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OVERVIEW OF OCCUPATIONAL ACCIDENTS IN BRAZILIAN CIVIL CONSTRUCTION: ANALYSIS OF INDICATORS AND STATISTICS

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Abstract

Civil construction employs millions of professionals and moves a significant part of the economy. However, it still records numbers of accidents, high indicators of the number of days of absence and lethality rate. Therefore, it is important to understand the behavior of accidents at work to identify as the most critical classes and to take actions to improve statistics. This study analyzed the statistics of occupational accidents in construction in the 2009-2018 decade, explaining as the main causes of the variations in the number of accidents, in addition to analyzing thoroughly how statistics and indicators in the 2016-2018 three-year period, listing the behavior of the sector's subdivisions within the number of accidents matrix and identifying a lethality rate and the impact of priority classes. From the study of the decade, there was a strong relationship between the number of accidents, the number of people in the sector and the economic moment, with no clear improvement in worker health and safety. Based on the analysis of the triennium, it was found that only 4 classes (construction of buildings, works for the generation and distribution of electricity and for telecommunications, incorporation of real estate projects and construction of highways and railways) accounted for more than 60% of accidents, highlighting the importance of being effectively monitored.

Keywords: Occupational accident. Construction. Statistics. Indicators.

1. Introduction

All types of work have risks associated with their execution, but with the development of production systems, especially after the emergence of factories and the inclusion of steam engines during the Industrial Revolution, in the eighteenth century, there was an increase in the risks to which workers were exposed, which led to the creation of the first regulations regarding the health and safety of workers (COELHO, 2016). Globally, the concern with the prevention of occupational accidents was reflected in the creation of the International Labor Organization (ILO) in 1919, which is responsible for the creation and application of international labor standards, in addition to providing statistics on accidents (ILO, 2020).

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The construction industry is one of the industries with the highest risk of serious accidents worldwide (KINES et al., 2010). In economically advanced countries, the probability of construction workers suffering fatal accidents is three to four times higher than in other industries, while in less developed countries the rate is three to six times higher (ILO, 2014). Thus, safety in the workplace remains one of the biggest challenges in this sector (GAO, GONZALEZ, YIU, 2020; LEE et al., 2020).

In Brazil, the concern with the safety of workers became greater after the approval of the Consolidation of Labor Laws (CLT), in 1943, through Decree-Law No. 5452, which in its Chapter V deals with occupational safety and medicine (COELHO, 2016). This chapter was amended in 1977 by Law No. 6514, which culminated in 1978, through Ordinance No. 3214, in the approval of the Regulatory Standards (NRs) referring to occupational safety and medicine. Even so, Brazil has a lot to advance with regard to worker health and safety, since every 49 seconds a new work accident occurs and a death is recorded every 3 hours and 43 minutes (SMARTLAB, 2020).

The National Institute of Social Security (INSS) has spent more than 98 billion reais on leaves generated by work accidents since 2012, which is equivalent to an average of 11 million reais spent per year (SMARTLAB, 2020). Among all the sectors considered in the count of these accidents, civil construction is one of those that concentrates a significant portion, being the 6th sector that caused the most accidents with 5.13% of the total, estimated from raw data from the Statistical Yearbook of Occupational Accidents (AEAT) 2018, second only to the sectors: Manufacturing Industries; Trade, Repair of Motor Vehicles and Motorcycles; Human Health and Social Services; Transportation, Storage and Mailing; Administrative Activities and Complementary Services (BRASIL, 2018).

Civil construction remains a sector with a high accident rate (ANDERSEN et al., 2018; LIANG, LEUNG, AHMED, 2020), whose severity, in many cases, leads to the death of the worker, which contributes to the high lethality rate.

