Abdelhafid Bousouf University Center - Mila

2024-2025 Semester 1

Sanitation

– Lesson 2 –

Chapter 2 : ***Sanitation Systems and Schemes***

teaching staff		
Name	**Institute Grade**	**E-mail address**
Boumessenegh Amel MCB Science and Technology		a.boumessenegh@centre-univ-mila.dz

Students concerned			
Institute	**Department Year**		**Speciality**
GC **Science and Technology**	License 3	Hydraulics	Urban hydraulics

Course Objectives 2

The objectives of the course on **sanitation systems and schemes** are:

1. **Understanding the fundamental principles of sanitation :** differentiating the Types of sanitation (collective, individual, stormwater) and their importance for health public and the environment.
2. **Identify the components of sanitation networks :** know the elements of a wastewater and rainwater drainage system (collectors, stations of pumping, wastewater treatment plants).
3. **Analyze sanitation schemes :** study the different configurations of networks (unitary, separate, mixed) and their adaptation to urban constraints and environmental.
4. **Evaluate the performance of sanitation systems :** measure efficiency hydraulics, transport capacity and wastewater treatment level before their rejection.
5. **Apply standards and regulations :** integrate technical requirements and environmental considerations in the design and operation of sanitation networks.
6. **Optimize wastewater and stormwater management :** propose innovative solutions for pollution reduction, stormwater management and resilience to floods.

Introduction

The characteristics of the water to be evacuated (domestic and industrial wastewater and the rainwater) presents very different qualitative and quantitative aspects, so that Various drainage systems, separating or not these waters, are technically feasible. There are fundamentally two basic sanitation systems: The system unitary and separate systems.

2.1 Sanitation Methods and Systems

Two sanitation methods exist:

- **Public sanitation:** consisting of a public collection and transport network wastewater and rainwater towards a treatment facility or outlet.

ÿ **Individual sanitation:** Any sanitation system that collects, the pretreatment, purification, infiltration, or discharge of domestic wastewater buildings not connected to the public sewage system.

2.2 Wastewater and Stormwater Drainage Systems

The establishment of a network in an urban area must meet two categories of concern, namely:

- Ensure proper drainage of rainwater to prevent submersion of urbanized areas, and avoid any stagnation after the rain showers.
- Ensure the disposal of household wastewater, sewage, and other wastewater industrial waste.

It allowed us to imagine one or more networks of pipes through which the effluent flows. generally by gravity.

The evacuation systems that could be put into service are:

- Unitary system
- Separation system
- Pseudo-separate system
- Mixed system

2.2.1 Unitary System

This system allows for the evacuation of wastewater and rainwater in the same unit. collector, therefore resulting in much more extensive drainage and purification works important.

This system is practical because it only requires one connection per dwelling.

The system is generally oversized for handling peak stormwater runoff,

The operation of the wastewater treatment plant is compromised by the arrival of water from different sources. origins with a different composition.

(figure2.1).

