2. Sanitary Plumbing General Installation Requirements

On completion of this section, students should be able to:

Identify and describe sanitary plumbing installations requirements in accordance with the Building Code of Australia, Plumbing Code of Australia and AS/NZS 3500. Install and develop a bill of quantities for sanitary pipework from sanitary fixtures to sanitary plumbing/drainage systems to meet the requirements of the Building Code of Australia, Plumbing Code of Australia and AS/NZS 3500.

Assessment Criteria

2.1 List and describe the design requirements for sanitary plumbing, such as, fixture units, traps, lengths, diameters and floor waste requirements.

2.2 Design, install and develop bills of quantities for sanitary plumbing pipework from sanitary fixture outlets to sanitary/drainage systems to meet the requirements of the Building Code of Australia, Plumbing Code of Australia and AS/NZS 3500.

Assessment Method may include

- Written assessment based on assessment criteria.
- Practical activities based on assessment criteria.
- Designs based on assessment criteria.
- Assignment based on assessment criteria.
Sanitary Plumbing General Installation Requirements

A sanitary plumbing system is defined within AS/NZS3500.0 as:

An assembly of pipes, fittings and apparatus, which is used to collect and convey sewage to the sanitary drainage system.

2.1 List and describe the design requirements for sanitary plumbing, such as, fixture units, traps, lengths, diameters and floor waste requirements

The successful operation of a sanitary plumbing system will depend on the accuracy of the design. During the design stage you will need to consider such things as loss of water seal, vent placement on discharge pipes, junction design and location and floor waste gullies.

This section will cover the general installation requirements that are common to all current sanitary plumbing systems.

For a sanitary plumbing system to operate correctly it must be sized to receive the fixture unit discharge rate of all connected fixtures.

AS/NZS 3500.0 defines a fixture unit as:

A unit of measure, based on the rate of discharge, time of operation and frequency of use of a fixture, expressing the hydraulic load imposed by that fixture on the sanitary plumbing installation.

The system is based on the discharge from a handbasin, ie 28.4 litres per minute. The fixture unit is based on this discharge rate, so a W.C. with a discharge of 116.5 litres per minute would have a discharge rate of 116.5 or approximately 4 fixture units.

AS/NZS 3500.2 gives the fixture unit ratings for the common and most frequently used fixtures, Using this table (6.1) complete the table below showing the:

- Fixture abbreviation
- Minimum size of trap outlet and fixture discharge pipe and
- Fixture unit rating
### Fixture traps and water seals

AS/NZS 3500.2 requires each sanitary fixture and appliance to have a trap or self-sealing device. The trap or self-sealing device shall be in the same room as the fixture and/or appliance that it serves and it must be accessible.

AS/NZS 3500.2 requires all traps to retain a water seal of not less than 25mm under normal operating conditions. AS/NZS 3500.2 requires this to be checked after each test.

The purpose of a water seal is to act as a barrier to the passage of air through the trap and is the vertical distance between the dip and the weir of a trap.
 Trap Component Parts

Refer Plumbing & Drainage Guide (BRANZ)

Fig. 2.1 Trap design
The water seal within a fixture trap may be lost in many ways, the most common being syphonage.

There are two types of syphonage:
- Self Syphonage or direct syphonage.
- Induced Syphonage or indirect syphonage.

**Self Syphonage** generally occurs in waste pipes of small diameter, eg hand basins.

Example:

The discharge through the pipe fills it completely, causing a solid core of water pushing the air in front of it, causing a partial vacuum. The atmospheric pressure acting on top of the water in the trap will then force the water seal out of the trap and down the waste pipe.

Factors likely to cause self syphonage
- Small bore of discharge pipe
- Long discharge pipe
- Lack of pressure relief (vent)

Refer Plumbing & Drainage Guide (BRANZ)

**Fig. 2.2 Loss of water seal by self syphonage.**

**Induced Syphonage** is caused when water from one fixture is discharged into the waste pipe, rushing past the discharge opening of a lower inlet causing a partial vacuum within it.

Adequate design of the system either by junction location, discharge pipe size or ventilation will maintain an equal air pressure within the system preserving the trap seal.
Fig. 2.3 Loss of water seal by induced syphonage

**Compression Effects**

Trap seals can be lost in a sanitary plumbing system where several fixtures on different floors are connected to a single stack.

