ВИСОКА ТЕХНИЧКА ШКОЛА СТРУКОВНИХ СТУДИЈА

ФАКУЛТЕТ ТЕХНИЧКИХ НАУКА НОВИ САД

TECHNICKÁ UNIVERZITA VO ZVOLENE

4. МЕЂУНАРОДНА НАУЧНА КОНФЕРЕНЦИЈА

БЕЗБЕДНОСНИ ИНЖЕЊЕРИНГ

ПОЖАР, ЖИВОТНА СРЕДИНА,
РАДНА ОКОЛИНА, ИНТЕГРИСАНИ РИЗИЦИ

И

14. МЕЂУНАРОДНА КОНФЕРЕНЦИЈА

ЗАШТИТЕ ОД ПОЖАРА И ЕКСПЛОЗИЈЕ

ЗОП 2014

НОВИ САД, 2-3. ОКТОБАР 2014.

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ОДСЕК ЗАШТИТЕ ОД ПОЖАРА,
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The Higher Education Technical School of Professional Studies in Novi Sad, Serbia, founded in 1959, fulfills its mission in higher education, fields of expertise and research in order to apply the acquired knowledge.

It educates engineers at four Departments in 20 accredited study programme of professional bachelor and specialist studies.

In the Department of Protection Engineering the following areas are studied:

- Fire protection,
- Occupational health and safety,
- Environmental protection, and
- Civil protection and emergency rescue.

Since 2010 Fire Protection and IT studies are accredited distance learning programme. The continual application of modern scientific, technical and technological processes of production and business increases the quality of activities in the School.

TECHNICKÁ UNIVERZITA VO ZVOLENE

The main mission of the Technical University from Zvolen is to provide university education in accredited study programme as well as to develop scientific research in different fields of industry. The Technical University in Zvolen comprises four faculties: the Faculty of Forestry, the Faculty of Wood Sciences and Technology, the Faculty of Ecology and Environmental Sciences, and the Faculty of Environmental and Manufacturing Technology.

The continual application of modern scientific, technical and technological processes of production and business increases the quality of activities at the University. Department of Fire Protection is at the Faculty of Wood Sciences and Technology.

UNIVERSITY OF NOVI SAD

FACULTY OF TECHNICAL SCIENCES

The Faculty of Technical Sciences in Novi Sad is an institution of higher education and scientific research founded in 1960, whose mission is to realize high quality educational programme, develop scientific disciplines and apply the acquired knowledge in economy and society.

There are four disciplinary-related science and educational fields implemented by the FTS:

- engineering and technology,
- natural science and applied mathematics and
- human sciences and applied art.

Faculty consists of 13 departments implementing 88 study programme at the undergraduate and postgraduate levels.

The Department of Civil Engineering and Geodesy offers a comprehensive study programme in the field of civil engineering, survey (geodesy) and disaster and fire risk management: Disaster management and Fire Safety B.Sc. Honours and M.Sc. Qualification levels. Disaster Risk Reduction Centre established in 2007, has the mission to promote and contribute to the culture of resilience by dissemination of the latest research results of hazard, vulnerability and risk-related indicators.

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PREFACE

The Higher Education Technical School of Professional Studies in Novi Sad, traditionally organizes scientific and professional conferences on the highest level in the country in the field of fire and explosion protection. We proudly emphasize our leading position in education when it comes to professions concerning fire protection.

In 1976, 1st Yugoslav conference of fire and explosion is held at the Faculty of Agriculture in Novi Sad. It gathers the most eminent experts in the field of fire of the former Yugoslavia. Then, there are two more conferences, also held in Novi Sad in 1984, at "SPENS", and in 1989 at the "Putnik" Hotel.

In 1994, when 4th Yugoslav and 1st International conference of fire and explosion is organized, this conference grows into an international meeting with the help of our colleagues and experts from Ukraine, Poland and Hungary. Since then, the conference is organized biannually, and in 2006, on its 10th anniversary, it grows into the congress of the profession.

In 2008 the conference is organized as an international scientific meeting prepared in cooperation with the Faculty of Technical Sciences from Novi Sad and the Technical University in Zvolen from the Slovak Republic, bringing together experts in the field of safety and protection from Serbia and abroad.

