

Roads and pedestrian routes in the development of the construction site

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Abstract

A construction site is a place where vehicular and pedestrian traffic takes place. Compliance with general health and safety regulations and principles is no longer sufficient and requires additional regulations regarding the regulations and principles applicable to the organization of road and pedestrian traffic on a given construction site. Good traffic organization improves safety and reduces the number of accidents. Roads and pedestrian paths, in addition to machines and technical equipment, storage sites for building materials and structures, networks, pipelines and installation cables, administrative, social and sanitary rooms and equipment, are the basic elements of safe development of a construction site. Development of the construction site is the initial stage of preparation for the implementation of a construction task, which plays an essential role in ensuring safety and health protection during construction works. The article characterizes the role, importance and requirements for road roads and pedestrian routes in the development of a traditional construction site.

Keywords: construction, development of the construction site, roads, pedestrian routes, safety and health protection

1 Introduction

In every construction process, two basic stages can be distinguished: preparation and construction of the building. Within the meaning of applicable law, the participants in the construction process are:

- the investor,
- the investor's supervision inspector,

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- the designer,
- the construction manager or the works manager [17].

Each of them has specific responsibilities at particular stages of the process.

The investor supervises the entire process, but some of his responsibilities are his own transfers to other participants at individual stages, which does not release him from responsibility for the entire construction process. All participants of the construction process are responsible for safety and health protection in their own scope [1,2,3,4,5,6,7,8,9,10,11,12,15]. There are two basic stages in the construction process: preparation stage and stage of execution of construction works (execution of the facility).

During *the preparation stage of the construction process*, the investor has the basic responsibilities. The investor's obligations include organizing the construction process, taking into account the safety and health protection principles contained in the regulations, and in particular ensuring:

- development of a construction design and, as appropriate, other projects,
- taking over the construction management by the construction manager,
- developing a safety and health plan,
- execution and acceptance of construction works.

The investor may appoint an investor's supervision inspector on the construction site and oblige the designer to supervise the author [6, 14, 17].

The *basic duties of an investor supervision inspector* include:

- representing the investor on the construction site by checking compliance of its implementation with the design and construction permit, regulations and principles of technical knowledge;
- checking the quality of works and built-in construction products, and in particular preventing the use of defective construction products and those not approved for use in construction;
- checking and acceptance of construction works that are covered or disappearing, participating in tests and technical acceptance of installations, technical devices and chimney flues, as well as preparation and participation in acceptance activities of finished construction objects and putting them into use;
- confirming actually performed works and removing defects, as well as, at the investor's request, controlling construction settlements.

The investor supervision inspector also has certain rights. He may issue instructions to the construction manager or works manager, confirmed by an entry in the construction log, regarding: the removal of irregularities or threats, the performance of tests or examinations, including those requiring the discovery of works or hidden elements, and the presentation of expert opinions regarding the construction works carried out and evidence of approval for use in construction. construction products and technical devices. The investor's supervision inspector may also demand that the construction manager or works manager make corrections or re-perform defectively performed works, as well as suspend further construction works if their continuation could pose a threat or cause unacceptable non-compliance with the design or construction permit [17].

The investor commissions a designer to prepare a construction project. The basic duties of a designer include:

- development of a construction design in a manner consistent with the arrangements specified in the decision on the conditions of development and land development, in the decision on environmental conditions, the requirements of the Act, regulations and principles of technical knowledge;
- ensuring, if necessary, the participation in the development of the project of persons with construction qualifications for design in the appropriate specialty and mutual technical coordination of design studies prepared by these persons, ensuring that the safety and health protection principles contained in the regulations are taken into account in the construction process, taking into account the specificity of the designed facility construction;
- preparation of information regarding safety and health protection due to the specificity of the designed building, taken into account in the safety and health plan [13];
- obtaining the required opinions, arrangements and verifications of design solutions to the extent specified in the regulations;
- clarifying doubts regarding the project and its solutions;

- exercising author's supervision at the request of the investor or the competent authority in the scope of confirming the compliance of the implementation with the project in the course of construction works and agreeing on the possibility of introducing alternative solutions to those provided for in the project, reported by the construction manager or the investor's supervision inspector.