A column of water discharged from an upper fixture, passing an outlet of a lower discharge pipe, produces a compressing of air and gasses ahead of it and a reduction in pressure behind it, similar to a piston moving in a cylinder.

The first condition (compression) can force foul air and gasses from the stack past the trap seals lower down. The second condition can cause induced syphonage and complete loss of seal in all traps.

To avoid these two conditions, each fixture trap is vented to a common vent pipe called a “relief vent”. Alternative air admittance valves and pressure attenuator valves may be used.
To prevent this, regulations may:

- Restrict areas where connections may be made.
- Require pipes to be of a certain size.
- Require venting to relieve pressure changes.
- Prescribe minimum radii of bends.

Refer Plumbing & Drainage Guide (BRANZ)

**Fig. 2.4 Loss of water seal by compression**
Fig. 2.5 Loss of water seal by compression
Momentum

If a trap is placed at some distance from a fixture the momentum of waste discharge from the fixture may carry away the trap water seal.

To prevent this AS/NZS 3500.2 requires trap and self-sealing devices be connected as close as possible to the outlet of the fixture or appliance. The maximum distance from the outlet to the surface of the water seal shall be ______ mm for fixtures except for floor waste gullies and fixture pairs.

Fig. 2.6 Loss of water seal by momentum.
Capillary Action

The loss of a trap seal by capillary action occurs by the suspension of a foreign object in the trap seal, such as hair, lint or string which extend over the weir of the trap. The foreign matter soaks up the water until it drips from the end reaching into the outlet of the trap. Once it reaches this stage the water flows from the trap quite rapidly and may in time empty the whole of the water seal from the trap.

Paper, cloth, hair, hemp etc. act as a wick and draw water from the trap

Refer Plumbing & Drainage Guide (BRANZ)

Fig. 2.7 Loss of water seal by capillary action
Wind Effect

High velocity winds passing over a vent terminal may generate a wave motion on the surface of the water seal. This wave motion may be sufficient to cause some of the water to spill over the weir and down the waste or soil pipe. This is not a serious problem as it is improbable that the entire seal will be removed.

![Fig 2.8 Loss of water seal by wind effect](image)

Evaporation

When fixture traps are not re-charged for a length of time the obvious result is the loss of the water seal by evaporation. When such a condition is anticipated, the period for which the seal can remain effective is extended, although not indefinitely, by covering the water seal with a small amount of vegetable oil, which could retard evaporation.

![Fig 2.9 Loss of water seal by evaporation](image)

Failure of seal by evaporation. Regulations may require intermittently fixture (such as floor waste gullies) to have some method of recharging.

Refer Plumbing & Drainage Guide (BRANZ)
Actions and measures that will prevent seal loss.

a) Ensure water seals are the correct depth and are retained during testing and commissioning.

b) Installation of vents/Air Admittance Valves in the appropriate positioned as outlined within AS/NZS 3500.2 Clause 7.5.

c) Possible change of pipe size to eliminate self syphona ge and momentum effect.

d) Decrease size of flush pipes to water closets to eliminate momentum effects by reducing large volume flushes.

e) Ensure all pipe branches are installed within their appropriate grade and length.

f) Ensure junctions in stacks connecting graded discharge pipes are not within restricted zones as outlined within AS/NZS 3500.2 Section 6.

Pipe Lengths

The size and maximum lengths for fixture discharge pipes is outlined within AS/NZS 3500.2 Table 6.1 (size) and Appendix D (length).

The length of pipe is measured along the centre-line from the weir of the trap to the point of connection to a stack, graded discharge pipe, drain or other trap.

Refer AS/NZS 3500.2.

![Fig. 2.10 Pipe length – method of measurement](image)

If the length of discharge pipe exceeds that specified within AS/NZS 3500.2 Appendix D, it still may be connected provided a vent is installed as required within AS/NZS 3500.2 Section 7.5.1 (Trap Vent) or an Air Admittance Valve is fitted as outlined within AS/NZS 3500.2 Section 6.9.
Pipe Diameters.

