Accidents in Building Engineering in the European Union Countries in the Years 2008 - 2014

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Abstract. According to the ESAW ¹, an accident at work is an event that results in physical or mental harm to the person doing the work. As a result of this incident, fatal accidents may occur (which in the course of one year lead to death of the victim) or non-fatal accidents (that imply at least four full calendar days of absence from work). In the paper the authors present the number and the analysis of the causes of accidents at work in the construction industry in the years 2008 - 2014 in 28 countries of the European Union. The descriptive statistics method was used to achieve the intended goal. The accident rate indicator for individual European Union countries has been shown in the analyzed period. The structure and trends of accidents during the period under investigation, divided into two groups: fatal accidents and non-fatal accidents, were presented. Both groups were analyzed for what caused them and what factors affected the quantity (Age of the victim, work experience, month of occurrence). On the basis of the analyzed causes and factors causing accidents in the construction industry in years 2008 - 2014, the classification of EU countries has been shown in terms of accidents. The paper was concluded with a summary.

1. Introduction

The aim of the article is to present the problem of accidents in the construction industry in 28 European Union countries. The analysis was conducted for accidents that occurred in the years 2008-2014. The structure and trend of accidents during the analyzed period, divided by fatal accidents and non-fatal accidents, were presented. In both groups of cases, the cause of their occurrence was analyzed and the factors influencing their number (age of the victim, job seniority, month of occurrence). On the basis of the analyzed causes and factors causing accidents in the construction industry in 2008-2014, the classification of the EU Member States has been shown in terms of accidents. The objective was achieved using the descriptive statistics method.

¹ European Statistics on Accidents at Work.
2. Accidents in 2008–2014
Construction has been seen for many years as one with significant levels of occupational risk [1,2,3,5,6]. The number of accidents is shown in Table 1.

Table 1. Number of accidents\(^2\) at work in 2008-2014.

| Specification: | Year                  |
|---------------|-----------------------|
|               | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  |
| a) accidents in overall economy | 3,856,434 | 3,534,240 | 3,586,077 | 3,418,876 | 3,169,332 | 3,131,220 | 3,180,379 |
| b) accidents in construction | 627,571   | 549,813  | 505,581  | 480,826  | 419,283  | 379,033  | 370,579  |
| Belgium       | a)  | 76,610 | 66,483 | 67,337 | 65,108 | 58,467 | 56,471 | 65,639 |
|               | b)  | 12,740 | 11,486 | 10,996 | 11,193 | 9,895  | 9,185  | 8,555  |
| Bulgaria      | a)  | 3,188  | 2,572  | 2,423  | 2,351  | 2,376  | 2,251  | 2,363  |
|               | b)  | 423    | 337    | 258    | 275    | 245    | 220    | 244    |
| Czech Republic| a)  | 99,652 | 66,516 | 65,230 | 57,685 | 57,808 | 55,970 | 54,195 |
|               | b)  | 7,721  | 6,034  | 5,593  | 5,385  | 3,056  | 3,150  | 2,784  |
| Denmark       | a)  | 71,335 | 61,423 | 62,564 | 57,685 | 57,808 | 55,970 | 54,195 |
|               | b)  | 8,908  | 7,088  | 6,841  | 6,791  | 7,058  | 6,640  | 6,471  |
| Germany       | a)  | 944,615 | 861,286 | 931,014 | 887,356 | 855,18  | 852,505 | 847,870 |
|               | b)  | 125,881 | 127,744 | 112,295 | 125,418 | 117,006 | 105,132 | 114,594 |
| Estonia       | a)  | 7,249  | 5,032  | 5,573  | 5,944  | 5,861  | 6,195  | 6,304  |
|               | b)  | 2,094  | 935    | 1,033  | 1,074  | 1,074  | 878    | 847    |
| Ireland       | a)  | 18,129 | 11,430 | 19,336 | 16,797 | 15,327 | 18,089 | 18,162 |
|               | b)  | 3,180  | 736    | 2,480  | 2,408  | 1,408  | 942    | 1,282  |
| Greece        | a)  | 24,275 | 19,910 | 15,493 | 13,527 | 11,109 | 9,698  | 3,438  |
|               | b)  | 6,001  | 4,332  | 3,407  | 2,455  | 1,665  | 1,352  | 423    |
| Spain         | a)  | 689,660 | 535,846 | 494,127 | 445,827 | 356,110 | 370,446 | 387,719 |
|               | b)  | 162,332 | 104,322 | 85,613  | 69,053  | 44,960  | 37,623  | 38,322  |
| France        | a)  | 637,646 | 590,551 | 593,529 | 612,356 | 587,666 | 567,960 | 725,251 |
|               | b)  | 109,479 | 102,453 | 98,155  | 98,888  | 92,268  | 86,211  | 83,062  |
| Croatia       | a)  | :      | :      | 11,938  | 13,606  | 11,207  | 11,738  | 11,695  |
|               | b)  | :      | :      | 1,295   | 1,372   | 719     | 1,016   | 951     |
| Italy         | a)  | 504,211 | 448,219 | 438,539 | 406,509 | 359,967 | 329,921 | 313,834 |
|               | b)  | 78,339 | 67,472  | 59,803  | 50,507  | 39,975  | 37,863  | 33,110  |
| Cyprus        | a)  | 2,367  | 2,227  | 2,184  | 2,010  | 1,741  | 1,538  | 1,618  |
|               | b)  | 649    | 562    | 539    | 418    | 328    | 250    | 185    |
| Latvia        | a)  | 1,748  | 1,187  | 1,220  | 1,387  | 1,541  | 1,738  | 1,766  |
|               | b)  | 226    | 119    | 102    | 137    | 174    | 157    | 151    |
| Lithuania     | a)  | 3,235  | 2,068  | 2,316  | 2,676  | 2,866  | 3,101  | 3,175  |
|               | b)  | 601    | 266    | 285    | 371    | 363    | 357    | 366    |
| Luxembourg    | a)  | 8,143  | 6,884  | 6,998  | 7,142  | 7,177  | 7,061  | 7,193  |
|               | b)  | 2,650  | 2,187  | 2,235  | 2,364  | 2,432  | 2,238  | 2,342  |

