

Waste water systems

1.3 Waste water systems

Waste water systems encompass the system of drainage and pressure-relief pipes within a building and terminate 0,5 m outside the external wall. Waste water systems are based on the primary pressure-relief system in which water and air-flow occurs in the same pipe. The waste water system must be separated from the roof drainage system.

1.3.1 Pipe system and flow conditions

For a properly functioning interior sewer system, the flow conditions of the various types of pipe must be known so that they can be taken into account in the design. In the pipework for a soil & waste system, the following pipes are defined as indicated in illustration 1.21.

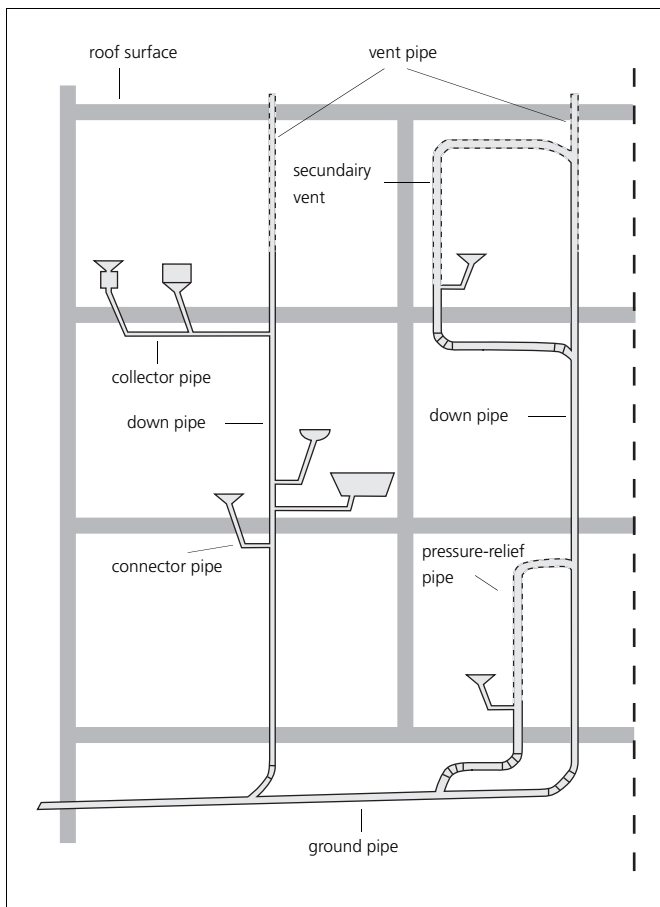


Illustration 1.21

Connectors

A connector links a drain fixture to the collector, down or underground pipe. Only one drain fixture is to be connected to a connector. In an internal sewer, a connector can be both horizontal and vertical and may, in contrast to collectors, become completely full. To prevent stench traps from being siphoned empty, certain parameters are normally imposed on connectors. These parameters relate to:

- minimum pipe diameter
- maximum pipe length
- maximum height difference

Collectors

A collector is a horizontal pipe that links connectors to down pipes.

Down pipes

A down pipe is a drain pipe that deviates no more than 45° from vertical. A down pipe connects a collector to a ground pipe and is outfitted with a pressure-relief pipe.

In a soil & waste system, the design must focus on preventing large pressure difference in down pipes. Pressure differences in a down pipe can be reduced by implementing joint-free zones, appropriate types of joints for connectors and the proper sizing of the down pipe.

Underpressure arises in a down pipe as a result of a connector draining waste water into the down pipe. Depending on the flow volume, the drainage water will gradually spread over the entire pipe wall. Due to gravity and pipe friction, the drainage water will reach a maximum velocity and carry the air in the core along with it. This creates a pressure difference that transmits up the pipe to a point above the input of the drainage flow.

Overpressure is created at the base of the down pipe where the drainage flow is forced to slow down substantially in transitioning to the horizontal collector or underground pipe. The air in the horizontal pipe can only escape to a limited extent, causing the air at the base of the down pipe to be pressed together, giving rise to overpressure.

The transition to a collector or underground pipe must therefore occur using 2 x 45° bends so that the air in the horizontal pipe can flow away.