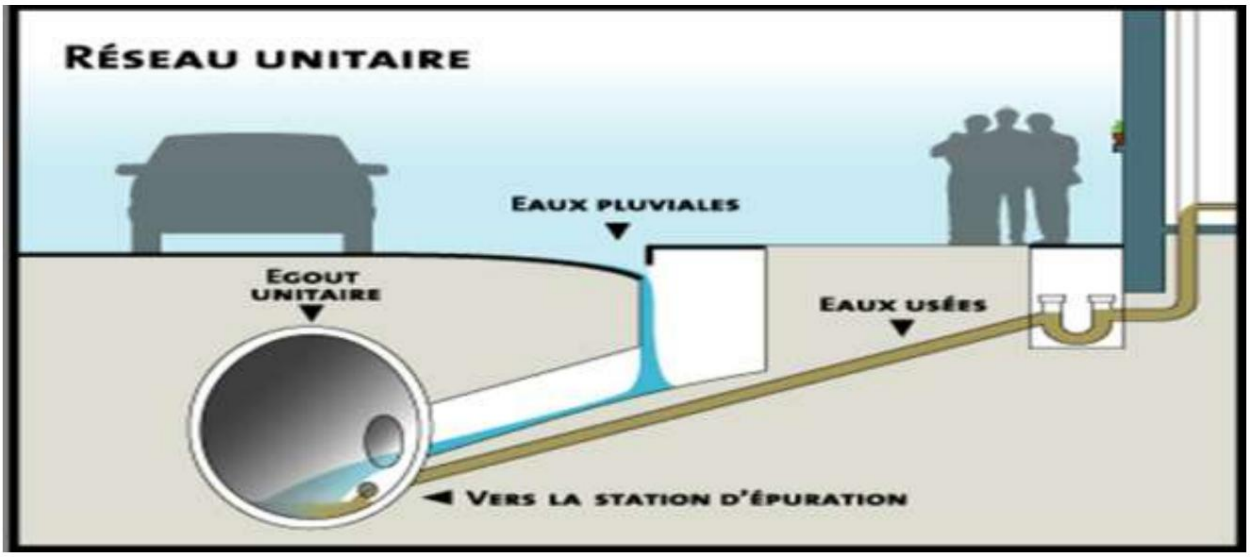


Figure 2.1. Unitary system

A/-The advantages:

• Simplicity

• The economy of design and maintenance

• There is no wiring error

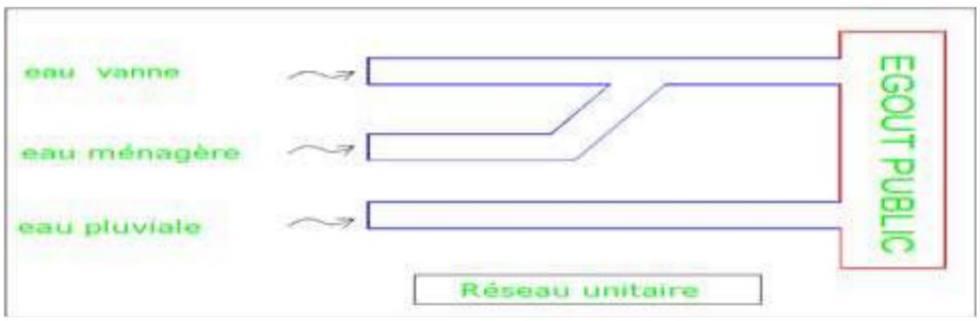
• Ease of implementation

B/-The disadvantages:

• Risk of pollutant deposition in dry weather

• Disruption of the wastewater treatment plant's operation (due to flow rate variations)

• Oversizing of the network (cumulative bandwidth)



2.2.2 Separation System

This system provides for the drainage of rainwater into a single pipe and the drainage domestic and industrial wastewater into a separate pipe.

• *Stormwater Network:* it is designed to evacuate rainwater, that is to say the
At peak rainfall, it follows the line of steepest slope. It carries the water towards the streams
nearest water.

• Wastewater network: it is designed for the evacuation of wastewater originating
domestic and industrial up to the wastewater treatment plant with a slope that can be
weak.

Figure 2.2. Separation system

A/ Advantages

Rainwater may be discharged into various outlets.

- The wastewater treatment plant can simply be sized for the flow rate of
A dry spell. Hence the resulting savings.
- Since the composition of wastewater is essentially constant, the treatment plant can
to operate safely and efficiently.

B/ - the disadvantages

• Problems with self-cleaning at the head of the wastewater drainage network

• Higher cost than the unit

- The problems of connecting each building to two pipes
different connections are difficult, and often lead to incorrect connections (i.e.
wastewater into the stormwater network and vice versa).

2.2.3 Pseudo-separating system

It consists of evacuating wastewater of domestic and industrial origin into a
piped with a fraction of rainwater generally coming from roofs, and spaces
private, the other fraction is transported through gutters and storm drains.

Figure 2.3 *Pseudo-separator system*

2.2.4. Mixed network

It is a system whose network is structured according to residential areas, part of which is one system unitary and another to the separate system.

2.2.5 The composite system

This system provides, through various modifications, for a partial diversion of the waters more polluted from the stormwater network to the wastewater network, for the purpose of their treatment. Knowing from experience that the first wave of rain and storm is supposed to have washed the roads public; indeed, during this short period, runoff water carries always a significant amount of soiling.

2.3 Choice of sanitation network

The choice of network type must meet the following criteria:

- the type of system already existing and to which a connection is possible.
- The cost of implementation
- The existence or absence of a wastewater treatment plant
- The topography of the terrain (gravity flow or pressurized flow)
- Urbanization density: in an agglomeration with dense urbanization, the system unitary is generally the most used.

