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ASSESSMENT OF THE ACCIDENT RATE COEFFICIENT AT PEDESTRIAN RAILWAY CROSSINGS

Summary. *The object of the study is pedestrian railway crossings, which are specially designed pedestrian paths across railway tracks intended to ensure the safe passage of pedestrians over railway infrastructure, including areas outside of official level crossings. An analysis of statistical data found that in the first three quarters of 2024, the percentage of injuries and accidents caused by moving railway rolling stock involving unauthorized individuals increased by 12.7 % compared to 2023. This study reviews international and Ukrainian methods and models for forecasting accidents at railway crossings. The methodology for calculating the pedestrian accident rate coefficient at railway crossings – within and outside existing level crossings – has been improved. This allows for assessing accident risk based on the number of daily trains, hourly pedestrian flow volumes, technical equipment, and informational support at the railway crossing. Additionally, the methodology accounts for pedestrian speed, the layout, and the crossing profile. A comparison was made between accident rate coefficients at railway crossings with and without a pedestrian train-approach warning system. The results showed that implementing such an informational system reduces accident rates. The average reduction in accident rate coefficient due to the warning system, depending on the number of daily trains, is 3.4. When considering pedestrian flow volume with a constant number of trains, the reduction is 5.32. It was also established that increased train traffic results in a greater difference in accident rate coefficients with and without the warning system. The coefficient shows a slight upward trend at a pedestrian flow of 75 people/hour. In this case, the accident rate coefficient is 13.35 without the warning system and 10.1 with it. Multivariable calculations showed that pedestrian flow volume has the most considerable impact on safety and must be considered when designing modern pedestrian railway crossings, especially in urbanized areas, to ensure pedestrian safety*

Key words: *pedestrian railway crossing, level crossing, traffic safety, pedestrian, accident rate coefficient.*

1. INTRODUCTION

A significant issue in Ukraine's railway sector is ensuring pedestrian safety at railway crossings [1–3]. This challenge is exacerbated by the rapid development of agglomeration zones and urbanization in large cities [4]. One key aspect of urban development is infrastructure, including railway infrastructure. However, existing regulations and standards [5, 6] do not specify safety requirements for pedestrian movement across railway tracks in urbanized areas. In practice, pedestrian safety is often enforced by pedestrian prohibitions rather than general restrictions affecting all road users.

A railway pedestrian crossing is often a barrier in pedestrian routes [7]. This is primarily because railway lines divide urban territories, and official pedestrian crossings are generally only located at stations or where streets intersect the railway. Meanwhile, the frequency of unauthorized mass crossing locations [8]

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is much higher than that of official crossings. Banning pedestrian access in these cases is ineffective. The increase in unauthorized pedestrian crossings over railway tracks compromises pedestrian safety and contributes to higher injury and fatality rates. This is supported by data from the State Transport Safety Service of Ukraine [9]. According to accident analysis for the first nine months of 2024, 230 incidents involving unauthorized individuals and moving railway stock were recorded, resulting in 90 injuries and 141 fatalities. Year-on-year, the accident rate on railway transport is increasing. In 2024, accidents rose by 12.7 % compared to 2023, with a 12 % increase in fatalities. Therefore, enhancing pedestrian safety at railway crossings is a pressing concern. This calls for implementing modern pedestrian warning systems for approaching trains and improving the methodology for assessing accident risk at pedestrian railway crossings.

2. STATEMENT OF THE PROBLEM AND RELEVANCE OF THE STUDY

Currently, various informational, technical, and legislative factors influence the prevention of pedestrian-related railway incidents [1]. In international practice [10–13], multiple methods, which include different coefficients affecting pedestrian safety in interactions with railway transport, are used. In [10], the authors propose a model called Comprehensive-Biased Random Walk with Different Restart (CBRWDR), which incorporates a range of causes for railway incidents and provides potential indicators for quantitatively assessing railway accidents. These indicators are based on observations and analysis of the Federal Railroad Administration’s (FRA) accident database.

In [11], the authors apply graph theory to analyze railway accidents. By describing the relationships between incidents and hazards in the graph network, the authors derived a potential law of incident occurrence and identified correlation dependencies between different types of danger.

In [12], it is noted that pedestrians at passive crossings are at the highest level of risk. A key safety factor is how long the crossing remains closed for a single train to pass. This waiting time is often long enough to encourage pedestrians to break the rules and endanger themselves.

