber is to be decided at site by Superintendent Officer (S.O). It is important that the statement "*Final adjustment to be done at site*" be included in the tender drawing of sanitary piping, because the location and the depth of inspection chamber are different for every project. The underground drainage pipe's gradient among the inspection chambers and manhole should comply to MS 1228 or Section F in JKR Standard Specifications for Building Works 2014. **FIGURE 2** shows the detail of mechanical and civil scope.

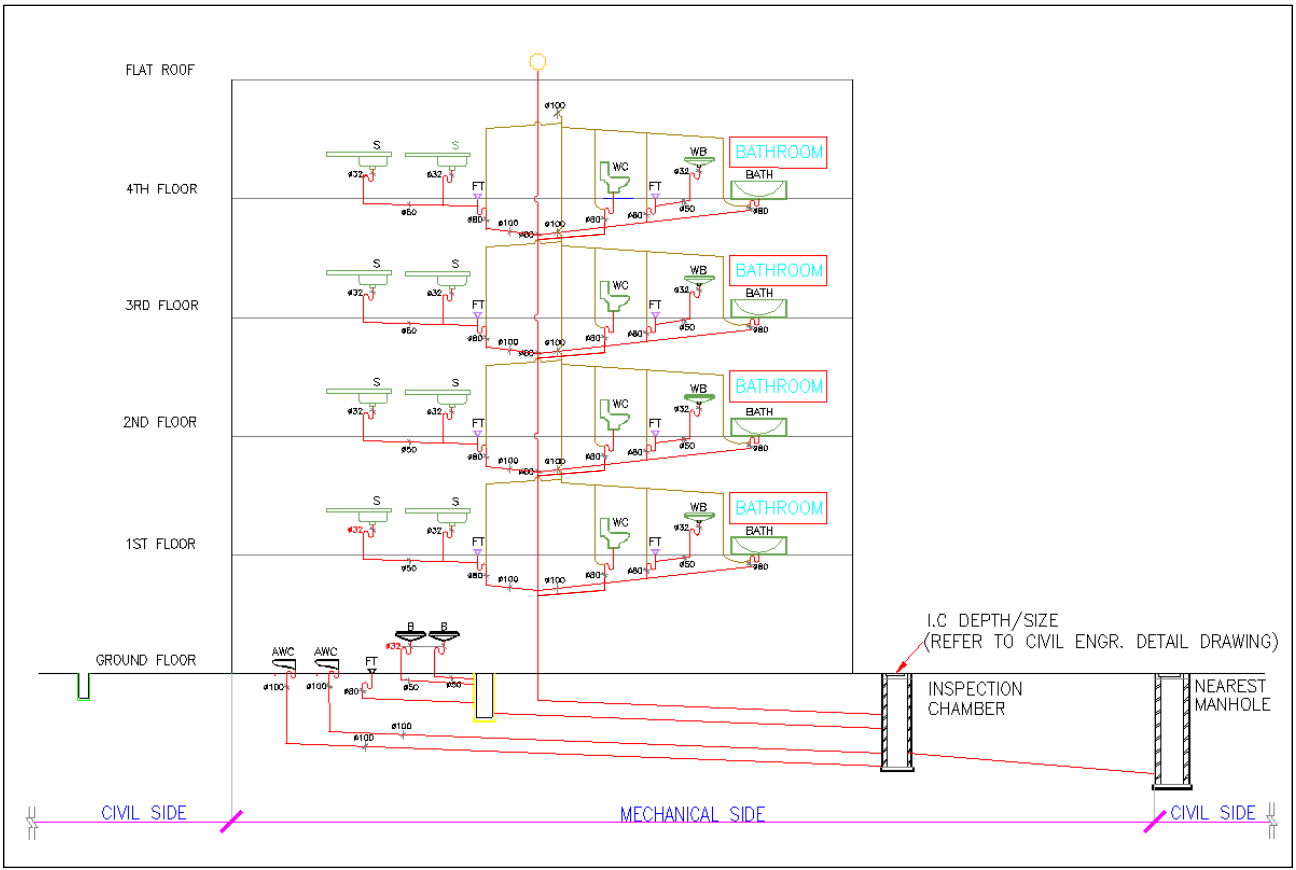



**FIGURE 2: Scope Boundary for Mechanical Side and Civil Side**

<u>Note</u>: Architect determines the number of water closets and type of sanitary fittings.

## 2.0 ACT, RULES AND STANDARDS

The following rules, regulations, standards, guidelines and specifications must be followed to their latest edition but not limited to:

- *Sewerage Services Act, 1993.*
- *Drainage, Sanitation and Sanitary Plumbing By-Laws of the proposed Street, Drainage and Building Act, 1974.*
- *Uniform Building By-laws, 1984.*
- *Occupational Safety and Health Act, 1994*
- Gravity Drainage Systems Inside Buildings - Sanitary Pipework, Layout and Calculation, BS EN 12056-2:2000.
- Code Of Practice For Sanitary System In Buildings, MS 1402 :Part 1: 2006.
- Local Authority By-Laws.
- JKR Standard Specifications for Building Works 2014
- *Panduan Nilai Estetik CKM 2015*
- CKM Acceptance Criteria For Installation of Sanitary System

The design of sanitary plumbing shall strictly follow the above rules with regard to:

a) Information on the number, position and types of sanitary wares and fittings to be installed
b) Types and details of sanitary system in use
c) Details on ventilation of sanitary system

## 3.0 MATERIALS

This section specifies requirements for materials and products to be used in sanitary plumbing system. Materials and products used in the installation should comply with SPAN requirements.

Generally, all waste pipes above ground including stack pipes and vent pipes for internal sanitary plumbing shall be UPVC complying with MS 1085. **TABLE 1** provides some normal applications of commonly used materials for sanitary pipework.

**TABLE 1: Normal Application of Commonly Used Materials for Sanitary Pipework**

| Application | Pipe Materials |
|---|---|
| Less than three storeys | UPVC, GI, Cast Iron |
| More than three storeys | UPVC |
| Underground drainage | UPVC Brown Pipe, Vitrified Clay Pipe |
| Laboratory | High Density Polypropylene, Cast Iron, GI (Hot waste water) |
| Sterilizer (Hospital) | Copper Pipe, Hubless Ductile Iron, Cast Iron |

## 4.0 SANITARY PLUMBING SYSTEM DESIGN CRITERIA

Sanitary pipework should be designed as simple arrangement as possible to quickly and quietly carry away the discharge from all connected sanitary appliances. The discharge pipework should therefore be kept as short as possible, with fewer bends, and adequate gradient. The criteria and requirements to be considered in the design of sanitary system are shown below:

a) **Discharge**

Discharge rates from sanitary appliances should be the primary concern of the designer. Discharge pipes served more than one appliance should be sized accounted for simultaneous discharge. **TABLE 2** gives information on the duration and frequency of use of sanitary appliances that may be used in calculations of simultaneous discharge. (*MS 1402: PART 1:2006)*

b) **Exclusion of foul air**

Exclusion of foul air from buildings depends on water-filled traps at the appliances for conventional gravity discharge system. Trap performance criteria is given in **TABLE 3**. (*MS 1402: PART 1:2006)*

c) **Containment of water and air**

Any leakage from the discharge pipework system should be avoided. (*MS 1402: PART 1:2006)*

d) **Resistance to blockage**

The sanitary discharge system should be designed with minimal risk of blockage especially for high grease content application. (*MS 1402: PART 1:2006)*

e) **Durability**

All materials, joints, supports and fittings of the discharge system should be durable under operating conditions. (*MS 1402: PART 1:2006)*

f) **Access for maintenance & testing**

Discharge pipework should be easily accessible and traceable. Hence, access opening should be allocated to allow cleaning, maintenance work or testing. (*MS 1402: PART 1:2006)* (Refer section 7.0 for details)

g) **Replacement**

The pipework system and fittings should be designed and installed so that defective parts can be replaced conveniently. (*MS 1402: PART 1:2006)*

**TABLE 2: Flow and Usage Data of Sanitary Appliances**

| Sanitary appliances | Capacity | Discharge data | | Frequency of use (T) s | Individual probability (p) of discharge $p \frac{t}{T}$ |
|---|---|---|---|---|---|
| | | Maximum flow rate $1s^{-1}$ | Duration (t) S | | |
| Washdown Water Closet (WC) | 9 | 2.3 | 5 | 1200<br>600<br>300 | 0.0041<br>0.0083<br>0.0167 |
| Urinal (per person unit) | 2.5 | 0.15 | 30 | 1200<br>900 | 0.0167<br>0.0333 |
| Wash Basin (32 mm branch) | 6 | 0.6 | 10 | 1200<br>600<br>300 | 0.0083<br>0.0167<br>0.0083 |
| Sink (40 mm branch) | 23 | 0.9 | 25 | 1200<br>600<br>300 | 0.0208<br>0.0417<br>0.0834 |
| Long Bath (40 mm branch) | 80 | 1.1 | 75 | 4500<br>1800 | 0.0167<br>0.0417 |
| Automatic washing machine | 4 kg to 5 kg dry load | 0.6 | 30 | 15000 | 0.0200 |
| Shower | - | 0.1 | - | - | - |
| Spray tap basin | - | 0.06 | - | - | - |

Note: A washing machine will discharge at various intervals during any selected program. The maximum number of discharges will be 6 and the volume discharged each time will be in the order of 20 l. Hence:

- 240 s represents the minimum time between rinses;
- 900 s represents a mean discharge interval of 20 minute during the use of the machine;
- 15000 s represents a 4.2 h interval between uses of the machine.

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

**TABLE 3: Trap Performance Data**

| Typical seal loss [due to negative pressure (suction) of 325 $\frac{N}{m^2}$ (38 mm water gauge) in discharge systems] | | Typical evaporation loss | |
|---|---|---|---|
| Trap detail | Approximate seal loss | Trap detail | Accepted average figure per week |
| Typical washdown WC, 50 mm seal depth | 25 mm | Small and large before traps | 25 mm (U.K. value) |
| Small diameter tubular trap, 75 mm seal depth | 19 mm | | |

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

## 5.0 DESIGN OF SANITARY PIPEWORK

Basic approaches to the design of the sanitary plumbing system are as below:

a) **Study the architectural drawing**
- Determine the location where the water discharge is required.
- Determine the location of main discharge stack dropper and avoid mechanical & electrical room, lift shaft, lift motor room and public area.

b) **Sketch the discharge piping layout**
- Sketch the simple discharge pipework arrangement.
- Avoid the crossing and minimize the bending of discharge pipework.
- Find the shortest possible path.

c) **Determine the size of the branch discharge pipe**
- Sizes of branch discharge pipe are selected based on **TABLE 4**.

d) **Determine the size of the stack**
- Sizes of discharge stack are selected based on **TABLE 5**.

e) **Determine the type of the discharge system**
- Determine the required ventilation system of the discharge system.

f) **Determine the size of the branch ventilating pipe**
- Branch ventilating pipe is sized as described in **5.4.1**.

g) **Determine the size of the ventilating stack**
- Vent stack is sized as described in **5.5.1**.

h) **Determine the size of the relief and stack vent**
- Refer to **TABLE 7**.

## 5.1 Branch discharge pipes

Branch discharge pipes are like branches of a tree that connect toilets, showers, sinks, washing machines, dish washers, etc. to the corresponding vertical stack, which carries waste to the building's underground drain or basement.

### 5.1.1 Sizing of Branch Discharge Pipes

Branch discharge pipes should be increased in diameter in the direction of flow towards the stacks. Sizes of branch discharge pipes relative to the maximum fixture unit loadings for graded discharge pipes are given in **TABLE 4**. However, oversizing branch discharge pipes to avoid self-siphonage problems can be uneconomic and can lead to an increased rate of deposit accumulation.

**TABLE 4: Maximum Fixture Unit Loadings for Graded Discharge Pipes**

| Graded % | Nominal size of pipe | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | DN 40 | DN 50 | DN 65 | DN 80 | DN 100 | DN 125 | DN 150 | DN 225 |
| 5.00 | 6 | 15 | 51 | 65 | 376 | 953 | 1959 | 7098 |
| 3.35 | 5 | 10 | 29 | 39 | 248 | 686 | 1445 | 5583 |
| 2.50 | 4 | 8 | 21 | 27 | 182 | 509 | 1148 | 4513 |
| 2.00 | - | - | - | 20 | 142 | 410 | 953 | 3739 |
| 1.65 | - | - | - | 16 | 115 | 342 | 813 | 3258 |
| 1.25 | - | - | - | - | - | 254 | 627 | 2656 |
| 1.00 | - | - | - | - | - | - | 509 | 2272 |

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

### 5.1.2 Gradients

The gradient of a branch discharge pipe should be uniform and adequate to drain the pipe efficiently. Practical considerations usually limit the minimum gradient to 1° or 1¼° (18 mm/m or 22 mm/m). This can be undesirable and adequate self-cleansing of such an arrangement is only possible with high flow rates (e.g. of not less than 2.5 l/s) and workmanship of a high standard. Pipe sizes, gradients and pipe capacities are inter-related as shown in this section and this relationship is vital for the 32 mm branches normally connected to wash basins. Vertical 32 mm branch pipe to wash basins with 's' traps often run full bore and ventilating pipework may be needed to prevent self-siphonage and noisy discharge. (*MS 1402: PART 1:2006)*

### 5.1.3 Direct Connections to an Underground Drain

**Gullies**

Generally, in low-rise houses, bungalows and ground floor flat, waste water from sanitary appliances is discharged into an external gully. The sanitary appliances should be fitted with suitable traps and the discharge pipes should terminate below the grating but above the water level in the gully. (*MS 1402: PART 1:2006)*

**WC Connections**

WCs can be connected directly to an underground drainage pipe without individual venting, provided that the vertical distance from the crown of the trap to the invert of the drainage pipe is not more than 1.5 m as shown as **FIGURE 3**. (*MS 1402: PART 1:2006)*