The Fixture Unit Rating for each appliance determines the size of the discharge pipe and trap, as outlined within AS/NZS 3500.2 Table 6.1 (Fixture Unit Ratings), Appendix D (maximum length of fixture discharge pipe without venting) and Table 7.1 (maximum fixture unit loading for graded discharge pipes).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Nominal size of pipe, DN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td>5.00</td>
<td>6</td>
</tr>
<tr>
<td>3.35</td>
<td>5</td>
</tr>
<tr>
<td>2.50</td>
<td>4</td>
</tr>
<tr>
<td>2.00</td>
<td>X</td>
</tr>
<tr>
<td>1.65</td>
<td>X</td>
</tr>
<tr>
<td>1.25</td>
<td>X</td>
</tr>
<tr>
<td>1.00</td>
<td>X</td>
</tr>
</tbody>
</table>

Connection of Fixtures

It must also be noted within the design and installation, invert level of a trap or floor waste gully weir must to be a minimum of 10 mm above the soffit of the common discharge pipe to which it connects.

![Fig. 2.11 Typical Connection of Fixture Discharge pipe to a Common Discharge pipe](Image)
Within NSW the invert level of a trap or floor waste gully weir must to be a minimum of 80 mm above the invert of the common discharge pipe to which it connects.

Fig. 2.12 Typical Connection of Fixture Discharge pipe to a Common Discharge pipe within NSW

Minimum Grades of Discharge Pipes

Refer AS/NZS 3500.2 Table 6.3

<table>
<thead>
<tr>
<th>Size of graded section of pipe (DN)</th>
<th>Minimum grade (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>2.50</td>
</tr>
<tr>
<td>50</td>
<td>2.50</td>
</tr>
<tr>
<td>65</td>
<td>2.50</td>
</tr>
<tr>
<td>80</td>
<td>1.65</td>
</tr>
<tr>
<td>100</td>
<td>1.65</td>
</tr>
<tr>
<td>125</td>
<td>1.25</td>
</tr>
<tr>
<td>150</td>
<td>1.00</td>
</tr>
<tr>
<td>225</td>
<td>0.65</td>
</tr>
<tr>
<td>300</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Vent Grade

Refer AS/NZS 3500.2

It should be noted that vents should be installed at a minimum grade of 1.25% so that any condensation or other liquids that form in or enters the vent will drain to the sanitary plumbing/drainage system, regardless of the size of the vent.

Using Appendix D students are required to complete the following table; all fixtures are connected to a sanitary plumbing system via an unvented fixture discharge pipe.

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Size of fixture trap and discharge pipe</th>
<th>Fixture Unit Rating</th>
<th>Minimum grade %</th>
<th>Maximum length of unvented fixture discharge pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bidet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking Fountain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor water gully</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shower</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sink (kitchen)</td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinal (wall)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Closet (DN 80 outlet)</td>
<td></td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Closet (DN 100 outlet)</td>
<td></td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Floor Waste Gullies

The requirement for when a floor waste gully is to be installed is referenced from the Building Code of Australia (BCA) and not the Plumbing Code of Australia or AS/NZS 3500.

F1.11 Provision of floor wastes

(a) Within the Building Code of Australia a Class 2, 3 or 4 buildings, requires a floor waste or floor waste gully to be provided in any of the following rooms where that room is located above another sole-occupancy unit:

   (i) A room containing a closet pan.
   (ii) A bathroom.
   (iii) A laundry.

(b) The draining of the floor to a shower recess incorporating a floor waste satisfies the requirements of (a).
Floor waste gullies must be installed at the lowest point in the floor of any room or compartment containing a bath, basin, shower, water closet, bidet, urinal, tub and slop hopper.

Floor waste gullies may be omitted where:

(a) A room containing a water closet or a water closet and basin only, and the cistern has an internal overflow or the cistern overflow discharges to the outside atmosphere and the basin has an internal overflow.

(b) The floor is graded to a urinal channel or shower.

(c) A dry floor waste is permitted.

The water seal of every floor waste gully must be maintained by either:

Refer AS/NZS 3500.2.

a) A charge pipe from a flushing device, connected at the heel or the base of the flush pipe with a union. The charge pipe shall enter the floor waste gully at 45°, not less than 50 mm above the water seal and shall be silver brazed or joined by a union to the riser (see Figure 4.3 (b)).

b) A charge pipe from a tap set or a drain from a hot water relief valve, which shall drain over a tundish so that the air gap is maintained (see Figure 4.3 (a)).

c) A charge pipe from a mechanical trap-priming device extended to floor drain within the same room or compartment (see Figure 4.3 (c)).

d) A lockshield (shrouded) hose tap installed in the same room, and with a graded floor,
Fixtures allowed to be connected to Floor Waste Gullies

Using AS/NZS3500.2 students are to complete the table below.