Similarly, [13] highlights the importance of waiting time in evaluating pedestrian safety. Norwegian researchers and a technology company developed “The Level Crossing Warning System” (LCWS). The system detects approaching trains using acoustic sensors installed on the tracks (see Fig. 1).

Fig. 1. Placement of acoustic sensors on the railway track, warning system for approaching rolling stock to a level crossing (LCWS) [13]

Acoustic sensors are sensitive to the noise and vibration of a train several kilometers from the crossing. Thus, the signal transmitted by these sensors to the light and sound warning systems can timely alert pedestrians about the approaching train, thereby enhancing pedestrian safety at railway crossings.

Attention should also be paid to the effectiveness of road signs informing pedestrians about railway crossings. In [14], the authors conducted a comparative analysis of the likelihood of pedestrians crossing railway tracks in the presence of various types of road signs. It was found that signs conveying actions and emotionally motivated messages are more effective than purely informational signs. However, the key factors influencing a pedestrian's decision to cross the tracks are primarily the presence of a train and the type of physical barriers, with the type of sign being secondary.

Studies [15–18] analyzed pedestrian behavior using video surveillance data and geographic spatial models. Several behavioral characteristics of pedestrians were identified: ignoring active warning devices, pedestrian distraction, and varied walking speeds at crossings. Other important factors influencing pedestrian safety in urban areas include population density, housing types, and crossing width.

Beyond the technical aspect, improving the legal framework for pedestrian traffic safety is also necessary. In [19], the authors outlined key strategic directions to enhance pedestrian safety, including developing public education policies on railway safety, creating safe and accessible infrastructure, improving management systems, and urban legislative improvements to support pedestrian safety. These strategic directions can be used to develop railway safety policies and pedestrian safety programs in urban environments.

Based on the analysis of sources [10–19], it can be concluded that the issue of pedestrian safety when crossing railway tracks, especially in cities where passenger flows are increasing, is highly relevant. Current pedestrian safety methods can provide information about potential risks, but do not isolate the key factors of railway accidents, which are critical for developing safety measures and preventing accidents on railway transport.

The most detailed methods in terms of factors influencing pedestrian safety and the prevention of transport incidents on railways are those used in the United States [20]. One well-known method is the accident prediction method (NCHRP 50), which includes a mathematical model for forecasting collisions between trains, vehicles, and pedestrians at railway crossings. The NCHRP 50 accident prediction model is used as the primary method for hazard assessment. The predicted accident frequency is calculated using the following formula:

$$EAF = A \cdot B \cdot T, \tag{1}$$

where: A – the coefficient of the Annual Average Daily Traffic ($AADT$); B – the safety coefficient, which accounts for the type of equipment at the railway crossing with pedestrian traffic and is taken from Table 1; T – the current number of trains per day.

Table 1

Indicators and values of safety coefficients according to the NCHRP 50 model [20]

Safety coefficients (B)		
1	Crossbucks, $AADT$ < 500	3.89
2	Crossbucks, Urban	3.06
3	Crossbucks, Rural	3.08
4	Stop sign, $AADT$ < 500	4.51
5	Stop sign	1.15
6	Wigwag	0.61
7	Flashing Lights, Urban	0.23
8	Flashing Lights, Rural	0.93
9	Barrier gates, Urban	0.08
10	Barrier gates, Rural	0.19

A well-known method is calculating the Connecticut Department of Transportation (CTDOT) hazard index [20]. It includes more protection factors for different types of warning devices at crossings and corrections for accident history. In this case, the calculated hazard index is determined by the formula:

$$HI = \frac{(T+1)\cdot(A+1)\cdot AADT \cdot PF}{100}, \tag{2}$$

where: T – number of trains per day; A – number of accidents over the last 5 years; $AADT$ – annual average daily traffic; PF – safety coefficients (Table 2).

Table 2

Indicators and values of safety coefficients according to the CTDOT model

Safety coefficients (*PF*)		
1	No active or passive warning devices	1.250
2	Stop control sign	1.000
3	Stop and guard control	0.750
4	Manually activated traffic light signal	0.750
5	Railway flashing lights	0.250
6	Traffic light signal control with advance	0.250
7	Railway flashing light barriers	0.010
8	Inactive railway line	0.001
9	Closed level crossing	0.000

In Ukraine's mainline railway transport, methods for identifying and assessing hazardous accident-prone areas are based on statistical data about the number of traffic accidents. Ukravtodor has proposed a methodology for evaluating traffic safety levels on Ukrainian highways – M 218-03450778-652:2008 [21]. However, this methodology does not allow for determining a pedestrian accident rate coefficient at railway pedestrian crossings. Therefore, improving the method for evaluating the pedestrian accident rate coefficient at railway crossings is a relevant and timely research task.