With the same team, 4th International scientific conference and 14th International conference on fire and explosion is organized this year at the Higher Education Technical School of Professional Studies in Novi Sad on 2nd and 3rd October 2014. The aim of the conference is the exchange of the latest scientific knowledge and experience of experts in the field of safety engineering, and the main topic of fire protection is complemented by topics in the field of environmental engineering, occupational health and safety, and civil protection.

In order to efficiently manage risk situations, it is necessary to identify conditions and hazards, study the causes of risk events and build a strategy for preventing their development and consequences.

Positive results can be expected by involving scientists and experts dealing with safety engineering and process management in the living and working environments. The exchange of opinions and knowledge is essential and one of the steps contributing to progress

Organizing committee

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FIRE SAFETY ENGINEERING

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Review paper

FIRE SAFETY SYSTEMS MINIMISE ECONOMIC LOSS

Abstract: The paper provides an insight on the importance of fire protection systems which minimise economic loss in buildings and technologies in the case of a fire, industrial accident or natural disaster. The impact of fire safety systems is also important from the personal- and environmental-safety point of view.
Key words: fire, fire safety equipment, personal safety, fireman safety, environmental safety

SISTEMI ZA ZAŠTITU OD POŽARA MINIMIZIRAJU EKONOMSKE GUBITKE

Rezime: Rad pruža uvid u značaj sistema za zaštitu od požara kojima se minimizira ekonomski gubitak u zgradama i tehnologiji u slučaju požara, industrijskih nesreća ili prirodne katastrofe. Uticaj sistema za zaštitu od požara je takođe važan kako za bezbednost pojedinca tako i za životnu sredinu.
Ključne reči: požar, oprema za zaštitu od požara, lična bezbednost, bezbednost vatrogasaca, zaštita životne sredine

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1. INTRODUCTION

Current time is affected by a deepening economic crisis. The main interest of every subject in the economic area is growth and economic stability. Any negative deviation from the stabilised state of prosperity and growth may lead to the loss of market share and subsequently to the decline of the enterprise. Incorrect economic decisions in setting mid- and long-term goals are not the only negative deviations. Technological failures, industrial accidents and emergency situations, such as fires and natural disasters also have significant negative impact on the enterprise. The consequence of such emergency situation may be personal losses, irretrievably damaged technologies, destroyed or severely damaged buildings. In the case of environmental accidents, a technological process is breached by human intervention or negligence, or due to a natural disaster. Apart from direct loss, the enterprise – polluter – is also punished by financial and economic sanctions taking into account the costs spent on the removal of ecologic accident consequences.

Early diagnostic of a malfunction state, discovery of service fluids leakage, dangerous concentrations of gaseous substances, discovery, or elimination of a starting fire, all minimise the consequences of the above events or at least reduce their impact.

In the field of fire protection such a group is known as fire safety systems.

2. TYPES OF FIRE SAFETY SYSTEMS

The basic categorisation of fire safety systems is defined in the protection again fires law as amended [1].

Fire safety systems are:

- fire extinguishers,
- fixed and semifixed suppression systems,
- smoke and heat ventilation systems,
- fire detection and alarm systems,
- park suppression systems and explosion protection systems,
- fire doors and shutters.

The law orders the responsible person to use technic and technological equipment in accordance with the manufacturer's instructions. Subsequently, the responsible person is must also secure regular maintenance and inspection for fire safe operation and address identified problems.

In subsequent clauses, the law orders the responsible to obtain and install in buildings, taking into account the fire risk, "appropriate types of fire safety systems, keep them in working order and provide regular inspection and maintenance by a professionally competent person and keep service documentation".

To be considered in working order, access must be provided to the fire safety system.

A responsible person shall not use any fire safety system which is not certified.

In accordance with the law, design, installation and maintenance and inspection of fire safety systems may be carried out only by competent persons, professionally trained to an

extent specified by the system manufacturer, having passed testing and obtained specific certification [2].