<table>
<thead>
<tr>
<th>Waste fixture connected to gully riser</th>
<th>Maximum length of waste pipe, m</th>
<th>Untrapped fixture</th>
<th>Trapped fixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin, drinking fountain</td>
<td>Not permitted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bath, Shower/bath</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bidet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaner’s sink</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bar sink, clothes-washing machine,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glass-washing machine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shower</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bain-marie, refrigerated cabinet,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sterilizer (see Section 11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laundry and ablution trough</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE:

1. Where foaming is likely to cause a problem (soft water areas), fixtures such as Laundry troughs or clothes washing machines should not discharge through a floor waste gully.

NOTE: See Table 4.5 for minimum riser heights

Fig 2.13 Typical connection of wastes to a floor waste gully
Connection of fixtures

Refer AS/NZS 3500.2 Clause 4.6.7.3

Each fixture, or fixture pair that is connected to a floor waste gully shall be connected by a separate wastepipe at a grade of not less than 2.5% and with a length not exceeding that specified in Table 4.4.

Refer AS/NZS 3500.2 Table 4.5

<table>
<thead>
<tr>
<th>Waste fixture connected to gully riser</th>
<th>Size of gully riser</th>
<th>Minimum height mm (water seal to floor level)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DN 88 1/2º entry</td>
<td>88 1/2º entry</td>
</tr>
<tr>
<td></td>
<td>DN 45º entry</td>
<td>45º entry</td>
</tr>
<tr>
<td>All permitted waste fixtures</td>
<td>80</td>
<td>200</td>
</tr>
<tr>
<td>including maximum one bath</td>
<td>100</td>
<td>150</td>
</tr>
</tbody>
</table>

The maximum length of a riser is __________ mm from the water seal to the level of the floor grate unless an inspection opening is fitted to the trap. Within a plant room the maximum rise is __________ mm from water seal to finish floor level.

Removable grate

Refer AS/NZS 3500.2 Clause 4.6.7.6

Floor waste gullies shall be installed with an accessible removable grate and have a riser of not less than DN 80 to finished surface level. Where the sole function of the floor waste gully is to dispose of water spillage and wash-down water, a minimum DN 50 riser may be used.

The outlet size of a floor waste gully depends on the total number of fixture units passing through it.

Using AS/NZS3500.2 students are to complete the table below

<table>
<thead>
<tr>
<th>Maximum number of fixture units discharging into gully riser</th>
<th>Minimum nominal size of outlet DN</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>10 (including the discharge from not more than one bath)</td>
<td></td>
</tr>
<tr>
<td>&gt;15</td>
<td></td>
</tr>
</tbody>
</table>
Note:

The floor of a room containing one or more wall-hung urinals shall grade to a floor waste gully. Such floor waste gullies shall be charged by either a waste fixture (see Table 4.4) or in accordance with Clause 4.6.8.

Residential buildings with two floors may be drained to the outside of the building by the installation of a dry floor waste.

Dry floor wastes must be:

- Minimum size of 40 mm.
- Discharge where it will not cause damage or nuisance.
- Discharge not less than 25mm above ground level.
- Fitted with an air break over a tundish if more than 1.8m above ground level.

In multi storey residential buildings dry floor wastes may discharge to a common pipe, provided, the common pipe is:

- A minimum size of 50mm.
- Fitted externally.
- Connected to floor waste with air breaks and tundishes.

Commercial dry floor wastes must be 50mm minimum.

Note:

Dry floor wastes cannot be fitted in rooms containing a urinal.
An approved flap fitting to be installed:

‘A’ Approved pipe and tundish required if ‘A’ exceeds 1.8 m.

‘B’ Max 100 mm Min 25 mm above ground level.

Fig. 2.14 Dry floor waste layouts
2.2 Design, install and develop bills of quantities for sanitary plumbing pipework from sanitary fixture outlets to sanitary/drainage systems to meet the requirements of the Building Code of Australia, Plumbing Code of Australia and AS/NZS 3500.

Fixture Connection.