The designer is obliged to ensure that the architectural and construction design is checked for compliance with regulations, including technical and construction regulations, by a person with unlimited design qualifications in an appropriate specialty or a construction appraiser. The designer also has certain rights during construction, in particular the right to:

- entering the construction site and making entries in the construction log regarding its implementation;
- demand, with an entry in the construction log, the suspension of construction works if a risk is identified or if they are carried out contrary to the design [17].

At the stage of construction of a building, the investor ensures taking over the construction management as well as the execution and acceptance of construction works. From that moment on, some of the investor's responsibilities are taken over by *the construction manager (works manager)*. The basic duties of a construction manager include:

- protocol takeover from the investor and appropriate security of the construction site along with the construction facilities, technical devices and permanent points of the geodetic control network as well as protected elements of the natural and cultural environment;
- maintaining construction documentation;
- ensuring the geodetic delineation of the facility and organizing the construction and managing the construction of the building in a manner consistent with the design and building permit, regulations, including technical and construction regulations, and occupational health and safety regulations [13];
- coordinating the implementation of tasks to prevent threats to safety and health protection when developing technical or organizational assumptions for planned construction works or their individual stages, which are to be carried out simultaneously or sequentially, and when planning the time required to complete construction works or their individual stages;
- coordinating activities to ensure compliance with the safety and health rules contained in legal provisions during construction works;
- introducing necessary changes to the information and the health and safety plan resulting from the progress of construction works;
- taking necessary actions to prevent unauthorized persons from entering the construction site;
- suspending construction works if a possible threat is identified and immediately notifying the competent authority thereof;
- notifying the investor about an entry in the construction log regarding the suspension of construction works due to their execution not in accordance with the design;
- implementation of recommendations entered in the construction log;
- reporting to the investor for inspection or acceptance of completed works that are covered or disappearing, and ensuring that the tests and inspections of installations, technical devices and chimney flues required by regulations or specified in the contract are carried out before submitting the building for acceptance;
- preparation of as-built documentation for the construction facility;
- reporting the building for acceptance by making an appropriate entry in the construction log and participating in the acceptance activities and ensuring the removal of any defects found, as well as providing the investor with an appropriate declaration in this respect.

The construction manager also has certain rights. The basic ones include the right to ask the investor for changes in design solutions if they are justified by the need to increase the safety of construction works or improve the construction process, and the right to respond to the recommendations contained therein in the construction log [17].

During the construction stage of a building, the number of participants in the construction process responsible for health and safety increases to include the employer and employees. The Labor Code Act specifies the basic rights and obligations of the employer and employees in the field of occupational health and safety [14, 15]. The employer is responsible for occupational health and safety at the construction site. He is obliged to protect the health and life of employees by ensuring safe and hygienic working conditions with the appropriate use of achievements of science and technology, and in particular by:

- organizing work in a way that ensures safe and hygienic working conditions,
- ensuring compliance with occupational health and safety regulations and principles on the construction site, issuing orders to remove deficiencies in this regard and monitoring the implementation of these orders,
- responding to the needs to ensure occupational health and safety and adapting measures taken to improve the existing level of health and life protection of employees, taking into account the changing conditions of work,
- ensuring the development of a coherent policy to prevent accidents at work and occupational diseases, taking into account technical issues, work organization, working conditions, social relations and the influence of work environment factors,
- taking into account the health protection of adolescents, pregnant or breastfeeding employees and disabled employees as part of preventive measures taken,
- ensuring the implementation of orders, statements, decisions and orders issued by the authorities supervising working conditions.

The employer is also obliged to provide employees with information about:

- threats to health and life occurring in the workplace, at individual workstations and during the work performed, including rules of conduct in the event of failures and other situations threatening the health and life of employees,
- protective and preventive actions taken to eliminate or reduce threats occurring on the construction site [14, 15].