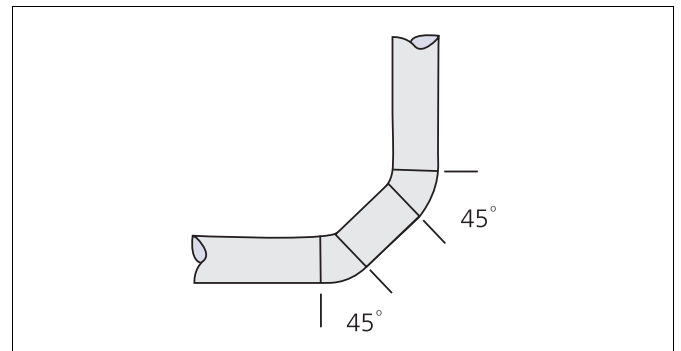


Illustration 1.22

Pressure-relief pipes

A pressure-relief pipe must ensure proper air intake and venting of the internal sewer. The pressure relief is the part of the down pipe that extends above the highest collector joint and is open to the air above the roof surface. This is the principle of primary pressure relief, and it is associated with pressure differences as described in the chapter on down pipes. In some cases, secondary pressure-relief pipes are required to prevent large pressure differences from occurring. Such secondary pressure-relief pipes are directly or indirectly connected to the primary pressure-relief pipes.

Ground pipes

A ground pipe is a horizontal pipe that collects drainage flows from connectors, collectors and down pipes and discharges them into the external sewer. The ground pipe remains inside the 0,5 m boundary of the internal sewer.

Flow conditions in horizontal pipes

Flow conditions in horizontal pipes depend on the nature of the individual discharges that can, in turn, partly or fully coincide. In practice, draining occurs in waves that quickly reach their maximum level of drainage and subsequently subside to nil due to the friction of the pipes and fittings. Flow calculations are therefore extremely complex but are simplified into a system with 70% water filling of the pipe during the maximum expected flow volume. The remaining 30% air is unrestrictedly in contact with the pressure-relief pipe so that no large positive or negative pressure differences arise.

Pressure differences can be created in the pipe system if the drain flow hydraulically seals the pipe, causing the system to become completely full. Pressure differences can seriously disrupt the system, causing an odour problem due to the emptying of siphons. It is also possible that a noise nuisance can arise due to the enclosed air and air that is pressed through the stretch traps.

A completely full system is more likely to occur when there is large incline because the high flow velocity tends to cause build up in the bends. The standard limits the incline to 1:50 (20 mm/m). A risk of hydraulic sealing also may occur where pipes join together, both in the case of two horizontal pipes and in the transition to a stand pipe. The standard therefore specifies requirements for the installation of drain pipes.

1.3.2 Drain fixtures and connectors

Drain fixtures and stretch traps

All drain fixtures are connected to the soil & waste system with a siphon, such as a stretch trap. The height of the siphon must be at least 50 mm, so it offers good resistance to the pressure differences in the pipe system and will not be drained empty.

Connectors

Only one drain fixture can be connected to one connector. The total length of a connector (horizontal and vertical together) may not exceed 3,5 m, without any restrictions on the number of bends. There is no specific incline because the horizontal portion may become completely full. Some incline is recommended.

If the design cannot satisfy this requirement, a secondary pressure reliever needs to be installed directly behind the stretch trap. The total horizontal length of the connector and the collector is also subject to regulations.

1.3.3 Horizontal pipes

Connecting to a horizontal pipe

The connection of a connector to a horizontal pipe must occur by means of a 45° branch in which the diameter of the stem is equal to the diameter of the branch. Three types of joints can be distinguished.

- Side joint

If the joint has a smaller diameter, an eccentric route must be used so that the bottoms of all pipes are at the same level.

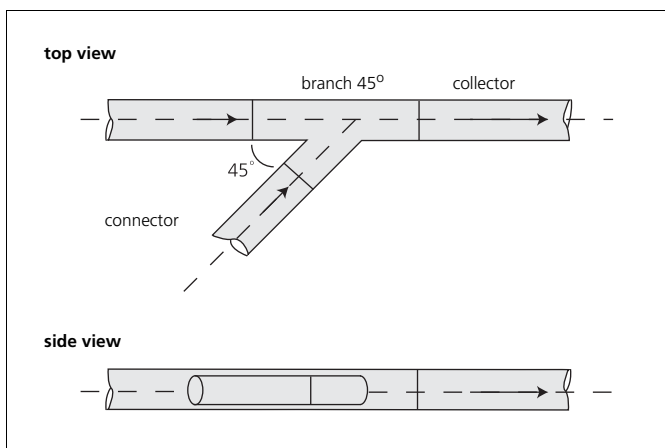


Illustration 1.23 Side joint

- Inclined joint

The diameter of the branch of the branch fitting may be equal to the diameter of the joint if the joint lies between 30° and 45° above horizontal.