All fixtures are connected to the sanitary Plumbing or Drainage in accordance with AS/NZS 3500.2 Section 6.

Fixture Traps

The discharge from all sanitary fixtures must pass through traps before entering a sanitary system. Traps must be in the same room as the fixture they service and be fully accessible.

![Diagram of P-Trap and S-Trap]

Fig. 2.15 Parts of a trap.

The trap must be fitted as close as practicable to the outlet, but not more than:
Refer AS/NZS 3500.2.

- 600 mm for other fixtures except for:

Exceptions

- Fixtures connected through a floor waste gully provided the fixture discharge pipe does not exceed 1.2 m untrapped and 2.5 m trapped

- When a pair of fixtures is connected through a common trap.
Fixture Pairs

Refer AS/NZS 3500.2.

A pair of waste fixtures only, may discharge to a common fixture trap, subject to the following conditions.

a) The fixtures have a similar spill level.

b) Only the following fixtures are permitted:
   - Basins
   - Sinks
   - Showers
   - Laundry Troughs
   - Ablution Troughs

c) Both fixtures must be installed in the same room.

d) The fixture trap for a pair of showers may be a floor waste.

e) The fixture pair trap size is set out in AS/NZS 3500.2

Note: Fixture trap size for basins is a minimum of 40mm diameter

The untrapped fixture discharge pipe must be:
   - as short as possible.
   - connected into the trap above the trap seal.
   - a maximum of 1.2m in length.

Fig. 2.16 Fixture pair.
Connections to the Stack.

Refer AS/NZS 3500.2 Clause 6.6

The connection of discharge pipes to a stack may be either manufactured junction fittings or site formed junctions, depending on the type of material used.

The types of junctions allowed are:

a) 45° junctions.

b) Sweep junctions.

c) Entry at grade with throat radius

d) Entry at grade without throat radius

Students are to name the junctions shown.

Fig 2.17 Junctions used in connecting to a stack.
The type of junction that may be used depends on the size of the stack and the size of the branch.

Branches DN 50 or less, connection to stacks DN 65 or less may use 45° entry, sweep junctions or entry at grade with throat radius.

Branches DN 65, connected to a DN 65 stack must use a 45° entry or sweep junction.

Branches DN 65 or less, connected to a stack DN 80 or larger may use any type of the junctions mentioned.

**Restrictions on the use of junctions**

Discharge pipes 500mm or less in length and connected to the stack using entry at grade junctions, shall only be used provided:
Refer AS/NZS 3500.2.

- a)
- b)
- c)

**Restricted Zones**

Refer AS/NZS 3500.2.

The restricted zone is the area of the stack immediately opposite and a distance vertically down from another junction in the stack.

Opposed connections at the same level shall be made using double Y-junctions with an inclined angle of 90°

Fig. 2.18 Double Y-junction connection
Graded fixture or common discharge pipes that are located at a lower level than any other opposed similar pipes shall not be connected to a stack within a restricted entry zone, as given in Table 6.4 and Figure 6.3, unless the lower pipe enters the stack at an angle of 45°.

![Restricted zones diagram](image)

**Fig 2.19 Restricted zones for connections to a stack.**

The depth of the restricted zone is determined by the following:

a) Size of the stack

b) Size of the branch

The restricted zone depth is measured from a point on the stack where the centre line of the branch and the centre line of the stack intersect.

The restricted zone depth can be calculated from AS/NZS3500.2.

<table>
<thead>
<tr>
<th>Discharge pipe size DN</th>
<th>Stack size DN</th>
<th>Restricted entry zone vertical depth, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;40 &lt;65</td>
<td>&gt;40 ≤80</td>
<td>90</td>
</tr>
<tr>
<td>&gt;40 &lt;65</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>&gt;40 &lt;65</td>
<td>125</td>
<td>210</td>
</tr>
<tr>
<td>&gt;40 &lt;65</td>
<td>150</td>
<td>250</td>
</tr>
<tr>
<td>≥80 &lt;65</td>
<td>≥80</td>
<td>200</td>
</tr>
</tbody>
</table>
The restricted zone depth where a DN100 x 45° junction is installed in a DN 100 stack. 
\[ \text{R.Z.D.} = 200\text{mm} \]

The restricted zone depth where a DN 50 sweep junction is installed in a DN 100 stack. 
\[ \text{R.Z.D.} = 100\text{mm} \]

However, there are three methods of connecting opposing branches that would normally infringe the restricted zone.