A construction worker also has certain rights and obligations regarding health and safety. In particular, the employee is obliged to:

- know the regulations and rules of occupational health and safety, take part in training and instruction in this field and take the required examinations,
- perform work in a manner consistent with the provisions and principles of occupational health and safety and follow the orders and instructions issued by superiors in this regard,
- take care of the proper condition of machines, devices, tools and equipment as well as order and tidiness in the workplace,
- use collective protective equipment, as well as use assigned personal protective equipment and work clothes and footwear, in accordance with their intended purpose,
- undergo initial, periodic and follow-up and other recommended medical examinations and follow medical recommendations,
- immediately notify the supervisor about any accident or threat to human life or health noticed at the workplace, and warn co-workers as well as other people in the danger area about the danger threatening them,
- cooperate with the employer and superiors in fulfilling obligations regarding occupational health and safety [14,15].

2 Requirements for internal roads and pedestrian routes on traditional construction sites

To ensure efficient and safe communication on a traditional construction site, the requirements for communication on the construction site must be met.

Requirements for communication on the construction site are regulated by law. Efforts should be made to separate road traffic routes from roads and pedestrian crossings. Construction traffic routes should be maintained in good technical condition and their patency should be ensured on an ongoing basis [14].

Requirements for road traffic and machinery

On the construction site, all road intersections are equivalent and the maximum permissible speed on all internal roads of construction sites is 30 km/h, unless local conditions provide otherwise.

Roads can be organized as one- or two-way roads. The width of a one-way road should be from 3.0 to 5.5 m if no unloading works will be carried out, and the width of a two-way road should be from 6.00 to 8.00 m if unloading works will be carried out along it. To ensure road patency and proper traffic organization, internal road routes may be through or peripheral. Materials, equipment or other items must not be stored there. Perimeter routes may occur as swing, ring or radial systems. Before road intersections with overhead power lines, warning gates are placed at a distance of not less than 15 m, illuminated in conditions of limited visibility and marking the permissible dimensions of passing vehicles. Crossings in dangerous zones should be protected with protective canopies. Protective canopies should be of appropriate width - at least 0.5 m more on each side than the width of the passage. The covering of protective canopies should be tight and resistant to penetration by falling objects.

Communication routes for trolleys and wheelbarrows located more than 1 m above ground level should be protected with a balustrade consisting of a main railing at a height of 1.1 m and a curb board at a height of 0.15 m above ground level. The space between the curb board and the main railing should be secured to prevent falls from height. The slope of these roads cannot be greater than: for rail bogies - 4%; for trackless carts - 5% and for wheelbarrows - 10%.

Requirements for pedestrian crossings

Pedestrian crossings should be designated in safe places. The width of a road intended for one-way pedestrian traffic should be at least 0.75 m, and for two-way traffic - 1.2 m. Passages over or next to depressions should be equipped with balustrades with a protective handrail at a height of 1.10 m and a curb board at a height of 0.15 m and filling the space between the handrail and the board in a way that protects employees against falling from a height. Passages and dangerous zones should be illuminated and marked with warning or prohibition signs.

Passages for employees located on slopes with an inclination of more than 15% should be equipped with slats mounted transversely, at intervals of not less than 0.4 m, or with stairs with a width of not less than 0.75 m, with at least one-sided balustrade protection. Ramps on which loads are manually moved should not have slopes greater than 10%. Exits from warehouses and passages between buildings leading to roads should be secured with protective railings 1.1 m high or in another way, e.g. by creating the so-called forcing mazes slowing down and changing the direction of traffic. No materials, equipment or other items may be stored on pedestrian or employee crossings.

