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Surface water drainage SYSTEM FAILURES

The factors that can influence the dynamics of surface water drainage failures and floods are varied – so are design considerations and solutions.

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The management of flood risk on large scales (and other environmental objectives) drive the need to manage surface water at development sites and elsewhere. Currently adopted approaches to the design of surface water drainage systems are well established.

On individual sites the need is to prioritise approaches that avoid or heavily limit surface water discharges to sewers and watercourses, and instead focus on:

- Harvesting and re-using surface water.
- Attenuating surface water within a site. This might be done via storage within a drainage system, buried tanks, swales, ponds, or basins.
- Disposing of surface water via infiltration into the ground and evapotranspiration (instead of discharging it.)

In practice this can lead to small to medium-sized developments implementing multifaceted and relatively complex surface water drainage systems. It is usually necessary to evaluate the response of such systems to a range of rainfall events of varying likelihood and duration. There will be design criteria for limiting discharge, runoff, and surcharging and flooding frequency.

Perhaps unsurprisingly, computer modelling is widely used in the design of such systems.

Drainage system failures

Because modern systems are held up against different criteria under different conditions, there is scope to consider precisely what constitutes a failure. For instance, flooding of external parts of a site due to a drainage system being overwhelmed during a relatively severe 1:50 year rainfall event might be anticipated in design, and might also be tolerated, so long as buildings are not flooded.

Whatever the circumstances and criteria for failure, failures of systems might be accounted for by various issues. On the next page are some examples of the issues that can be encountered in investigations of drainage failures.

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The possibility that severe rainfall and associated run-off might exceed the capacity of a system, or part of a system, is generally unavoidable. This issue alone might account for drainage failure and flooding in some in some circumstances.

The management of risks associated with future rainfall events warrants consideration given that climate projections[1] point towards increases in the intensity of heavy summer rainfall events and other rainfall increases. Climate projections raise questions for the long-term resilience of existing systems and how current methods of designing and assessing drainage systems might adapt in the future.

Any restriction or shortfall in the capacity of a system might lead to ineffectiveness in response to rainfall.

For example:

- Blockages can occur and might be accounted for by issues such as damage to or structural failure of pipes, or deposits of debris and sediment in pipes. Proper design, specification, detailing, construction, and maintenance will seek to minimise the potential for such issues.
- Design and installation errors, for example, associated with pipework arrangements, might lead to shortfalls in capacity or otherwise exacerbate the potential for other problems such as blockages.
- Other service problems can occur. Pumps can lose power or otherwise fail. Back-ups and telemetric alarms can be incorporated for this reason but are not always.
- Occasionally, the omission of an overflow at a critical point in a system might lead to a relatively minor service problem (for example, a blockage) causing disproportionate damage.

Climate projections raise questions for the long-term resilience of existing systems and how current methods of designing and assessing drainage systems might adapt in the future.

- **Circumstances can dictate that a system cannot discharge as expected, for instance:**
  - Accumulation of sediment is one problem that can significantly reduce the effectiveness of infiltration devices. Good design and detailing around sediment control along with regular maintenance will seek to avoid such issues.
  - High levels in receiving waters can occur and prevent discharge from a system. This can include circumstances of public sewers surcharging, which is to be expected in some locations and under some circumstances. Furthermore, where it is not prevented by design and construction (for instance via an anti-flood valve or pumped system), high receiving waters or surcharging sewers have potential to cause backflow into connecting sites and flooding.

Mitigating the impacts of drainage system failures

Propensity for the sorts of failures outlined above will be significantly influenced by the quality of design and construction of a system, and by maintenance. Nonetheless, extreme rainfall events can occur, as can other failures, and flooding cannot be avoided in all possible circumstances. This raises the question of how risks associated with system failures can be managed.

Current good practice is to provide designed flood pathways to carry away surface water if drainage systems become ineffective. In this approach flood pathways are designed to convey excess surface water away from buildings and infrastructure, for example, following the routes of roads or ditches. Flood pathways might also incorporate areas of emergency storage that would flood preferentially if needed.

Flood pathways can only be designed effectively when details of drainage systems and drainage design criteria are related to site layouts, site levels, and building levels. This speaks to the need for surface water drainage to be considered as part of a holistic site design and not seen in isolation. ●

References and resources

[1] *UK Climate Projections: Headline Findings*, Met Office

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