Fig 2.20 Connection within restricted zone

Fig 2.21 Connection within restricted zone

Fig 2.22 Connection near restricted zone
Restricted zones within stacks

Other areas of restricted zones in stacks are:


Fig 2.23 Connection within a graded offset single stack
Discharge pipes shall not be connected to a drain or graded pipe in accordance with Figure 2.24 and the following:

**Stacks of three floor levels or more**

(a) No connection can be made closer than ________ m downstream
Or ________ m upstream of the stack.

(b) No discharge pipe connecting a fixture upstream of a junction which connects a stack to a drain or graded pipe can be closer than _____ m from the base of the stack.

**Stacks of two floor levels or less**

(a) No connection can be made closer than ________ mm downstream or upstream of the base of the stack.

(b) No discharge pipe connecting a fixture upstream of a junction that connects a stack to a drain or graded pipe must be within ________ mm or the base of the stack.

**Above the base of Stacks**

a) ________mm for stacks that extend not more than five floor levels above the base of the stack to the invert of the branch.

b) 1 m for stacks that extend more than five floors.

c) ________m for all stacks in areas where foaming is likely to occur. (eg soft water areas.)

Note: The Plumbing Code of Australia NSW Appendix states:

Soil and waste stacks shall not discharge through a reflux valve except where a reflux valve is installed at the connection to the sewer required with surcharging sewers.

See figure 2.24 on next page.
Restricted zones at base of stacks.

Fig. 2.24 Restricted zones near the base of stacks
Connection of stacks to drains or graded pipes

Refer AS/NZS 3500.2.

Connection of stacks to graded pipes or drains above the ground shall be made by—

(a) a 45° junction installed on grade and a bend at the base of the stack in accordance with Clause 6.7.4; or

(b) a 45° junction installed in the vertical plane with an extended branch so that the vertical projection of the stack, on the graded pipe or drain above the ground, is wholly outside the junction area, as shown in Figure 6.5.

### TABLE 6.5
RADIUS FOR BENDS AT THE BASE OF STACKS

<table>
<thead>
<tr>
<th>Pipe size DN</th>
<th>Radius ($R$) Mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤100</td>
<td>225</td>
</tr>
<tr>
<td>&gt;100</td>
<td>300</td>
</tr>
</tbody>
</table>
Fig. 2.25  Connection of discharge stacks to graded discharge pipes

Venting a graded discharge pipe

When connecting a vent or Air Admittance Valve (AAV) to a graded or common discharge pipe, it must meet the requirements of AS/NZS 3500.2.

a) In the case of basins and bidets, the vent/AAV shall be connected no closer than 75 mm and no further than 600 mm from the crown of the fixture trap, provided no change of direction occurs between the trap and the vent/AAV.

b) In the case of fixtures other than basins and bidets, the vent/AAV shall be connected between 75 mm and 1.5 m, provided that where an S-trap or a bend is fitted downstream of a P-trap, the vent/AAV connected on the vertical discharge pipe shall be at least 300 mm from any bend at the base of the vertical section.
Fig. 2.26  Connection of vents/AAV to graded or common discharge pipes

Support and Fixing
Refer AS/NZS 3500.2 Section 9

All pipes have to be supported to ensure proper function. Pipes are not permitted to be supported by brazing or welding a short section of any material to their surface.

The pipework design should be so that:

a) it does not interfere with normal operation of any door, window, and access opening or with any other aspects of the normal operation of a building;

b) where it does not cause a nuisance or injury to persons;

c) not directly above drinking water storage tanks;

d) as close as practicable to the wall of any building or supporting structure;

e) with clearance from other services in accordance with Clause 3.6.1; and

g) when constructed of plastic:

i) at a minimum distance of 75 mm from a insulated heated water pipe or 150 mm from an uninsulated heated water pipe; and
below a heated water pipe at a minimum distance of 150 mm from an insulated heated water pipe or 300 mm from an uninsulated heated water pipe.

Brackets, clips and hangers shall be:

a) formed of a suitable material;
b) securely attached to the building structure and not to any other service;
c) designed to withstand the applied loads;
d) protected against corrosion where exposed to a corrosive environment;
e) made from compatible material;
f) clamped securely to prevent movement unless designed to allow for thermal movement;
g) restrained to restrict lateral movement and
h) designed so that pipes and fittings are supported with minimal load being taken by the joints.