-It is preferable to use the separate network in regions with high rainfall.

2.4. Diagrams of drainage networks

Most often, the urban area that we want to clean up is located nearby from a river or a thalweg which ensures final drainage, after possible treatment, and which indicates the general shape of the landforms that dictate the orientation of the sewers.

2.4.1 Perpendicular Diagram

This scheme involves bringing a number of [unclear] perpendicularly to the river collectors which in turn receive wastewater from the primary sewers. It does not allow the

Concentrating wastewater to a single treatment point is suitable when treatment is not not deemed necessary, and also for rainwater drainage.

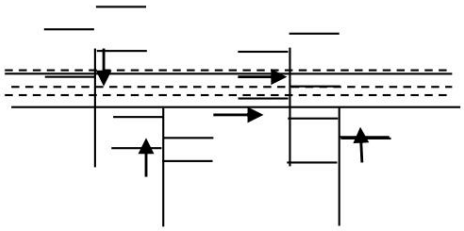


Figure 2.3: Perpendicular network

2.4.2 Lateral Shift Equipment Diagram

This type of layout allows wastewater to pass through a single treatment point by arranging a single collector lateral to the river, if the slope of the latter is sufficient.

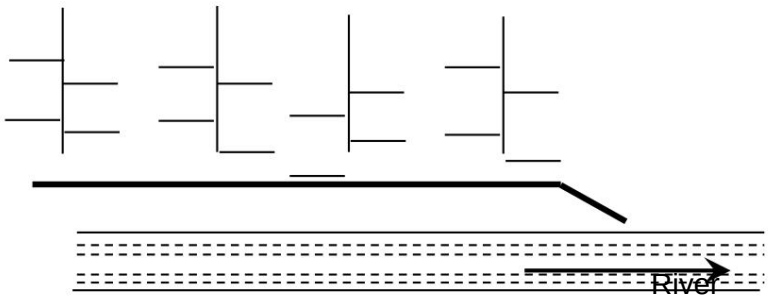


Figure 2.4: Lateral collector network.

2.4.3 Equipment Diagram with Transverse or Oblique Collector

This design is intended to increase the slope of the collector when that of the river is not sufficient to take advantage of the slope of the land towards the river.

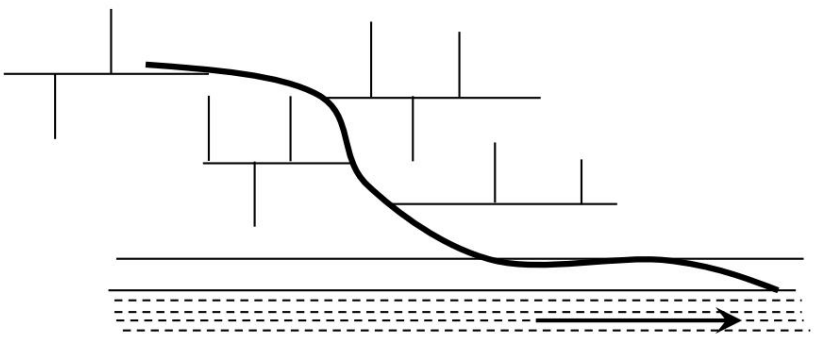


Figure 2.5: Oblique transverse collector network.

2.4.4 Staged Manifold Equipment Diagram

When we want to avoid overloading our network, and when our metropolitan area is extensive and our slope is quite shallow, it is necessary to carry out the sanitation work at several levels.

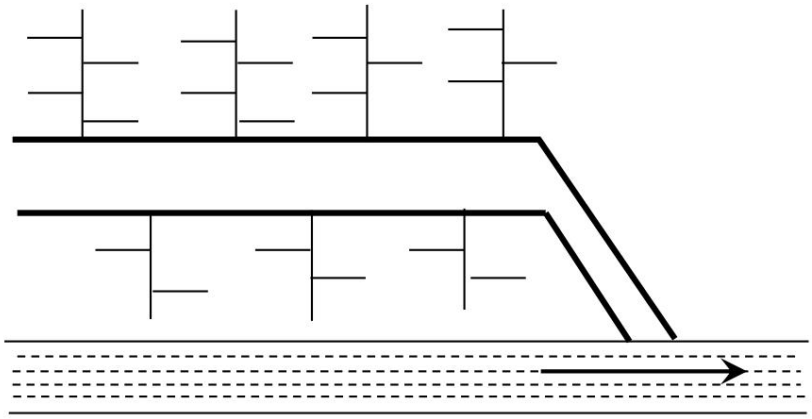


Figure 2.6: Layered collection network.