Requirements for roads, emergency exits and parking spaces

Escape routes should meet the requirements of technical, construction and fire safety regulations. Emergency routes and exits requiring lighting should be equipped with emergency lighting, ensuring sufficient light intensity in the event of failure of primary lighting. Parking spaces should be designated for vehicles used during construction works on the construction site. The law does not specify requirements in this regard. However, it should be remembered that construction workers, in most cases, come to work in their own cars and parking spaces must be secured for them. Such places should be located in the so-called "open zone" of the construction site intended for all people directly or indirectly related to the construction site.

3 Requirements for internal roads and pedestrian routes on closed construction sites

The term "closed construction" is not clearly defined by law. According to environmental protection law, a closed area is understood as an area, and in special cases a building or part thereof, accessible only to authorized persons and designated in the manner specified in the Geodetic and Cartographic Law [16]. Another act that refers to the definition of a closed area as defined in the Geodetic Cartographic Law is the Construction Law. In the case of facilities located in closed areas, it imposes additional administrative obligations [17].

The author uses the term "closed construction site" to refer to a construction site where there is a large concentration of works and resources: people, materials and equipment. For example, the construction of the National

Stadium or the construction of Złote Tarasy in Warsaw can be called closed construction. The organization of communication on closed construction sites requires the application of additional requirements regarding, among others, internal roads and pedestrian routes.

Internal vehicular and pedestrian traffic on closed construction sites may only take place on designated and marked communication and transport roads and pedestrian routes. For each closed construction site, an internal communication system should be developed in accordance with applicable regulations and standards. Such a system, in addition to road and pedestrian traffic routes, should also include maneuvering, parking and storage areas, as well as fire access roads. The developed and approved internal communication system is part of the construction site development concept.

It is updated as the works progress. Road surfaces, maneuvering areas, parking and storage areas, fire access roads and pedestrian crossings should be even, hard or hardened with stormwater drainage. Depending on the type of construction of the building and the building materials used, it is necessary to ensure that the width of roads and pedestrian routes is appropriate to the needs and regulations, and that the appropriate load-bearing capacity of the surface should be assumed.

On a closed construction site, any collisions between communication roads and power lines should be marked in accordance with regulations and, where necessary, supporting measures, e.g. gates, should be used. Each driver of a truck (dumper) or construction machine is required to make sure there are no obstacles or collisions with power lines before starting unloading of the truck or working on the construction machine.

Traffic on internal roads should be designed based on the principles arising from road traffic law, and internal roads should be marked with road signs in accordance with road traffic law. All construction workers should be familiarized with the designed internal communication system, mainly the route of roads for vehicular traffic and pedestrian routes. Practically, this can be done as part of occupational health and safety training (initial, periodic, information). When specifying internal communication rules, please pay attention to:

- the right of entry to the construction site for authorized vehicles meeting current production needs: deliveries of materials, equipment, services, import or export of soil, and for special vehicles: fire brigade, ambulance service, police, construction supervision. All other vehicles may only enter the construction site's public parking lots;
- parking prohibited outside designated places;
- equivalence of all intersections;
- overtaking prohibited - heavy vehicles can only pass each other when the vehicle they are passing has stopped;
- the way heavy transport moves and machines operate – not interfering with road traffic;
- audible and visual reversing alarm, which turns on automatically during such a maneuver in all trucks and construction and road machinery; right of entry to the construction site.

A good practice on closed construction sites is to appoint a traffic management team. Such a team, appointed by the construction manager, manages the delivery of bulk and large-sized goods. Employees directing traffic should have up-to-date training in this area and, in accordance with the requirements of the regulations, be equipped with: a protective helmet, work shoes, a warning vest, and auxiliary equipment (e.g. a lollipop for traffic control).

The basic rules enforced by the traffic management team include:

- admitting persons and/or vehicles with an identification card or permanent/temporary pass to the construction site. Identification cards, permanent or single-use passes are issued after the vehicle driver has completed training/instruction on the rules of traffic organization on the construction site. Each time you leave the driver's cabin, you must wear a protective helmet, a warning vest and safe footwear. The required training/instruction may be conducted by a person designated for this task by the construction manager who has the required preparation and necessary knowledge in this area. Completion of the training is confirmed by the trainee's signature. Otherwise, the visiting person is under the supervision of an employee designated for him.
- traffic control in the case of construction works carried out in the immediate vicinity of communication routes.