The aim of this article is to improve the methodology for evaluating the accident rate coefficient at railway pedestrian crossings and to establish the patterns of how this coefficient changes depending on the number of trains and pedestrian traffic volumes. The following research objectives must be addressed to achieve this goal:

– to improve the methodology for evaluating the accident rate coefficient at railway pedestrian crossings within and outside railway level crossings.
– to perform multi-scenario calculations of the accident rate coefficient at railway pedestrian crossings within an existing railway level crossing, depending on the number of trains and the pedestrian traffic volumes.

3. ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Based on method [21], the methodology for evaluating the accident rate coefficient at railway pedestrian crossings has been improved. A composite pedestrian accident rate coefficient method is applied. The accident rate coefficient for railway pedestrian crossings can be used by road safety specialists, transport infrastructure designers, railway transport analysts, government authorities, and researchers in the field of transport safety. By incorporating physiological, technical, and behavioral parameters, the method enables a comprehensive assessment of risks – even in the absence of direct accident history – and supports effective planning of safety improvement measures. The accident rate coefficient at a railway pedestrian crossing is determined by multiplying eight partial accident rate coefficients:

$$K_p = \prod_{i=1}^{8} K_i = K_1 \cdot K_2 \cdot K_3 \cdot K_4 \cdot K_5 \cdot K_6 \cdot K_7 \cdot K_8, \tag{3}$$

where: K_1 – coefficient accounting for the daily train traffic volume through the railway pedestrian crossing; K_2 – coefficient accounting for hourly pedestrian traffic volume at the crossing; K_3 – coefficient accounting for the visibility distance from the crossing to an approaching train; K_4 – coefficient accounting for the equipment available at the pedestrian crossing; K_5 – coefficient accounting for artificial lighting at the crossing; K_6 – coefficient accounting for the curvature radius of the railway track approaching the crossing; K_7 – coefficient accounting for the longitudinal slope of the pedestrian crossing approaches to the railway; K_8 – coefficient accounting for the age and physiological characteristics of pedestrians.

The values of coefficients K_1 – K_8 are provided in Tables 3–5.

The value of the coefficient that accounts for the daily train traffic volume through the pedestrian crossing K_1 is determined by the following formula:

$$K_1 = \frac{N_t}{3 + 0.1N_t}, \tag{4}$$

where N_t – train traffic volume through the pedestrian crossing (trains/day).

Table 3

Partial accident rate coefficients K_1, K_2, K_3

Coefficient value K_1					
Train traffic volume, N_t, trains/day					
<10	11–20	21–30	31–40	41–50	>50
2.5	4	5	5.7	6.25	6.67
Coefficient value K_2					
Pedestrian volume at the pedestrian crossing, N_p persons/hour					
< 20	21–50	51–100	101–200	201–300	>300
0.42	0.55	0.80	1.14	1.50	2.05
Coefficient value K_3					
Train visibility distance from the crossing, m					
<50	51–100	101–200	201–300	301–400	>400
Railway pedestrian crossings within the existing railway crossing					
3.2	2.8	2.0	1.6	1.3	0.9
Railway pedestrian crossings outside the existing railway crossing (category E)					
6.5	5.1	4.0	2.5	1.42	1.0

Table 3 shows the coefficient values considering the hourly pedestrian volume (K_2) at a railway pedestrian crossing by the methodology [21]. In this case, pedestrian volume is equated to the hourly car traffic volume. The initial value of the coefficient K_2=0.42 is justified by the number of transport events that occurred with the participation of pedestrians according to statistical data [22].

The numerical value of the coefficient that takes into account the visibility distance from the crossing to the train (K_3) for railway pedestrian crossings within the railway crossing is adopted in accordance with the methodology [21]. They correspond to the values of the coefficients for a railway crossing with automatic traffic light signaling and a duty officer. At the same time, the value of the coefficient K_3 for railway pedestrian crossings outside the existing railway crossing corresponds to the indicators of a railway crossing without a duty officer.

