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Safe operation of buildings during the winter period

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ABSTRACT

Purpose: The article presents legal regulations and principles for the safe operation of buildings in winter and proposes a procedure for clearing snow from flat roofs.

Findings: The Construction Law regulates the activities involving building design, construction, maintenance, and demolition and defines the operation principles of public administration bodies in these areas.

Research limitations/implications: The safety of buildings in the winter requires specialist knowledge and special care on the part of managers, employers, persons managing employees, and employees performing work related to their safe operation.

Practical implications: The safe removal of snow from flat roofs requires adequate legal knowledge, skills, training, and experience on the part of employers, managers, and workers.

The *employer's* most important obligations to employees in the case of snow clearance work on flat roofs (tantamount to work at height) include providing them with protective equipment appropriate to their position and tasks, with collective protective equipment. The employer is obliged to ensure that persons who carry out work at height are assisted by other employees who do not carry out such work directly. The employer should also ensure that workers receive instruction, taking into account, in particular, the personal division of work, the sequence of tasks to be performed, and the health and safety rules necessary for the various activities. It is also necessary to establish supervision of work at height.

Originality/value: *Employees carrying out snow clearing* should have a current height examination and hold a valid (current) medical certificate of no contraindication to work at height. The employee must also receive health and safety training prior to working at height, as well as an introduction to the specifics of the job, know the potential hazards and risks, and learn to use the personal protective equipment required for the job properly.

Keywords: Complementary roles of developed and developing nations in promoting a global industrial and economical infra-structure and requirements on common international research and teaching development in the field of safety, Technical safety, Hazards characterisation

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EDUCATION AND RESEARCH TRENDS

1. Introduction

A proper interpretation of the safe operation of buildings during the winter period requires the definition of basic terms. The term "*operation of a building*" is not defined in the building regulations. According to the Dictionary of the Polish Language [1], the word "*exploitation*" covers the use of something rationally, the use of equipment in a rational way in accordance with its purpose. In practical engineering terms, "*exploitation of a construction object*" is a technical and economic activity concerning a construction object related to its manufacture, use, and its physical decommissioning [2].

The term "safety" appears in the Polish Constitution [3] and is also not clearly defined. The regulations [4] oblige the owner or manager of a building to use it in accordance with its intended use and environmental protection requirements and to maintain it in a sound technical and aesthetic condition, thus implicitly obliging the owner or manager to use the building safely.

Building structures are operated in changing weather conditions. It is important to bear in mind that changing climatic conditions can cause weather anomalies and adversely affect the safe operation of a building [5]. It is particularly relevant during the winter period. For example, strong winds, intensive precipitation, including heavy snowfall may cause hazards to the safe operation of the building facility, and the specificity of snow load is its unpredictability [6]. Snow load is a variable load over a short period of time, and the principles of snow load [7] apply. These concern the snow zoning, the load factor (Fig. 1), and the return period of the impact, which has been significantly extended. Before the change, it was five years, and after the change, it is 50 years. It means that the deviation of the snow load norm value (Tab. 1) should not be exceeded for another 50 years after design.

In order to comply with the quoted legal requirements, it would be necessary to redesign all buildings erected before 2006, as they were designed for lower values of the design snow load, or to scrupulously monitor the snow load during its operation by measuring the weight of snow deposited on the roof, which allows assessing whether the amount of snow present does not pose a threat to the facility [8-12].

