

Sprinkler systems in historic churches

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Historic churches combine irreplaceable cultural value with concealed combustible construction, great height and difficult fire service access. Many Dutch churches still contain sprinkler pipework installed decades ago. The engineering challenge is no longer simply whether a system exists, but whether it can deliver water automatically, promptly and reliably when a fire starts.

The protection objective has not aged

The Netherlands has a distinctive collection of historic churches and church towers that shape the identity of cities, villages and landscapes. Their value is cultural, architectural, religious and social. Fire can therefore cause much more than repairable property damage: it can remove original fabric, interiors, archives, organs and

AT A GLANCE

- A substantial number of Dutch churches and church towers contain sprinkler systems that are several decades old.
- Age alone does not determine fitness for service. Condition; hydraulic capability; water supply; detection; alarm transmission and management must be assessed together.
- A pipe network without an automatic water supply may provide only limited protection because fire growth continues while the fire service connects and supplies water.
- Revitalisation should start with explicit heritage-protection objectives and an integrated review of building, installation and organisational measures.

the familiar landmark around which a community has developed.

The Dutch government recognised this national interest before, during and after the Second World War. Under government responsibility, dozens of important monuments were equipped with sprinkler installations. This policy continued after the Second World War and,

until the early 1980s, important churches and towers received government-funded sprinkler protection.

Why churches remain a demanding fire risk

Church roofs and towers often contain extensive dry timber constructions. Fire may start in voids that are difficult to inspect and even harder to reach with hose streams. Height causes static pressure loss, access routes may be restricted, sometimes to a narrow internal staircase, and the seat of the fire may be above vaults or behind historic finishes. Renovation work; electrical faults; lightning; arson; changing use and sustainability measures, such as PV panels, can all introduce ignition sources or alter fire development.

The legal minimum is not the same as heritage conservation. Dutch building regulations primarily address life safety and the prevention of fire spread to adjacent plots. They do not guarantee preservation of the monument itself. Owners therefore need to define additional private objectives, particularly limitation of damage to the building and its contents, continuity of use and reduction of societal impact.

What an automatic sprinkler system contributes

An automatic sprinkler system detects heat locally and applies water to the developing fire. Only sprinklers sufficiently heated by the fire operate. The principal effects are cooling of the fuel, limitation of pyrolysis and pre-wetting of nearby materials. These mechanisms restrict heat release and prevent a local fire from developing into a building-wide event. Early control also creates a more stable situation for fire service intervention and can reduce the amount of water ultimately required compared with a developed fire.

For heritage applications, this local response is particularly important. A sprinkler does not wait for visual discovery, alarm verification, mobilisation, access to a difficult roof space and manual deployment of hose lines. It acts where heat is produced, while the fire is still comparatively small.

The legacy-system problem

Many historic systems are now around half a century old or older. Some remain in good condition, while others have lost essential elements. Pumps may have been removed, water sources may have deteriorated, fire service connections may no longer suit current operations, alarm transmission may have changed, and sections may have been isolated or taken out of service. In several churches only the (corroded) dry pipe network remains.

This does not mean that every old installation is obsolete. Properly installed steel pipework can remain serviceable for many decades. A condition-based assessment is therefore more useful than replacement based on age alone; it helps identify which parts can be retained, which require repair and which must be upgraded to restore a reliable protection concept.

Automatic versus fire service-fed systems

A conventional sprinkler system includes an automatic water supply capable of delivering the required flow and pressure for the specified duration. A number of historic church systems, by contrast, rely on the fire service to connect an appliance and feed the dry network. These arrangements are often described as non-automatic sprinkler systems.

“The central question is not whether an old sprinkler system complies word for word with a modern rulebook. It is whether the complete protection concept can still control credible fire scenarios”

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The delay is critical. As the fire grows, additional sprinklers may open and the operating area can exceed the area for which the pipe network and available water supply were intended. High towers also impose approximately 1 bar of static pressure loss for every 10 metres of elevation, before friction losses are considered. Historical calculations for some churches indicate water demands exceeding 4 m³/min at supply pressures in the order of 8 to 13 bar. Such demands may be beyond the practical capability of a single fire truck or the available hydrant supply. Once a fire has developed, firefighters may also be reluctant to operate close to the church because of the risk of falling or collapsing building elements; accidents involving partial collapse have occurred in the past.

A fire service connection can remain useful as a supplementary or contingency provision, but it should not be mistaken for an automatic water supply. If full automation is not immediately feasible, the residual risk and the operational assumptions must be made explicit and agreed through pre-incident planning.

This distinction is especially relevant for owners and advisers because it determines whether the system can be treated as an active fire-control measure or only as an operational aid for the fire service.