Table 4

Partial accident rate coefficients K_4, K_5, K_6

Railway pedestrian crossing equipment	Numerical values of coefficients
Coefficient K_4	
Automatic barrier with automatic traffic light signaling	1.6
Automatic traffic light signaling	2.2
Mechanized barriers with signaling	4.8
Mechanized barriers without signaling	9.1
Information system for warning pedestrians about the approach of a train:	
– within the railway crossing	1.2
– outside the railway crossing (category *E*)	1.65
Coefficient K_5	
Artificial lighting is available at railway pedestrian crossings	1.0
No artificial lighting is available at railway pedestrian crossings	1.5
Coefficient K_6	
Radius of the curves on the approaches to the railway pedestrian crossing:	
– 151–200 m	1.45
– more than 200 m	1.00

Additional equipment for a railway pedestrian crossing within the existing railway crossing with an information system for warning pedestrians about the movement of a train reduces the accident rate by 25 % compared to equipping the crossing with an automatic barrier with automatic traffic light signaling. Therefore, the coefficient considering the pedestrian crossing equipment is $K_4 = 1.2$. At the same time, its value for a railway pedestrian crossing outside the existing railway crossing is taken as $K_4 = 1.65$, corresponding to a 25 % reduction in the accident rate compared to equipping the crossing with automatic traffic light signaling [21]. The accepted reduction in the accident rate by 25 % when implementing an information system for warning pedestrians about the movement of a train at railway pedestrian crossings corresponds to the studies presented in [23]. This work has established that implementing intelligent transport systems at the national level reduces the number of accidents by 20–30 %. This is ensured by improving traffic flow management and timely warning pedestrians of the threat.

Table 5

Partial accident rate coefficients K_7, K_8

Coefficient value K_7					
Longitudinal slope of the pedestrian crossing on the approaches to the railway track, ‰					
less than 20	30	40	50	60	over 60
1.00	1.38	2.45	2.72	2.81	3.64
Coefficient value K_8					
Average pedestrian speed, km/h					
Schoolchildren (8–10 years)	Youth (15–20 years)	Middle-aged (30–40 years)	Elderly (50–60 years)	Low-mobility population groups	
4.6	5.4	5.7	4.8	3.4	
1.2	1.02	0.97	1.15	1.62	

The value of the coefficient that takes into account the artificial lighting of the crossing (K_5), the coefficient that takes into account the radius of the curve on the approaches to the crossing (K_6), and the coefficient that takes into account the longitudinal slope of the pedestrian crossing on the approaches to the railway track (K_7) are given in accordance with the methodology [21]. And the value of the coefficient K_8 is obtained by the formula:

$$K_8 = \frac{V_{avg}}{V_{ped}}, \qquad (5)$$

where V_{avg} – the established average pedestrian speed (V_{avg} = 5.5 km/h is taken according to the work [24]); V_{ped} – the pedestrian speed depending on age and physical characteristics [25].

It should be noted that the coefficient K_8 is calculated depending on the actual speed of pedestrian movement through the railway crossing.

The practical application of the accident rate coefficient is possible for comparative risk assessment at various railway pedestrian crossings. In project justification, it can be used to evaluate the safety of future projects at the planning stage. In safety audits, it can be used as part of expert analysis when inspecting existing facilities, and in scenario modeling, to assess the impact of individual measures (e.g., lighting installation, slope adjustment) on overall safety levels. A key feature of using the coefficient is its ability to assess pedestrian crossing safety after modernization or new design implementation, even without accident data.

According to the given values of the coefficients (Tables 3–5), it is possible to carry out multivariate calculations of the accident rate of pedestrians when crossing railway tracks, taking into account the daily number of trains, hourly pedestrian volumes, the technical arrangement and information support of the railway pedestrian crossing, etc.

4. RESULTS OF MULTIVARIATE CALCULATIONS OF THE ACCIDENT RATE COEFFICIENT AT RAILWAY PEDESTRIAN CROSSINGS

4.1. Calculation of the accident rate coefficient at a railway pedestrian crossing within a railway level crossing depending on the number of trains per day

The calculation of the accident rate coefficient for transport incidents at a railway pedestrian crossing within an existing railway level crossing is carried out depending on the number of daily trains (N_t). The crossing is equipped with an automatic barrier and automatic traffic light signaling. Artificial lighting is present at the crossing. The curve radius in the horizontal alignment on the approaches to the railway pedestrian crossing is 180 meters, and the longitudinal slope of the pedestrian crossing on the approaches to the railway track is 30 ‰. The visibility distance from the crossing to the train is 250 meters.