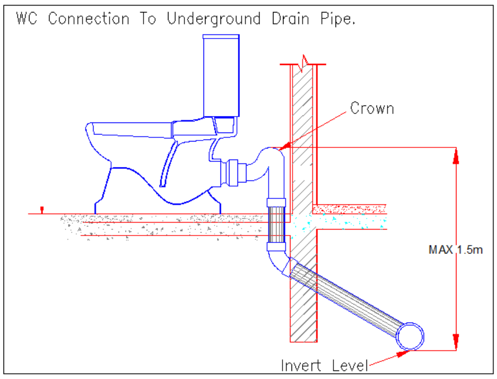



**FIGURE 3: WC Connection to Underground Drain**

**Stub Stacks**

For single storey buildings, a short straight 100 mm discharge stack with top closed, can be used to connect one set of domestic sanitary appliances directly to the drainage pipe. The vertical distance between the topmost connection to the stub stack and the invert of the branch drain is not more than 2m as shown as **FIGURE 4**. This method can also be used for ground level sanitary appliances of other buildings, where it may be undesirable to connect them to the main stack due to positive pressure at the base of the stack. (*MS 1402: PART 1:2006)*

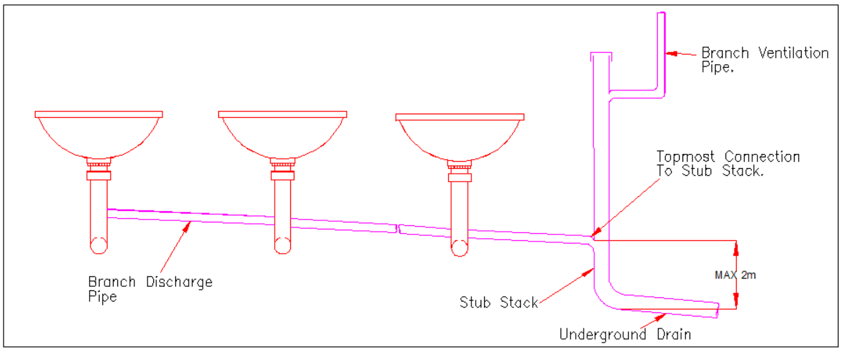



**FIGURE 4: Stub Stack Connection to Underground Drain**

## 5.2 Capacities of Stack

Stacks are vertical lines of pipe that extend from the horizontal building drain under the slab or in the basement up to and through the roof of the building.

Depending on the terminal velocities which are attained in vertical pipes, there is a practical limit to the capacity of a given stack. In order to reduce hydraulic and pneumatic disturbances to minimum, most authorities recommend as an upper limit stack loading of about a quarter full. This degree of loading provides room for an air core to flow freely down the stack during fluctuating discharges.

The maximum flow possible at any given stack loading depends also upon the frictional resistance of the inner surface of the stack. Smooth pipes of copper and plastics allow slightly higher terminal velocities to be reached than rougher pipes such as cast iron. When adequate ventilation is provided to the system, stack loading above a quarter full can be considered.

### 5.2.1 Sizing of Discharge Stacks

The internal diameter of a discharge stack should be not less than that of the largest trap or branch discharge pipe connected to it. The discharge stack above the topmost sanitary appliance connection should be continued without any reduction of diameter to the point of termination, except for one and two storey housing where, in certain cases, savings can be made by using a 75 mm vent pipe without detriment to the performance of the system. The sizes of discharge stacks are given in **TABLE 5 (a) & (b)**.

**TABLE 5 (a): Maximum Loading on Stacks in Fixture Units**

| **Four or more floor levels** | | |
|---|---|---|
| **Size of stack** | **Maximum loading per floor level** | **Maximum loading per stack** |
| DN 40 | 4 | 16 |
| DN 50 | 9 | 36 |
| DN 65 | 14 | 56 |
| DN 80 | 20 | 80 |
| DN 100 | 125 | 500 |
| DN 125 | 250 | 1000 |
| DN 150 | 600 | 2400 |
| DN 225 | 1750 | 7000 |

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

**TABLE 5 (b): Maximum Loading on Stacks in Fixture Units**

| Three or fewer floor levels | | |
|---|---|---|
| **Size of stack** | **Maximum loading per floor level** | **Maximum loading per stack** |
| DN 40 | 2 | 6 |
| DN 50 | 5 | 15 |
| DN 65 | 6 | 18 |
| DN 80 | 13 | 40 |
| DN 100 | 65 | 195 |
| DN 125 | 150 | 450 |
| DN 150 | 250 | 750 |
| DN 225 | 950 | 2850 |

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

### 5.2.2 Termination of Discharge Stacks

The outlet of every discharge stack to the open air should be at such a height and position that foul air does not cause a nuisance or health hazard. In general, this is achieved if the stack is not less than 900 mm above the head of any window or other opening into a building and within a horizontal distance (*L*) of 3 m as shown in **FIGURE 5**. Outlets should also be positioned away from parapets and corners of buildings.

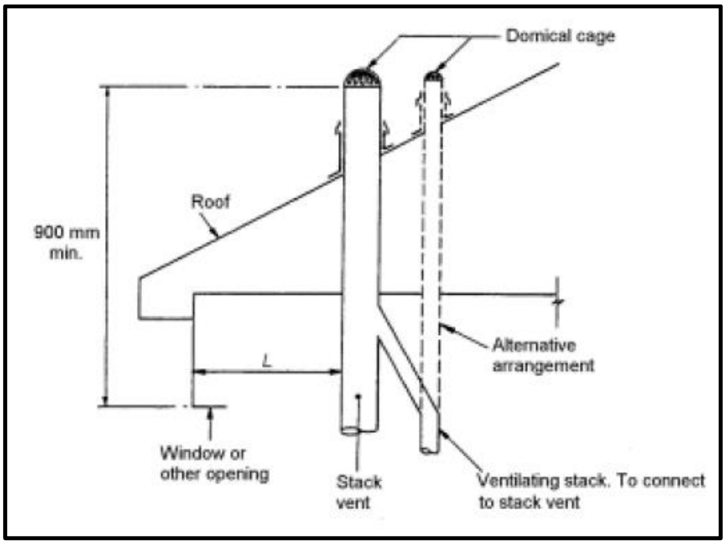



**FIGURE 5: Termination of Discharge Stacks**

### 5.2.3 Discharge Stacks Serving Only Urinals

A stack carrying only discharges from urinals is likely to become rapidly encrusted with sediment. Thus, special attention to access for regular cleaning is necessary. It is an advantage to connect other sanitary appliances, such as WCs and hot water discharges to a urinal stack to reduce this encrustation. (*MS 1402: PART 1:2006)*

### 5.2.4 Discharge Stacks Serving Only Sinks

In some multi-storey flat layouts, it may be convenient to connect the kitchen sinks to a separate stack. This arrangement resulted to very heavy stack deposits especially with soft water, which will require frequent removal to avoid partial blockage. If the blockage cannot be avoided, ready access to the stack should be provided for regular maintenance. (*MS 1402: PART 1:2006)*

### 5.3 Classification of Discharge Systems

Each system below may be configured in a number of ways, governed by the need to control pressure in the pipework in order to prevent foul air from the waste water system entering the building. The principal configurations are described below but combinations and variations are often required. The discharge systems in this guideline can conveniently be classified as follows:

#### 5.3.1 Single Stack System

A single stack system is used in situations where the discharge stack is large enough to limit pressure fluctuations as shown in **FIGURE 6**.

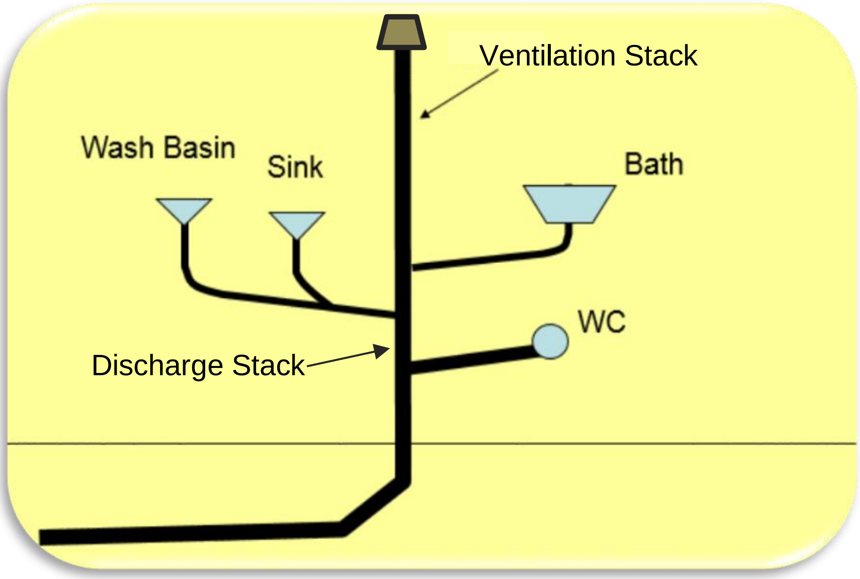



**FIGURE 6: Single Stack System**

#### 5.3.2 Modified Single Stack System

The single stack modified system permits tasks to receive a higher discharge loading or to be extended to serve a greater number of floor levels by introducing a relief vent. A modified single stack system can be used where the positioning of appliances on a branch discharge pipe could cause loss of their trap seals. Therefore, ventilating pipework and relief vent are connected to a ventilating stack and extended to the atmosphere as shown in **FIGURE 7**. However, the ventilating stack need not be connected directly to the discharge stack and can be smaller in diameter than that required for a ventilated stack system.

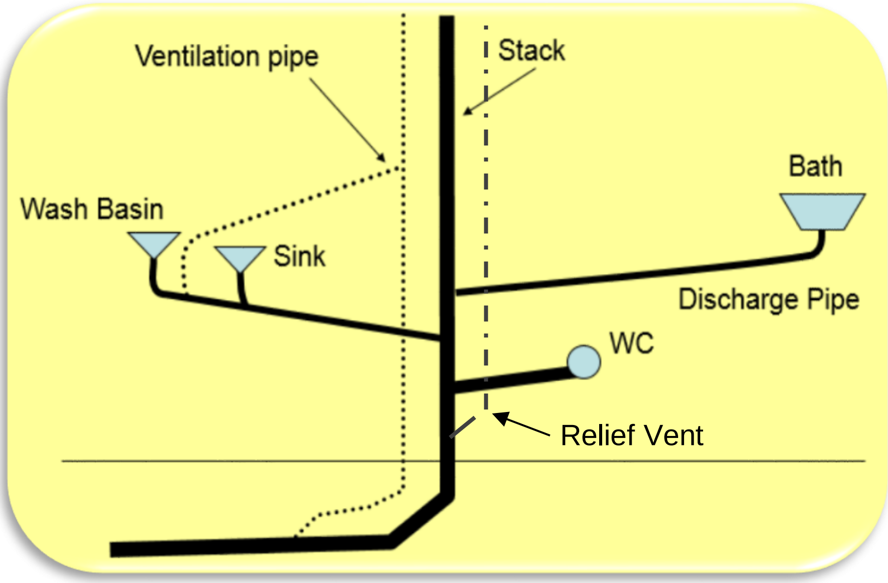



**FIGURE 7: Modified Single Stack System**

### 5.3.3 Ventilated Stack System

A ventilated stack system is used in situations where vent stack is connected to the branch discharge pipes and extending the stack to the atmosphere when there are close group of appliances as shown in **FIGURE 8**.

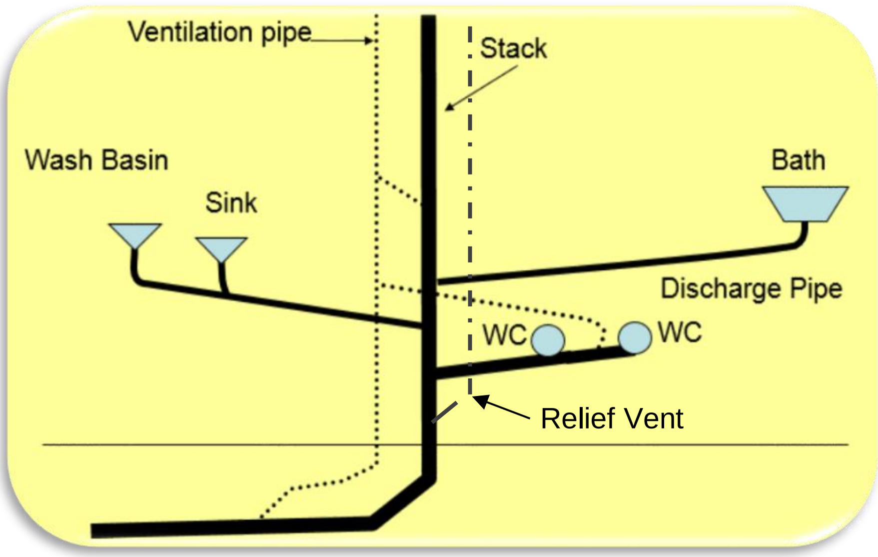



**FIGURE 8: Ventilated Stack System**

### 5.3.4 Fully Ventilated System

A fully ventilated system is used in situations where there are large numbers of sanitary appliances in ranges or where they have to be widely dispersed. Thus, it is impractical to provide discharge stack in close proximity to the appliances. Trap seals are safeguarded by extending the ventilating stack by providing individual branch ventilating pipe as shown in **FIGURE 9**.