In 2018, the total fatality rate of occupational accidents in Brazil, estimated from AEAT 2018 data, was 3.52 deaths per thousand accidents that occurred, while civil construction was the second sector with the highest fatality rate that year, with 8.88 deaths per thousand accidents, behind only the agriculture sector (9.51). a data that demonstrates the importance of analyzing and understanding the behavior of accidents over the years in this sector (BRASIL, 2018). The AEAT, published since 2000, was created to assist in the dissemination of statistical information on occupational accidents, consequently, it allows the supervision of fluctuations and trends in historical behaviors, supporting the planning of actions not only at the national level, but also at the municipal level of economic activities based on accidents and their aspects such as, incidence, lethality and quantity (BRASIL, 2016). Statistical yearbooks are important tools, however, as they cover all sectors of the Brazilian economy, they only present raw data from all classes, and there is a need for a more detailed analysis of the sector of interest, given the large number of accidents and the high lethality rate of the sector when compared to national averages, in addition to the absence of studies in the literature that carry out this type of investigation.

In view of the above, the objective of the present study is to carry out an analysis of the number of occupational accidents in Brazilian civil construction between the years 2009 and 2018, considering their different types, in addition to evaluating in a more in-depth way the last three years, exploring the classes that make up the accidents, as well as their indicators, in order to contribute to preventive decision-making against accidents.

2. Methodology

2.1. Analysis of accident statistics in the decade 2009-2018

For the analysis of the panorama of construction-related accidents, the last ten AEATs, from 2009 to 2018, made available by the Special Secretariat for Social Security and Labor (SEPT), were gathered. It is worth noting that the AEAT made available annually also presents the updated data from the two previous years, with the most recent ones being adopted for the present research (BRASIL, 2018). In each AEAT report, data belonging to the construction-related classes were selected, presented in Table 1. For each class, information was gathered regarding the number of typical accidents with Occupational Accident Communication (CAT), commuting accidents with CAT, occupational diseases with CAT and accidents without CAT, for the reference years. Typical accidents are linked to the characteristics of the professional activity performed, commuting accidents are those resulting from the commute between the workplace and the insured person's home, and occupational diseases can be defined as those triggered or acquired as a result of the special conditions in which the work is performed or is directly related to it (BRASIL, 2018).

The data on annual work accidents, referring to the aforementioned classifications, are computed through the CAT, presented by the companies and registered by the INSS, with or without absence from work. However, the issuance of CAT does not always occur, and it is not registered directly with the INSS, resulting in accidents without CAT. This type of accident is identified through possible nexuses such as: technical nexus due to disease equivalent to an occupational accident, social security epidemiological technical nexus, and technical labor/professional nexus (BRASIL, 2018). After separation, the data were arranged in the form of a table, which summarizes the number of accidents from 2009 to 2018 and their composition.

Based on the statistics of occupational accidents in the last decade, an analysis of the behavior of the number of accidents was carried out year by year. Then, for a more detailed study of occupational accidents, an analysis of the indicators for the 2016, 2017 and 2018 triennium was carried out by class, which are presented in section 2.2. The selection of this period was justified by the fact that the most recent data were published and, in addition, by the presence of a smaller sample space that allowed a more detailed analysis of the data presented.

2.2. Breakdown of accident statistics and indicators, 2016-2018 triennium

Analysis focused on the statistics of the number of accidents, class by class of construction, of the last three years. However, it was noticed that of the 21 classes present, there were 9 classes that together represented approximately 85% of the total accidents year by year. Therefore, the analyses were directed to this group, and they are identified in bold in Table 1, the analysis of the other classes occurred in a punctual manner, when necessary. It is worth noting that the National Classification of Economic Activities (CNAE) is made up of 21 sections, composed of 86 divisions that bifurcate into several classes. Construction is one of these sections, represented by the letter "F", and is composed of divisions 41, 42 and 43: construction of buildings, infrastructure works and specialized services for construction, respectively (IBGE, 2020).