\(^2\) An accident is considered as an event resulting in a 4 - day absence.
It is clear from Table 1 that in the years 2008-2014, the European Union experienced a greater decline in construction work accidents than the overall economy. The drop was 40.95% for the construction industry and 17.53% for the economy. Only in Sweden and Switzerland in the analyzed period was the increase in accidents at work for the whole economy and for the construction industry. The increase was:
- for overall economy:
  a) Sweden 3.48 %,
  b) Switzerland 17.21%,
- for construction:

### Table 1 continued.

| Country   | a)   | b)   | c)   | d)   | e)   | f)   | g)   | h)   | i)   | j)   |
|-----------|------|------|------|------|------|------|------|------|------|------|
| Hungary   | 22.454 | 18.664 | 20.085 | 17.384 | 20.542 | 19.854 | 19.572 |
| Malta     | 1.338  | 1.132 | 1.066 | 0.870 | 0.986 | 0.813 | 0.784 |
| Poland    | 3.216  | 2.756 | 2.754 | 2.460 | 2.536 | 2.605 | 2.636 |
| Austria   | 20.085 | 16.797 | 13.864 | 11.947 | 10.477 | 7.145 |
| Portugal  | 96.838 | 79.952 | 86.271 | 88.145 | 87.095 | 77.616 | 76.537 |
| Finland   | 147.570 | 135.315 | 130.475 | 126.104 | 113.348 | 102.329 | 130.313 |
| Sweden    | 20.213 | 17.155 | 16.391 | 15.001 | 14.319 | 12.557 | 12.339 |
| Germany   | 3.185  | 2.709 | 2.315 | 1.869 | 1.666 | 1.411 | 1.457 |
| Finland   | 9.216  | 9.216 | 9.174 | 8.826 | 8.536 | 8.796 | 8.592 |
| Norway    | 5.056  | 4.369 | 4.130 | 3.516 | 3.557 | 3.722 | 3.668 |
| Switzerland | 3.826 | 3.469 | 3.276 | 2.946 | 2.746 | 2.574 | 2.496 |

Source: The authors’ study based on published data [4].
a) Sweden 33.02 %,
b) Switzerland 21.48 %.