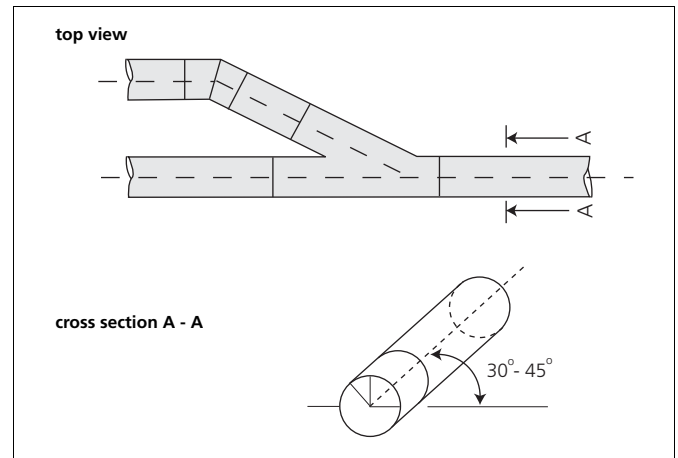


Illustration 1.24 Inclined joint

- Top joint

A top joint is only permitted if the design diameter of the collector or underground pipe is at least 100 mm and the drainage from the pipe being connected is not larger than 1 l/s.

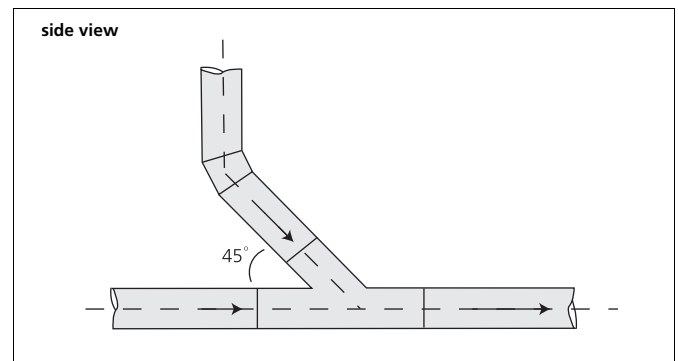


Illustration 1.25 Top joint

Minimum distance between joints on a horizontal pipe

Minimum distances are necessary because the joint alters the flow pattern in the pipe. The flow after a joint is restored in the space of the minimum distance.

General minimum distances

The minimum distance between two joints on a horizontal pipe is 5 times the inside diameter of the collector or underground pipe. The minimum distance may be twice the inside diameter if the collector or underground pipe has an inside diameter > 100 mm or if the highest joint has drainage of no more than 0,75 l/s.

Minimum distances for shower connections

No toilet, dishwasher or washing machine may be connected within 1 m upstream of a shower connection.

Minimum distances for toilet connections

Joints can only be made upstream from a toilet connection if there is also a pressure-relief pipe connected upstream. No drain fixture may be connected within 1 m downstream of a toilet connection.

Waste water systems

Joint-free zones

In the zone of the transition from a down pipe to a horizontal pipe, there are joint-free zones as specified in illustration 1.26. In low-rise construction in which the height h is less than 10 m, both l_a and l_b remain at least 1 m.

