New Demands on Buildings Spotlight The Need for Effective Duct Systems

Self-supporting ducts installed at Arena-Aufschalke, Germany

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The times are clearly still a changing and nowhere is this more evident than in global climatic patterns and the climate change issues at the core of current international debate. Their worrisome and far-reaching impact on agriculture, the built environment and overall sustainability on Planet Earth have yet to be fully calculated.

Indeed, the way we develop our world and in particular the way we use our buildings – and our expectations of them – have also change dramatically in the past couple of decades. This is especially conspicuous in a developing economy such as India's where more than 60% of the country's population still has direct or indirect links to agricultural industry.

The worldwide accessibility of media sound-bytes and daily headline news is a constant reminder that Mother Nature will always hold the ultimate key to how we develop and use the infrastructure of sustainable life systems.

Well-meaning initiatives like "The Three Rs" programme – reduce, re-use and recycle – are no longer enough. It is clearly now essential for human societies to find suitable ways and means to build and adapt systems that are sustainable over the long term, ensuring a viable future for the global community, on the one hand, while balancing the need for urban conurbations to adequately cope with the demands of consistently expanding population on the other.

Although many metropolitan community areas are involved in an invidious "chicken and egg" situation dealing with the desperate needs for daily survival of their citizens while inadequately planning for long term sustainability, it is also equally obvious that it is within humanity's scientific, technical and creative capabilities – assuming adequate funding and political will is available – to make towns and cities significantly more livable in the future.

A high level of ecologically sensible and sound accountability for all matters of fire safety in the built environment must soon become a reality sooner rather than later and not just a trendy and ultimately meaningless mantra.

Start with the Principles of Compartmentation

The history of human and societal development is, at the end of the day, a history of trial and error, punctuated by many successes and even more failures. Progress is measured, sometimes painfully, in terms of what does and what doesn't work, a net strategy case of

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two and half, perhaps three steps forward followed by two steps back.

Again, this kind of scenario has to be measured against a backdrop of industrial development and economic capabilities that have evolved in incremental, interconnected steps that traditionally have been linked to economic, political, scientific and technical development. A slow and frequently difficult process.

For a country like India, however, it is now possible to take the best of intellectual and technical processes available in the world today and literally leapfrog many of the slow inter-related steps of development, especially when they involve the known, identifiable and more obvious mistakes of the past.

Nevertheless, the science of how people use built environment space, despite a long history of living together for convenience and mutually assured survivability is still in its infancy.

Sometimes viewed as a confusing admixture of geography, sense of place and belonging, cognitive behaviour, technical capabilities and architectural language deeply rooted in cultural mores and environmental psychology, it can also be simplistically and effectively argued that whatever can be done to make the built environment a better and safer place in which to live and work can and should be implemented without further loss of time, property and human life!

Creating Safer Built Environments for all users

In a very short space of time – noticeably less than a generation by most reckoning – the way in which virtually all types of structures are now designed and built have been exposed to a groundswell of evolutionary and fundamental change.

As these trends have evolved, so too have the ways in which human societies use buildings. Indeed, societal perceptions and individual expectations of buildings have also changed.

The bottom line of course is quite simple, hard-nosed business pragmatism: buildings nowadays have to effectively deal with a multiplicity of demands unheard of less than a generation ago, and how this is done and what it achieves is expressed in dollars and cents, profit and loss.

Most buildings of course are built to house and accommodate numerous different users and their activities with a high degree of functional and pragmatic comfort…from office users, to shoppers, to residents.

To further complicate matters, the creative forces of design, architecture and engineering expression are today responsible for structures not only of incredible aesthetic beauty but also of technical complexity, too.

India's continuing building boom, rising educational levels and increasing awareness at virtually every strata of society, coupled with recent and hopefully ongoing changes to the country's building code, have created an unprecedented wave of interest and concern for building and fire safety in general.

Designing Fire Safety Into Buildings And Duct Systems At The Planning Stage

Optimising the security and fire safety of a building should ideally begin at the conceptual stage, long before the designer's or developer's pen sketches concepts on paper, certainly well before the pile driver sinks foundations deep to sturdy subterranean levels.