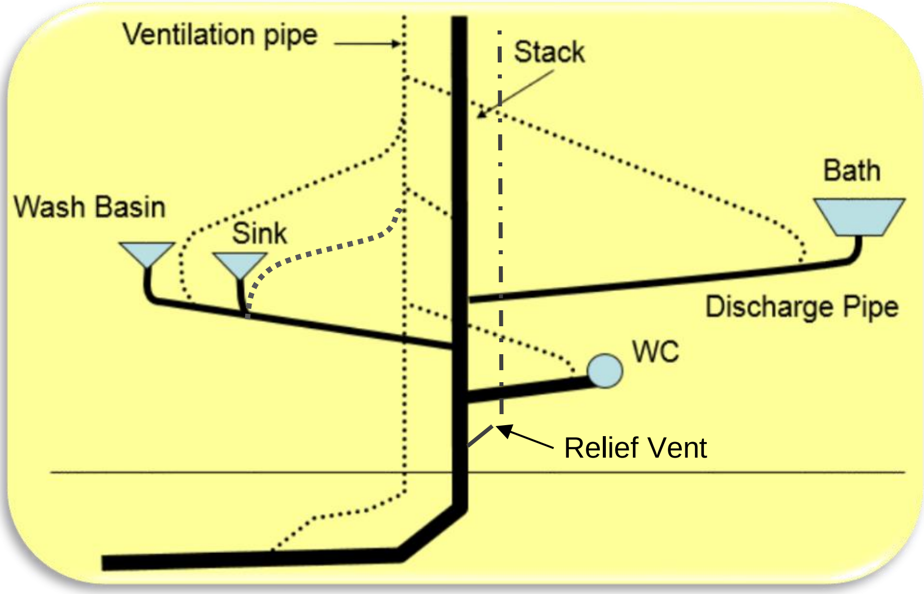



**FIGURE 9: Fully Ventilated System**

**TABLE 6** provides a few examples of different type of discharge systems on a variety of building applications.

**TABLE 6: General Application of Discharge System**

| Discharge System | General Application |
|---|---|
| Single Stack System | Bungalow, Terrace |
| Modified Single Stack System | Apartment, Shop house, hostel, School |
| Ventilated Stack System | Office |
| Fully Ventilated System | Shopping complex, Hospital, Airport |

## 5.4 Branch Ventilating Pipes

The purpose of ventilating pipes is to maintain equivalent of pressure within the sanitary piping system and thus prevent the destruction of trap seals by siphonage or compression.

### 5.4.1 Sizing of Branch Ventilating Pipes

The size of the ventilating pipes to branches from individual appliances as shown in **FIGURE 10** can be DN25 provided if they are less than 15 m or contain less than 5 bends. Otherwise, a DN 30 pipe should be used. If the application is likely liable to blockage due to repeated submergence on a WC branch, the diameter of the vent pipes should be larger but it can be reduced when above the spillover level of the appliance. (*MS 1402: PART 1:2006)*

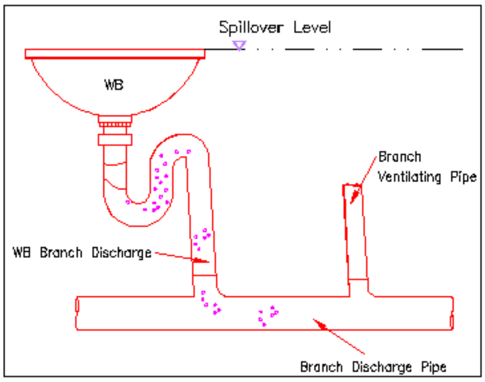



**FIGURE 10: Ventilating pipes to branches**

## 5.5 Ventilating Stacks

Every drainage stack should have an attendant vent stack. The purpose of installing a vent stack is to prevent the development of excessive pressure in the lower regions of the drainage stack by relieving the air as rapidly as it is carried down by the discharge of the drainage stack. The most effective location for the vent stack is detailed out in **Appendix A (A.9)**. (*MS 1402: PART 1:2006)*

### 5.5.1 Sizing of Ventilating Stacks

Sizes of ventilating stacks are as follows:

a) The trap connecting directly to a discharge pipe should be provided with a branch-ventilating pipe of not less than 50 mm in diameter.

b) For multi-storey buildings of seven-stories or higher, the discharge pipe serving the second storey should be connected to a discharge stack of diameter not less than 100 mm. This stack should be extended to serve as ventilating stack but may be reduced to 75 mm diameter.

## 5.6 Relief Vents

A relief vent primarily eliminates positive and negative pressure of the drainage system. It should be provided on any stack if one or more floors separate the floor levels of the highest and lowest branch pipe connected to the stack as **FIGURE 11**, where at any stack is offset at less than 45° to the horizontal, a relief vent should be provided:

a) on the stack, below the offset, if disregarding the offset one or more floors separate the floor levels of the highest and lowest branch pipe connected to the stack.
b) on the stack, above the offset, if one or more floors separate the floor levels of the highest and the lowest branch pipe connected to the section of the stack above the offset as shown in **FIGURE 12 (a) & (b)**.

Relief vents should either:

a) extended upwards at a minimum grade of 1° and interconnect with the stack vent, or another relief vent.
b) extended upwards to the open air.

The size of any relief vent should be in accordance with **Table 7**, having regard to the size of the stack, the sum of the rating of all fixture connected and the developed length of the vent measured along the pipework from its lowest connection to the stack to its upper termination point.

The lower relief vent may interconnect with the upper relief vent above the spillover level of the fixtures served by the upper relief vent. A relief vent need not be larger than the stack to which it is connected.

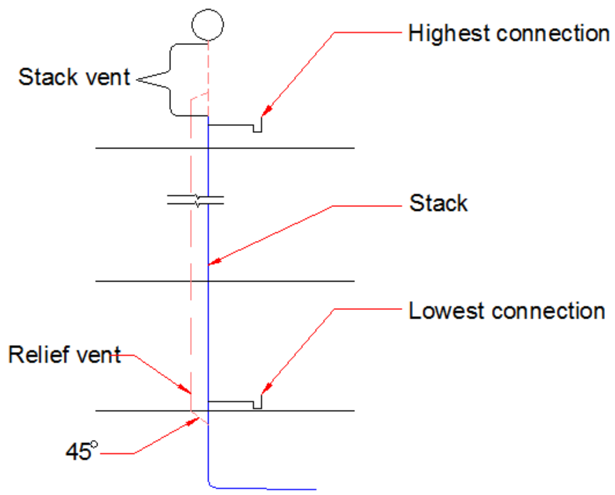



**FIGURE 11: Typical Arrangement of Relief Vent**

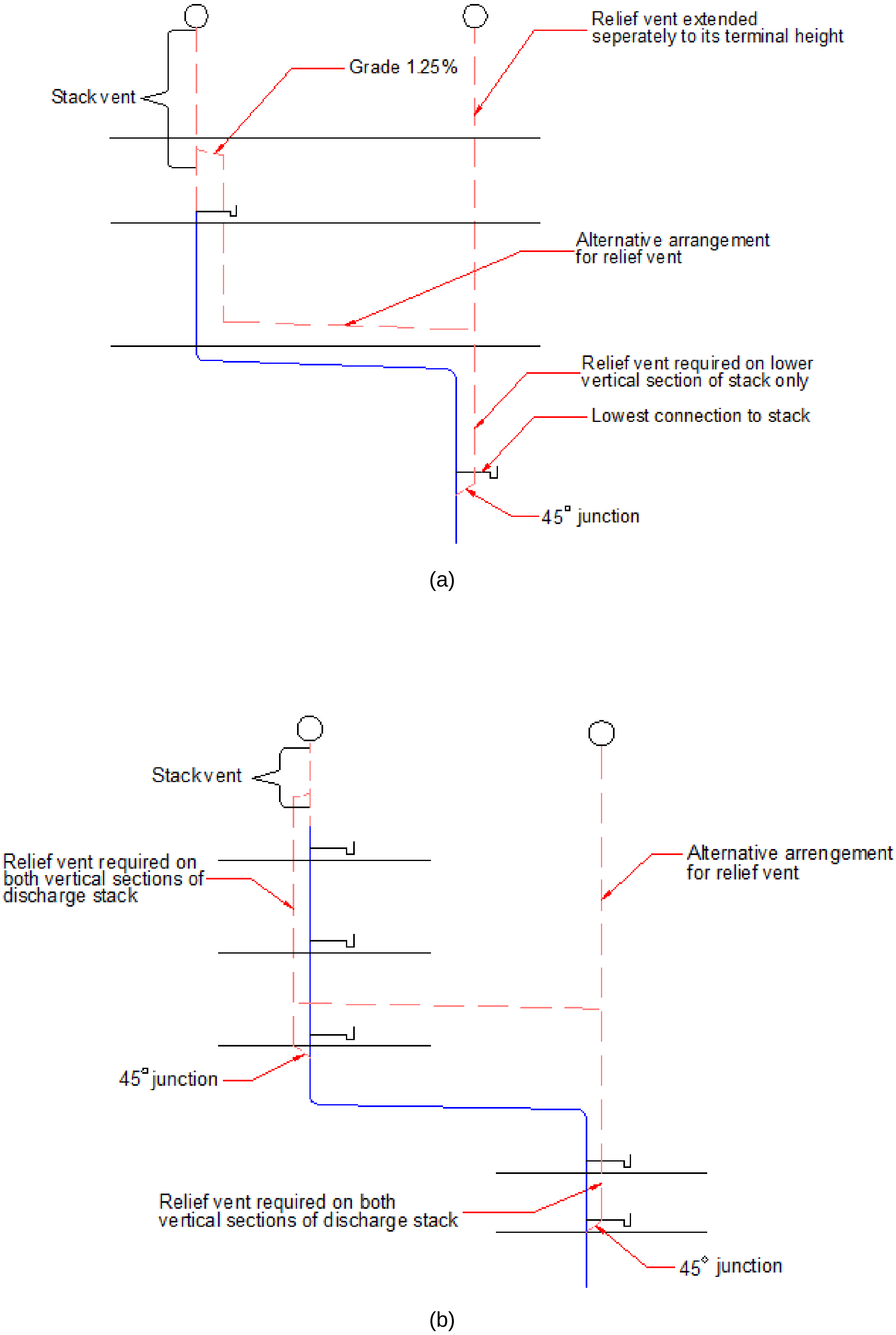



**FIGURE 12: Typical Arrangement of Relief Vent at Stack Offsets**

### 5.7 Stack Vents

The stack vent may extend separately to the atmosphere or interconnect with the relief vent above the overflow level of the highest fixture connected to the stack, and should be sized in accordance to **TABLE 7**, except that the stack vent need not be larger than the stack. Sample calculation is shown in section 9.0.

**TABLE 7: Size of Relief Vents and Stack Vents**

| Size of stack | Maximum appliance units connected | Maximum developed length of vents (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Required vent size | | | | | | | |
| | | DN 32 | DN 40 | DN 50 | DN 65 | DN 80 | DN 100 | DN 125 | DN 150 |
| DN 40 | 16 | 6 | 15 | | | | | | |
| DN 50 | 20 | 8 | 15 | 46 | | | | | |
| DN 50 | 36 | 6 | 10 | 30 | | | | | |
| DN 65 | 20 | | 12 | 40 | 110 | | | | |
| DN 65 | 56 | | 7 | 24 | 80 | | | | |
| DN 80 | 20 | | 8 | 27 | 70 | 170 | | | |
| DN 80 | 80 | | | 12 | 20 | 110 | | | |
| DN 100 | 150 | | | 9 | 25 | 70 | 280 | | |
| DN 100 | 300 | | | 8 | 22 | 60 | 216 | | |
| DN 100 | 500 | | | 6 | 19 | 50 | 197 | | |
| DN 125 | 300 | | | | 9 | 22 | 95 | 280 | |
| DN 125 | 750 | | | | 7 | 19 | 72 | 230 | |
| DN 125 | 1100 | | | | 6 | 14 | 62 | 190 | |
| DN 150 | 700 | | | | 4 | 9 | 37 | 155 | 300 |
| DN 150 | 1300 | | | | | 7 | 30 | 130 | 250 |
| DN 150 | 2400 | | | | | 6 | 24 | 100 | 200 |
| DN 225 | 1700 | | | | | | | 16 | 62 |
| DN 225 | 4000 | | | | | | | 14 | 43 |
| DN 225 | 7000 | | | | | | | 6 | 31 |

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

## 6.0 SPECIAL DESIGN REQUIREMENT

Special design is required for specific areas in the building for hygiene and safety purposes. These special sanitary systems need to be planned as part of the building process. The designer shall provide input regarding location and size of the equipment to the architect during initial stage of design**.** All underground drainage pipes layout should be well-coordinated to avoid obstacles such as ground beams. Three areas that require special sanitary pipework are highlighted as following:

- **Kitchen**
- **Laboratory**
- **Workshop**
- **Hospital**

### 6.1 Kitchen

In kitchens, the risk of pipe blockage is increased by the higher proportion of grease and suspended solids in the waste water. In addition to the normal provision of access points on the discharge stack above the spillover level of the appliances and at the high end of the branch discharge pipes, so access should be provided close to appliances such as food waste solids and vegetable paring machines where there is a high risk of blockage. It is also necessary to ensure that access points are located in positions, which will be accessible, after the sanitary wares and fittings have been installed. A typical kitchen drainage system is shown in **FIGURE 13**.