2.2.5 Radial Equipment Diagram

If our urban area is on flat land, the collectors must be sloped.
varying the depth of the trench, towards a collection basin subsequently
Pumping is necessary at or from the basin towards the wastewater treatment plant.

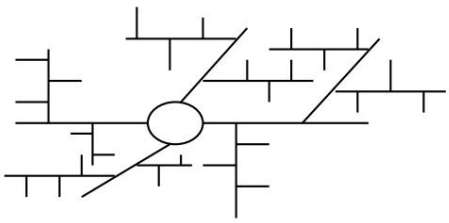


Figure 2.6: Radial network

2.5 Water evacuation

A sanitation network is "a system made up of different components, each of which, in Because of the role it plays, it complements all the others. They are numerous and they obey to a certain hierarchy of very diverse functions.

These organs are divided into two groups:

2.5.1 External Evacuations

This refers to all the devices installed outside of buildings.

2.5.2 Internal Evacuations

This refers to all the devices installed in private homes, which must comply with certain regulations.

rules.

1) External evacuation:

A: The collectors

Cylindrical pipes (nozzles): these are prefabricated, their diameter varies **from**

20cm to 1m.

*The pipes must be straight in both plan and profile

* It is strongly recommended to create a slope of at least **3%.**

* Changes of direction are achieved using prefabricated parts or by means of

poured-in-place junction boxes.

*The connections are inclined at **45°** or **60°** relative to the general axis.

2) ***Internal evacuation***

a- Rainwater

The water collected by the cover must be able to be collected and drained without risk of

Damage to the walls of the house. That is the role of *gutters* and their complementary elements.

It is essential that they are always in good condition.

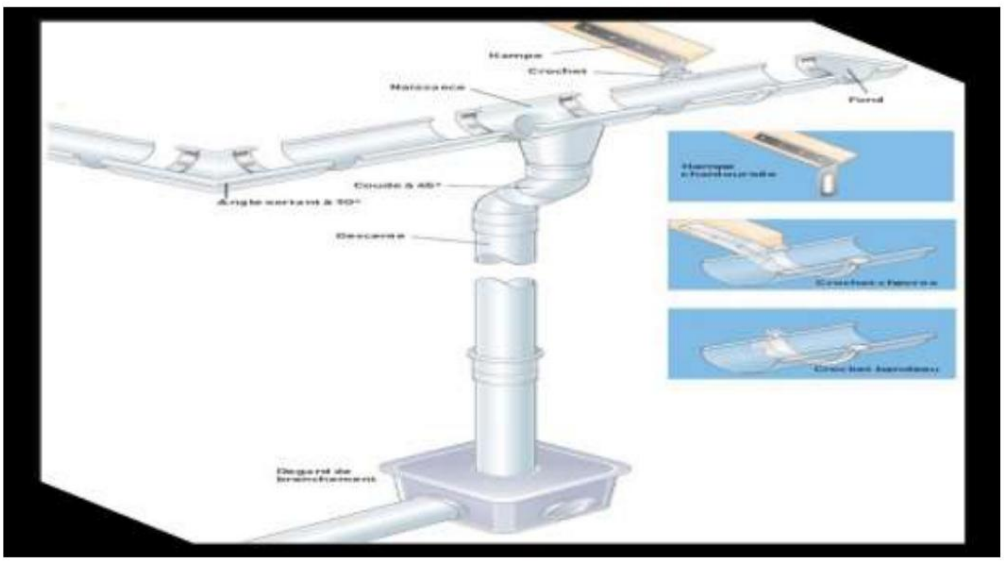


Figure 2.7: gutter.

ÿ **Gutter:**

A pipe fixed along the base of a roof, designed to receive and drain rainwater.