The decrease or increase in accidents at construction work in 2014 in comparison with 2008 is shown in Figure 1.

| Country      | Decrease/Increase |
|--------------|-------------------|
| Sweden       | -33.02 %          |
| Switzerland  | -21.48 %          |

The large decrease in work-related accidents in construction in the European Union countries has been caused by a significant reduction in accidents in 12 countries, which amounted to more than 50%.

* Data for 2010-2014
** Data for 2009-2014
*** Data for 2008-2013

Figure 1. Decrease/increase in occupational accidents in construction in 2014 compared to 2008, Source: The authors’ study based on published data [4].
The share of construction in accidents at work in relation to the total accident presents in each European Union country is presented in Table 2.

**Table 2. The share of construction accidents at work, in relation to the total number of accidents in 2008 – 2014.**

| Specific          | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|-------------------|------|------|------|------|------|------|------|
| European Union    | 16.27| 15.56| 14.10| 14.06| 13.23| 12.10| 11.65|
| Belgium           | 16.18| 17.28| 16.33| 17.20| 17.08| 16.27| 13.04|
| Bulgaria          | 13.27| 13.11| 10.65| 11.70| 10.32| 9.78 | 10.33|
| Czech Republic    | 7.75 | 9.08 | 8.58 | 7.94 | 7.38 | 7.13 | 6.57 |
| Denmark           | 12.49| 11.54| 10.94| 11.78| 12.21| 11.87| 11.94|
| Germany           | 13.33| 14.84| 12.07| 14.14| 13.69| 12.34| 13.52|
| Estonia           | 28.89| 18.59| 18.54| 18.07| 18.33| 14.18| 13.44|
| Ireland           | 17.54| 6.44 | 12.83| 14.34| 9.19 | 5.21 | 7.06 |
| Greece            | 24.72| 21.76| 21.99| 18.15| 14.99| 13.99| 12.31|
| Spain             | 23.54| 19.47| 17.33| 15.49| 12.63| 10.16| 9.89 |
| France            | 17.17| 17.35| 16.54| 16.15| 15.70| 15.18| 11.46|
| Croatia           | 15.54| 15.06| 13.64| 12.43| 11.11| 11.48| 10.55|
| Cyprus            | 27.42| 25.24| 24.68| 20.80| 18.84| 16.26| 11.44|
| Latvia            | 12.93| 10.03| 8.36 | 9.88 | 11.30| 9.04 | 8.55 |
| Lithuania         | 18.58| 12.87| 12.31| 13.87| 12.67| 11.52| 11.53|
| Luxembourg        | 32.54| 31.77| 31.94| 33.10| 33.89| 31.70| 32.56|
| Hungary           | 5.96 | 6.07 | 5.31 | 5.00 | 4.80 | 4.20 | 4.01 |
| Malta             | 17.48| 18.29| 19.57| 18.94| 17.51| 15.12| 17.49|
| Netherlands       | 9.78 | 5.96 | 9.17 | 6.53 | 11.10| 6.88 | 8.12 |
| Austria           | 19.98| 19.86| 16.36| 17.93| 18.51| 18.50| 18.07|
| Poland            | 10.46| 10.42| 10.08| 10.04| 9.14 | 8.14 | 7.73 |
| Portugal          | 5.67 | 5.96 | 5.31 | 5.00 | 4.80 | 4.20 | 4.01 |
| Romania           | 17.64| 16.91| 13.48| 14.25| 12.99| 12.28| 13.33|
| Slovenia          | 15.76| 15.79| 14.12| 12.46| 11.63| 11.24| 11.81|
| Slovakia          | 8.00 | 8.09 | 7.18 | 6.13 | 5.99 | 5.32 | 5.19 |
| Finland           | 16.88| 16.57| 16.55| 15.20| 16.68| 15.79| 13.33|
| Sweden            | 8.97 | 9.24 | 9.51 | 9.68 | 9.29 | 9.59 | 11.64|
| United Kingdom    | 17.16| 12.17| 11.24| 11.72| 10.01| 9.88 | 10.17|
| Great Britain     | 10.18| :    | :    | :    | :    | :    | :    |
| Iceland           | 12.16| 11.74| 12.08| 12.38| 12.20| 12.09| 13.55|
| Norway            | 23.53| 23.35| 23.45| 23.53| 23.09| 24.14| 24.39|