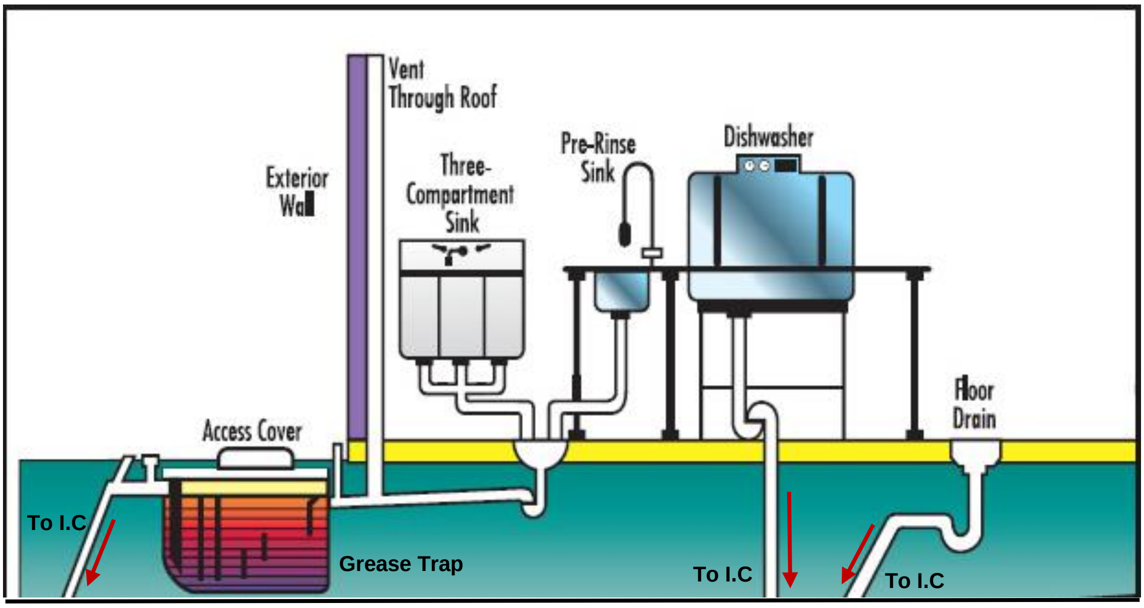



**FIGURE 13: Typical Kitchen Drainage System**

### 6.1.1 Specific Requirements

(*Extracted from MS 1402: PART 1:2006*)

i. 'Drain-off' valves on food containers should be of the full way plug-cock type with quick release bodies for easy cleaning. These valves should not be connected to a discharge pipe or drain without an intervening air break.

ii. Scupper drain and gratings to gullies in kitchens, food preparation and wash-up rooms, harbour dirt and grease and if the gratings are not properly fitted they can be hazardous to pedestrian traffic. This form of drainage is unhygienic and should be avoided.

iii. Sinks and washing up machines should be individually trapped and connected directly to the discharge/drainage system.

iv. The pipes from appliances which discharge waste water containing heavy concentrations of solid matter should not be connected to the long runs of horizontal discharge pipes. They should be connected as close as is practicable to the main vertical discharge stack or drain to gain the maximum flushing advantage from appliances with high waste water discharge rates.

v. Where practicable items of kitchen equipment such as steaming ovens, bain marie, boilers and cafe sets should discharge over a drip tray having a trapped outlet connected to the discharge system.

vi. Boiling pans should be drained separately into trapped gullies. The trapped gully should be fitted with a solid hinged flap flush with the floor, the flap kept closed when not in use.

### 6.1.2 Grease Trap

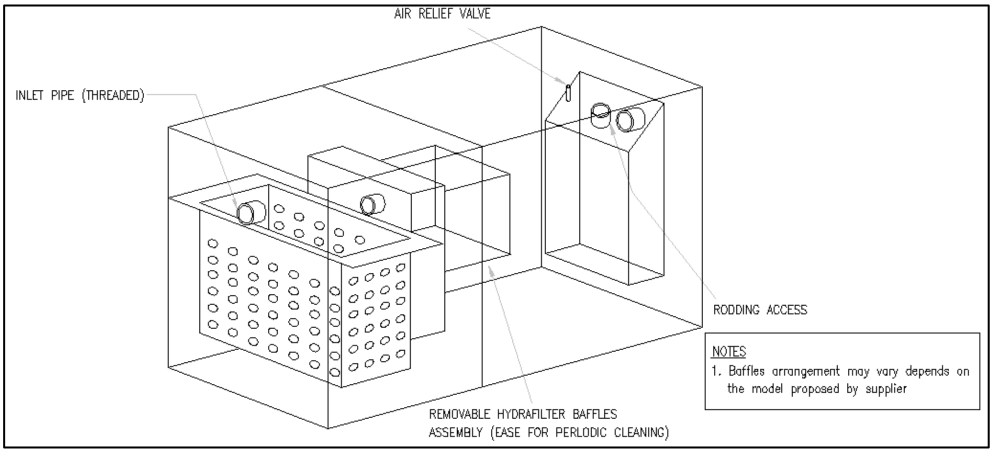



**FIGURE 14: Example of Grease Trap**

Where used, grease trap should be designed and located to promote cooling, coagulation, and retention of the grease within the trap.

They should be sized to achieve maximum efficiency. The temperature and velocity of flow of the waste water should allow the grease to separate and collect on the surface of the water in the trap reservoir. In the standard type of grease trap, the process of separation will be impaired or even prevented by the use of detergents, which emulsify the grease.

Consideration should also be given to the general nature of the waste matter discharged, since the reduced flow velocity through the trap will allow solid waste matter in suspension to settle and collect in the trap reservoir.

Provision should be made to facilitate the hygienic removal and disposal of the grease. Grease trap should be completely emptied and cleaned periodically to prevent the development of septic conditions in the trap reservoir. To avoid the risk of food contamination, grease traps should not be located in food rooms.

## 6.2 Laboratory

At any design of laboratory waste system, it is important to confirm with the client as to the type and probable quantities of chemical waste that will be discharged. Generally, vertical distribution is ideal for laboratory premises with repetitive planning on successive floors.

Due to the nature of discharges from laboratory, despite the fact that the best material for the job should be selected, the life expectancy may well be less than for ordinary discharge systems. Therefore, the design must take into consideration ease of replacement.

### 6.2.1 Special Requirements

i. It is preferable for each laboratory to have its own connection to the main stack in order to avoid undesirable chemical effect.
ii. Discharge pipes must be sealed throughout their run to the sewer which should be as short as possible.
iii. The routing of pipes must take into account areas which might be cause hazard by leakage and should be freely accessible for inspection and repair.
iv. Radioactive pipe runs must be labelled at points of access.

### 6.2.2 Neutralizing Tank

Neutralizing tank as shown in **FIGURE 15** is designed to receive, dilute and neutralize corrosive and harmful chemical wastes, before allowing such materials to be discharged in accordance with local environmental requirements. It is suitable for centralized installation for neutralizing and dilution of laboratory acids and chemicals. Approximate sizing of neutralizing tank should be decided by designer and to be indicated in the tender drawing. **FIGURE 16** shows the typical installation pipework of neutralizing tank.

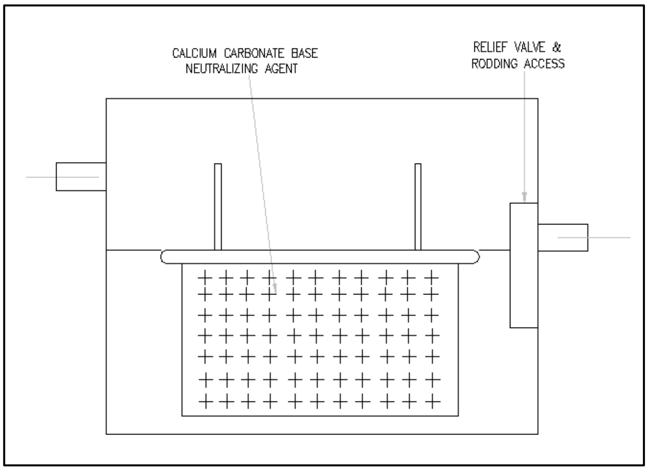



**FIGURE 15: Example of Neutralizing Tank**

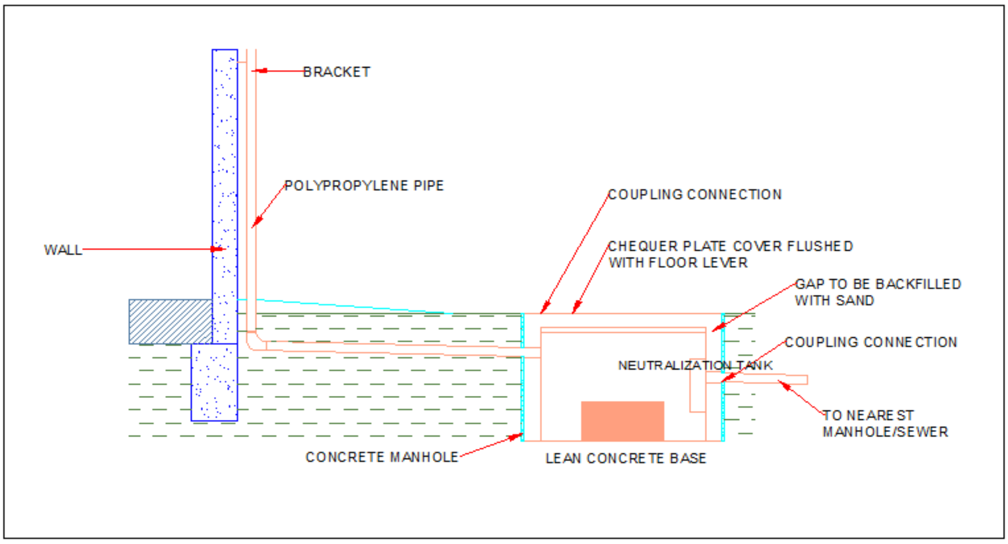



**FIGURE 16: Typical Installation of Neutralizing Tank**

## 6.3 Workshop

In site such as workshop and fuel storage area, there is always the problem of flammable or high volatile liquids entering the sanitary drainage system, which can contaminate the sewer line or cause an explosive condition. With the high risk of oil contamination, it is appropriate to include oil interceptor as shown in **FIGURE 17** as part of the sanitary drainage system in the workshop. Designer should request scupper drain with grating from architect during planning stage.

### 6.3.1 Oil Interceptor

The discharge of oily waste to the natural environment is disastrous to nature. Oil interceptor can be fitted to water drainage system to protect the environment. To be effective, oil interceptor need to be correctly selected, installed and maintained. Below are some general considerations for proper oil interceptor selection.

- The discharge point of your proposed interceptor
- The environment sensitivity of your location
- Activities on your site

The European Standard BS EN 858-1:2002 could be referred for the design, use, selection, installation, operation and maintenance of oil interceptor.

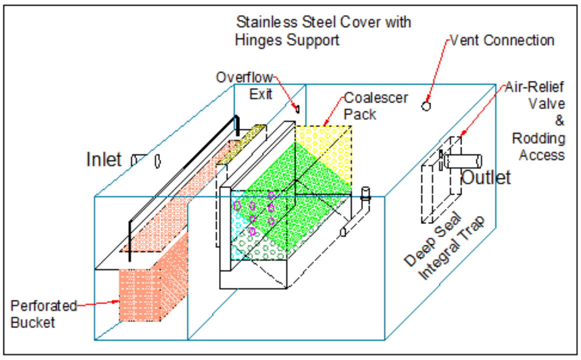



**FIGURE 17: Example of Oil Interceptor**

## 6.4 Hospital

For equipment in the hospital, there are specific requirements on sanitary plumbing appliances in dentistry and orthopedics department such as the installation of plaster trap. A large amount of waste or debris from orthopedic and dental mould from these departments could cause the blockage of drainage system. Using plaster without the proper trap systems could potentially damage drainage pipes and eventually cost a lot of money for repairs.

### 6.4.1 Plaster Trap

Plaster trap is designed to provide a filter within a draining system as shown in **FIGURE 18**. Plaster trap shall be provided when precious metals, heavy metals, (such as silver and barium) or sediment is in the waste drainage from spaces such as dental laboratories, cast rooms, prosthodontics laboratories, barium procedure areas, and spaces employing blood analyzers. Interceptors for barium waste shall be aluminum. Designer should request plaster trap from architect during planning stage.