• Types of gutters:

1. Zinc gutter.

2. Copper gutter.

3. Grey PVC gutter.

b) domestic water

EXAMPLE: Sanitation in a detached house

1--Equipment and operation:

a. The bathroom and toilet:

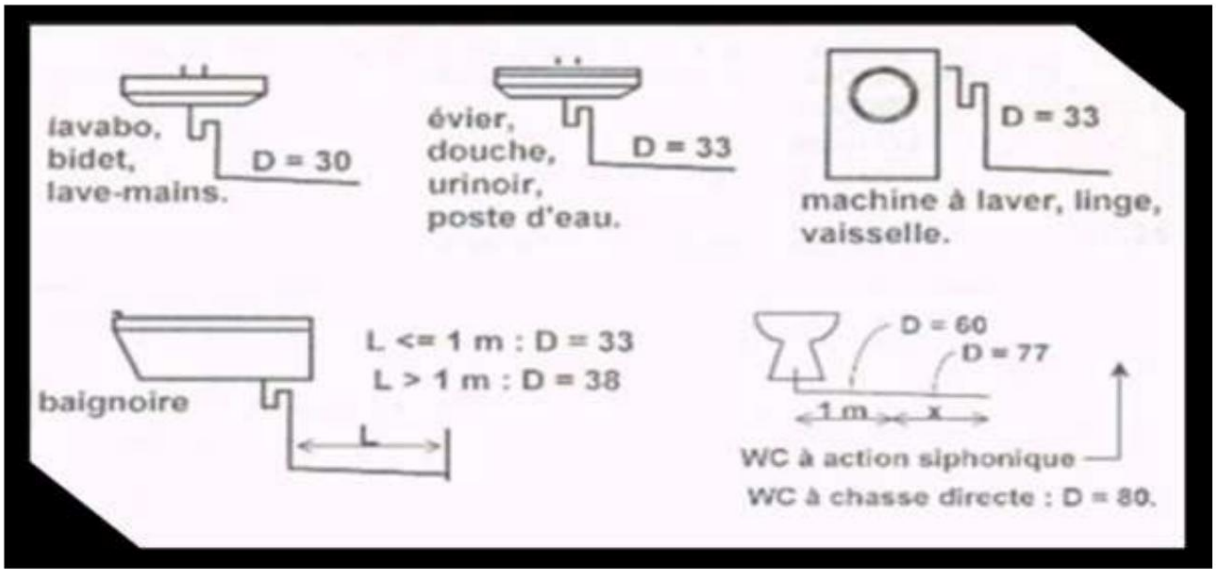


Figure 2.8: Bathroom and WC fittings.

b. The kitchens:

**Kitchen sinks:* are usually made of stainless steel, or some other material that

It withstands chemical attacks from cleaning products.

* *Ventilation:* This is an important element of kitchen comfort.

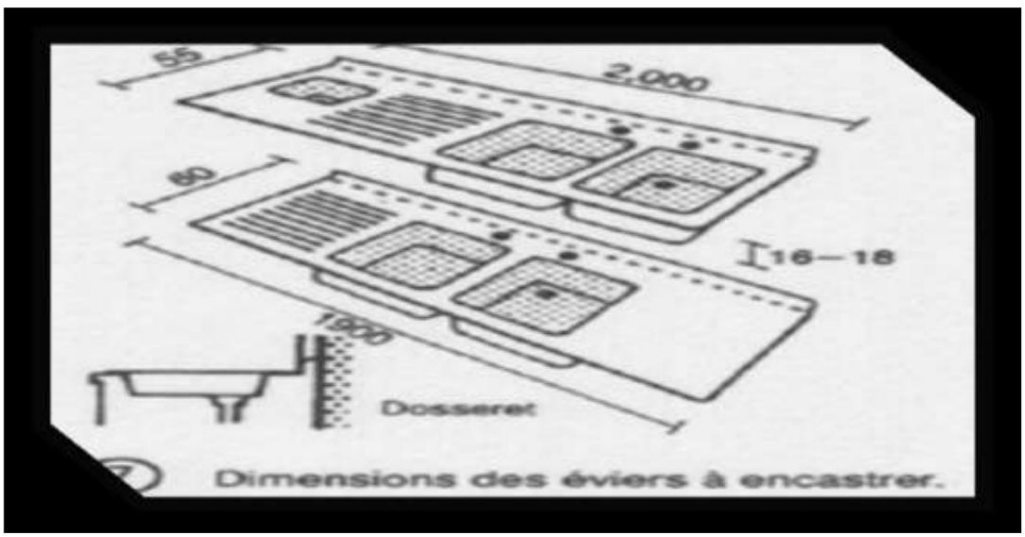


Figure 2.9: Kitchen equipment.