3. INFLUENCE OF FIRE SAFETY SYSTEMS ON BUILDING SAFETY

Fire safety systems have an influence on the reduction of damage caused by a fire if they:

- provide notification of fire occurrence,
- have ability to restrict fire spread,
- have ability to reduce fire intensity,
- secure early fire-fighting operations.

The above conditions are fulfilled by:

- fire detection and alarm systems,
- fixed fire suppression systems with automatic operation,
- spark suppression systems for pneumatic conveyors,
- smoke and heat ventilation systems with automatic operation.

The above listed fire safety system may be considered active fire protection systems. Other fire safety systems, despite their availability, completeness and functionality, are considered only passive, since in the case of a fire they are not able to affect (suppress or extinguish) the fire without direct intervention from the user.

3.1. Fire extinguishers

The starting point for the evaluation of fire extinguisher effect on the safety of a building is meeting the requirements for the calculation of the number and type of fire extinguishers and adhering to the rules of their siting.

Fire extinguishers are devices consisting of a pressure vessel containing a suppressant which is after manual activation of the triggering device discharged by pressure from the vessel onto the fire [3].

Depending on the suppressant, fire extinguishers are categorised as:

- water,
- foam,
- halon,
- powder,
- carbon dioxide - CO_2.

Advantages:

- simple operation and easy use of the extinguisher,
- high extinguishing efficiency when used during ignition or growth phases of fire,
- low price and operating costs,
- simple inspection, maintenance and repair,
- minimal negative health effects on operator,
- minimal negative environmental effects.

Disadvantages:

- insufficient suppressant capacity for fires in the second phase of growth,

- low resistance against intentional damage and theft,
- high rate of error in the selection of a proper suppressant of a given type of fuel,
- absence of an active member signalising damage or non-functionality of the device.

3.2. Fixed suppression systems

Fixed suppression systems are designed for suppression or extinction of a fire without human intervention shortly after the start of a fire.

Fixed suppression systems are divided in the following categories, based on the type of suppressant:

- water,
- gas,
- halon
- powder,
- combined[4].

Advantages

- active localisation and extinction of a fire without the need for human intervention,
- high protection efficiency within the designated area, assuming that the design, installation and maintenance rules are adhered to,
- sufficient supply of suppressant in the case of water suppression systems,
- high degree of protection against intentional damage or theft of systems components,
- elimination of the possibility of inappropriate suppressant selection,
- high reduction of required amount of suppressant when compared to amounts required for fire-fighting operations in the developed stages of fire,
- active signalling elements of all operation modes of the system (activation, damage, non-functionality of fire suppression system),
- elimination of adverse health impacts – employees need not to enter the areas affected by fire,
- minimisation of environmental impacts – fire suppression is in early phases of fire therefore less combustion products is emitted.

Disadvantages:

- high price and maintenance costs,
- demanding inspection, maintenance and repairs,
- possible risk of high damage on equipment and building in the case of fire suppression system failure,
- potential risk of negative health effects in the protected space by sudden (failure) suppressant discharge (halons, CO_2),
- risk of inappropriate design,
- nonfunctionality due to the building layout changes or use.

3.3. Smoke and heat ventilation systems

Large amounts of heat are released during fires, causing high temperatures is the fire affected area. At temperatures above 800°C, it is not possible to carry out fire-fighting operations in the vicinity of fire, which put high demands on the protection of the firefighters

and their equipment; fire-fighting must be carried out from a distance. Firefighters need to take actions which restrict spread of fire in the building and its vicinity. The exchange of fire gases can be significantly affected by ventilation openings and smoke and heat ventilation systems. Smoke and heat ventilation systems may be activated by:

- fusible-link device,
- pneumatic activation device,
- signal from fire detection and alarm system,
- manually.

Principles of smoke venting:

- natural ventilation (appropriate ratio of inlet and outlet ventilation areas),
- forced ventilation (positive and negative pressure ventilation) ventilation installations and ventilators.

Smoke and heat ventilation systems help:

- maintain evacuation and access routes clear of smoke,
- help fire fighting by removal of smoke from fire areas,
- postpone or preclude flashover occurrence,
- protect building and its contents,
- reduce heat effects on building constructions,
- reduce loss caused by fire, heat and smoke.

