A FAÇADE OF FIRE SAFETY

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What’s the problem?

Since the energy crisis in the early 1970ies there has been an interest in making buildings more energy efficient. This has caused a significant increase in the requirements to the thermal performance of exterior walls leading to extensive use of insulated exterior walls. There are several different ways to make an insulated exterior wall. The most frequently used systems include ETICS (External Insulating Composite System)/ EIFS (external Insulating Façade System) which consist of a layer of insulation, a reinforced mesh layer, and a thin coating of exterior material—as well as the ventilated façade system, where an air gap of at least 25 mm between the insulation and the covering panels allows moisture to escape. The insulation used in these systems can be combustible (such as Polystyrene, Polyurethane and Polyisocyanurate) or non-combustible (including stone wool, glass wool and Foam Glass). Price, weight, and thermal performance often makes combustible insulation the preferred option. This choice comes with the inherent challenge of ensuring that it does not become involved in a fire. The covering used in ventilated facades also comes in many different versions, from inert natural stone to metal composite panels with combustible cores—again, spanning a vast range of potential risk in the event of fire. The ease with which these systems ignite and spread fire depends on the combustibility of the materials used and how the system is designed to limit ignition and fire spread.

While some experts were trying to warn about the potential risk of combustible façade systems it took many years before enough of these systems were in use for us to start to see their impact. Then we started to see more and more fires with a dramatically fast fire spread over the exterior of the building. According to research done at Imperial College in London [1], the frequency of façade fires in large buildings has increased by seven times in the last three decades. Surprisingly the only way that researchers know about this increase in these types of
fires is from the media. There is no coordinated effort globally at this point to collect consistent and comparable data on these or any other fire incidents.

Despite the increase in number of fires involving combustible exterior walls the number of fatalities were low so even a report published by the Fire Protection Research Foundation in 2014 on Fire Hazards of Exterior Wall Assemblies Containing Combustible Components [2] providing insights into the potential dangers of these systems was not enough to inspire policy makers into action. It was not until the fire in Grenfell Tower on the night of June 14, 2017 claimed the lives of 72 people that the world woke up to the hazard presented by combustible exterior walls.

**How is this regulated?**

Most buildings codes and regulations attempt to control the fire performance of exterior walls through requirements to the fire performance of the façade system. While the safety objectives of these requirements are similar from country to country, the way they’re carried out can be very different. As with all fire requirements around the world, those related to exterior facades are based on national experience with catastrophic fires as well as local building tradition.

One approach used in many countries is to apply combustibility and/or flammability requirements to each material used in the façade system—the rationale being that by controlling the performance of each component, the combined system should perform appropriately safe. The requirements are linked to the perceived hazard for the building and are dependent on the height of the building and its occupancy. A typical example is to require the use of only non-combustible materials if the building exceeds a certain height, which can range from 12 to 50 meters depending on the country.

Another approach is to require testing of the entire façade system, often in a large-scale test to replicate the perceived real behavior of the system. Some countries have chosen to include large-scale testing of façade systems in their requirements, while others have opted to use large-scale façade testing in addition to testing of individual components. Despite that these countries are all trying to mitigate the same hazard, there are almost as many tests as there are countries with testing requirements. Key differences exist in the tests, including heat exposure, testing geometry, and criteria for passing the test. Consequently, the same exterior wall system might get very different results in different tests, one deeming it safe and another unsuitable for its intended purpose. Fire, however, does not recognize geopolitical borders and behaves the same way everywhere. Yet, worldwide, our testing contains no consistent scientific basis that could help eliminate these critical safety differences from country to country.

Adding to the challenges there is a lack of understanding of how different materials interact within combustible exterior wall assemblies during fire. A minor change in the material, geometry, or assembly of a façade system can drastically impact its flammability so it is dangerous to assume that these variations can be used interchangeably in building design without further research. Yet too often these simplified assumptions are made causing the
safety of the final design to be questionable. The complexities of these systems require a high level of competence of the designer.

Not only is a high level of competency required by the designer. An important aspect that is often overlooked when discussing the fire performance of exterior walls is the quality of the installation of these systems. When using combustible materials, it is critical to ensure that they are protected from ignition and that added protective measures such as fire stopping and barriers are installed correctly. A system that was designed to be safe can turn deadly if not installed correctly. Many installers are often unaware of how even minor details can have major impact on how the finished system will perform if exposed to fire. A highly skilled workforce is therefore essential if we hope to ensure the safety of these complex façade systems.

**Where is the data?**

So how can we improve our understanding of the fire performance of combustible exterior walls and thereby implement better codes, regulations and tests? This will require research into the fire performance of materials and systems and especially how they interact. An important part of this research is to learn from the fires that has already happened. Without that we can understand neither the true scope of the problem nor the details necessary to create consistent testing requirements and building regulations.

Unfortunately we do not have detailed data about these fires: the kind of exterior assemblies that were used, what kind of fire testing (if any) those assemblies had been subjected to, how the fires started and spread, the types of safety regulations that may have been in place, and more. Without that level of detail, we are unable to make a convincing case for jurisdictions to institute new or more stringent testing methods. Relying on media reports also means we can’t gather data on the small fires that never developed into large disasters due to fire safety provisions working as they were intended. The information we are getting is skewed towards disaster and provides few lessons about what works compared to what doesn’t.

Even data recorded by the fire service after incidents have their challenges. Researchers from different countries have indicated that incident reports often provide limited information about the type of façade system, the components used in the assembly, and the development of the fire. Another limitation of international data is that different metrics are often recorded by different countries. If data collection is inconsistent between nations, it is impossible to compare the frequency of incidents without a high level of uncertainty as well as to quantify how different requirements around the world impact the level of risk. With few exceptions, we continue to validate unknown quantities of different building materials with various test methods and often install them through an undertrained workforce bound by minimal regulations. The progression of these practices is seemingly bottlenecked by a lack of knowledge and fire incident data to validate or disprove hypotheses.

If we do not learn from fire incidents, we will continue to try to solve a set of problems we can barely identify. There is an opportunity to learn from failures, and even successes, and develop
strategies based on real-world fire incidents. We owe it to the fire victims as well as future generations to do better.

A first small step towards getting more data on the façade fire problem is a new Wikipedia page [3] with a list of high-rise façade fires. The page is set up by the Hazelab research team at Imperial College with support from NFPA and everyone with knowledge of high-rise façade fires are encouraged to add information to the list. While in no way a perfect solution or a way to get all the detailed data that researchers need it is a beginning and a way to explore alternative ways to get the data we need while waiting for national fire data systems to catch up.

References


[3] https://t.co/fwNl6p6cK0v