### TABLE 9.1
MAXIMUM SPACING OF BRACKETS, CLIPS AND HANGERS

<table>
<thead>
<tr>
<th>Pipework material</th>
<th>Maximum spacing of supports, m</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vertical pipes</td>
<td>Graded pipes</td>
</tr>
<tr>
<td>Cast iron</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ductile iron</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Copper, copper alloy</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>FRC</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>PUC-U DN 40-50</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PVC-U DN 65-150</td>
<td>2.5</td>
<td>1.2</td>
</tr>
<tr>
<td>PP</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PE</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**NOTE:** For all pipe materials maximum spacings shall be in accordance with manufacturer’s recommendations.
Testing and Inspection Openings

All pipes conveying discharge from soil fixtures shall be provided with inspection openings in the following locations:

a) wherever necessary for testing purposes;

b) as close as practical to or at the first bend downstream for the outlet of every fixture trap

c) at maximum intervals of 30 m in any graded pipe;

d) at the base of every stack and

e) at junction fittings that connect any graded pipe or branch to a stack or at the upstream section of such graded pipe or branch.

Inspection openings shall have a clear diameter of 25 mm for pipes up to DN 65 and 32 mm for larger pipes.

Provision for Expansion

Copper and Copper Alloy
Refer AS/NZS 3500.2.

Students should read this section to gain an understanding of the requirements for expansion joints.

PVC-U

General Principles
Refer AS/NZS 2032.

a) expansion joints should be fitted in cold pipelines at maximum spacings of 6 m and in hot pipelines at maximum spacings of 4 m;

b) the maximum length of pipeline between fixed points without an expansion joint or provision for thermal movement should be 2 m for cold pipelines and 1 m for hot pipelines.
Vertical Pipelines

Refer AS/NZS 2032.

a) at each floor at which fixtures or branch lines are connected, immediately above the highest branch connection;

b) at the base of a stack or at the end of a drain connection for a discharge pipe when required under 6.6.1 (b) above;

c) at maximum spacing intervals subject to the requirements of 6.6.1 (a) above.

Graded Pipelines

Expansion joints shall be provided in graded pipelines in the following positions:

a) immediately upstream of the entry to a vertical stack, subject to the requirements of 6.6.1 (b);

b) immediately upstream of each change of direction in graded lines subject to the requirements of 6.6.1 (b);

c) at maximum spacings intervals subject to the requirements of 6.6.1 (a).

Expansion joints may be omitted in the following locations:
Refer AS/NZS 2032.

c) at a junction or bend in a graded pipeline where the thermal movement in the pipeline can be accommodated by deflection of the offset leg without affecting the grade of the pipeline; the lengths of pipeline and the offset leg shall be as specified in table 6.1.

NOTE:
The supports of the pipe should not impede expansion in such cases.
d) at a junction or bend a graded pipeline where the thermal movement in the pipeline can be accommodated at a trap or plastic material, provided that the length of the pipeline does not exceed 6 m for cold pipelines or 4 m for hot pipelines, and the trap in alignment with the pipeline.

<table>
<thead>
<tr>
<th>Nominal size of pipe DN</th>
<th>Maximum pipe length m</th>
<th>Minimum free length of offset leg m</th>
</tr>
</thead>
<tbody>
<tr>
<td>32, 40, 50</td>
<td>2.0</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>1.0</td>
</tr>
<tr>
<td>65, 80, 100</td>
<td>2.0</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>1.2</td>
</tr>
<tr>
<td>150</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>3.0</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>6.0</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Fig. 2.27  Expansion joints and fixed points in vertical stacks
Fig. 2.28  Expansion joints and fixed points in graded pipelines

Rule 6.6.1 (b)
Expansion joints provided where distance between fixed points exceeds 2 m (cold pipeline)

Rule 6.6.3 (a)
Expansion joint at connection to stack

Rule 6.6.3 (b)
Expansion joint at change of direction in graded lines

= Pipe support
= Expansion joint
= Fixed point
Assignment 1 Drainage connections and Assignment 2 Stack connections.

Using information from sources available draw in single line the connections of **six** of the fixtures listed below to **sanitary drainage** and the other **six** to **sanitary plumbing**.