In this study, the pedestrian volume is assumed to be 50 persons/hour, with an average walking speed of 5.7 km/h.

The accident rate coefficient involving pedestrians is calculated using formula (3) and the coefficient values K_1-K_8, presented in Tables 3–5. The calculation is carried out in two scenarios:

– a railway level crossing with pedestrian movement without an information system to warn pedestrians about an approaching train;
– a railway level crossing with pedestrian movement equipped with an additional information system to warn pedestrians about an approaching train.

The graphical dependence of the pedestrian accident rate coefficient at a railway pedestrian crossing within a level crossing, depending on the number of trains per day, is shown in Fig. 2.

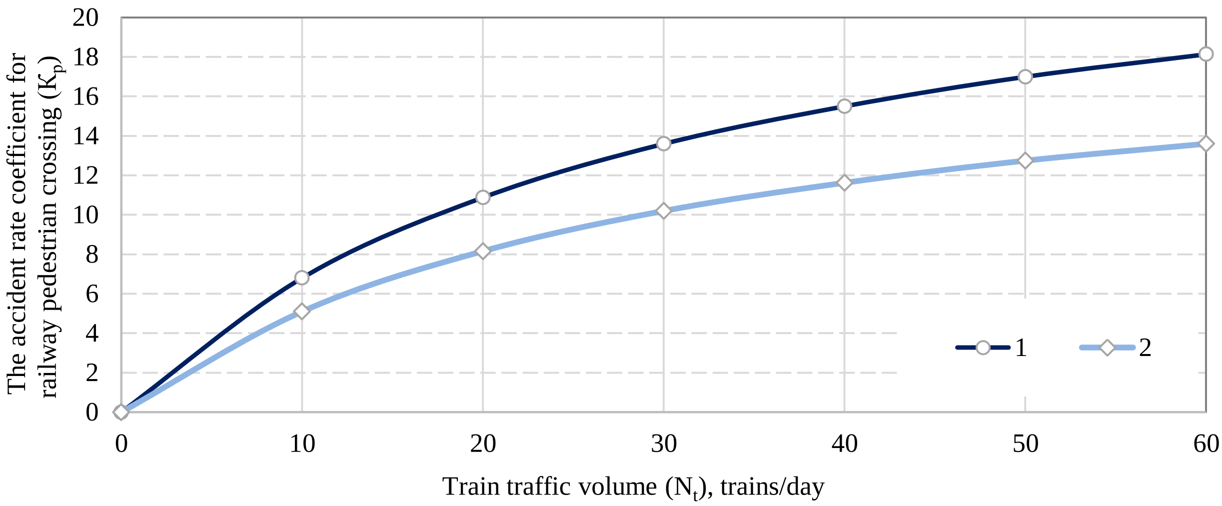

Fig. 2. Dependence of the accident rate coefficient at a railway pedestrian crossing on the number of trains per day: 1 – railway crossing without a pedestrian warning information system; 2 – railway crossing with a pedestrian warning information system.

The results of the accident rate calculation (Fig. 2) show that implementing a pedestrian warning information system reduces the accident rate at railway crossings with pedestrian traffic, compared to crossings without such a system. With 10 trains per day, the accident rate coefficient without the warning system is K_p=6.8, while with the warning system it is K_p =5.1. At 20 trains per day, the values are K_p =10.9 and K_p =8.15, respectively, and at 30 trains per day, they are K_p =13.6 and K_p =10.2.

Fig. 3 illustrates that the difference between the accident rate values with and without the pedestrian warning system increases as the number of trains increases. With 10 trains per day, the difference is 1.7, at 20 trains it is 2.72, and at 30 trains it is 3.40. This confirms the effectiveness of implementing a pedestrian warning information system about approaching trains, as it significantly enhances pedestrian safety at railway crossings.