Unfortunately we do not live in a perfect world but at the same time it is not necessary to reinvent the wheel – there exists plenty of empirical evidence and sufficient tried and tested systems available on an international basis that can be absorbed and adapted to set a high standard of structural integrity and safety for most types of structures.

Safety measures, particularly those relevant to fire safety, should weighed, balanced and factored into the overall equation as integral components of a holistic safety system for every structure and the surrounding environment. A long term holistic view is sensible.

Generally considered a good starting point is understanding and implementing building design strictly on the principles of compartmentation. This is the idea that fire safety is optimised if a building is constructed as a series of fireproofed compartments (within other fireproofed compartments) to prevent the spread of fire to, or from, another part of the same building.

It makes even more sense to consider, assess and utilise each and every component of a building according to the same or similar scientific discipline and recognised international standards, and fireproofed in a similar way…from structural steel components to walls, partitions, ceilings, floors and of course ducts.

The Purpose of Fire Resistant Ducts

Duct systems in modern buildings can be compared to the lungs of a human body, vital for efficient operations.

Ducts ensure the adequate flow of ventilation, heating and air-conditioning throughout a modern building, allowing it to "breathe" and operate as a functional structural entity.

Given their relevance to most HVAC systems prevalent in most modern structures, a planned system of tactically important ducts also multitask as a vital link in a building's smoke control and management strategies.

In fact, most ductwork systems can be categorised in one or more of the following:

- Ventilation and air conditioning;
- Natural smoke extract;
- Fan assisted smoke extract;
- Pressurisation of escape routes and fire fighting lobbies.

In the event of an actual fire scenario, the function and

performance of a duct system can often change. A duct functioning as an air-conditioning system can, for example, switch to become a fan-assisted smoke extraction system.

It is therefore clearly essential that performance requirements in both normal ambient situations and in fire conditions are taken fully into account from the outset.

Traditionally, ductwork has been fabricated from steel and then encased in a fire protection system to ensure prescribed or performance rated levels of fire resistance, especially where the duct passed through a compartment wall or floor, without the aid of a fire damper. Recent developments however enable the system to be constructed without the need for a steel duct, thus reducing overall on-site time and activity.

Ducts Fire Resistant Up to International Standards

There are many standards in use today. Two of the most widely accepted and used are BS476: Part 24 and ISO 6944. Both of these standards are currently identical to one another in all aspects, although ISO 6944 will soon be updated in some ways to bring it more into line with the EN 1366 series of Parts 1, 8 and 9 relating to ducting and smoke extraction systems. You will possibly at some point also come across AS 1530:4 section 9

Although these two standards (BS/ISO and AS) are in fact written specifically for ventilation ducts, guidance is also outlined in these standards for the performance requirements for "smoke outlet" ducts and "kitchen extract" ducts.

It should be noted, however, that there indeed substantial differences between these two standards – particularly in terms of testing methodology which in turn affect the results – but accordance with either will likely ensure most regulatory agency approval and a confident level of fire safety. However it should be very clearly noted, a test performance to AS 1530:4 does NOT imply an equivalent performance to BS 476: Part 24 or ISO 6944.

According to the Blue Book on Ducts of the Association for Specialist Fire Protection in the United Kingdom, for example, fire resisting ductwork can be provided either by specialist companies producing proprietary systems, or by treatment to satisfactorily constructed and supported steel ductwork with the addition of fire insulating materials.

Where fire resisting ductwork needs to pass through compartment walls or floors that will have a prescribed fire resistance period in terms of the load-bearing capacity (stability), integrity and insulation criteria, for durations of 30 to 240 minutes, it is therefore a requirement that where these compartment walls/floors are penetrated by ducts or other building services, the fire performance criteria for the penetrated wall or floor are maintained, such that fire in one compartment may not spread to other areas.

The fire performance of a duct which penetrates a fire resisting/separating element requires careful consideration by developers, designers, specifiers and regulatory authorities. The standard periods of stability and integrity should in all cases be at least equal to those required for the penetrated element of construction.