Table 1 - Classes of economic activities related to construction

Classes
41.10-7 Development of Real Estate Projects
41.20-4 Construction of buildings
42.11-1 Construction of Highways and Railways
42.12-0 Construction of Special Works of Art
42.13-8 Urbanization Works - Streets, Squares and Sidewalks
42.21-9 Works for the Generation and Distribution of Electric Power and for Telecommunications
42.22-7 Construction of Water Supply Networks, Sewage Collection and Related Constructions
42.23-5 Construction of Pipeline Transportation Networks, Except for Water and Sewage
42.91-0 Port, Maritime and River Works
42.92-8 Erection of industrial plants and steel structures
42.99-5 Civil Engineering WorksNot Previously Specified

43.11-8 Demolition and Preparation of Construction Sites
43.12-6 Drilling and Drilling
43.13-4 Earthworks
43.19-3 Ground Preparation Services Not Specified Above
43.21-5 Electrical Installations
43.22-3 Plumbing, Ventilation and Cooling Systems
43.29-1 Works of Facilities in Buildings Not Previously Specified
43.30-4 Finishing works
43.91-6 Foundation works
43.99-1 Specialized Services for Construction Not Specified Above

Source: CONCLA (Adapted).

Once the scope was defined, the data were filtered and compared class by class throughout the triennium, and the data were presented according to the numerical order of the 9 pre-listed classes.

The accident rates in the triennium analyzed were: incidence rate and lethality rate. The incidence rate of occupational accidents is represented by the ratio, times 1,000, between the number of new cases of registered and unregistered occupational accidents by the average annual number of links. This relationship makes up the most global and synthesized expression of risk, symbolizing the relationship between the circumstances of work and the average number of workers subject to those conditions (BRASIL, 2018). The case fatality rate is calculated by ratio, times 1,000, of the number of deaths resulting from occupational accidents to the number of registered and unrecorded occupational accidents. This reason expresses the possibility of the accident resulting in the death of the injured worker, and can be used as an indication of the severity of the accident (BRASIL, 2018). The process of acquisition and organization of these data followed the same protocol as the data presented in the previous item.

3. Results and discussion

Work accidents generate enormous losses to the INSS, from 2012 to 2018 alone, R$ 26,235,501,489 were spent on benefits from new concessions (SMARTLAB, 2020), in addition to causing both physical and psychological human suffering. Thus, the analysis of accidents is essential to prevent the recurrence of similar problems and to control the risk of this sector (HOLA, 2017; VASCONCELOS, 2015; ZHANG, 2019).

3.1. Occupational accidents for the decade 2009-2018

Between 2012 and 2018, there were 4,503,631 notifications of occupational accidents, of which 104,646 were attributed to the construction of buildings, being the fourth sector with the highest number of CAT in this period. In addition, in this period, 16,455 accidents ended in death in Brazil (SMARTLAB, 2020).

Civil construction is one of the sections that has a large participation in the Brazilian economy, its Gross Value Added at basic prices (GVApb) has significant amounts in contribution to the Gross Domestic Product at market price (GDPpm). In 2010, civil construction accounted for 6.3% of the total Brazilian GVApb, while in 2017, this value was 4.3% (CBIC, 2019). In addition to being a sector with great economic participation, the construction sector also has a high incidence of work accidents. The summary of the number of accidents in the last decade is presented in Table 2.