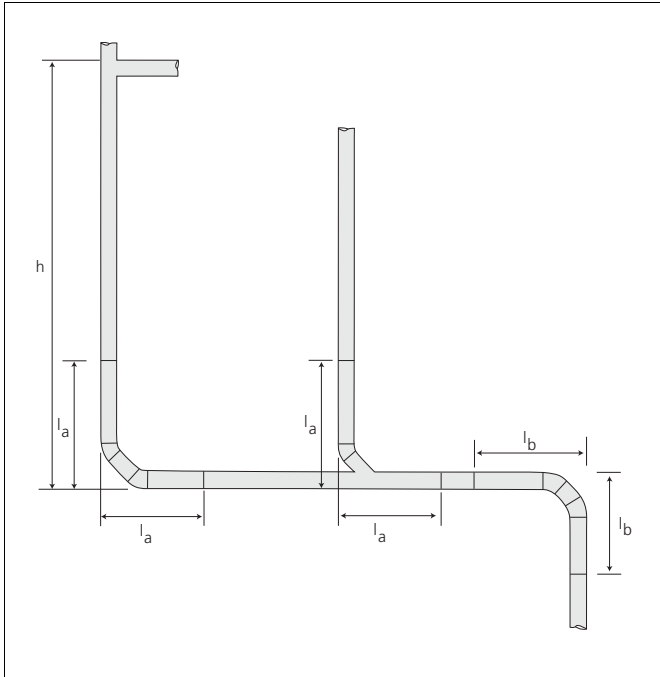


Illustration 1.26

1.3.4 Collectors and underground pipes

Incline

The incline of collectors and underground pipes must be at least 1:200 (5 mm/m) in order to prevent blockage resulting from too low flow velocity. The incline may not exceed 1:50 (20 mm/m) in order to prevent excessive flow speed that would cause a hydraulic seal.

Maximum pipe lengths

The length of a horizontal pipe depends on the connected drain fixture and incline of the pipe. In addition, there are maximum changes of direction prescribed for combinations of various connected drain fixtures. Toilets have a large influence on the length of the pipe because these must be conceived a manner to enable the waste materials travel down a given incline and reach the down pipe with one flush. Pipe length is to be understood to encompass the entire length of the connector and collector. National standards and guidelines typically provide a complete overview of the maximum pipe lengths for given diameters and pipe inclines.

The previously described connection requirements for horizontal pipes also apply to:

- the manner of connecting collectors and underground pipes together
- the manner of connecting collectors to down pipes
- the minimum distances between connector joints on collectors, underground pipes and down pipes
- the joint-free zone in the transitions from horizontal pipes to down pipes and down pipes to horizontal pipes

Reductions

In collectors and underground pipes, there are to be no reductions in the direction of draining.

1.3.5 Down pipes

How to connect to a down pipe

The connection to a down pipe must occur at an angle of between 87,5° and 90°. This prevents a hydraulic seal from being created. Improved inflow can be achieved by providing the inflow branch with a radius.

Minimum distance between joints on a down pipe

If the angle between connectors is smaller than or equal to 90°, there are no restrictions placed on the height differences between the connections on the down pipe. A minimum 0,5 m height difference must exist if the angle is greater than 90°.

Offset in a down pipe

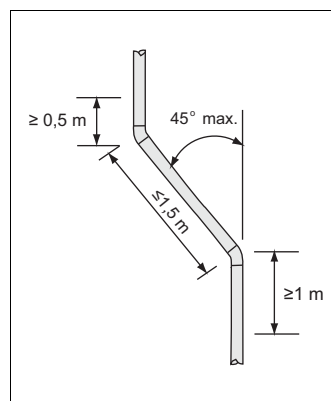


Illustration 1.27

A down pipe may be offset without an equalisation pipe if the following conditions are met:

- the length of the offset must not exceed 1,5 m
- the angle may not exceed 45°
- no joints in this segment may be installed in a zone ranging from 0,5 m above the offset to 1 m below the offset

If the offset cannot satisfy these conditions, the resulting pressure differences can be alleviated by means of good air transport using an equalisation line.

Connecting a down pipe to a collector or ground pipe

The down pipe base must be constructed from two 45° bends between which a straight 250 mm segment is placed. This causes the deceleration to be less abrupt, the transported air can escape more easily and the under pressure remains limited.

A diversion pipe must be installed if the down pipe continues as a down pipe after a horizontal section and the highest joint on the down pipe is 20 m above the horizontal segment.

Each down pipe must be connected to a (combined) pressure-relief or equaliser pipe. The equaliser line connecting two parts of an offset down pipe must be constructed so that:

- No connection less than or equal to 1 m above and below the transition from down pipe to horizontal pipe and the inverse.
- The equaliser line must be connected to the down pipe by means of a 45° downward angle.
- Joint-free zones according to national standards.

1.3.6 Pressure-relief pipes

An internal sewer system must always be in contact with the outside air by means of a pressure-relief pipe. Each down pipe must also be connected to a (combined) pressure-relief pipe. No more than 10 down pipes may be connected to a combined pressure-relief pipe. A primary pressure-relief system is based on water and air transport in the same pipe without any parallel venting.

In situations in which the internal sewer design does not allow any primary pressure-relief, it is possible to resort to secondary pressure-relief, which prevents hydraulic sealing and is downstream from the last drain fixture connected to the horizontal pipe. The secondary pressure-relief line is at least 1 m above the floor connected to the down pipe at a downward 45° angle.

National standards and guidelines further describe requirements on the outlet of the pressure-relief pipe.