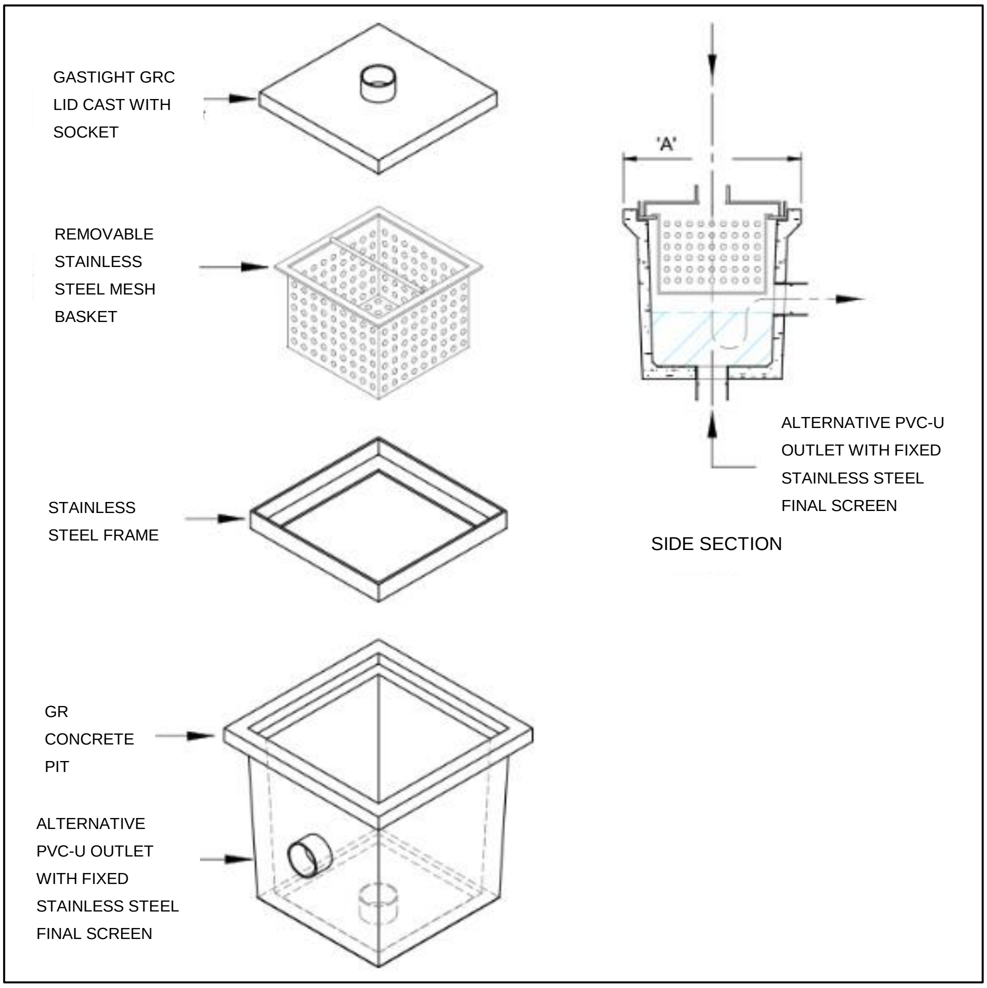


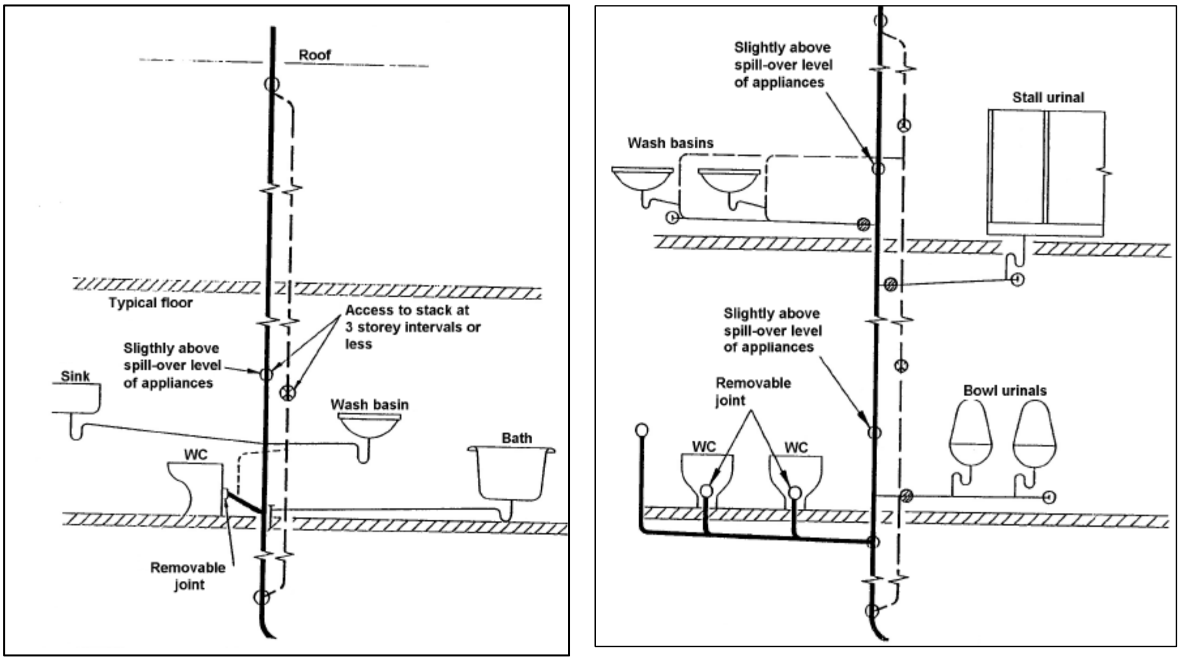

**FIGURE 18: Example of Under Sink Plaster Trap**

## 7.0 ACCESS FOR MAINTENANCE

Sufficient and suitable access should be provided to enable all pipework to be tested and maintained effectively. The access covers, plugs or caps should be sited so as to facilitate the insertion of testing apparatus and the use of equipment for cleaning and/or for the removal of blockages. Their use should not be impeded by the structure or other services.

Access points as shown in **FIGURE 19 (a) & (b)** should not be located where their use may give rise to nuisance or danger if spillage occurs. This can be mitigated if access is above the spillover level of the pipework likely to be affected by a blockage and/or are extended to suitable positions.

Access opening shall be decided at site by Superintendent Officer (S.O). It is important that the statement "*Final adjustment to be done at site*" be included in the tender drawing of sanitary piping.




(a) Example of access positions on stacks in a multi-storey application with single appliances

(b) Example of commercial system

**FIGURE 19: Access for Maintenance Purpose**

## 8.0 TYPICAL SANITARY SYSTEM INSTALLATION

Kindly note the following rules:

a) For system up to five storeys high, the distance between the lowest branch connection and the invert level of the drain shall be at least 750mm. Traditionally in Malaysia, all ground floor outlets are connected directly to the nearest inspection chambers or manholes.

b) For higher multi-storey buildings and where manhole is quite far from appliances it is better to connect the ground floor appliances into the horizontal drains and not at the stack.

c) It is recommended to allow up to 5 discharge pipes to be connected to each inspection chamber as shown in **FIGURE 24**.

d) For detailed installations, refer to **Appendix A1** to **A9**.

e) The symbols of sanitary fittings that are typically used in architect drawing are as shown in **Appendix B**.

f) This guideline also emphasizes on the selection of innovative top removal floor trap for the ease of maintenance and to prevent insects and gases from entering the building. It is a removable trap that is easier to be cleaned.

Examples of sanitary system installation are as shown in **FIGURE 20 - 23**:

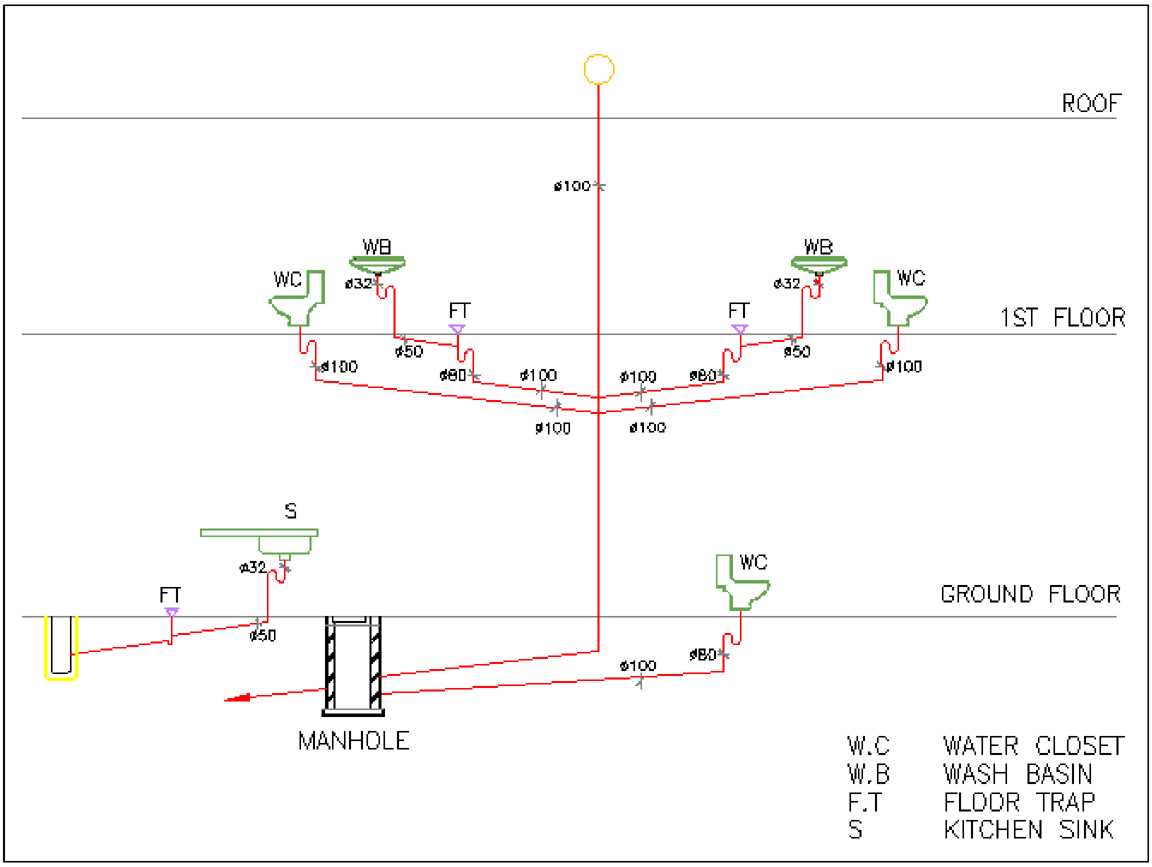



**FIGURE 20: Single Stack System – Double Storey Bungalow**

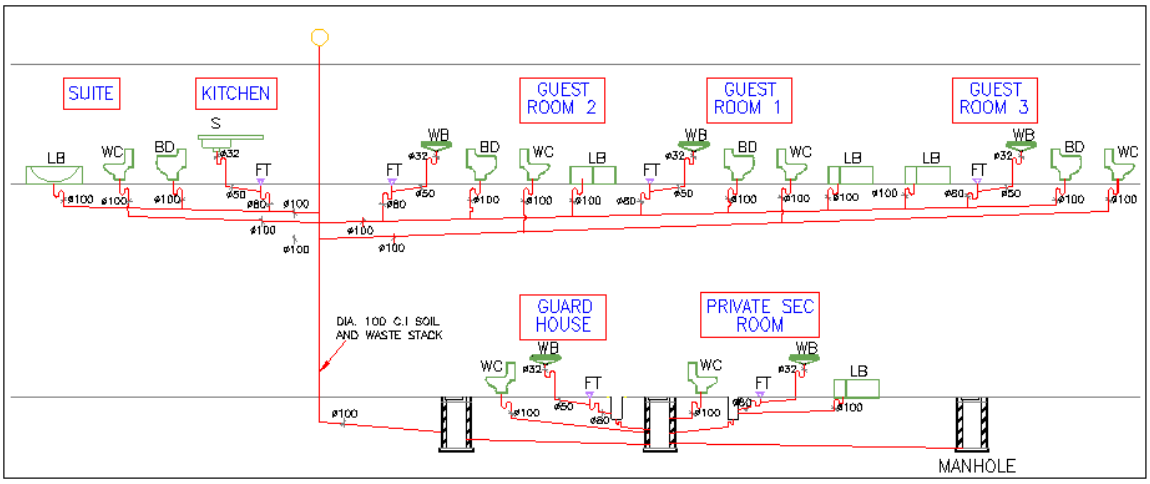



**FIGURE 21: Two Storey Building with Appliances in Range**

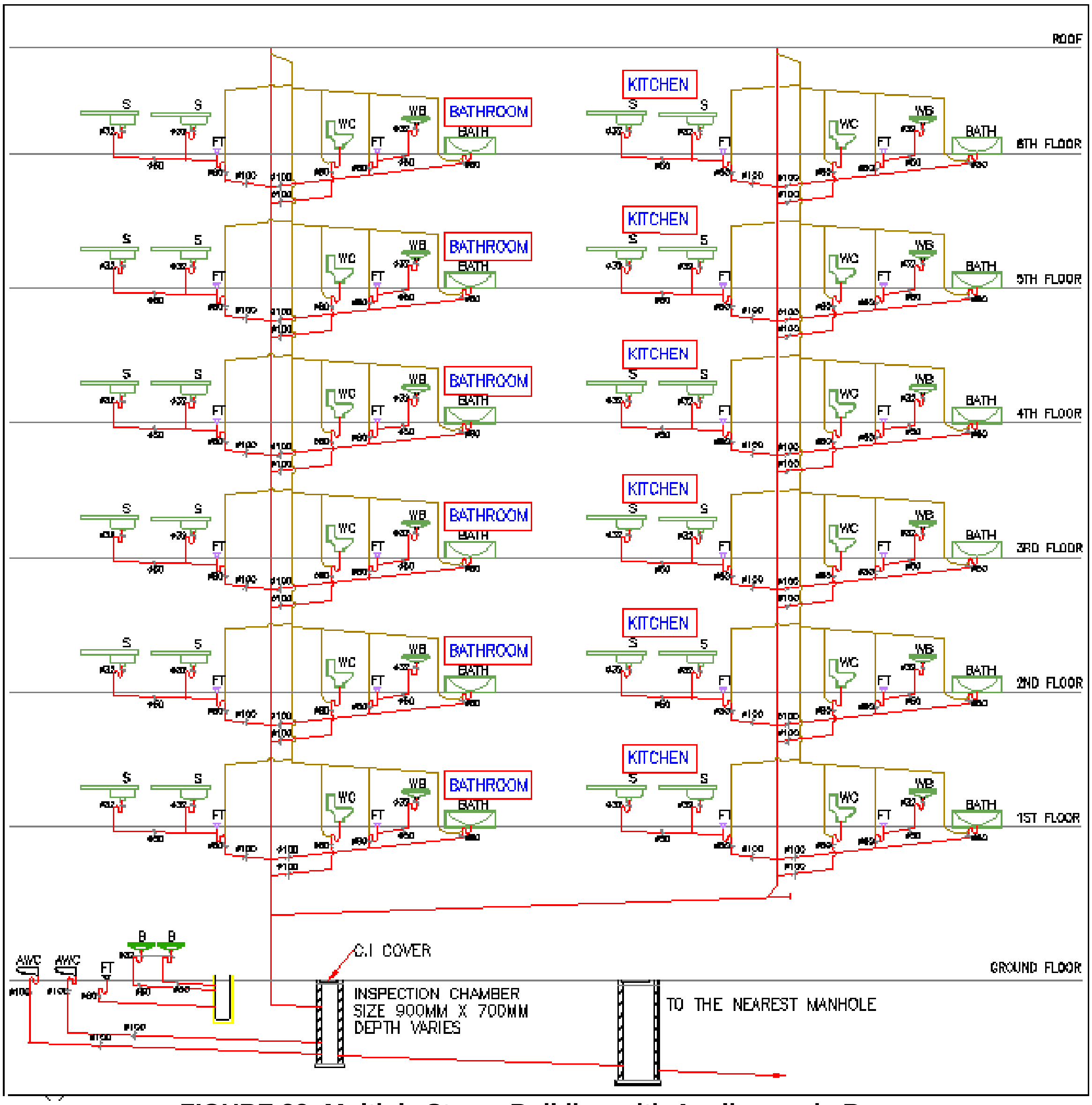



**FIGURE 22: Multiple Storey Building with Appliances in Range**

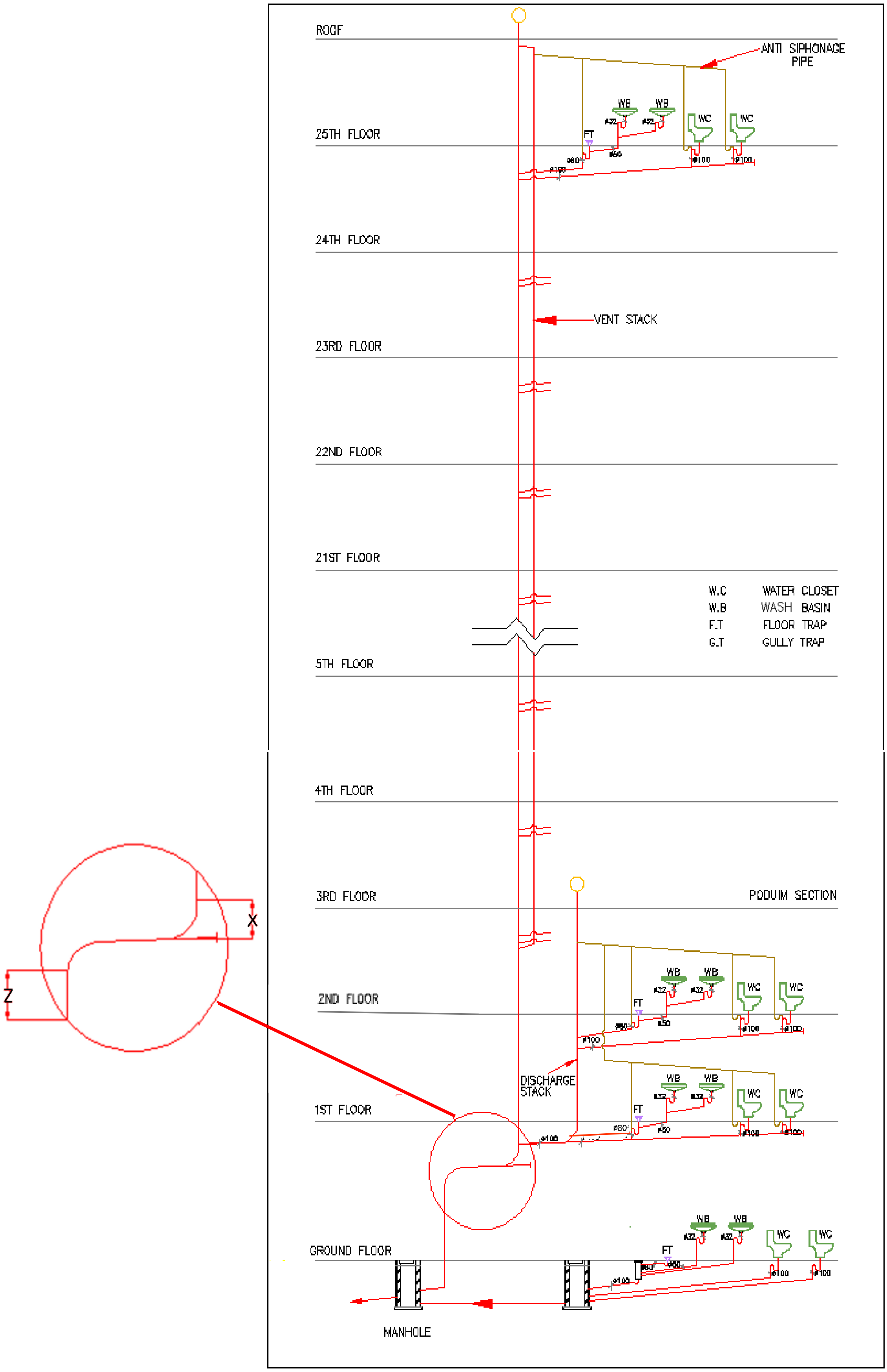



**FIGURE 23: Restricted Connection Zones Above and Below Offset with Min. X=1 m, Min. Z=0.6 m if the Stack Cannot Continue Vertically**

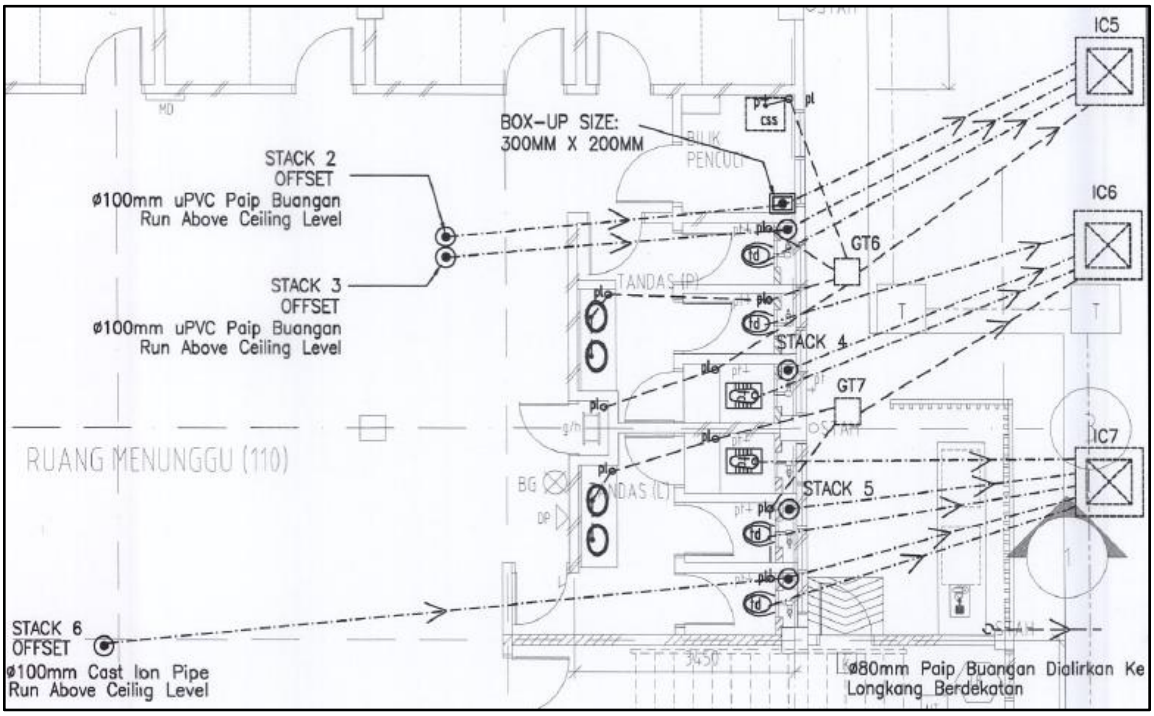



**FIGURE 24: Discharge Pipe to Inspection Chamber**

## 9.0 SAMPLE CALCULATION

Calculate the size of the branch discharge pipe and the main stack as shown in **FIGURE 25**.

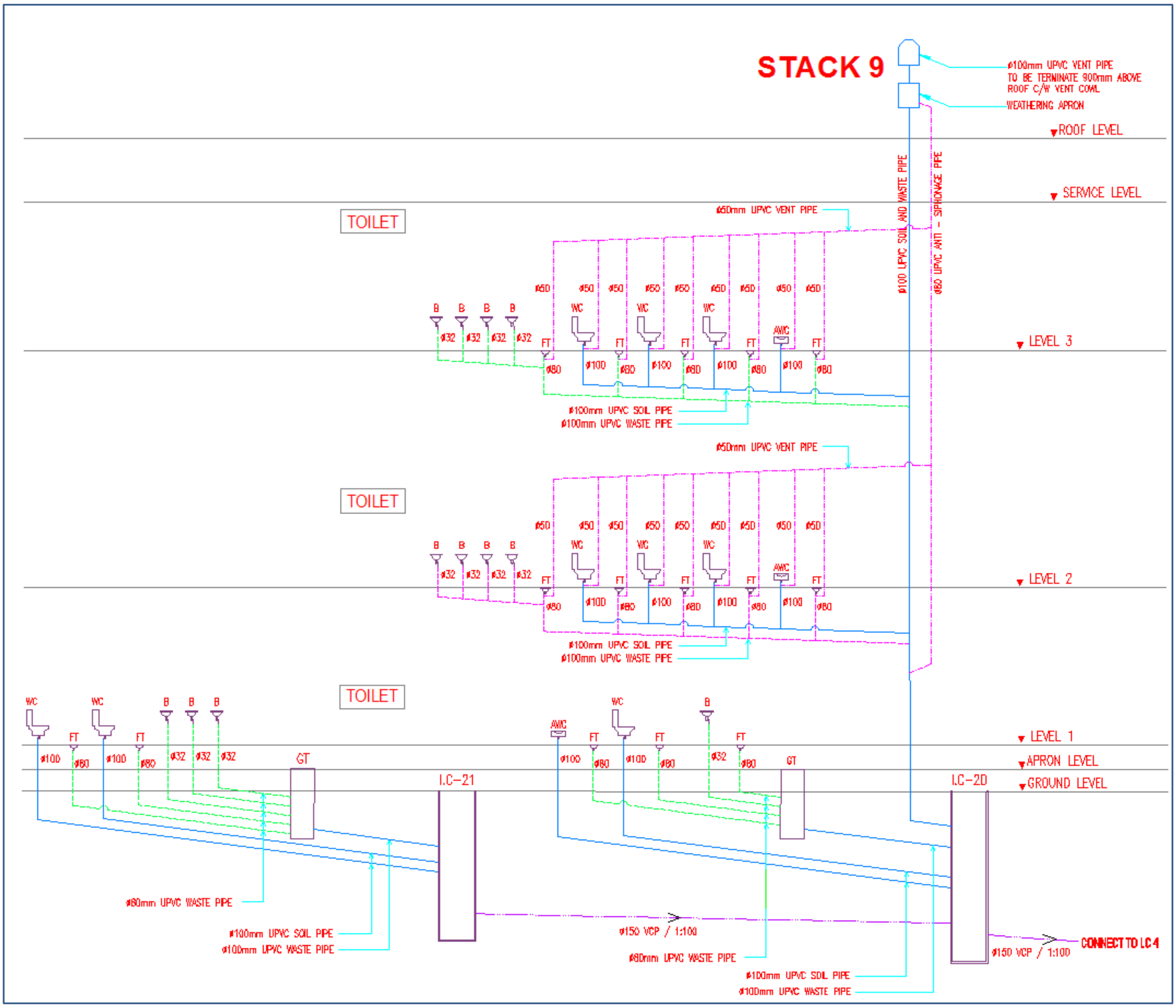



**FIGURE 25: Discharge Piping Layout**

<u>Solution:</u>

Discharge unit based on the capacity given in **TABLE 2**:

| Level 2 | | | | | |
|---|---|---|---|---|---|
| | **Fitting** | **Qty** | **Discharge Unit per Fitting** | **Sub Total** | **Total** |
| Waste Pipe | Basin | 4 | 6 | 24 | 24.5 |
| | F.T. | 5 | 0.1 | 0.5 | |
| Soil Pipe | W.C. | 4 | 9 | 36 | 36.0 |
| **Total per Floor** | | | | | **60.5** |

| **Level 3** | | | | | |
|---|---|---|---|---|---|
| Waste Pipe | Basin | 4 | 6 | 24 | 24.5 |
| | F.T. | 5 | 0.1 | 0.5 | |
| Soil Pipe | W.C. | 4 | 9 | 36 | 36.0 |
| **Total per Floor** | | | | | **60.5** |
| **Total per Stack** | | | | | **121.0** |

**i) Determine the size of branch discharge pipes for Level 2 and Level 3 based on TABLE 4:**

Since total discharge units for the waste pipe and soil pipe is 24.5 and 36 each on both levels, branch discharge pipe of size **DN 100** could be selected theoretically with 2 % gradient. Percentage (%) gradient is defined as $\frac{vertical\ rise}{horizontal\ distance} x100$. Referring to **5.1.2**, the practical minimum gradient is 1° which is close to 2 % gradient.

| **Graded %** | **Nominal size of pipe** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | DN 40 | DN 50 | DN 65 | DN 80 | DN 100 | DN 125 | DN 150 | DN 225 |
| 5.00 | 6 | 15 | 51 | 65 | 376 | 953 | 1959 | 7098 |
| 3.35 | 5 | 10 | 29 | 39 | 248 | 686 | 1445 | 5583 |
| 2.50 | 4 | 8 | 21 | 27 | 182 | 509 | 1148 | 4513 |
| 2.00 | | | | 20 | 142 | 410 | 953 | 3739 |
| 1.65 | - | - | - | 16 | 115 | 342 | 813 | 3258 |
| 1.25 | - | - | - | - | - | 254 | 627 | 2656 |
| 1.00 | - | - | - | - | - | - | 509 | 2272 |

**ii) Determine the size of discharge stack size based on TABLE 5 (b):**

Level 2 and 3 have a totalled discharge unit of 121.0, therefore the size of discharge stack selected is **DN 100 or higher**. In this case, **DN 100** discharge stack is selected. Please note that since **DN 100** branch discharge pipe is selected, the size of discharge stack selected must be equal or larger than the **DN 100** branch discharge stack.

| Three or fewer floor levels | | |
|---|---|---|
| **Size of stack** | **Maximum loading per floor level** | **Maximum loading per stack** |
| DN 40 | 2 | 6 |
| DN 50 | 5 | 15 |
| DN 65 | 6 | 18 |
| DN 80 | 13 | 40 |
| DN 100 | 65 | 195 |
| DN 125 | 150 | 450 |
| DN 150 | 250 | 750 |
| DN 225 | 950 | 2850 |

**iii) Determine the type of discharge system required:**

The discharge system required would be **fully ventilated system** as there are a large number of sanitary appliances installed, and individual branch ventilating pipe is preferable for ventilation within the system.

**iv) Determine the size of the branch ventilating pipe:**

Based on **5.4.1**, the minimum size of the branch ventilating pipe being used would be **DN 25**. In this particular example, branch ventilating pipe of **DN 50** is selected.

**v) Determine the size of the ventilating stack:**

In this design, the **DN 100** stack can be extended to serve as ventilating stack.