Table 2 - Overview of occupational accidents for the 2009-2018 decade

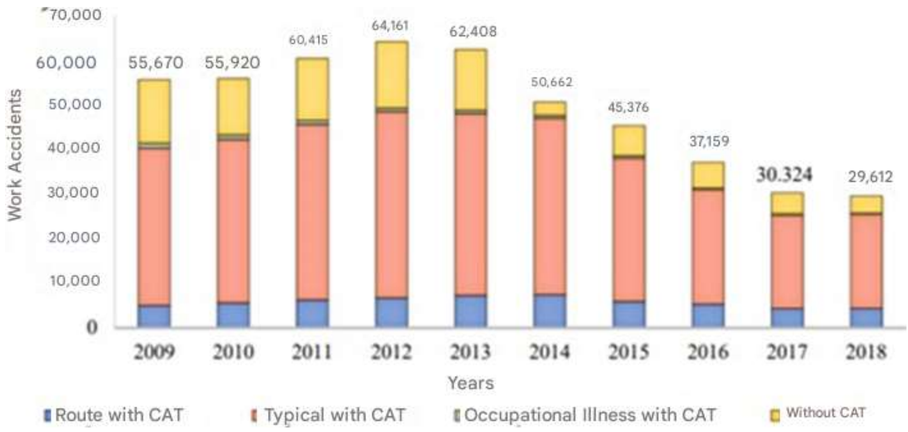
Year	Occupational Disease with CAT	Typical with CAT	Route with CAT	No CAT	**Total**
2009	1.111	35.265	5.042	14.252	55.670
2010	1.052	36.611	5.660	12.597	55.920
2011	931	39.282	6.335	13.867	60.415
2012	794	41.748	6.759	14.860	64.161
2013	800	40.694	7.324	13.590	62.408
2014	681	39.520	7.486	2.975	50.662
2015	567	32.118	5.962	6.729	45.376
2016	431	25.622	5.346	5.760	37.159
2017	346	20.895	4.399	4.684	30.324
2018	295	21.032	4.423	3.862	29.612

Source: BRAZIL 2009-2018 (Adapted).

Through the data in Table 2, it can be seen that the main cause of accidents are typical accidents with CAT and that there was an increase in the total number of accidents between 2009 and 2012, reaching the mark of 64,161 accidents, however, there was a sharp drop in the total number of accidents in 2014, followed by successive falls in the period from 2015 to 2018. For a better visualization of the contribution of each type of accident with CAT, as well as accidents without CAT, Figure 1 was constructed.

It can be seen that the main cause of the drop in the number of accidents in 2014 was accidents without CAT, which went from 13,590 in 2013 to 2,975 in 2014. It is possible to relate this drop to the launch of the National Strategy for the Reduction of Occupational Accidents 2015-2016, which aimed to expand actions by the Ministry of Labor and Employment (MTE), seeking to reduce occupational diseases and accidents (BRASIL, 2015). After the launch of the campaign, between January and March, 26,378 tax actions were carried out, with 16,545 notifications being applied, fining 25,902 companies and embargoing or interdicting 1,108 works (JUNIOR, 2015). These actions may have had repercussions on the number of accidents in 2014 and in the following years, even though they were instituted in 2015, since in the 2014 AEAT the number of accidents without CAT was 12,254 for the year 2014, while for the AEAT 2016 the accidents in 2014 were updated to 2,975, the value considered in this study.

Figure 1 - Statistics of occupational accidents for the decade 2009-2018

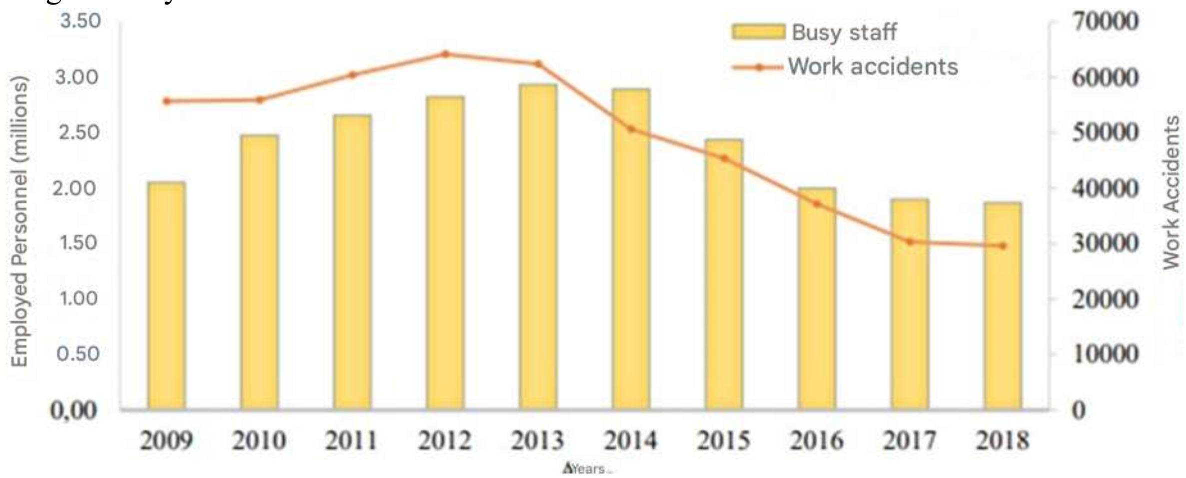


Source: BRAZIL 2009-2018 (Adapted).

