

Safety of Infrastructure Operation in New Climate Conditions

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http://doi.org/10.29227/IM-2019-01-28

Submission date: 11-07-2018 | Review date: 02-04-2019

Abstract

The reliability of infrastructure buildings is a basic prerequisite for utility values of built-up in towns and municipalities areas. It creates the prerequisites for the long-term sustainability of the housing stocks of humans and, at the same time, is a condition for the region industrial base development. This reality is perceived by the public as an obvious standard which is a part of human life. However in the reality this is a very complex mechanism that can be severely disturbed in various conditions and situations. To prevent these situations from happening in practice it is imperative that state, government and different infrastructure types know the security risks that have a potential to change natural and operational environment and are ready to eliminate them. The following article deals with these issues, how to recognize the threat of an imminent emergency or critical situations and which resources are needed to increase the infrastructure reliability.

Keywords: reliability, security, infrastructure, risk, emergency, risk elimination, system immunity

Introduction

The current European human population knows no longer its environment other than benefits that national infrastructure provides to its citizens. In most non-European countries, however the real living conditions are completely different.

Infrastructure environment is not a natural stable phenomenon but a human variant of life which is not only necessary to maintain but also to develop further. Infrastructure maintenance and development must not be natural but have to respect the full range of rules that respect the natural environment and human needs. Immediate human needs and interests must not be preffered to balanced states. Humanity in today's technologically advanced countries since the 19th century has not respected the number of natural laws or underestimated their signifikance. Consequences are now beginning to show up in secondary phenomena in their own natural environment, aquatic ecosystems and also in infrastructure, its reliability and the safety of operating systems.

Now the time occures when part of mistakes will need to be remedied and change the overal approach to the use of the natural environment. As mentioned in this article some mistakes are only a regional character and a negative scope. Others are beginning to manifest themselves on a global scale which can be reduced bz a global approach to solving the problem. With their concurrent action, without solutions, they may not only affect the current living conditions of the people in the coming years but also have a serious to critical negative impact on flora and fauna worldwide and consequently may appear in the social society sphere [1]. In addition to aspects above it will also affect the reliability and safety of different operation types of public and private infrastructure.

Infrastructure and its impact on the function of the economically and industrially used area The infrastrucutre of technologically advanced states in the world consits of a numer of object and technical line structures in particular the energy supply, drinking water and wastewater drainage to the recipients. Their incorporation in territorialunits has a fundamental geostrategic significance not only in a standard environment but also in extraordinary events or crisis situations. They have a potential to incriese or mitigate consequences of these extraordinary events possibly with the appropiate composition to prevent these negative phenomena.

Without the operational reliability and basic infrastructute function it is not possible to develop the economic aktivity of the built-up areas in the regions and to improve the newly created environment.

The basic infrastructure consists of the following tecnical and operating systems:

- residental public and private buildings,
- technical infrastructure of territorial unit (natural gas, electricity, drinking water, sewage),
- transport infrastructure (roads, railway communications),
- medical facilities (hospitals, medical instituitions),
- industrial objects (production and storage facilities),
- industrial zones,
- business zones.

The facilities and building are changing over time. It has been changing not only their basic parametres but also their reliability and usability for their primary purpose. In the case of general constructions in particular the changes are slow and so called comestic, the construction of the technical infrastructure during its lifetime often loses its initial performance parametres. These parametres can seriously endanger general city stability, municipalities, industrial base and broader concepts and also citizen security.



Fig. 1. Flooded area due to flood in 1997 [2] Rys. 1. Zalany teren w związku z powodzią w 1997 r. [2]

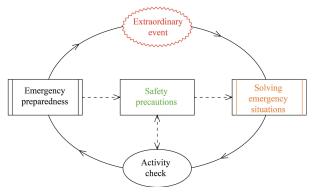


Fig. 2. Emergency management concept in the Czech republic [3] Rys. 2. Koncepcja zarządzania kryzysowego w Republice Czeskiej [3]

Security threats to infrastructure in new climatic conditions

As clear from the previous chapter in this article, the general urban funcionality and operability are conditioned by reliability of theornical infrastructure. Despite technical progress however technical infrastructure can not achieve 100% system realiability and security of energy supply or drinking water. These systems can affect two fundamental factors which have a potential to shut down for a different time:

- natural influences,
- anthropogenic events.

These events occurance is dependent on the geological and natural conditions in which the infrastructure is located in and at the same time on the technical adaptation of infrastructure facility concerned to handle difficult natural changes or anthropogenic events. With the upcoming climate change it is not only possible to increase the natural incidents number but also to increase intensity of the secondary anthropogenic emergencies impact in the affected area.

Natural influences

In the whole range of occurance possibilities an extraordinary event with a natural character with an extremely negative impact on the useful environment of bulit-up areas and its infrastructure are floods, see in Fig. 1.

Floods, climatic and hydrological droughts will be almost certainly major threats in 21st century global climate threat. They will fundamentally influence the whole range of human activities and infrastructure facilities. Without a sufficient preventive preparation for their preparation, the consequences will increase in many cases and accumulate at the same time.