Engineering comparison

The following comparison (see overleaf) highlights the main engineering differences between fully automatic sprinkler systems and legacy systems that depend on fire service intervention for water supply. The distinction is important: both systems may use similar pipework and sprinkler heads, but their reliability, response time and hydraulic assumptions are fundamentally different.

A rational renewal strategy

Bringing or keeping the installation to a working fire safety strategy should not begin with a shopping list of new components. It should begin with the protection objectives, credible fire scenarios and the heritage values that must be preserved. The outcome is an integrated concept that combines building, installation and organisational measures.

- Establish ownership and responsibilities: Church buildings and towers may have different owners, while the fire-protection system crosses that boundary.
- Recover available documentation: Drawings, hydraulic calculations, operating instructions, test records and modification history are essential.
- Survey the system: Record protected areas, omissions, pipe routing, sprinkler types, valves, alarms, fire service inlets, supports, drainage and accessibility.
- Assess condition: Use representative internal pipe inspection, wall thickness measurements where

Aspect	Automatic system	Fire service-fed legacy system
Water application	Starts automatically after sprinkler operation.	Starts only after alarm receipt, mobilisation, access and connection.
Design basis	Dedicated supply matched to hydraulic demand and duration.	Dependent on appliance, hydrant capacity, hose layout and operational access.
Fire growth	Water is applied at an early stage.	Fire may continue to grow before water is applied.
Water requirement	For a small fire, the required water demand is well established.	For a larger fire, the required water demand is uncertain and cannot be based reliably on sprinkler design codes.
Pressure/flow at elevation	Established by pump and hydraulic calculation.	Available pressure is reduced by static head and hose/pipe friction and fire brigade capacity
Operational dependency	Low, provided the system is available and maintained.	High; relies on people, equipment, access and correct procedures.
Preferred role	Primary automatic fire-control measure.	Interim, supplementary or contingency measure with explicit limitations.

justified, obstruction checks, sprinkler sampling and functional testing.

- Verify hydraulic performance: Reconstruct or update calculations using the actual pipework, elevations, hazards and available water supply
- Review detection, alarms and follow-up: A local alarm without prompt and effective response will not provide the intended protection; even an automatic system still requires organised follow-up.
- Provide an automatic and reliable water supply wherever reasonably practicable.
- Document the final concept, design criteria, deviations, management requirements and inspection basis in a clear fire-protection specification.

Fire brigade

Pre-incident planning with the fire service remains important, even for a fully automatic system. Responders need to know where activation occurred, how the water supply is arranged, where alarm valves and controls are located, which parts of the building contain exceptional heritage value and when the system may safely be isolated. The sprinkler system should normally remain in operation until the fire is confirmed to be extinguished.

Funding the next generation of protection

The original systems were installed because the monuments were considered to be of national importance. The same cultural value remains, but the accumulated maintenance and modernisation task now often falls on owners with limited resources.

Although funding options are limited, available subsidy schemes for monument maintenance can provide an important opportunity. In particular, installations originally provided at the request of the government may qualify for financial support. Several current projects are already exploring this route through formal subsidy applications.

The objective should be more than a one-off catch-up programme. It should bring systems to a defined condition and then keep them there through planned testing, maintenance, periodic review and clear allocation of responsibility. The programme should also allow risk-based consideration of important churches that do not yet have automatic suppression, but where sprinklers or water mist could provide substantial heritage benefit.

Conclusion

Historic sprinkler systems should neither be removed simply because they are old nor trusted simply because

pipework is present. Their value depends on the complete chain from heat-operated sprinkler to water supply, alarm, management and fire service follow-up. A technically sound assessment may show that substantial parts of an existing network can be retained. It may equally show that automatic water supply, alarm transmission, corrosion control or hydraulic capacity must be restored.

For sprinkler specialists, historic churches offer a clear engineering lesson: preservation is achieved through early control of fire, but the system to provide that control must be verified, maintainable and aligned with the realities of the building. Revitalising these systems protects more than steel pipe and sprinkler heads. It protects irreplaceable architecture, interiors, memory and community value.

Practical checklist

	Action	Technical intent
1	Define the objective	Preservation of the building and contents, life safety, support for fire service intervention and acceptable residual risk.
2	Confirm the legal and stakeholder framework	Identify owners, users, authority, insurer, heritage adviser and fire service.
3	Inspect the existing installation	Establish scope, condition, accessibility, modifications, omissions and impairment status.
4	Verify water supply and hydraulics	Confirm demand, elevation losses, friction losses, duration, source reliability and redundancy.
5	Review alarms and response	Confirm fire and fault transmission, responsible recipients and response procedures.
6	Select the intervention	Retain, repair, automate, extend or replace, on the basis of evidence.
7	Embed maintenance	Assign a trained manager, maintenance contractor, test regime, logbook and impairment procedure.
8	Plan for the next review	Link major maintenance, condition monitoring and funding to a multi-year programme.