Another point that should be related to the behavior of the number of occupational accidents in the period 2009-2018 is the country's economy. In 2009, the economy felt the impacts of the international crisis, however, it showed a good recovery in 2010, showing a growth of 7.5% in GDP pm (CBIC, 2019). In the following years, the economy went through a period of deceleration that only did not have a greater impact due to government interventions such as the conclusion of the Growth Acceleration Program (PAC) 1 and the implementation of PAC 2, reaching a contraction of 3.5% in 2015 (MATTOS, 2015; CBIC, 2019).

Since civil construction is one of the sectors directly linked to the country's economy, it is expected that the number of people involved in this sector will vary according to their performance and, as a consequence, the number of accidents as well. In this way, it is possible to draw a parallel between the number of people involved in the construction and the number of accidents in the 2009-2018 decade. To this end, it is possible to compare the number of annual accidents present in the AEAT with the Annual Survey of the Construction Industry (PAIC) year by year, which is shown in Figure 2. Through it, it is possible to perceive a similarity between the behavior of the number of accidents and the number of people working in the sector in most years. In 2012, for example, there was an increase of 6.3% in the number of persons employed in construction and the number of accidents increased proportionally (6.2%).

Figure 2 - Comparison between the number of accidents and the number of people working annually



Source: IBGE 2009-2018 (adapted).

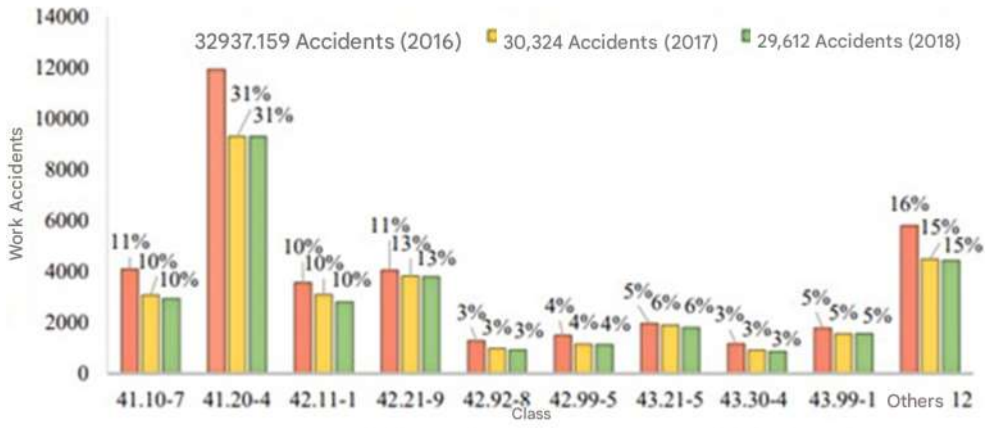
Thus, the growth in the number of accidents between 2009 and 2013 can be attributed to the annual increase in the number of people working in this sector, as a consequence of the growth of activities related to civil construction, driven by government measures, such as the investment of 278.2 billion reais in the Minha Casa Minha Vida program, part of PAC 2 (CUT, 2010). During this period, construction showed a growth rate of 7% in 2009, reaching its highest value, 13.1% in 2010 and showing a growth of 4.5% in 2013.

In the 2014-2019 period, the total number of accidents gradually dropped. This drop can be attributed to the launch of the National Strategy for the Reduction of Occupational Accidents 2015-2016, previously mentioned, and to the year-on-year reduction in the number of people working in the sector due to its deceleration in this period, which faced consecutive annual retractions, reaching a 10% retraction of GVA in 2016 and 9.2% in 2017 (BRASIL, 2015a). Thus, it can be seen that there has been a reduction in the global number of accidents in recent years, however, this sector has not necessarily become safer.