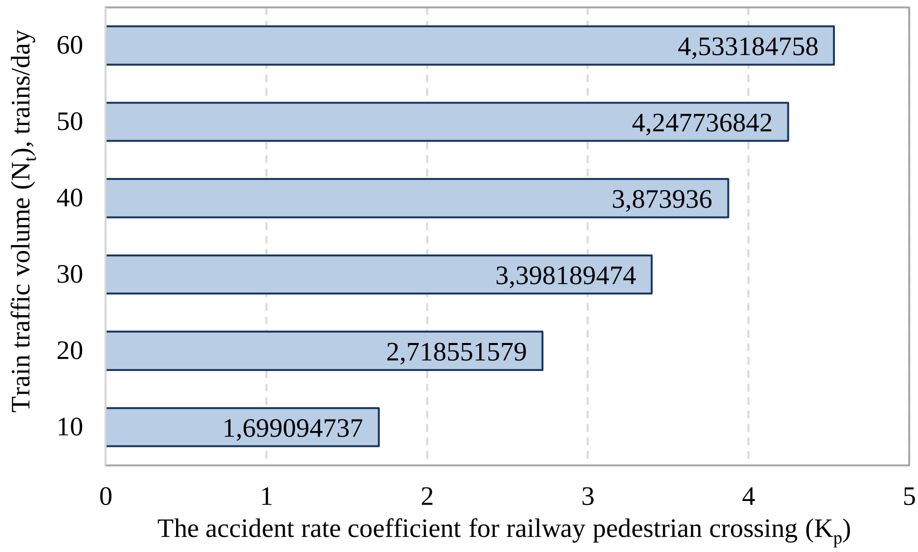

Fig. 3. The difference in accident rates at a railway pedestrian crossing without and with an information system for warning pedestrians about train traffic, depending on the number of trains per day.

The average value of reducing the accident rate at a railway pedestrian crossing when implementing an information system for warning is 3.41.

4.2. Calculation of the accident rate at a railway pedestrian crossing within railway crossings depending on the intensity of pedestrian traffic

The accident rate at a railway pedestrian crossing will be calculated depending on the hourly pedestrian volume (N_p) at the value N_t =20 trains/day. Other parameters of the railway pedestrian crossing are taken from previous studies, which are given in section 4.1. The graphical dependence of the accident rate coefficient at a railway pedestrian crossing, taking into account the intensity of pedestrian traffic, is shown in Fig. 4.

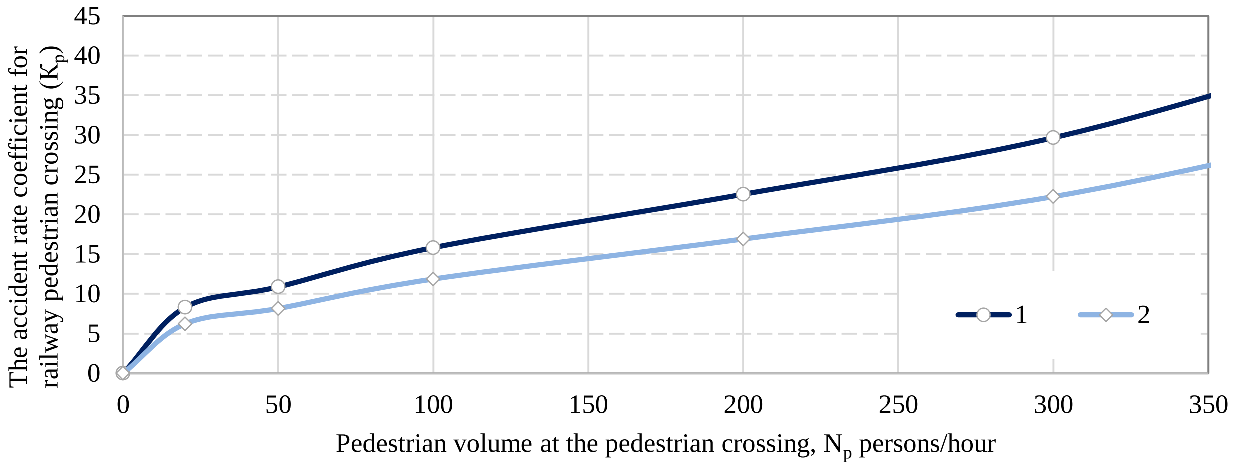

Fig. 4. Dependence of the accident rate coefficient at a railway pedestrian crossing considering pedestrian volume: 1 – railway crossing without a pedestrian warning information system; 2 – railway crossing with a pedestrian warning information system.