**vi) Determine the size of the relief vent based on TABLE 7:**

Based on **FIGURE 25**, there are about 26 appliance units from Level 2 and Level 3 connected to the 100mm discharge stack and the size of relief vent should be at least one half of the discharge stack. Since 9 metres of maximum develop length of relief vent is sufficient to accommodate a 3-storey building, the relief vent of size **DN 50** is selected.

| Size of stack | Maximum appliance units connected | Maximum developed length of vents (m) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Required vent size | | | | | | | |
| | | DN 32 | DN 40 | DN 50 | DN 65 | DN 80 | DN 100 | DN 125 | DN 150 |
| DN 40 | 16 | 6 | 15 | | | | | | |
| DN 50 | 20 | 8 | 15 | 46 | | | | | |
| DN 50 | 36 | 6 | 10 | 30 | | | | | |
| DN 65 | 20 | | 12 | 40 | 110 | | | | |
| DN 65 | 56 | | 7 | 24 | 80 | | | | |
| DN 80 | 20 | | 8 | 27 | 70 | 170 | | | |
| DN 80 | 80 | | | 12 | 20 | 110 | | | |
| DN 100 | 150 | | | 9 | 25 | 70 | 280 | | |
| DN 100 | 300 | | | 8 | 22 | 60 | 216 | | |
| DN 100 | 500 | | | 6 | 19 | 50 | 197 | | |
| DN 125 | 300 | | | | 9 | 22 | 95 | 280 | |
| DN 125 | 750 | | | | 7 | 19 | 72 | 230 | |
| DN 125 | 1100 | | | | 6 | 14 | 62 | 190 | |
| DN 150 | 700 | | | | 4 | 9 | 37 | 155 | 300 |
| DN 150 | 1300 | | | | | 7 | 30 | 130 | 250 |
| DN 150 | 2400 | | | | | 6 | 24 | 100 | 200 |
| DN 225 | 1700 | | | | | | | 16 | 62 |
| DN 225 | 4000 | | | | | | | 14 | 43 |
| DN 225 | 7000 | | | | | | | 6 | 31 |

**vi) Determine the length/termination of the stack vent:**

The stack vent should not less than 900 mm above the head of any window or other opening into a building and within a horizontal distance of 3 m.

## 10.0 TENDER DRAWINGS

Tender drawing issued for tendering purposes must be able to convey the location, requirements and scope of work of the project. It shall form a uniform set, consistent in sheet size and general appearance. It shall be used as a reference to get a clear and complete requirement.

At tender drawing shall consist of the list of drawings, the site plan, the floor plan (layout), the schematic drawings, notes and details which shall consist of but not limited to the following:

a) Dimension
b) Pipe Material
c) Scale (normally set to 1:100)
d) Fitting Connection
e) Legend
f) View and Projection
g) Typical Installation
h) Notes

## 11.0 REFERENCES

i. MS 1402: PART 1:2006 - Code Of Practice For Sanitary System In Buildings – Part 1 : Design.
ii. Code Of Practice For Sanitary Pipework, BS 5572:1994
iii. Gravity Drainage Systems Inside Buildings - Sanitary Pipework, Layout and Calculation, BS EN 12056-2:2000.

# APPENDIX A: METHODS OF INSTALLATION

## A.1 Branch Pipe Bends and Junctions

Bends in branch discharge pipes should be avoided, especially for single or ranges of wash basins, as they can cause blockages and increase self-siphonage effects. When they are unavoidable they should be of large radius.

Junctions between branch discharge pipes of about the same diameter should be swept in the direction of flow using swept entry branches with a 25 mm minimum root radius, otherwise 45° branches should be used as shown in **FIGURE 26**.

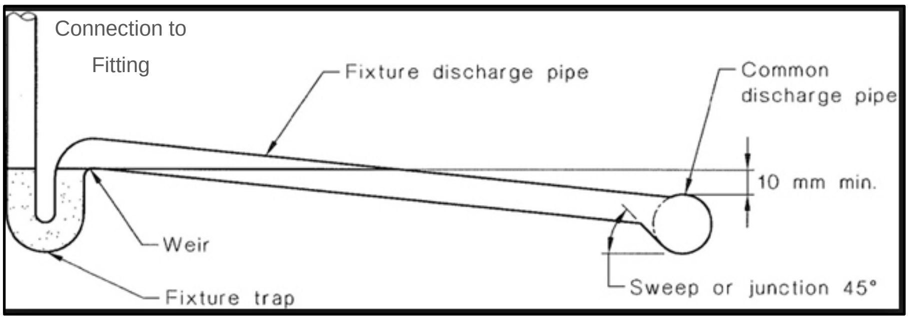



**FIGURE 26: 45° Swept In Entry Branch**

To minimize the risk of blockage, branches up to 40 mm size joining larger diameter horizontal branches of 100 mm or over should, if practicable, connect to the upper part of the pipe wall of the larger branch as shown in **FIGURE 27**. For the same reason, opposed branch connections in the horizontal plane to a main branch discharge pipe should be avoided as shown in **FIGURE 28**. (*MS 1402: PART 1:2006)*

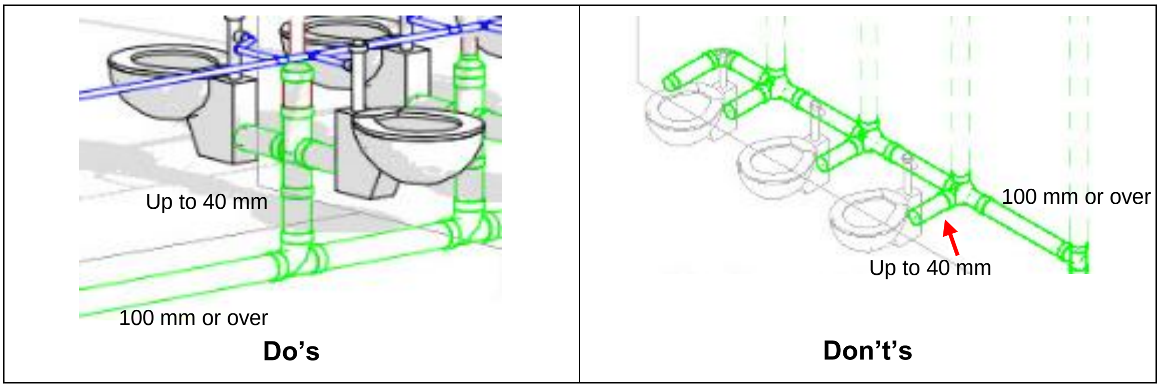



**FIGURE 27: Do's and Don'ts of Branch Pipe Connections**

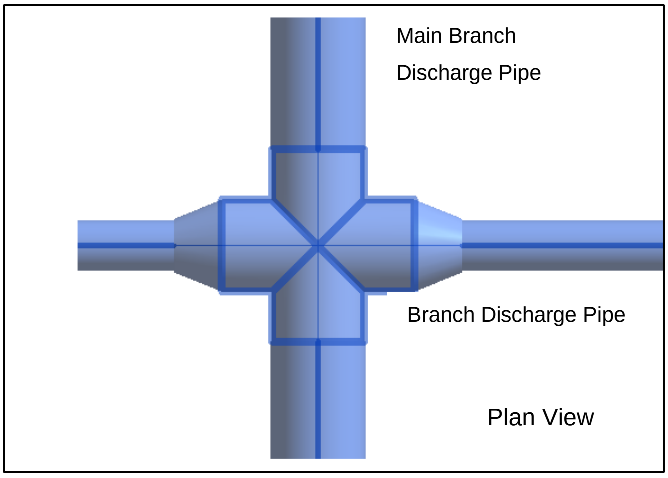



**FIGURE 28: Avoid Opposed Horizontal Branch Connection to Main Branch Discharge Pipe**

## A.2 Branch Pipe Connections to Discharge Stacks

Generally, small diameter branch discharge pipes of up to 65 mm size may be connected to stacks of 75 mm or larger by swept or unswept branch connections and some change in gradient close to the stack is permissible to allow the use of a standard 87.5° branch boss.

As for 32 mm pipes serving wash basins, the sweep radius should not be greater than 25 mm (**FIGURE 29**) and the change in gradient should be within 250 mm from the stack.

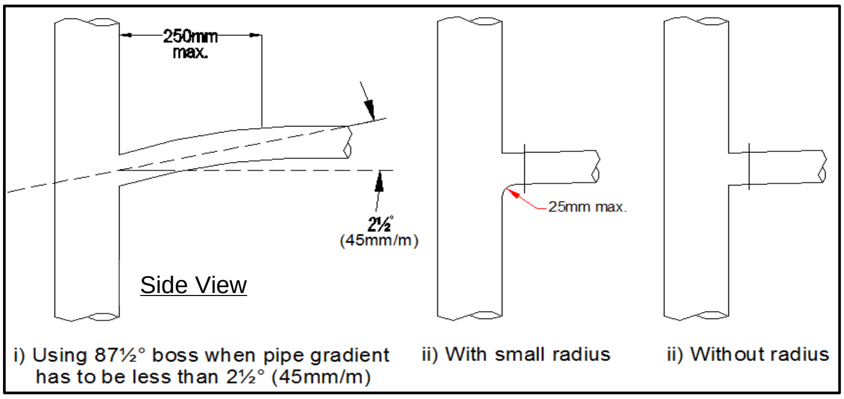



**FIGURE 29: For Branch Discharge Pipes of 32 mm Serving Wash Basin**

A branch inlet of 75 mm to 150 mm size joining a discharge stack of equal diameter should be swept in the direction of flow with a radius of not less than 50 mm for angles of 87.5° to 67.5° as shown in **FIGURE 30 (a)**, whereas branch pipe connections at 45° or less do not need swept inlets [**FIGURE 30 (b)**].

Branch inlets of 75 mm size joining 100 mm or 150 mm discharge stacks and branch inlets of 100 mm joining 150 mm stacks may be swept or unswept as well as shown in **FIGURE 30 (c)**. (*MS 1402: PART 1:2006)*

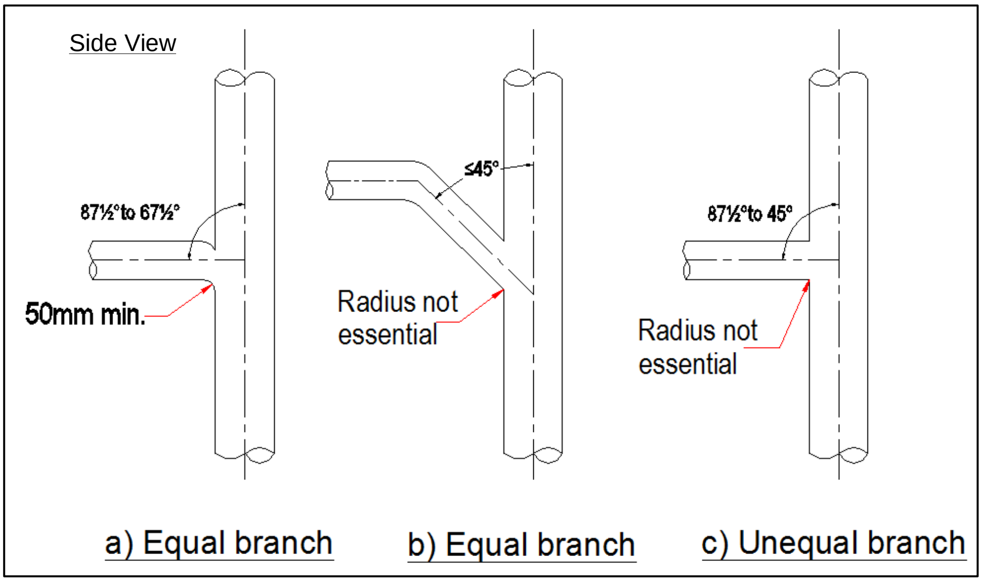



**FIGURE 30: For Branch Discharge Pipes of 75 mm to 150 mm Diameter (Connected to Stacks of Up to 150 mm Diameter)**

### A.3 Cross Flow Prevention of Branch Discharge Pipe

Opposed small diameter branch discharge pipes without swept entries should be arranged so that the risk of the discharge from one branch into the other is avoided.

To prevent the discharge from a large diameter branch (e.g. a WC branch) backing up a smaller diameter branch (e.g. a long bath branch) the latter should be connected to the stack so that its center line meets the center line of the stack at or above the level at which the center line of the large branch meets the center line of the stack as illustrated in **FIGURE 31**. **TABLE 8** provides an offset distance required for two opposite branch discharge pipes meeting at the stack. **FIGURE 32** is given for better visualization when applying **TABLE 8**. (*MS 1402: PART 1:2006)*

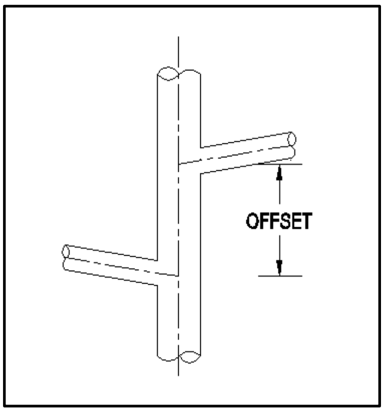



**FIGURE 31: Prevention of Cross Flow**

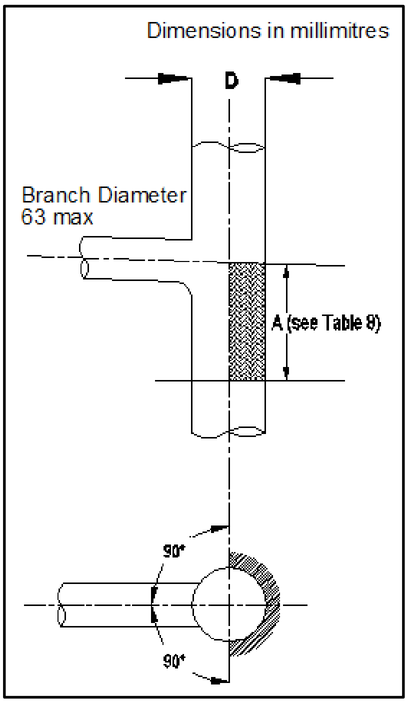



**FIGURE 32: No Connection Zone**

**TABLE 8: Offset Distance of Opposite Branch Connections**

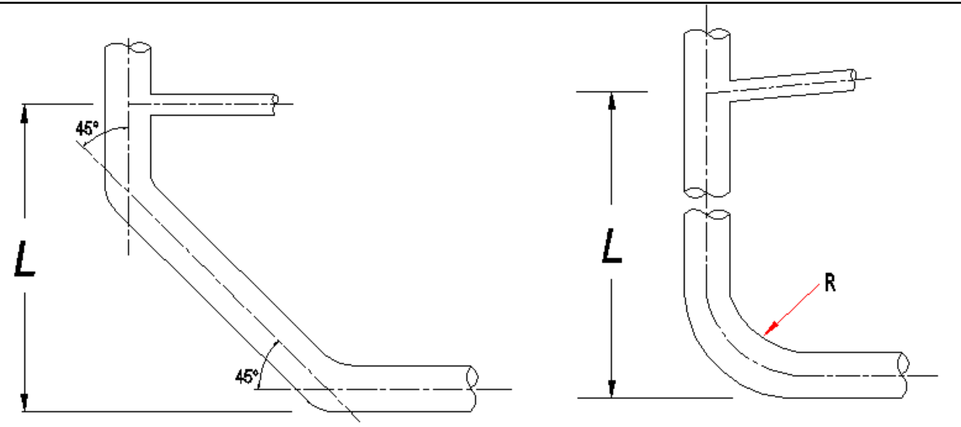
| Stack Diameter (mm) | Distance A |
|---|---|
| 75 | 90 |
| 100 | 110 |
| 125 | 210 |
| 150 | 250 |

Source: Department of Standard Malaysia. (2006). *MS 1402: Code of Practice For Sanitary System In Buildings – Part 1: Design*.