Source: The authors’ study based on published data [4].

Table 2 shows that in the years 2008-2014 the share of construction in occupational accidents in relation to the number of accidents in the entire economy of the European Union countries tends to decrease (Figure 2). Not applicable to the following countries: Germany, Luxembourg, Malta, Sweden, Norway, Switzerland. In these countries in 2014, the share of construction in occupational
accidents increased in relation to the economy as a whole. Compared to 2008, the largest drop in the share of construction in occupational accidents in the whole economy in 2014 occurred in Ireland, Cyprus, Spain. The largest increase in the year of 2014 compared to 2008 was the increase in the share of construction in accidents Sweden reported.

**Figure 2.** Decrease / increase in 2014, compared to 2008, share of construction in accidents at work.

Source: The authors’ based on published data [4].

The structure of accidents at work in construction in 2008-2014 is presented in table 3. In 28 EU countries in the years 2008-2014, the share of fatal accidents in all cases at work in construction has a slight upward trend. The share of fatalities in 2014, compared to 2008, increased by 5.00%.
Table 3. The structure of accidents at work in construction in 2008-2014.

| Specification | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---------------|------|------|------|------|------|------|------|
| a) fatal accidents | b) non-fatal accidents | % share per year |
| **European Union** | | | | | | | |
| Belgium a) | 0.20 | 0.21 | 0.21 | 0.20 | 0.21 | 0.21 | 0.21 |
| b) | 99.80 | 99.79 | 99.79 | 99.80 | 99.79 | 99.79 | 99.79 |
| Bulgaria a) | 0.19 | 0.18 | 0.20 | 0.17 | 0.14 | 0.22 | 0.14 |
| b) | 99.81 | 99.82 | 99.80 | 99.83 | 99.86 | 99.78 | 99.86 |
| Czech Republic a) | 12.29 | 8.61 | 10.47 | 6.91 | 6.53 | 9.09 | 9.02 |
| b) | 87.71 | 91.39 | 89.53 | 93.09 | 93.47 | 90.91 | 90.98 |
| Denmark a) | 0.74 | 0.31 | 0.48 | 0.86 | 0.72 | 0.86 | 1.01 |
| b) | 99.26 | 99.69 | 99.52 | 99.14 | 99.28 | 99.14 | 98.99 |
| Germany a) | 0.10 | 0.07 | 0.08 | 0.09 | 0.08 | 0.08 | 0.09 |
| b) | 99.90 | 99.93 | 99.92 | 99.91 | 99.92 | 99.02 | 99.91 |
| Estonia a) | 0.29 | 0.53 | 0.39 | 0.37 | 0.28 | 0.68 | 0.59 |
| b) | 99.71 | 99.47 | 99.61 | 99.63 | 99.72 | 99.32 | 99.41 |
| Ireland a) | 0.41 | 1.22 | 0.20 | 0.21 | 0.50 | 1.06 | 1.65 |
| b) | 99.59 | 98.78 | 99.80 | 99.79 | 99.50 | 98.94 | 98.35 |
| Greece a) | 0.43 | 0.42 | 0.38 | 0.65 | 0.66 | 0.59 | 1.65 |
| b) | 99.57 | 99.58 | 99.62 | 99.35 | 99.34 | 99.41 | 98.35 |