As shown in Fig. 4, the implementation of a pedestrian warning information system leads to a reduction in the accident rate at railway pedestrian crossings. With a pedestrian volume of 20 persons/hour, the accident rate coefficient without the warning system is K_p=8.3, while with the warning system it is K_p=6.22. At 50 persons/hour, the accident rates are K_p =10.9 and K_p =8.15, and at 100 persons/hour, the values are K_p =15.82 and K_p=11.9, respectively.

Furthermore, Fig. 5 shows that the accident rate tends to increase slightly as pedestrian volume approaches 75 persons/hour. In this case, the values are K_p = 13.35 without the system and K_p =10.1 with it. A pedestrian volume greater than 75 persons/hour leads to a more significant increase in the accident rate, posing a greater risk to pedestrian safety.

Increasing pedestrian volume also results in a growing difference between the accident rate values with and without the pedestrian warning system, as illustrated in Fig. 5.

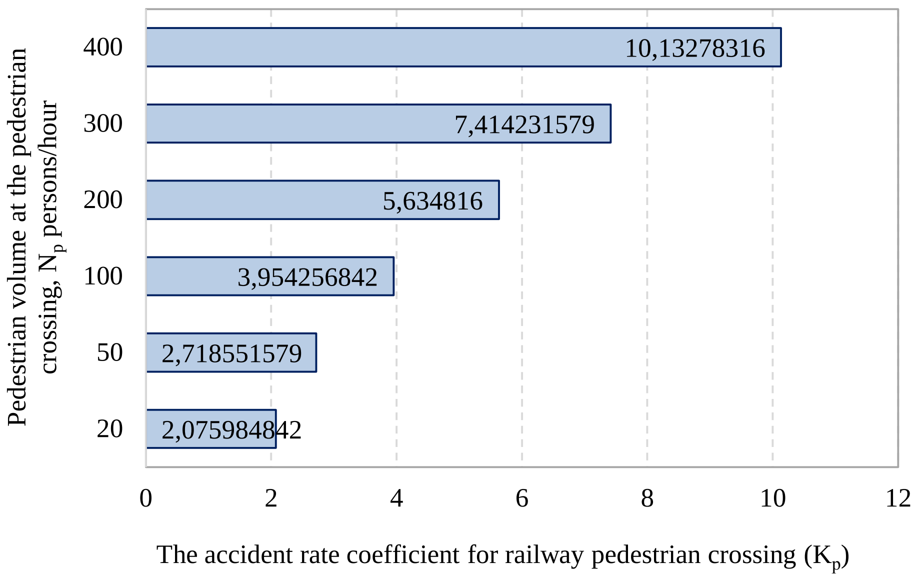

Fig. 5. Difference in accident rate coefficients at railway pedestrian crossings with and without the implementation of a pedestrian train-approach warning information system, depending on pedestrian traffic intensity

With a pedestrian volume of 20 persons/hour across railway tracks, the difference in accident rate coefficients is K_p =2.08; at 50 persons/hour it is K_p =2.72; and at 100 persons/hour the difference reaches K_p =3.95. This indicates the effectiveness of implementing a pedestrian warning information system at railway crossings with pedestrian traffic, as the accident rate coefficient decreases when such a system is used to warn pedestrians of approaching trains. The average reduction in the accident rate coefficient at railway pedestrian crossings due to implementing a warning information system is 5.32.

The results of the accident rate coefficient calculations for railway pedestrian crossings, depending on the number of trains per day and the pedestrian volume, emphasize the effectiveness of using a pedestrian warning information system to notify pedestrians of approaching rolling stock. This, in turn, contributes to increased pedestrian traffic safety.

5. CONCLUSIONS AND RESEARCH PERSPECTIVES

Based on the improved comprehensive methodology for evaluating the accident rate coefficient at railway pedestrian crossings, the following conclusions have been made:

1. The improved methodology enables a comprehensive evaluation of accident rate coefficients at pedestrian railway crossings, taking into account the number of trains per day, hourly pedestrian volume, technical equipment and information systems, pedestrian speed, and geometric characteristics of the railway crossing (plan and profile), among other factors. A key feature of applying the accident rate coefficient is the ability to assess the safety level at railway pedestrian

crossings in the absence of statistical data on transport incidents, which is particularly important when analyzing new projects or evaluating the effectiveness of infrastructure modernization.