## A.4 Bends and Branches at the Base of the Stacks

Bends at the base of a discharge stack should be of large radius, at least a 200 mm radius to the center line, but preferably, two 45° large radius bends should be used as shown in **FIGURE 33**. Increasing the size at the base of a 100 mm stack and bend to 150 mm is an alternative but this may oversize the drain and be uneconomical.

Generally, for systems up to five storeys the distance between the lowest branch connections and the invert of the drain should be at least 750 mm, but for low rise single dwellings 450 mm is adequate. (*MS 1402: PART 1:2006)*




i) Preferable arrangement ii) Alternative arrangement

*L* ≥ 450 mm (for single houses up to three storey high)

or *L* ≥ 740 mm (for multi-storey systems up to five storeys high)

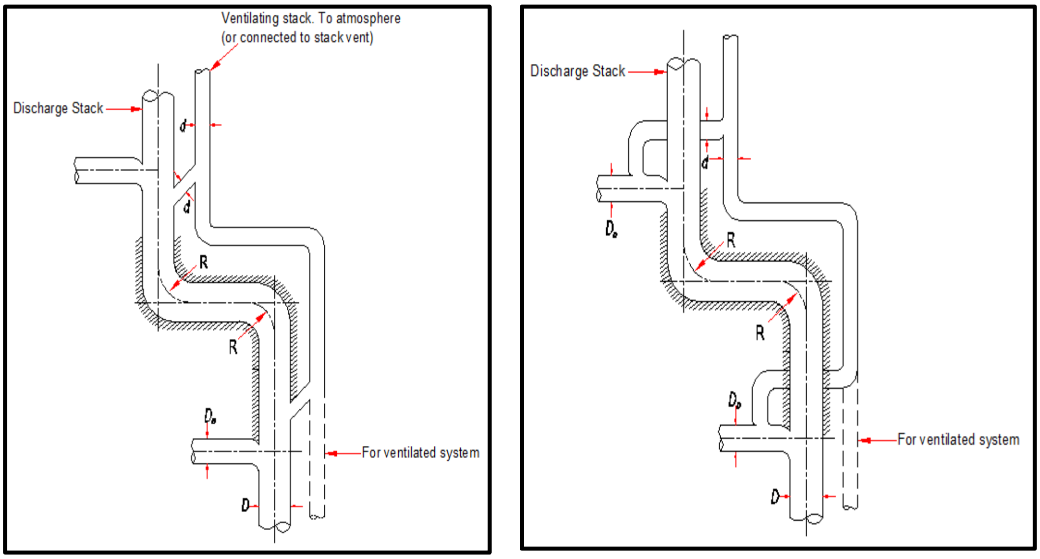
or *L* ≥ one storey height (for multi-storey systems higher than five storeys) i.e. no connections on ground floor level

*R* is as large as possible (twice internal diameter (*ID* X 2)

**FIGURE 33: Bend and Branch Connections at Base of Discharge Stack**

## A.5 Offsets of Discharge Stack

Offsets in the wet portion of a discharge stack should be avoided. When they have to be fitted, large radius bends should be used as described in **A.4** but a ventilation stack may still be necessary with connection to the discharge stack above and below the offset as illustrated in **FIGURE 34 (a) & (b)**. Offsets above the topmost sanitary appliance or branch connection do not require venting.




(a) (b)

**FIGURE 34: Offsets of Direct & Indirect Connections to Ventilation Stack**

**NOTE:**

1. *R* is as large possible (200 mm minimum)
2. d (D/2), ventilated systems as required if larger than *D/2*
3. $D_b$ > 75 mm (see Note 5)
4. No branch connections in shaded area unless vented.
5. Arrangement indirect connection is only possible if $D_b$ is 75 mm or larger.
6. No offset venting is required in lightly loaded systems of up to three storeys in height.
7. Offsets above highest branch connections do not require venting.

### A.6 Branch Ventilating Pipe Connections to Ventilation Stack

For branch discharge pipes requiring relief venting, the ventilating pipes can be connected to the ventilation stack in a ventilated system. For a modified single stack system where the discharge stack does not need a ventilating stack, the ventilating pipes can be run to the open air either directly or, in multi-storey systems, via a common connecting ventilating stack. Connections between the branch ventilating pipes and any vertical stack should normally be above the spillover level of the highest fitting served as shown in **FIGURE 35 (a)**. An alternative solution for situations where such a pipe run would be unappealing is also shown in **FIGURE 35 (b)**. (*MS 1402: PART 1:2006)*

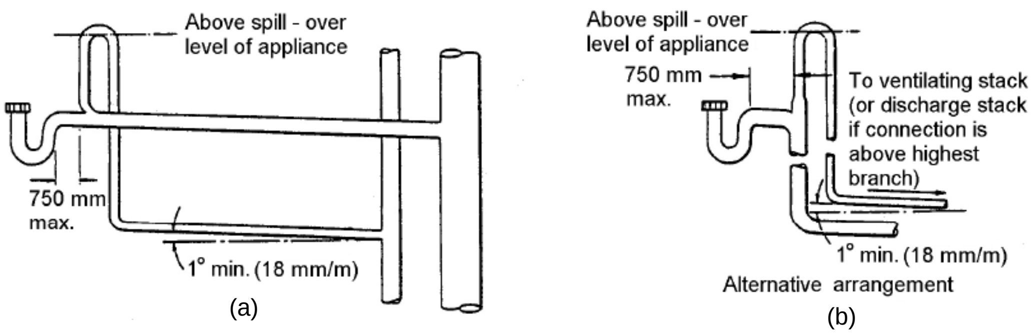



**FIGURE 35: Avoiding Unappealing Pipes to Single Appliances**

### A.7 Branch Ventilating Pipe Connections to Branch Discharge Pipe

Connections to the sanitary appliance discharge pipe should normally be as close to the crown of the trap as practicable but within 750 mm. Connections to the end of branch runs, i.e. end venting, should be to the top of the branch pipe, away from any likely backflow which could cause blockage. (*MS 1402: PART 1:2006)*

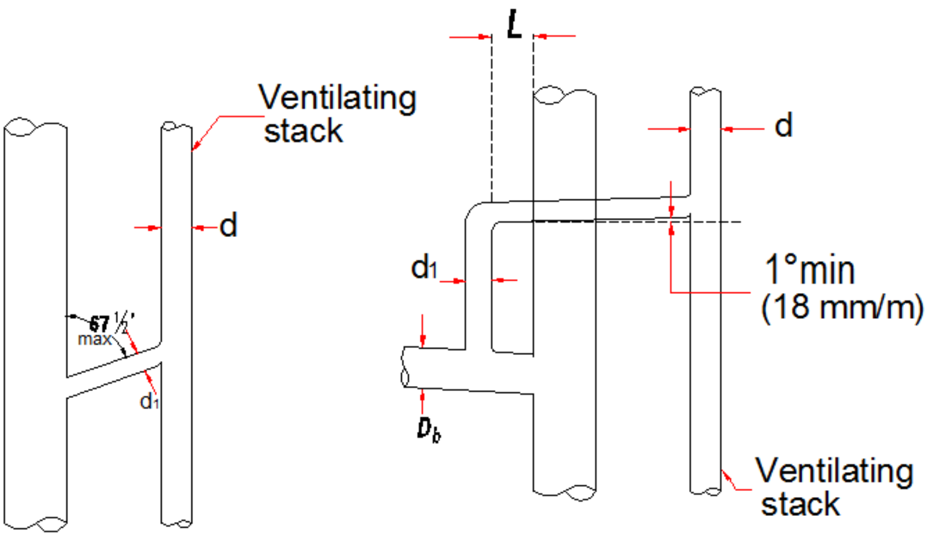
## A.8 Installation of Branch Ventilating Pipe

Ventilating pipes should be installed so that there is a continuous fall back into the branch discharge pipe system as a safeguard against the possibility of a condensation waterlock preventing the movement of air through the ventilating system and to minimize the risk of internal corrosion. An exception to the venting method shown in **FIGURE 35** in which the fall is towards the vent stack. (*MS 1402: PART 1:2006)*

## A.9 Ventilating Stack Connections to Discharge Stack

In ventilated and fully ventilated stack systems (see **FIGURE 8** and **9**) the ventilating stack can be joined to the discharge stack by cross-connections, usually on each floor. These cross connections should slope upwards from the discharge stack (67½ degree maximum) to prevent discharge water from entering the vent system and should be of the same diameter as the ventilating stack. Another method of connection is via large size (minimum 75 mm) branch pipes at each floor level. These connections should be the same size as the ventilating stack and should be made to the branch discharge pipe as close to the stack as practicable. The latter method is preferable for ventilating stacks smaller than 50 mm **FIGURE 36 (a)**.

The lowest end of the ventilating stack should normally be connected to the discharge stack at or below the lowest branch connection; the upper end can be connected to the discharge stack above the spillover level of the topmost sanitary appliance or pass through the roof to the atmosphere as shown in **FIGURE 36 (b)**. (*MS 1402: PART 1:2006)*

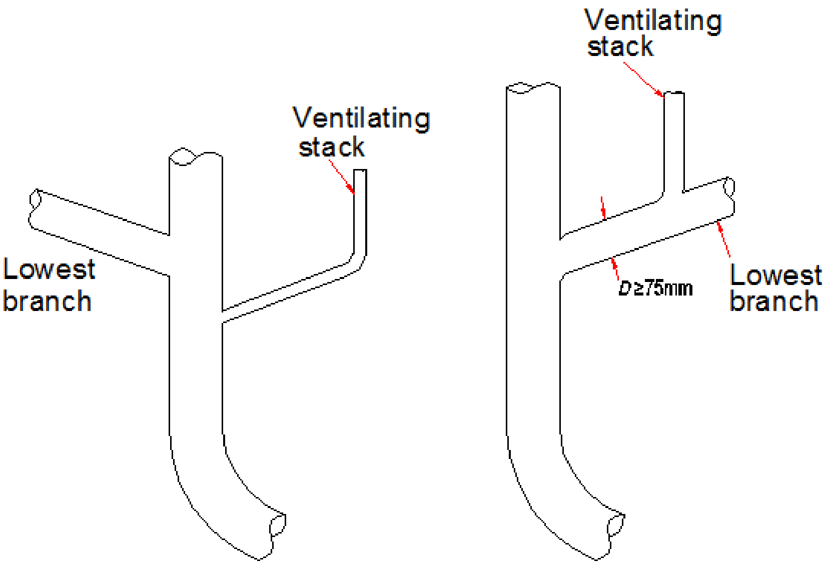



$d_1$ is same as ventilating stack

$D_b$ ≥ 75 mm (if *d* is smaller than 50 mm, the method shown in the right-hand figure is preferable)

*L* is a small as practicable

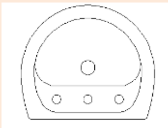
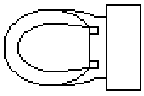
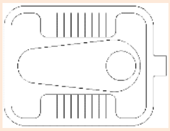
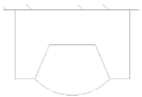
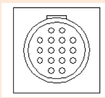
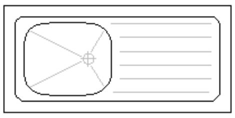
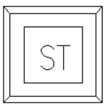
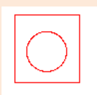
a) Cross-connection for discharge stack ventilation




b) Bottom of stack

**FIGURE 36: Ventilating Stack**

## APPENDIX B: LEGEND

| Symbol | Name |
|---|---|
|  | Wash Basin |
|  | Water Closet |
|  | Asian Water Closet |
|  | Urinal |
|  | Floor Trap |
|  | Sink |
|   | Gully Trap |
|   | Septic Tank |
|  | Vent Cowl |

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Ir. Mohammad Nazri Bin Sulaiman

Ir. Yahyatu Nizam Bin Yahaya

Ir. Rozian Bin So-Om

Ir. Mohd Azmi Bin Asif

Ir. Ahmad Faris Bin Mohd Salleh

En. Hasnol Badri Bin Mohd Yusoff

En. Izzat Zumairi Bin Che Harun

En. Muhd Khairul Azmi Bin Mohd Salleh

En. Mohd Fadzil Bin Rahim @ Yusof

En. Ku Amirreza Bin Ku Mahazir

En. Pua Zi Rui

En. Norul Hisam Bin Lockman

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