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A Multi-Storey Car Park Fire – Was the Fire Strategy at Fault?

Пожар на многоэтажной автостоянке. Была ли виновата система противопожарной защиты?

Pożar wielopoziomowego parkingu. Czy winna była strategia ochrony przeciwpożarowej?

ABSTRACT

Introduction: At the beginning of 2018, a massive fire affected a multi-storey car park in Liverpool. The car park serves a nearby major arena that was hosting a horse show at that time. Fortunately, there were no fatalities. However, the damage was extensive as approximately 1,150 cars were destroyed, many people were evacuated and some animals had to be rescued.

Aim: This article considers the need to revise fire strategies for car parks. Do modern vehicle designs introduce a changing risk profile? Could new concepts in car park design also affect the risk profile? And, most of all, should fire strategies better address the issues of property protection, business continuity and environmental protection?

Summary: Following the fire, several questions were asked. Could such a fire have been prevented? What lessons can be learned? Would a fire sprinkler system have prevented the fire from growing so large? Sometimes, when discussing the issue of fire safety, we mainly focus on the potential consequences of a fire for human life. The majority of fire safety regulations around the world focus on the protection of human life, with other objectives being rarely duly considered. However, the fire that occurred in the UK has shown that perhaps we need to consider much more factors and thoroughly analyse the fire strategies of buildings. The term "fire strategy," thought widely used, often appears misunderstood, even by those operating within the fire safety sector. In essence, a fire strategy needs to be specific to the unique set of fire-related parameters of the building or structure to which it applies, including the processes that occur within it and the actual occupancy profiles. Moreover, it should be modified and adjusted when necessary, in order to remain adequate for its inherent goal, which is to prevent and mitigate fire incidents and their impact. The factors dictating the need for document modification include changes in the legislation or stakeholder requirements, revised building structures or layouts, changes in the occupancy or use of the building, and new technology or research. The fire strategy process is covered by BS PAS 911, and it is actually designed for more complex building arrangements or special structures where no obvious or quick solutions can be found. The question is whether the Liverpool car park represented such complex geometry?

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АННОТАЦИЯ

Введение: В начале 2018 года произошел огромный пожар на многоэтажной автостоянке в Ливерпуле. Автостоянка была предназначена для людей, посещающих выставочный зал, в котором в тот день происходила выставка лошадей. К счастью, вследствие пожара никто не погиб. Однако причиненный пожаром ущерб был очень значительным. Пожар уничтожил более 1400 автомобилей, было эвакуировано 4000 человек. Не удалось спасти некоторых животных.

Цель: В этой статье обсуждается вопрос о том, следует ли переосмыслить стратегию противопожарной охраны в случае с подземными паркингами и гаражами. Требуют ли современные типы автомобилей внесения изменений относительно предполагаемых факторов риска на стоянках? Или, может быть, новый подход к дизайну парковки влияет на факторы риска? И самый важный вопрос касается необходимости обеспечения защиты собственности, непрерывности ведения бизнеса и окружающей среды с помощью систем противопожарной охраны.

Заключение: Как и в случае любого пожара такого масштаба, пожар на подземном паркинге в Ливерпуле вызвал негодование в обществе. Была ли возможность предотвращения этого пожар или, по крайней мере, его значительного сведения к минимуму? Какие выводы следует сделать из этого инцидента? Может ли автоматическая система пожаротушения справится с таким стремительным развитием пожара? Чаще всего, когда мы думаем о противопожарной защите, мы рассматриваем прежде всего последствия пожара в аспекте защиты жизни