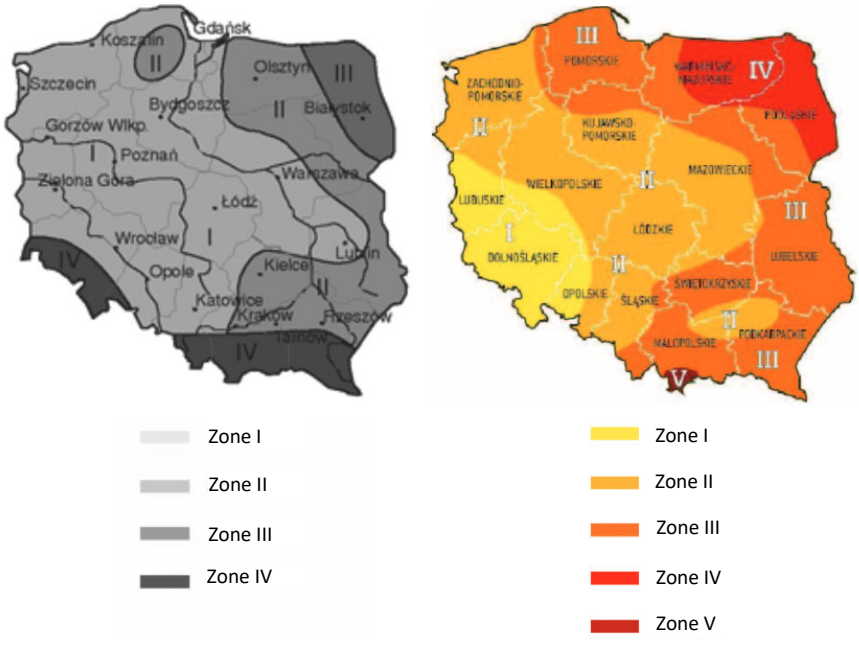

Fig. 1. Snow zones in the area of Poland according to PN-80/B-2010 (left) and PN-80/B-2010/Az1:2006 (right) [13]

Table 1.
Average volume weight of snow according to PN-80/B02010/Az1:2006 [13]

Type of snow and ice	Volume weight, kN/m^3
fresh	1.0
settled (several hours or days after precipitation)	2.0
old (several weeks or months after precipitation)	2.5-3.5
wet	4.0
icy	6.0-7.0
Iced (from iced water)	9.0

The Construction Law regulates activities covering matters of design, construction, maintenance, and demolition of buildings and sets out the rules for public administration bodies in these areas. The regulations pay particular attention to proper maintenance and use. In the colloquial sense of the word, use refers to the use of a construction object, while maintenance means remaining in the current unchanged state [1]. Obligations in this respect are assigned to the owner or manager of the construction work, which includes:

- maintaining and using the facilities in accordance with legal requirements and principles;
- ensuring, with due care, the safe use of the facilities in the event of external factors affecting the facility, man-made or natural phenomena such as lightning, seismic shocks, strong winds, intense rainfall, etc. atmospheric discharges, seismic shocks, strong winds, heavy rainfall atmospheric phenomena, landslides, ice phenomena on rivers and sea, lakes and reservoirs, fires, explosions, etc. lakes, and reservoirs, fires or floods which result in damage to buildings or imminent threat of such damage which may cause danger to human life or health, the safety of property or the environment;
- carrying out periodic inspections during the use of the facilities [4].

Compliance with those obligations is particularly important during the winter period. The winter period is defined as the period from 1 November to 31 March [14].

The property manager is responsible for the winter maintenance of the managed outdoor areas, i.e., clearing snow from walkways, stairs, estate roads, and waste disposal areas. However, the scope of those duties is nowhere precisely indicated.

The Act on Maintaining Cleanliness and Order in Municipalities states that property owners are obliged to ensure that the property is kept clean and tidy. In addition, they should ensure that mud, snow, ice, and other debris are cleaned up from the pavements running along the managed property [15].

The Building Act obliges managers of buildings to take care of the proper technical condition of the building, including not allowing its structure to be overloaded by snow lying on the roof and to ensure that the roof and elements of the building's facade are cleared of snow. The obligation includes the removal of icicles, lumps, ice, and snow overhangs that may endanger the safety of people on the pedestrian and roadway routes running directly by the building [4]. The Chief Inspector of Building Control also reminds of the obligation [8].

2. Monitoring snow cover on the roof

The roof is the element of a building located at the highest point, which is intended to cover and shield it from the weather. The basic elements of a roof include the supporting structure and the covering. The roof structure depends on the size of the building. In medium-sized buildings, it is usually made of wood; for larger buildings, steel, reinforced concrete, or glulam structures are used between the walls. The roofing material depends on the climate zone and the mass and architecture of the building. It can be traditional roofing (thatch, shingle, slate, tile, sheet metal, roofing felt) and contemporary (insulating membranes, waterproof layers, green roofs).

Depending on local conditions and architectural design, roofs can have different shapes and pitch angles. The shape of the roof can be determined by climate or aesthetic considerations [16].