Advantages

- active effect on gas and heat exchange in fires,
- prolonged use of unprotected escape routes (increased visibility, reduced temperatures, reduced amounts of smoke gases in the air),
- reduced heat effects on building constructions prolonging their load-bearing ability (primarily ceiling and roof construction),
- reduction of fire spread by flowing of hot fire gases into adjacent parts of buiding,
- better access for firefighters to fire-affected spaces,
- use of natural ventilation in single-storey buildings and top storey in multi-storey buildings,
- reduced direct and subsequent losses on building and its contents.

Disadvantages

- high investments and maintenance costs associated with installation of smoke and heat forced ventilation systems (underground areas and multi-storey buildings),
- low efficiency of negative pressure ventilation systems.

3.4. Fire detection and alarm systems

Fire detection and alarm systems are defined as systems of components including a fire alarm unit, which, when designed and installed properly, are capable of:

- fire identification,
- fire indication to operating personnel,
- send predefined signals to interconnected and controlled devices.

Basic fire detection and alarm systems consists of:

- fire detectors,
- device (fire) loops or lines,
- fire alarm panel – control unit,
- signalling loop or line,
- supplementary devices (alarm devices, information forwarding devices, control unit etc.)

Advandates:

- reduction of fire discovery times and thereby the period of free fire growth,
- fire alarm signal to the local fire brigade,
- activation of devices which can significantly affect the development of fire – ventilation systems, fire door holder release, suppression system activation...

Disadvantages

- errors – false alarms,
- need for operator being trained by the manufacturer or approved third party organisation,
- need for permanent operator presence at fire alarm panel or in security room,
- failures due to changes in local ambient and environmental conditions,
- prone to damage (large number of system components),

3.5. Spark suppression systems for pneumatic conveyors and explosion protection systems

For protection of pneumatic conveyors, a number of special safety and suppression systems have been developed. These usually have two functions:

- identification and localisation of spark (fire or explosion initiator) in the starting phase,
- activation of suppression device which extinguishes fire in its initial phase.

For spark suppression after successful detection the following suppressants are used:

- water mist,
- carbon dioxide - CO_2,
- gaseous mixutres replacing halons
- extinguishing powder.

Advantages

- automatic detection and suppression of fire or explosion ignition source,
- independent of the conveyor operator,
- continuous function without the need for interruption of production process,
- high efficiency.

Disadvantages

- high investments,
- technically demanding system maintenance,

Explosion protection systems are special additional systems and equipment installed to technological lines in which a dangerous concentration of dusts, gases or aerosols may be created. The group of explosion protection systems comprises:

- explosion suppression devices,
- devices restraining passage of explosions,
- explosion and pressure release devices,
- special application systems (e.g. automatic lines protection – painting booths).

4. CONCLUSION

Fire safety systems have their irreplaceable role in buildings. Their importance and effect on building and occupant safety is often underrated. The return of funds invested in installation and maintenance of fire safety systems is only obvious in the case of a fire (fire extinguishers, fire alarms, fire suppression systems, smoke and heat ventilation systems).

Analyses of material losses caused by fires in buildings protected by fire safety systems and those not have been prepared by well-known insurance companies. Literature [5] states that, for example, in buildings protected by a sprinkler system, the material losses are reduced by 70% and life loss of building users by 80% when compared to similar buildings without sprinkler protection. Also, buildings without sprinkler protection suffer losses 6-10 times higher as buildings in which the fire suppression system was functional during the fire. Interesting is also the information on the amount of water required for the extinguishment of the same fire in a sprinkler protected and unprotected building; the ratio of used water is 2:9.

Fire safety systems have also a significant impact in environmental protection. The smaller a fire grows, the less of smoke and toxic pollutants are emitted, meaning a lower impact on the air and water.

Fire safety systems also significantly affect the safety of fire fighters during their operations. Fire safety systems provide fast fire detection, alarm broadcasting, and subsequent evacuation of occupants from the affected building. They prolong the time during which the building interior is accessible for fire fighters (visibility, ambient temperature, stability of building construction).

The investors and building users should realize, that the investments into fire safety systems for securing of personal and building safety are not wasted funds, but rather a guarantee of safety in the time of emergency situation.

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