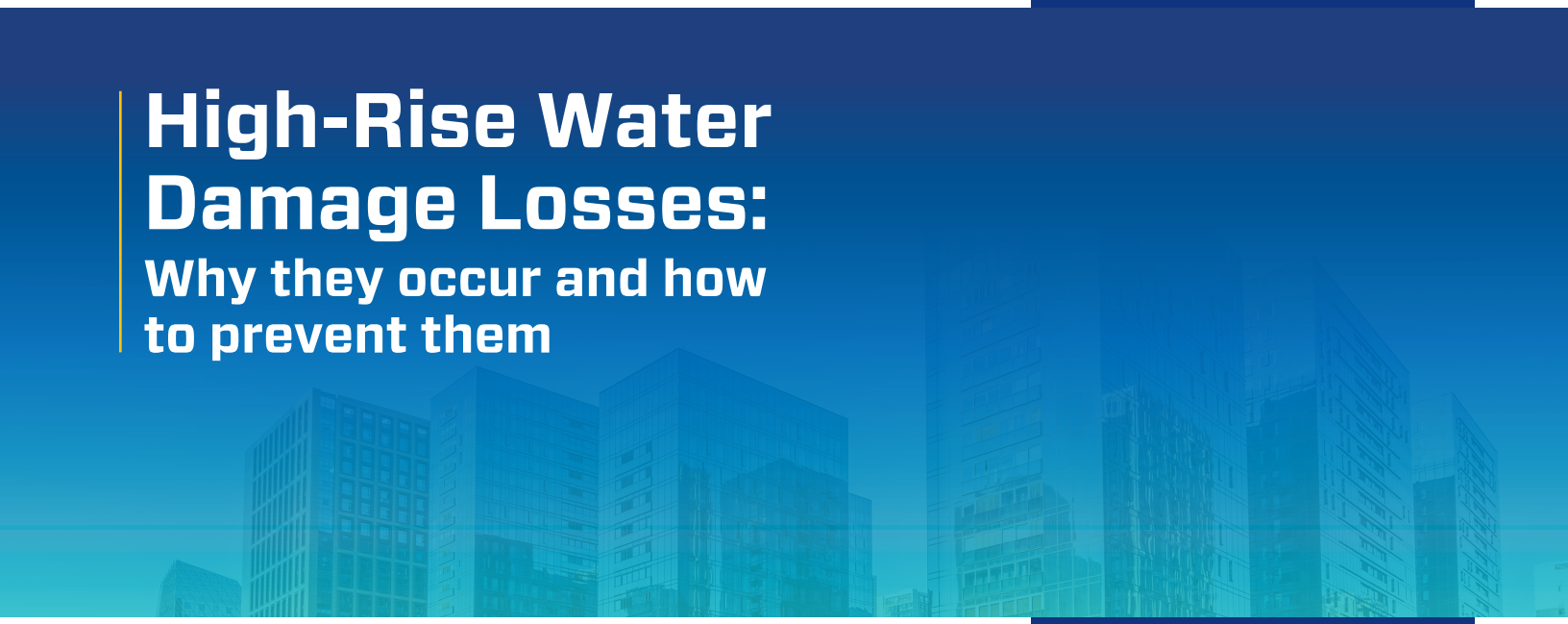
WHITEPAPER

High-Rise Water Damage Losses:

Why they occur and how to prevent them



If you work in construction or design high-rise buildings, or if you insure them, you've probably experienced an incident occurring on a construction site that was nearly finished. The grand-opening was being planned and walk-throughs for owners and tenants were in full swing. Construction workers were working frantically to meet the final target date and suddenly, water leaked throughout dozens of units.

This scenario may be a little extreme, but it's not too unfamiliar for those of us who work with large structures on a near daily basis. Losses do occur regularly as occupancy nears or shortly thereafter. In either scenario, the incident is unfortunate and questions arise. Why did this happen? Why does this keep happening? Understanding the most common factors surrounding water damage losses is the first step.