In certain circumstances, regulatory agencies might consider waiving the insulation requirement or allow a reduced period of insulation, for example, in some car parks, where regulatory authorities may consider there is not a possibility of combustible materials being in close proximity of the ductwork.

At the end of the day, fire resistant ductwork must also take into consideration factors such as required fire exposure, required fire performance and the supporting structure.

Hanger support which includes supporting hangers, support and their fixing systems should be capable of bearing the full load of the complete ductwork system. This includes insulation material and other services supported from it.

Movement joints, air flow and leakage, acoustic performance, thermal insulation, water tolerance, strength and even aesthetic evaluation of outward appearance can all be important considerations when employing a durable, robust and effective ductwork system.

Fire Resistant Ducts with Dampers

Installed fire dampers are a closure system within a duct and are operated automatically or manually. Such a damper is designed to prevent the passage of fire and which, together with its supporting frame, is capable of satisfying the designated fire resistance criteria for a stated period of time.

Damper can also be designed and installed to control the movement of smoke. However, it should clearly be noted that a smoke damper is not necessarily a fire damper. A combination fire and smoke damper shall meet the requirements of both functions.

The fundamental principles of fire resistance mean that where a compartment is penetrated by ductwork, the ductwork and all related or interlinked systems must provide at least the same level of fire resistance as that of the floor, wall or ceiling it penetrates.

Similarly, any services installed in or enclosed by the ductwork must provide the same level of tested and approved fire resistance. Fire dampers installed within fire resistant ducts are no exception.

Good practice dictates that fire dampers should not be installed within certain ductwork systems in buildings. Kitchen extraction systems, staircase and lobby pressurisation, lift shaft ventilation and fresh air make-up provisions are very good examples of this commonsense approach.

Therefore, standard to observe for dampers in fire resistant

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ducts is Method 2 or Method 3 of BS 5588 Part 9 and this clearly outlines specific positions and methods to install dampers so that the fire resistance levels of the duct are sustained throughout.

On the other hand, steel ductwork systems for air movements around buildings are generally constructed to the HVCA guide DW/144 (formerly 142) which is a document covering a wide range of construction standards in the manufacture of sheet metal ductwork for use in low, medium or high pressure applications and includes various methods of jointing, stiffening and supporting of the ductwork.

According to ASFP, BS 5588: Part 9 paragraph 7.5.1 acknowledges that steel ductwork "if satisfactorily constructed and supported will be able to provide a high degree of resistance to the passage of smoke and decomposition products. However, rapid transfer of heat through the steel regardless of its thickness prevents the ductwork achieving any degree of fire resistance without supplementary insulation".

As we have seen, a satisfactorily constructed and supported fire rated steel duct is one proven by test and/or assessment to BS 476: Part 24.

Superior System Ducts conform to Insulation Criteria

Given the capital intensive nature of most constructions, most owners, developers and designers want to see buildings generate substantial return on investment over a long period of time. This is not always easy but it can be achieved.

Fire resistant construction is a sensible investment in the future. It is essential to deal with suppliers and proprietary systems from reputable international manufacturers, at all levels of the construction process, from foundations right through to fire protection and finishes.

It is usually a matter of routine policy and provable claims that their products and systems have withstood the test of time. They're tested to global quality standards by internationally recognised laboratories, and they're usually tried and proven in actual fire scenarios.

Not surprisingly, these products and systems are accompanied significant, published test data —usually available free of charge – that reinforce and prove their scientific claims, also underlining the superiority of their certifiable insulation criteria rather than just integrity only systems.

A subsequent article will deal with the following related topics.

1. Fire test standards and requirements for fire resistant and smoke extract ducts; - a simplified understanding of how ducts are tested, explaining why certain elements are important etc. Maybe this will also include a brief explanation of extended field of application i.e. assessments.
2. Smoke extraction; - why, where, how.
3. Design guide for smoke extraction ducts, showing differing types of building layout and where you would combine the use of plain galvanised steel ducts and fire resistant ducts. ❖