| Spain a) | 0.11 | 0.12 | 0.12 | 0.15 | 0.15 | 0.15 | 0.15 |
| b) | 99.89 | 99.88 | 99.88 | 99.85 | 99.85 | 99.85 | 99.85 |
| France a) | 0.07 | 0.13 | 0.12 | 0.13 | 0.13 | 0.15 | 0.15 |
| b) | 99.93 | 99.87 | 99.88 | 99.87 | 99.87 | 99.85 | 99.85 |
| Croatia a) | : | : | : | 1.08 | 1.09 | 2.50 | 0.79 |
| b) | : | : | : | 99.92 | 99.91 | 96.20 | 99.21 |
| Italy a) | 0.23 | 0.27 | 0.31 | 0.28 | 0.28 | 0.27 | 0.32 |
| b) | 99.77 | 99.73 | 99.69 | 99.72 | 99.72 | 99.73 | 99.68 |
| Cyprus a) | 0.77 | 0.36 | 1.67 | 0.24 | 0.61 | 1.60 | 0.54 |
| b) | 99.23 | 99.64 | 98.33 | 99.76 | 99.39 | 98.40 | 99.46 |
| Latvia a) | 5.31 | 5.88 | 4.90 | 7.30 | 6.32 | 1.91 | 3.31 |
| b) | 94.69 | 94.12 | 95.10 | 92.70 | 93.68 | 98.09 | 96.69 |
| Lithuania a) | 3.49 | 4.14 | 2.11 | 3.50 | 4.41 | 4.76 | 3.28 |
| b) | 96.51 | 95.86 | 97.89 | 96.50 | 95.59 | 95.24 | 96.72 |
| Luxembourg a) | 0 | 0.18 | 0.09 | 0.08 | 0.08 | 0.04 | 0.09 |
| b) | 100.00 | 99.82 | 99.91 | 99.92 | 99.92 | 99.96 | 99.91 |
| Hungary a) | 3.06 | 2.65 | 2.44 | 2.07 | 1.83 | 2.21 | 2.42 |
| b) | 96.94 | 97.35 | 97.56 | 97.93 | 98.17 | 97.79 | 97.58 |
| Malta a) | 0.18 | 0.40 | 0.37 | 0 | 1.35 | 0.25 | 0.22 |
| b) | 99.82 | 99.60 | 99.63 | 100.00 | 98.75 | 99.75 | 99.78 |
| Netherlands a) | 0.22 | 0.23 | 0.09 | 0.07 | 0.04 | 0.07 | 0.07 |
| b) | 99.78 | 99.77 | 99.91 | 99.93 | 99.96 | 99.93 | 99.93 |
| Austria a) | 0.19 | 0.31 | 0.16 | 0.08 | 0.25 | 0.20 | 0.13 |
| b) | 99.81 | 99.69 | 99.84 | 99.92 | 99.75 | 99.80 | 99.87 |
Table 3 continued.

| Country            | a)  | b)  | c)  | d)  | e)  | f)  | g)  | h)  | i)  |
|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Poland             | 1.23| 98.77 | 1.31| 98.69 | 1.12| 98.88 | 1.03| 98.97 | 0.93|
| Romania            | 15.25| 84.75 | 17.18| 82.82 | 11.78| 88.22 | 14.07| 85.93 | 12.25|
| Slovenia           | 0.28| 99.72 | 0.52| 99.48 | 0.27| 99.73 | 0.42| 99.58 | 0.35|
| Slovakia           | 1.92| 98.08 | 0.46| 99.54 | 0.55| 99.45 | 2.54| 97.46 | 1.50|
| Finland            | 0.06| 99.94 | 0.09| 99.91 | 0.05| 99.89 | 0.11| 99.95 | 0.05|
| Sweden             | 0.55| 99.45 | 0.18| 99.82 | 0.18| 99.82 | 0.19| 99.81 | 0.21|
| United Kingdom     | 0.11| 99.89 | 0.18| 99.82 | 0.18| 99.82 | 0.19| 99.81 | 0.21|
| Great Britain      | 0.13| 99.87 | 0.34| 99.82 | 0.18| 99.82 | 0.36| 99.91 | 0.80|
| Iceland            | :   | :    | :   | :    | :   | :    | :   | :    | :   |
| Norway             | 0.12| 99.88 | 0.06| 99.82 | 0.11| 99.82 | 0.06| 99.82 | 0.09|
| Switzerland        | 0.16| 99.84 | 0.11| 99.89 | 0.10| 99.90 | 0.11| 99.91 | 0.10|

Source: The authors’ based on published data [4].