2. The results of multivariable calculations of the accident rate coefficient at railway pedestrian crossings within railway level crossings, depending on the number of daily trains, showed that the accident rate coefficient decreases with a pedestrian warning information system. With 10 trains/day, K_p=6.8 without the system, and K_p=5.1 with it. With 20 trains per day, K_p =10.9 and K_p =8.15, respectively. With 30 trains/day, K_p=13.6 and K_p=10.2, respectively. The average reduction in the accident rate coefficient at railway pedestrian crossings within railway level crossings after implementing the information system is 3.41.
3. The results of multivariable calculations of the accident rate coefficient depending on pedestrian volumes showed that equipping railway pedestrian crossings with a warning information system reduces the accident rate. At 20 persons/hour, K_p =8.3 without the system, and K_p =6.22 with it. At 50 persons/hour, K_p=10.9 and K_p=8.15, respectively. At 100 persons/hour, K_p=15.82 and K_p=11.9, respectively.

It was also found that the accident rate shows a slight increasing trend with pedestrian volume up to 75 persons/hour: K_p=13.35 without the system, and K_p =10.1 with the system in place.

The average reduction in the accident rate coefficient at railway pedestrian crossings within railway level crossings, depending on pedestrian volumes, due to implementing the warning information system, is 5.32.

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ОЦІНЮВАННЯ КОЕФІЦІЄНТА АВАРІЙНОСТІ ПРИ ПЕРЕТИНІ ПІШОХОДАМИ ЗАЛІЗНИЧНИХ КОЛІЙ

Анотація. *Об'єктом досліджень є залізничні пішохідні переходи, які являють собою спеціально облаштований пішохідний перехід на перетині залізничних колій, призначений для безпечного пересування пішоходів через залізничну інфраструктуру, зокрема за межами залізничного переїзду. У результаті аналізу статистичних досліджень встановлено, що за три квартали 2024 р. відсоток травматизму та аварій зі сторонніми особами, спричинених рухомим складом залізничного транспорту, який переміщався, підвищився на 12,7 % проти 2023 р. Розглянуто методи та моделі прогнозування аварійності на залізничних переїздах, які використовують у світовій та українській практиці. Удосконалено методику розрахунку коефіцієнта аварійності під час перетину залізничних колій пішоходами на залізничних пішохідних переходах, як у межах залізничних переїздів, так і поза їх межами. Це дало змогу виконати оцінювання коефіцієнта аварійності із пішоходами на залізничному пішохідному переході із урахуванням кількості поїздів за добу, інтенсивності пішохідних потоків на годину, технічного облаштування та інформаційного забезпечення залізничного пішохідного переходу. Крім цього, запропонована методика дає змогу врахувати швидкість пішохода, план і профіль переходу. Здійснено порівняння коефіцієнта аварійності з пішоходами під час перетину залізничних колій у межах наявних переїздів із застосуванням та без застосування інформаційної системи попередження пішоходів про наближення поїзда. У результаті встановлено, що впровадження інформаційної системи дає змогу зменшити коефіцієнт аварійності на залізничних пішохідних переходах. Середнє значення зменшення коефіцієнта аварійності на залізничних пішохідних переходах у межах наявних залізничних переїздів із застосуванням інформаційної системи попередження пішохода про рух поїзда, залежно від кількості поїздів на добу, становить 3,4, а залежно від інтенсивності руху пішоходів за сталої кількості поїздів – 5,32. Також встановлено, що збільшення кількості поїздів призводить до зростання різниці між значеннями коефіцієнтів аварійності, отриманими за наявності та за відсутності інформаційної системи попередження. Значення коефіцієнта аварійності має незначну тенденцію до підвищення за інтенсивності руху пішоходів до 75 осіб/год. У цьому випадку значення коефіцієнта аварійності становить 13,35 без інформаційної системи та 10,1 із застосуванням інформаційної системи. Багатоваріантні розрахунки коефіцієнта аварійності на залізничному пішохідному переході показали, що на безпеку руху найбільше впливає інтенсивність руху пішоходів. Це необхідно враховувати під час проєктування сучасних залізничних пішохідних переходів, особливо в урбанізованих просторах, з метою забезпечення безпеки руху пішоходів.*

Ключові слова: *залізничний пішохідний перехід, залізничний переїзд, безпека руху, пішохід, коефіцієнт аварійності.*