людей. Основой большинства правил пожарной безопасности во всем мире является защита жизни, и редко учитываются другие аспекты. Однако пожар, который произошел в Великобритании, показывает, что нам, возможно, придется рассмотреть гораздо больше аспектов и проанализировать полную стратегию пожаротушения здания.
Термин «противопожарная система безопасности» широко используется, но его часто неверно истолковывают даже люди, работающие в секторе пожарной безопасности. По сути, противопожарная система должна быть адаптирована к специфике пожара для конкретного здания, его структуре, процессам или типу использования. Кроме того, ее следует обновлять и корректировать, чтобы она постоянно оставалась верной своей неотъемлемой цели, которая заключается в предотвращении и смягчении хода развития пожара и минимизации его последствий. Причины, требующие изменения документа, включают изменения в правилах или требованиях менеджеров, необходимость обновления структуры или систем, изменения способа использования и появление новых противопожарных технологий или тестов].
Процесс создания противопожарной системы, описанной в стандарте BS PAS 911, фактически предназначен для зданий с более сложной геометрией или для специальных архитектурных конструкций, когда нет очевидной и быстрой схемы решения. Вопрос здесь в том, относился ли «Ливерпульский паркинг» к такой сложной геометрии?
Ключевые слова: паркинг, автостоянка, пожар на автостоянке, противопожарная система
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ABSTRAKT

Wprowadzenie: Na początku 2018 roku miał miejsce ogromny pożar wielopoziomowego parkingu w Liverpoolu. Parking był przeznaczony dla osób odwiedzających halę widowiskową, która w tym dniu była gospodarzem pokazu koni. Na szczęście w pożarze nie było ofiar śmiertelnych. Jednak zniszczenia, które spowodował, były bardzo rozległe. Zniszczonych zostało ponad 1400 samochodów, 4000 osób ewakuowano. Nie udało się uratować niektórych zwierząt.
Cel: Niniejszy artykuł przedstawia rozważania nad pytaniem, czy w przypadku parkingów i garaży powinniśmy ponownie przemyśleć strategie przeciwpożarowe. Czy nowoczesne typy samochodów wprowadzają konieczność zmiany zakładanych profili ryzyka parkingów? Czy może nowe podejście do projektowania parkingów wpływa na ich profil ryzyka? I najbardziej istotna wątpliwość ze wszystkich, to czy nasze strategie przeciwpożarowe nie powinny być bardziej ukierunkowane na ochronę majątku, ciągłości biznesu i środowiska naturalnego.
Podsumowanie: Tak jak w przypadku każdego zdarzenia pożarowego o tak dużej skali, w środowisku społecznym pożar parkingu w Liverpoolu wywołał oburzenie. Czy pożarowi temu można było zapobiec lub przynajmniej znacząco zminimalizować jego skutki? Jakie wnioski należy wyciągnąć z tego zdarzenia? Czy samoczynny system gaśniczy zapobiegłby tak silnemu rozwojowi pożaru? Najczęściej, kiedy myślimy o ochronie przeciwpożarowej, rozważamy przede wszystkim konsekwencje pożaru w aspekcie ochrony życia ludzi. Podstawą większości przepisów przeciwpożarowych na całym świecie jest ochrona życia i rzadko inne aspekty są brane pod uwagę. Jednak pożar, który miał miejsce w Wielkiej Brytanii, pokazuje, że być może musimy rozważyć znacznie więcej i przeanalizować pełną strategię przeciwpożarową budynku.
Termin „strategia przeciwpożarowa" jest powszechnie stosowany, ale jest często źle interpretowany, nawet przez osoby działające w sektorze bezpieczeństwa pożarowego. W istocie strategia pożarowa musi być dopasowana do specyfiki pożarowej danego budynku, jego konstrukcji, zachodzących w nim procesów czy profilu użytkowników. Ponadto powinna ona być aktualizowana i dostosowywana, tak aby stale pozostawała wierna swojemu nieodłącznemu celowi, którym jest zapobieganie i łagodzenia przebiegu zdarzeń pożarowych oraz minimalizacja ich skutków. Powody, które wymuszają konieczność modyfikacji dokumentu obejmują zmiany w przepisach lub wymaganiach zarządców, konieczność zaktualizowania struktury lub układów, zmiany sposobu użytkowania oraz pojawienia się nowych technologii pożarowych lub badań. Proces tworzenia strategii pożarowej opisany w standardzie BS PAS 911 jest tak naprawdę przeznaczony dla budynków o bardziej złożonej geometrii lub dla specjalnych układów architektonicznych, gdy nie istnieje oczywisty i szybki schemat rozwiązania. Powstaje tu pytanie, czy parking w Liverpoolu należał do takich złożonych geometrii?
Słowa kluczowe: parking, garaż, pożar w garażu, strategia przeciwpożarowa
Typ artykułu: studium przypadku