HIGHLIGHTS

- 3 Common Factors of Why Water Damage Occurs
- 5 Important Questions to Ask to Prevent Water Damage

THREE COMMON FACTORS THAT SHOULD BE CONSIDERED WHEN ASSESSING WATER DAMAGES IN HIGH-RISES:

1. The large number of connections installed requires a near perfect installation record.

Let's say a building has 20,000 plumbing connections. If there is a 99.9% success rate with those connections, that still means there is one failure for every 1,000 connections. So, in a building with 20,000 connections, statistics would dictate there would be a minimum of 20

failures. That's how precise builders need to be. You can be nearly perfect and still succumb to a loss because sooner or later a connection somewhere within the system of thousands will fail.

2. Emerging technologies or cheaper methods are not tested for all types of applications or uses.

If a new product could be installed in half the time, reducing the installation and bulk supply costs, it would be difficult not to go that route. This might be the difference between winning and losing the bid for the next project.

If there are cheaper methods of installation, the industry will always be interested. Clients may decide to take on the risk and believe manufacturers' claims that their product is the way to go, until the day comes when the cheaper method no longer proves viable.

Take copper piping, for example. If you talk to experienced plumbers, many will say that they prefer standard copper pipe with soldered connections. Why? Well, they've been used for years, they last a long time (provided the fluid velocity isn't excessive and the soldering has been done appropriately), and most plumbers generally understand them. Also, when issues arise, copper pipes leak. This can be found and repaired, as opposed to other connections which may cause complete pipe disconnects and more significant damage. However, the issue with copper is that it's expensive, both in product and in installation costs. So, if a manufacturer claims to have a better option, people listen, and sometimes that decision can come with a very large price tag if it doesn't work out.

Another example is PEX piping. When it was first introduced, the product worked relatively well for cold water lines and it was thought that it would work similarly well for hot water lines. However, problems began when they started using the product in recirculating hot water lines. The PEX piping became embrittled, cracked, and eventually leaked. Entire systems had to be replaced. Because of these issues, new PEX products have been made that are built to handle these situations.

Similar issues arose with PVC piping in a hot water recirculation system, where it would become embrittled with time. PVC use is well-known and used, but that doesn't mean it is not without flaw.

In a similar fashion, installers would use brass connections for the PEX crimp connections—likely in an effort to cut costs. Those brass connections were made with a high zinc content (and lower copper content) and in certain water environments, would lead to stress, corrosion and cracking of the connection and ultimate fracture of the connection. There are a lot of great developing products, but they need to be thoroughly tested to be used, and their limitations should be well understood.

Many manufacturers tout how their products make life easy and how they are simple to install. However, what can be lost in the allure of shiny new products is that additional considerations in regards to the design or proper installation of those products may be missed. Careful consideration should be taken by the designer and the installer when using new products that have not been time-tested. Questions to consider include: Can the product withstand the

necessary temperatures? Can the product allow the adequate pipe movement that is found in the system? Are your installers qualified and trained to install the product and identify a good installation versus a bad one?

3. Expansion or contraction of water lines is not taken into account.

When pipes heat up, they expand. When pipes get cold, they shrink or contract. If the design, installation, or both restricts the pipe from movement, problems can occur. Common problems include:

a) Lack of expansion or contraction mechanisms on the riser. There are many methods to compensate for the expansion and contraction of risers. Whether specific fittings are installed (e.g. bellows) or pipe offsets are used, risers often require some sort of compensation. Even if it is just to have enough room to grow or shrink, risers without compensation can see branches and piping that are stressed, which can lead to water losses.

b) Over-constrained branch supports. In this situation, the riser is free to move, but the branches

off the riser are rigidly constrained. This induces stress onto the connection and it may eventually fail.

c) Cold water line expansion is not considered. We have seen designers in the past assume that the cold water lines will not expand any appreciable amount since they never get hot and as such, they do not design for an appropriate amount of expansion on the line. Envista has tested cold water risers which can get as hot as 36°C (97°F), in certain situations. Many designs do not account for a temperature swing on the cold lines from 4°C to 36°C (39°F to 97°F).

d) Plumbing issues related to riser clamp usage. A commonly misunderstood technology is the riser clamp, which is used to secure the pipe at the floor and prevent the riser from falling. Issues can involve the number of riser clamps needed, incorporating riser clamps into the expansion or contraction of piping, and properly installing riser clamps. These are all factors we've seen that can lead to systemic plumbing issues related to the riser clamp.

prudent engineer will render a design that both reduces the probability of known failures reasonable to expect in a particular application and reduces the risk of failures that are not known or expected. Therefore, the safety of a particular design is limited by the designer's knowledge of the application and environment in which the machinery operates.