Anthropogenic events

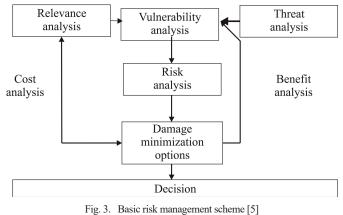
Anthropogenic events themselves have often far-reaching negative impacts on human health and people's lifes. However in many industrial activities they have also a potential to endanger the environment. This is particulary the case for aquatic ecosystems in which during the emergencies events with chemical leakage into receptacles or flooded soil layers, serious natural and safety damage can occure. These are in particular the following threats:

- groundwater or surface contamination
- temporary decommissioning of drinking water sources,
- serious damage to the environment, fauna and flora in the river basin,
- ampflication of abovementioned extraordinary events with the simultaneous hydrological drought.

If a person has limited possibilities to influence the occurrence of extraordinary events or crisis situations caused by natural influences, then creating sufficient preventive conditions to minimize the consequences of threats to anthropogenic events is in the human power.

Elimination of natural and anthropogenic risks

The theoretical elimination issue of natural and anthropogenic threats is currently relativem sophisticated. However



Rys. 3. Podstawowy schemat zarządzania ryzykiem [5]

its implementation in practice must be based on at least the following aspects:

- actual risks detailed analysis,
- thought maps for their elimination in space,
- crisis plans elaboration for public administration,
- developing crisis preparedness plans for infrastructure operators.

If these principles are appropriately incorporated into safety measures, see Fig. 2, an acceptable outcome can be obtained when an emergency or a crisis situation arises.

In the practice, a two-phase or three-phase model is used. The initial two-phase model (emergency preparedness, emergency situation) in real is then decomposed into a three-phase model (protection, response, recovery). Together with technical procedures, threats and risk management are accompanied by ethical issues [4]. At the same time it is necessary to maintain a sequence of steps and actions as part of activities to reduce extraordinary events consequences, see Fig. 3.

In assessing the continuity of the territory technical infrastructure it is appropiate among other measures to consider in addition to other measures, the ration of expected negative impacts arising from human factor failures or technological disasters and natural events effects and also the risk of crisis emergence.

Due to the dynamic scinetific knowledge development of new equipment and technologies, it is always necessary to consider whether the taken measures are only temporary or in line with a long-term development trends. One of these considerations may also be the search for new routes and resilence ways of regional infrastructure systems [6].

Finding new ways to increase resilence of regional infrastructure operating systems

Scientific knowledge has a fundamental importance in further long-term area sustainability and its environment. Together with the technical and industrial base development they have a potential to create defense systems that reduce current security risks [7]. However it is always appropriate for science and technology to respond to other stimuli that can be the part of security development after initial analysis. One of these ways can be solve by the following issues:

- approach changing to solve past ecological faults in the sustainability of water precipitation in areas threatened by hydrological drought
- deactivating ways to a large part of melioration structures,
- new types development of climate change monitoring systems not surface and underground water reserves, especially in vulnerable areas of meteorological drought.

The above mentioned research and searching for new routes based on scientific risk analyses while maintaining a link to the potential of technology development can reduce a considerable part of security threats in a relatively short time period. At the same time preventing new threats emerging in individual world regions can set in.

Conclusion

Given that the advent of climate change in 21st century is already proven it is necessary to adapt to that situation. It must not be a passive approach but an active solution to eliminate threats consequences. One of the ways in which approaches and remedies can be accessed is also suggested in this article. Its structure is based on long-term studies of the article author subject and their solution in practice. Perhaps the article will bet he next successive solution in coming years.

Acknowledgments

This work was supported by the research project VI20152019049 "RESILIENCE 2015: Dynamic Resilience Evaluation of Interrelated Critical Infrastructure Subsystems", supported by the Ministry of the Interior of the Czech Republic in the years 2015-2019 and project "Development project 2017", supported by the Ministry of the Interior of the Czech Republic in the years 2016-2018.

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Bezpieczeństwo eksploatacji infrastruktury w nowych warunkach klimatycznych

Niezawodność budynków infrastruktury jest podstawowym warunkiem wartości użytkowej zabudowy w miastach i gminach. Niezawodność tworzy warunki wstępne dla długoterminowej stabilności zasobów mieszkaniowych ludności, a jednocześnie jest warunkiem rozwoju bazy przemysłowej regionu. Ta rzeczywistość jest postrzegana przez opinię publiczną jako oczywisty standard, który jest częścią ludzkiego życia. Jednak w rzeczywistości jest to bardzo złożony mechanizm, który może być poważnie zakłócony w różnych warunkach i sytuacjach. Aby zapobiec takim sytuacjom w praktyce, konieczne jest, aby państwo, rząd i różni operatorzy infrastruktury znali zagrożenia dla bezpieczeństwa, które mogą podlegać zmianom przez zmiany w środowisku naturalnym i być gotowymi na ich wyeliminowanie.

Artykuł dotyczy tych zagadnień, dotyczących rozpoznawania zagrożeń wynikających z sytuacji awaryjnych lub sytuacji krytycznych oraz określenia jakie zasoby są potrzebne do zwiększenia niezawodności infrastruktury.

Słowa kluczowe: niezawodność, bezpieczeństwo, infrastruktura, ryzyko, awarie, eliminacja ryzyka, odporność systemu