This has led to an increase in the share of fatal accidents in 11 EU countries. In 2014, the increase in the proportion of fatal accidents in all cases at work in construction compared to 2008 was recorded in:

- Norway 566.67 %.
- Ireland 302.44 %.
- Greece 283.72 %.
- France 114.29 %.
- Estonia 103.45 %.
- United Kingdom 81.82 %.
- Slovenia 71.43 %.
- Italy 39.13 %.
- Czech Republic 36.49 %.
- Spain 36.36 %.
- Malta 22.22 %.

The largest share of fatal accidents in the years 2008-2014 in all construction work cases was recorded in Romania and the smallest in Germany.

The number of fatal and non-fatal accidents in 2008-2014, according to the size of the construction company in the 28 EU countries, is shown in Figure 3.
Figure 3. Fatal and non-fatal accidents in 2008-2014 in construction companies. Source: The authors’ based on published data [4].

Most fatal and non-fatal accidents in the years 2008-2014 occurred in construction companies employing 1-9 and 10-49 employees. They accounted for 67.84% of all fatalities and 73.66% of all non-fatal accidents in the years 2008-2014. The most fatal accidents occurred in Italy (501 accidents) in companies employing 1 to 9 employees. In the case of non-fatal accidents, most accidents at work in construction occurred in Germany (312,272 accidents) in companies employing 10-49 employees.

An important indicator in the assessment of the number of accidents at work is the rate of accidents. The accident rate for construction in 2008-2014 is shown in figure 4.

Figure 4. Accident rate and average employment in construction in 2008-2014. Source: The authors’ based on published data [4].
Figure 4 shows clearly that the number of employees in construction has no significant impact on accident rates. Attention should be paid to the fact that the accident rate is highest in these European Union countries where migration has occurred.

3. Conclusions

An analysis of accidents in construction in 28 EU countries, 2008-2014, allows the following conclusions to be drawn:

1) In the analyzed period there was a greater decrease in accidents at construction work than in the whole economy. Only Sweden and Switzerland recorded an increase in accidents at work both in construction and in the economy as a whole.

2) The share of construction in occupational accidents tends to decrease in all accidents that occurred in the economy of the European Union.

3) In 2014 there was a 5.00% increase in the share of fatalities in all accidents compared to 2008.

4) Most fatal accidents occurred in companies employing 1-9 employees and non-fatal accidents in companies employing 10-49 employees.

5) Size of employment on construction companies had no impact on accident rates.

References

[1] Błazik-Borowa E., Czarnocki K., Dąbrowski A., Hola B., Misztela A., Obolewicz J., Walusiak-Skorupa J., Smolarz A., Szer J., Szóstak M., 2015, Safety at work in the building industry, Lublin University of Technology, Lublin (in Polish).

[2] Drozd W., 2017, Identifying and profiling the patterns of construction accidents using affinity analysis, Technical Journal 5/2017 Civil Engineering, DOI: 10.4467/2353737XCT.17.065.6422.

[3] Drozd W., Kowalik M., Decision trees algorithm in the analysis of the construction site accidents, Scientific Review – Engineering and Environmental Sciences (2017), 26 (2), 226–233, DOI 10.22630/PNIKS.2017.26.2.21 (in Polish).

[4] EUROSTAT http://ec.europa.eu/eurostat/web/main/home.

[5] Haslama R.A., Hidea S.A., Gibbb A.G.F., Gyia D.E., Pavitt T., Atkinson S., Duff A.R., 2005. Contributing factors in construction accidents, Applied Ergonomics 36, 401–415.

[6] López M. A. C., Ritzel D. O., Fontaneda I., Alcantara O. J. G., 2008, Construction industry accidents in Spain, Journal of Safety Research 39 (2008) 497–507.