One of the basic types of roofs is the flat roof. It is a structure whose slope is at an angle of $\leq 12^o$. The maximum pitch of a flat roof is assumed to be 20^o and the minimum pitch should be $\geq 2^o$ due to rainwater drainage [17].

On a flat roof, whether a new building or a refurbishment is, there are the following layers: pitch layer or structure, vapour barrier, thermal insulation, and covering. Details of the roof elements can be found in the design documentation for the building [18]. The scope of the design documentation is determined by the contracting authority [4].

In winter, flat roofs require snow load monitoring by measuring the weight of snow on the roof to assess whether the snow load poses a risk to the building. If the established load is exceeded, removal of the snow accumulation from the roof slope is required.

3. Works on flat roofs related to snow removal

Work on roofs to remove accumulated snow is mainly carried out at height and often on sloping surfaces. While performing their duties, workers are close to the edges of roofs or dangerous roof openings. Those situations are dangerous for them as they can generate falls from the roof. Any fall from a roof, at best, results in serious injury. According to HSE (Health and Safety Executive) inspectors, falls most often occur while on:

- at the edge of the roof,
- at gaps or holes in the roofing,
- on roof elements characterised by poor strength, and at roof windows [19].

Roofing work can also pose a danger to people below due to being hit by objects or snow that has fallen or been thrown off the roof [20,21]. It is also common for people to have accidents when climbing or descending from a roof or when 'quickly checking' the snow cover or some item or carrying out a minor repair. In doing so, it is important to remember that there is always a high risk of injury when