### Sanitary Drainage
1. Bath
2. S Trap Pan
3. Urinal
4. Shower
5. A Kitchen Sink domestic
6. A Kitchen Sink commercial

### Sanitary Plumbing
7. Sterilizer
8. Cleaners Sink
9. Slop Hopper
10. Dental Unit
11. Bidet
12. Autopsy Table

Indicate on each diagram the size, grade, maximum length allowed without venting and the position of the vent in relation to the fixture if a vent was required.

Use the appropriate colour code:

<table>
<thead>
<tr>
<th>Pipe</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>Yellow</td>
</tr>
<tr>
<td>Soil</td>
<td>Blue</td>
</tr>
<tr>
<td>Drainage</td>
<td>Green</td>
</tr>
<tr>
<td>Vents</td>
<td>Red</td>
</tr>
</tbody>
</table>

Note the following:
- The drainage connections are one assignment and the stack connections are the second assignment.
- The drawings should be done on A4 paper. This paper can easily be put into a folder for presentation.
- Manufacturer’s information may also be presented attached to the back of your assignment.
- The reference material for each diagram must be nominated.
- The drawings must be done to a neat and agreeable standard.
Sectional Quiz:

Answer the following questions in the space provided and ‘Quote references’.

1. Neatly sketch a situation where a trap may lose its water seal by syphonage and explain how the syphonage may occur.

1a. Explanation

1b. In the above situation, how could you prevent syphonage from occurring?
2. Why is the length and size of the discharge pipe important?

3. What does DN. mean in relation to pipe size?

4. List the conditions that apply to dry floor wastes?
   a) 
   b) 
   c) 
   d) 

5. The size of a graded discharge pipe is determined by the fixture unit rating of the fixtures discharging through it. What is the table number for the fixture unit ratings according to AS/NZS 3500.2?

6. What is a floor waste gully?

7. Is a floor waste gully a soil or waste fixture?
8. What is the fixture unit rating for a floor waste gully?

9. Define the term ‘fixture unit”.

10. Name the fixtures that may be connected in pairs.

• ___________________________________________
• ___________________________________________
• ___________________________________________
• ___________________________________________
• ___________________________________________
• ___________________________________________

11. Define the meaning a trap:

12. How many basic types of fixture traps are there and name them?

• ___________________________________________
• ___________________________________________
• ___________________________________________
13. Draw a neat freehand sketch of one type of fixture trap; name it and at least FIVE (5) main parts or sections.

In the columns below, (ie Nominal Size of Outlet and Fixture Unit Rating) identify the minimum necessary discharge pipe size and the fixture unit rating for each of the fixtures listed, in accordance with AS/NZS 3500.2

<table>
<thead>
<tr>
<th>FIXTURE</th>
<th>Nominal Size of Outlet</th>
<th>Fixture Unit Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bar Sink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bath</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bidet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clothes Washing Machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dishwasher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchen Sink (domestic)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bar Sink</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trough (laundry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single Shower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Showers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shower Bath</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water closet pan (cistern)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bathroom Group</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Instructions: Each of the following questions is followed by alternative answers. Select the correct answer and place a **BOLD CROSS (X)** in the appropriate space.

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SANITARY PLUMBING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The minimum grade of a vent pipe shall be.</td>
</tr>
<tr>
<td></td>
<td>A 2.5%</td>
</tr>
<tr>
<td></td>
<td>B 1.00%</td>
</tr>
<tr>
<td></td>
<td>C 1.65%</td>
</tr>
<tr>
<td></td>
<td>D 1.25%</td>
</tr>
</tbody>
</table>

| 2     | The purpose of a large radius bend at the base of a stack is directly related to. |
|       | A Self syphonage       |
|       | B Back pressure        |
|       | C Induced syphonage    |
|       | D Back flow            |

| 3     | A basin with a DN 40 “S” trap connected to a floor waste gully shall have a maximum discharge pipe length of. |
|       | A 2.0 metres          |
|       | B 600 mm              |
|       | C 1.2 metres          |
|       | D 2.5 metres          |

| 4     | Fixture traps (except for those in a pressurised chamber) shall have a trap seal of. |
|       | A 25 mm               |
|       | B 50 mm               |
|       | C 85 mm               |
|       | D 70 mm               |