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The incident

On the last day of 2017, a car park situated in the area of Liverpool, England, known as the King's Dock, was the venue of a major fire that made headlines around the world. The multi-level car park, with capacity for 1,600 vehicles, was subjected to a fire that entirely engulfed the building and destroyed most of the cars on most of the levels. It is estimated that approximately 1,150 cars were destroyed by the fire. The local fire authority, Merseyside Fire and Rescue Service, said that the blaze was one of the worst it had ever dealt with.

In this article the authors, using the example of this fire incident, want to highlight the issues related to fire strategy documents developed for car parks. Such documents

need to be consistent with the legislation, stakeholder requirements, revised building structures or layouts, the current occupancy or use of the building, and the new technology or research [1, 2]. The fire strategy process covered by BS PAS 911 [3] is, in fact, designed for complex building arrangements or special structures where obvious and quick solutions can be found. The authors address the question of whether the Liverpool car park represented such complex geometry.

The car park is located next to a huge arena – the Echo Arena, right by the Liverpool Waterside. The Liverpool International Horse Show was being held at the Echo Arena at this time. This Arena has a total capacity of 11,000 people. People were evacuated during the Liverpool Show. Residents of the nearby apartments were also evacuated due to smoke.

It was reported that twenty-one fire engines were used to put out the fire. Along with assisting in the evacuation of all persons who might have been trapped, their objective was to eliminate the risk of the building collapse.

There were no fatalities or injuries. However, some animals had to be rescued. Two dogs were rescued from cars left on the second floor, and in the early hours of the New Year's Day, four more dogs were set free from vehicles parked on the seventh floor. Given that there was a horse riding event next door. Members of the public also helped to rescue 80 horses that were being stabled on the ground floor of the car park.

It is thought that an old Land Rover was the cause of the fire, when it burst into flames. This quickly spread from vehicle to vehicle until all the vehicles were on fire [4, 5]. Figures 1–2 show the fire and its aftermaths.

Figure 1. Fire at a multi-storey car park in Liverpool
Source: Merseyside Fire & Rescue Service resources.

a) b)

Figure 2. The aftermaths of the multi-storey car park fire in Liverpool: a) a view of the destroyed interior and cars b) a view from the street
Source: Merseyside Fire & Rescue Service resources.

The repercussions

In the cold light of the day, Joe Anderson, Mayor of Liverpool [5], said that the Council would take advice on any "lessons to be learned" over the fire at the local authority-owned building, constructed in 2007.

As with any serious fire, soul searching started as the fire had died away leaving horrific consequences. The UK fire sprinkler lobby became very vocal about the benefits of sprinkler systems. Whereas sprinklers are required for all basement car parks, they are not obligatory for those situated above the ground level [6]. The Fire and Rescue Service agreed that a sprinkler system

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would have made their task much easier by keeping the fire under control. It is most likely that the fire would never have spread as it did if one or more sprinkler heads had been operated at a sufficiently early stage.

However, is it the right time to look at car park fire strategies? Undoubtedly, the risk has greatly changed since many multi-storey car parks were first built.

A change in vehicle design

Vehicle technology has changed radically over the last decades and it will continue to do so. Cars have become much more sophisticated and, more importantly, reliable. The NFPA statistics [7] show that in 1980 there were around 460,000 vehicle fires in the USA while in 2014 this figure dropped dramatically to around 170,000. Given that car ownership grew rapidly in the reference period, it can be concluded that car fires have been on the decrease. Consequently, it could be said that the risk profile of car parks has been similarly reduced. But is this really the case going forward?