WHAT CAN BE DONE TO AVOID THESE SITUATIONS?

The good news is that several things can be done in the design or construction phase to reduce the likelihood of these failures, but not eliminate the possibility. That's an important distinction. It is practically impossible to eliminate all water losses from occurring in a new high-rise building because statistics will always win. With 20,000 connections, there will very likely be a bad apple somewhere in the lot. Nevertheless, the number of failures can be reduced with the following precautions in place. All of which are helpful to know and understand in the event of a loss, and when determining potential liability, by ensuring these measures were carried out during construction.

FIVE IMPORTANT QUESTIONS TO ASK TO PREVENT A HIGH-RISE WATER LOSS

1. What quality control measures are in place and what is the accountability of the mechanical contractor?

In recent years, we have seen some contractors sign the connection with their initials. This gives some ownership to that connection by the installer. Similarly, we have seen contractors paint riser clamps after they've torqued it appropriately onto the pipe. This makes it easier on the supervisor or engineer when they inspect the clamps. Additional quality control (QC) measures, such as pressure testing the system for

extended lengths of time, may also be helpful when avoiding a water loss.

2. Do the on-site general contractor and mechanical engineers understand potential problems and pro-actively complete inspections?

When Envista is involved in Quality Assurance (QA) and QC for high-rise buildings, a part of that process is educating people on-site with what engineers look for during an inspection. We also educate on risks associated with potential issues, such as allowing for the necessary expansion and contraction of pipes. Once contractors and supervisors understand how these problems could arise, they are able to use that knowledge to inspect the building and examine different areas that may pose potential problems.

3. What is the relationship like between the designer and contractor? Who is accountable?

We have seen situations in the past where the designer makes a note on the drawing, such as "mechanical contractor to account for adequate expansion/ contraction within the system," which essentially pushes that aspect of the design onto the contractor. The contractor would then have to hire their own engineer as a sub-contractor so they can design the system for appropriate expansion and contraction. We have seen situations where the mechanical contractor believes it's the original designer's responsibility to complete that task and the designer thinks the opposite because of the use of the clause mentioned above. This miscommunication can be catastrophic. Clear communication between parties, both at design review and during construction, needs to take place and be clearly documented.

4. Is there an established inspection program during the build?

Engineering firms, such as Envista, can be involved to review the installation process as it is happening to ensure that adequate room for piping has been accounted for in the system. Similar to contractors initialing the connections mentioned above, this may also have a psychological effect on the site workers, as it keeps them on their toes when someone is inspecting their work. Inspectors look for pinch points, over-constrained areas, floor clamps, and more. QA/ QC is important and should be included during the site build, essentially from the ground up, until completion of the project to help prevent failures from occurring.

5. Is there a destructive examination procedure to test connections during construction?

The general contractor, developer, or owner may choose to have an engineering firm destructively examine select connections that cannot be otherwise inspected, such as solder or PEX connections, in order to evaluate the quality of the connection. This type of testing, during the construction process, may help identify any systemic issues before water is turned on by testing to the point of failure. It also places some additional ownership on the mechanical contractor when their work is randomly selected for inspection. It's important to analyze behavior of some connections as it can help to better guarantee durability.

PUTTING IT ALL TOGETHER

In all of these cases, knowing the background of the products installed as well as the common modes of failure are essential components for assessing and preventing these types of large losses. While not all water losses can be prevented, engineering firms can assist in establishing an inspection program, promoting dialog regarding the implementation of the plumbing systems, and implementing a destructive examination procedure during the course of construction to help mitigate the chances of a water loss occurring.