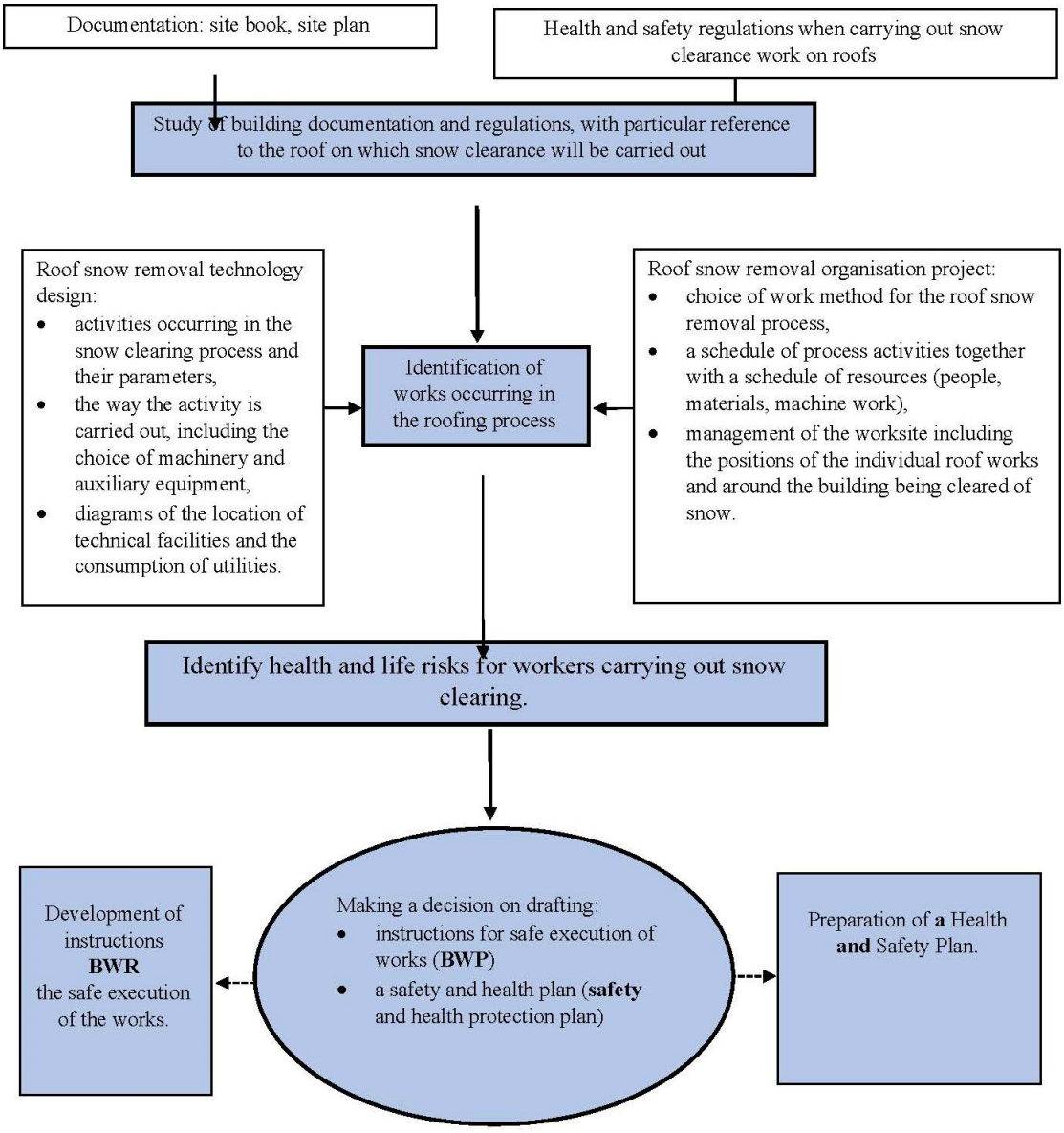

Fig. 2. Schematic diagram for planning activities prior to the commencement of roof snow clearance work [23-29]

shovelling snow from roofs. The risk is significant, especially in winter conditions, regardless of whether the work being done at the time is long or short or when climbing or descending from the roof [22].

Those in charge of snow removal from roof slopes should plan, organise, supervise, and control the work, and above all:

- determine whether carrying out work on the roof is really necessary, e.g., by seeking answers to questions:
  - whether clearing the roof of snow is necessary in a particular case,
  - whether the work involves inspecting the snow cover and it is not possible to use a mobile platform or to use a telescopic boom with a camera or optics mounted from a safe position on an adjacent building,
- decide whether working at height is necessary, take into account the use of appropriate equipment or other fall protection measures, e.g., by:
  - use of a mobile platform to carry out the work,
  - installation of roof edge protection,
  - use of personal protective equipment,
- if it is not possible to eliminate the risk of a fall, consider the use of appropriate equipment or other means of protection to minimise the length and impact of any fall, e.g., by the use of fall arrest ropes and harnesses,
- always consider in the first instance:
  - the use of measures to protect all persons at risk, i.e., people around the object on which the work is being carried out, from the snow being thrown from above, and only in the second instance safeguards to protect individuals, i.e., personal protective equipment such as safety harnesses for those throwing snow from the roof,
- ensure that work is only carried out in conditions that do not endanger the safety and health of workers [4,20,21, 23-33].

A methodical approach that includes:

- A study of the design documentation for the building facility and the regulations, with particular reference to the roof on which the works will be carried out,
- An identification of works occurring in the roofing works process,
- An identification of health and life risks for workers carrying out roofing work,
- a decision on drafting:
  - instructions for the safe execution of works (IBWP instructions)
  - a safety and health plan (BIOZ plan).

A diagram of the procedure is shown in Figure 2.

4. Completion

The safe removal of snow from flat roofs requires adequate legal knowledge, skills, training, and experience on the part of employers, managers, and workers themselves.

The *employer's* most important obligations to employees in the case of snow clearance work on flat roofs (tantamount to work at height) include providing them with protective equipment appropriate to their position and tasks, with collective protective equipment. The employer is obliged to ensure that persons who carry out work at height are assisted by other employees who do not carry out such work directly. The employer should also ensure that workers receive instruction, taking into account, in particular, the personal division of work, the sequence of tasks to be performed, and the health and safety rules necessary for the various activities. It is also necessary to establish supervision of work at height.

Those in charge of workers should be able to recognise roof snow removal activities and identify the hazards that these activities may generate. Particular attention should be paid to the following:

- designation of the danger zone around the snow-cleared roof of the building,
- installation of roof edge protection,
- operating tools, machinery, and equipment used during snow clearing,
- manual transport of materials,
- use of collective protection measures and personal protective equipment (including rescue procedures).

Employees carrying out snow clearing should have a current height examination and hold a valid (current) medical certificate of no contraindication to work at height. The employee must also receive health and safety training prior to working at height, as well as an introduction to the specifics of the job, know the potential hazards and risks, and learn to use the personal protective equipment required for the job properly.

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