2.6 Manifold Calculation Procedures

- Network layout plan
- Cut into sections of approximately 300 m
- Delineation of the catchment area drained by each section
- Calculation of the peak flow generated by this basin
    - Peak wastewater flow
    - Peak stormwater flow
- Calculating the dimensions of the pipe based on its slope
- Plotting the longitudinal profile of the pipeline
- Verification of proper functioning

2.7 Criteria for choosing between sanitation systems

In general, the choice of a given evacuation system depends primarily on the objectives and site-related constraints such as:

1. Rainfall data;
2. Data relating to population growth and development;
3. Urban planning data: distribution of housing...;
4. Site data: topography, soil type, groundwater regime;
5. Economic and financial data;
6. The environmental aspect, linked in particular to the level of treatment tolerated when the Self-purifying power is limited;
7. City Liquid Sanitation Master Plan.

Reminder :

Sanitation = wastewater disposal + purification

Waste disposal = all the processes that ensure the collection and rapid removal of waste.

Waste treatment = all the treatments applicable to waste before it is released into a natural environment.

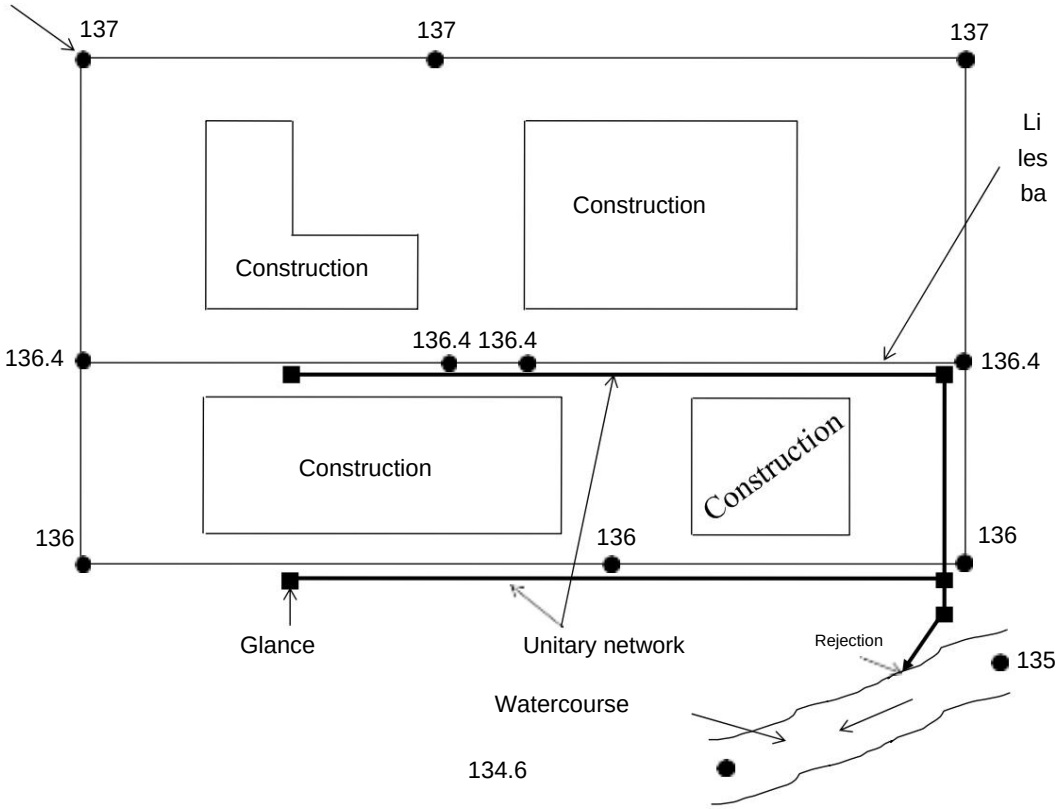


Figure 2.13: Diagram of a small sanitation network.

Conclusion

Sanitation systems and schemes play a crucial role in the management of Wastewater. The choice between centralized or decentralized sanitation often depends on the population density, available infrastructure, and local regulations. Each
The system has advantages and disadvantages that must be considered during the planning and installation.

Useful links

- https://youtu.be/v-gZ-DmS6R4
- https://youtu.be/a4nai0kXujA
- https://youtu.be/DcMeibIJDRI
- https://youtu.be/Djlt567v5AA

References

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