The issue of cars vulnerability to a fire has again been questioned, considering the ever-increasing demand for electric cars. Electric cars make use of lithium-Ion batteries. The issue of a lithium-ion battery is that lithium is the least dense metallic element, which means that, weight-for-weight, it can pack more power than other types of batteries. However, lithium is also a highly reactive substance as it belongs to the same alkali metal group as sodium and potassium. This, together with the manufacturing techniques employed to optimise power, by producing finely designed anode and cathodes, increases the likelihood of fire and explosion.

A few years ago, and in the early days of one of the most well-known commercially-produced electric cars – Tesla, a proud owner drove his Model S down a highway [4]. He accidentally ran over a piece of metal, possibly dropped by a truck. That metal somehow punctured the quarter-inch thick armoured undercarriage of the vehicle and penetrated its battery pack. Within 30 minutes, the car was in flames. This was the first fully electric vehicle fire on U.S. roads, and it was caught by a viral video that went around the world. As the car was equipped with a warning system, the driver was instructed to get off the highway as soon as the incident happened.

This, and many other examples, have dented the image of the electric car. However, car designers have recognised this issue, and it is commonly believed that that this problem can be designed out, in order to make electric cars no more likely to catch a fire than regular petrol-powered cars.

Car park design

As with all building designs in the European Union, car parks are governed by a set of ten Eurocodes, specifying how structural design should be conducted within the EU. These were developed by the European Committee for Standardisation with the purpose of providing a means to prove, among other objectives, the compliance with the requirements for mechanical strength, stability and safety in the case of fire. However, in order to understand how fire safety objectives, other than those referring to structural stability, are incorporated into the design of car parks, we need to look much further.

One of the recognised books used for the design of car parks in the United Kingdom, as well as in other countries, is *"The Car Park Designer's Handbook"* authored by Jim Hill [8]. This book discusses the key criteria used in calculating parking bays and stalls, aisle width, ramps, height limitations, etc. The book begins with listing over 20 factors in an overall design brief for a typical car park. However, none of these factors recognises fire safety as a critical feature.

The book goes on with identifying the requirements for horizontal and vertical escape, and it contains a dedicated section covering fire safety (which refers to the Building Regulations Approved Document B [6]). These provisions are solely designed to ensure the safety of car park users in the event of fire. However, there are two statements within the book that clearly neglect the need to consider any additional measures for the protection of the car park and vehicles against fire.

The first statement under fire-fighting measures states that *"it has long been recognised that the fire load in car parks is not particularly high and vehicle fires do not spread."* Another section under the *"Sprinklers"* title points out that *"the Building Regulations acknowledge that it is not essential to install sprinklers."* Given the above, it can be inferred that both statements are at least questionable and do not consider the property, business or environmental factors related to a fire.

But perhaps there are new ideas in car park design that require the review of such statements. In order to save valuable space in cities, a new form of multi-storey car parks is being introduced, referred to as "Stackers." Stackers are mechanical devices which hold cars within a car park. They are normally computer-controlled and designed to accommodate more cars in a given area, when compared to traditional car parks. This is achieved by stacking rows of cars, often with little vertical separation.

In the UK, following the introduction of a three-year government-sponsored car park programme, concerns were raised regarding the potential damage which may be caused by fires in stacker-type car parks.

The British Automatic Fire Sprinkler Association (BAFSA) believed that sprinkler systems could be a vital component of the fire strategy for car parks, especially of the stacker type. Therefore, they commissioned UK's Building Research Establishment (BRE) Global [5] to undertake a stacker fire test, with the use of a sprinkler system.

During the testing of sprinklers in a vertical pattern, it was revealed that the operation of high-level sprinklers could affect the operation of lower-level ones, due to the cooling effect of water on sprinkler heads.