Another good practice used on closed construction sites is separating pedestrian routes from roadways. In places where pedestrian routes intersect with roads, pedestrian crossings should be designated and marked, and barriers or

barriers should be used to prevent people leaving e.g. construction offices, canteens or toilets from entering the roads. Wheel washers are increasingly installed when leaving closed construction sites.

4 End

Roads and pedestrian routes on the construction site play an essential role in ensuring safety and health protection during construction works. Designing safe roads and pedestrian routes and ensuring that they are followed by road users and people moving around the construction site is particularly important because it allows, first of all, to protect employees and to reduce the risk of accidents and injuries as much as possible.

Bibliography

1. Baryłka A., Grzebielec A., Obolewicz J., Rusowicz A. (2019) Problemy inżynierii bezpieczeństwa obiektów antropogenicznych t.1
2. **Bednarczyk J. (2023) Zagospodarowanie placu budowy z bezpieczeństwo na budowie. Inżynier Budownictwa nr 11/2023**
3. **CIOP-PIB (2024) Zagospodarowanie terenu budowy materiały wewnętrzne**
4. **Marcinkowski R., Krawczyńska-Piechna A. (2019) projektowanie realizacji budowy (eBook), PWN Księgarnia Internetowa**
5. Obolewicz J. (2015) Bezpieczeństwo i ochrona zdrowia w budowlanym procesie inwestycyjnym: [rozd. w:] Bezpieczeństwo pracy w budownictwie / Ewa Błazik-Borowa, Krzysztof Czarnocki, Andrzej Dąbrowski, Bożena Hoła, Andrzej Misztela, Jerzy Obolewicz, Jolanta Walusiak-Skorupa, Anna Smolarz, Jacek Szer, Mariusz Szóstak, Politechnika Lubelska. Wydział Budownictwa i Architektury, s. 51-60
6. Obolewicz J. (2018) Demoskopia bezpieczeństwa pracy i ochrony zdrowia przedsięwzięć budowlanych, Oficyna wydawnicza Politechniki Białostockiej
7. Obolewicz J. (2018) Zagospodarowanie placu budowy – wymagania i standardy, Informator Budowlany – Murator ISSN 2450-906X, nr 1(2018) s.200-204
8. Obolewicz J. (2021) Poradnik inżynierii bezpieczeństwa pracy przedsięwzięć budowlanych, Wyd. Centrum Rzeczoznawstwa Budowlanego, Warszawa
9. **Obolewicz J. (2023) Etos bezpiecznej budowy, Promotor BHP 10/2023**
10. Obolewicz J. (2024) Utilizing Protective Clothing for Construction Workers: Safeguarding Against Hazards on the Construction Site, Open Access Journal Modern Engineering 1 (2024) 1-6
11. Obolewicz J., Baryłka A., Żółtowski M. (2024) Designing the organizational structure of construction, Inżynieria Bezpieczeństwa Obiektów Antropogenicznych nr 2(2024)
12. **Porozumienie dla bezpieczeństwa w budownictwie. Drogi wewnętrzne, wjazd, wyjazd i ciągi komunikacyjne na budowie (standard 9.4), (standard 9.1)**
13. Rozporządzenie MI z dnia 23 czerwca 2003 r. w sprawie informacji dotyczącej bezpieczeństwa i ochrony zdrowia oraz planu bezpieczeństwa i ochrony zdrowia
14. Rozporządzenie MI z dnia 6 lutego 2003r. w sprawie bezpieczeństwa i higieny pracy podczas wykonywania robót budowlanych
15. Ustawa z dnia 26 czerwca 1974 r. Kodeks pracy
16. **Ustawa z dnia 27 kwietnia 2001 r. Prawo ochrony środowiska**
17. Ustawa z dnia 7 lipca 1994 r. Prawo budowlane