However, following the test, important conclusions were formulated. Once activated, the sprinkler system rapidly controlled and extinguished the vehicle fire. Although there was some fire spread from the lower-ignition car to the upper car, it was evident that the sprinklers effectively controlled the fire. The sprinkled stacker showed a considerably reduced the overall fire size and resulted in lower temperatures. While the fire spread to the upper

vehicle, the upper vehicle did not become fully involved, and the risk of the fire spreading beyond the test geometry to nearby cars was significantly reduced by the presence of the sprinkler system.

Reviewing fire safety objectives for car parks

The fire should also encourage us to consider the issue of fire safety regulations binding in car parks. Legislation, regulations and codes are all focused on the human safety aspects related to car park fires. But perhaps the Liverpool fire has highlighted that our legislation, or at least the binding building regulations, should duly consider other objectives, too.

Back in 2007, British Standard Specification PAS 911 [3] introduced a concept of objectives setting in the formulation of fire strategies. This is represented by an objectives matrix (Figure 3).

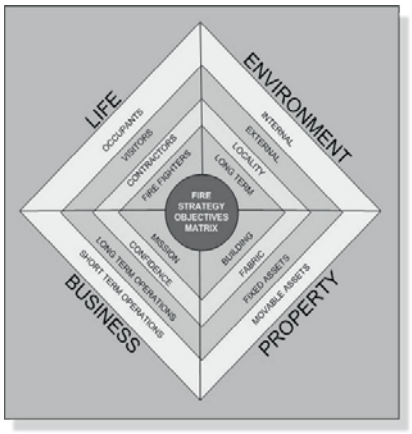

Figure 3. Objectives matrix [1–3]

Let us use the four base objectives to review how this could apply to a multi-storey car park.

Life Safety: Fire safety for car parks has been well established, and the fact that such a major fire led to no injuries could be regarded as supporting that stance.

Property Protection: This is the main crux of the issue in the case of the Liverpool fire. Property is lost in at least two respects:

1. The car park infrastructure. It is conceivable that the extent of damage may lead to the car park's being completely knocked down and rebuilt. It is estimated that the construction of a new car park costs, on average, around £8,000.00 per space [9]. The rebuilding of a car park with 1,600 spaces would, therefore, lead to a bill of around £13 m.
2. The cars and belongings of customers: Even if we used a conservative estimate of the average lost car value of £10k, and took the figure of a total of 1,500 cars that were lost, this would give us a figure of £15 m. However, a local newspaper estimated a higher figure of £20 m [9].

Business Continuity and Protection: What may not be immediately understood is the knock-off effect on the venue and local businesses. It was revealed in 2017 that the Echo Arena, acknowledged as one of the UK's premier venues, sustained a loss of £2.7 m [9]. Given that the car park is the main access to the 11,000-seat arena, any further negative impact to the attraction of customers could be potentially disastrous for the long-term survival of the venue. We should also not forget about the numerous restaurants, bars and other businesses that are highly reliant on the Echo Arena.

Putting a specific value on this is difficult but the failure of the many businesses that could permanently suffer appears rather sizable.

Environmental Protection: Twenty-one fire engines were employed to extinguish the fire. Given that the car park was situated next to a main river, this is no doubt the place where some of the fire-fighting water found its way. Given that the water run-off might have been contaminated with plastics, petrol and diesel, we should think about the environmental damage to the river and local community. This is rarely considered in fire strategies despite being a potentially vital factor. Again, the exact costs are hard to determine, but many examples from around the world show figures in millions or even tens of millions (GBP) for individual cases [10, 11].

Conclusion

Fire safety regulations have always been concentrated on the human safety aspects of building design and use. However, a major fire, such as the Liverpool multi-storey car park fire, points to the need to duly consider other factors, such as property protection, business continuity and environmental protection. Based on a simple assessment of the overall cost of the Liverpool fire, the total potential impact of the ignition of a single old car could easily run into many millions GBP. How would this measure against the cost of a sprinkler system? Not to mention that the longer-term impacts of the Liverpool car park fire are yet to be seen.

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