3.2. Occupational accidents and detailed indices for the 2016-2018 triennium

According to the AEAT 2017, there were 585,626 occupational accidents in Brazil in 2016, of which 37,159 accidents are related to the construction section, representing 6.35% of the total accidents that year. In 2018, there were 576,951 accidents, of which construction was responsible for 29,612 (5.13%) (BRASIL, 2018; BRAZIL, 2017). The number of accidents in the 2016-2018 triennium is represented in Figure 3, in which the data are arranged according to the classes of economic activities related to construction, with emphasis on the nine classes that contributed the most to the number of annual accidents.

Figure 3 - Occupational accidents by class and their percentage of annual incidence



Source: BRAZIL 2016-2018 (Adapted).

From Figure 3, it can be seen that the largest responsible for the number of accidents in construction was class 41.20-4, construction of buildings, with 11,917 accidents in 2016, 32% of the total for that year, 9,292 accidents in 2017 (31%) and 9,291 accidents in 2018 (31%). Although the number was reduced by 2,626 accidents from 2016 to 2017, the profile of the annual percentage participation of this class was almost unchanged. This behavior is repeated for the other classes, showing that the reduction in the number of accidents from 37,159 in 2016 to 30,324 in 2017 occurred proportionally between the classes.

Other classes that had the greatest impact on the number of accidents in the 2016-2018 triennium were class 42.21-9 – Works for Generation and Distribution of Electricity and for Telecommunications –, with 4,052 accidents in 2016, 3,827 accidents in 2017 and 3,799 in 2018, followed by class 41.10-7 – Development of Real Estate Projects –, with

4,096 accidents in 2016, 3,082 accidents in 2017 and 2,947 accidents in 2018 and class 42.11-1 – Construction of Highways and Railways – with 3,570 accidents in 2016, 3,102 accidents in 2017 and 2,815 accidents in 2018. These four sectors, when added together, accounted for more than 60% of construction accidents annually, and therefore deserve greater attention. The complete values of the contributions of each class to the annual number of accidents in civil construction are expressed in Table 3.

The behavior of the total number of accidents in this period followed the relationship with the number of people working in the construction, shown in Figure 2. In 2016, there was a drop of 18.1% in the number of accidents in relation to the previous year, a value close to the number of employed persons, which was 18.0%. In 2018, there was a small reduction in the number of accidents, of 2.3%, this period also showed the smallest drop in the number of people working in construction, with a reduction of 1.7%, the lowest value since 2014 (BELANDI, 2020?). Thus, it is verified that there was no class that was responsible for the drop in the number of accidents in this period. The variation in the total number of accidents behaved in a very similar way to the number of employed persons and the contribution of each class practically did not vary between the years.

Table 3 - Statistics and indicators of construction accidents in the 2016, 2017 and 2018 triennium

Year	Class	Number of Accidents	Incidence*	Rate Lethality**
2016	41.10-7	4.096	**22,32**	6,84
2017	41.10-7	3.082	**20,55**	5,52
2018	41.10-7	2.947	**21,05**	5,09
2016	41.20-4	11.917	14,22	6,80
2017	41.20-4	9.292	13,48	6,78
2018	41.20-4	9.291	14,21	8,40
2016	42.11-1	3.570	**23,77**	**7,00**
2017	42.11-1	3.102	**22,50**	**12,25**
2018	42.11-1	2.815	**23,42**	**15,63**
2016	42.21-9	4.052	**23,57**	**8,14**
2017	42.21-9	3.827	**22,85**	**11,24**
2018	42.21-9	3.799	**22,00**	**8,69**
2016	42.92-8	1.291	14,38	6,20
2017	42.92-8	986	13,10	9,13
2018	42.92-8	929	12,85	6,46
2016	42.99-5	1.502	17,55	7,99
2017	42.99-5	1.156	15,55	6,92
2018	42.99-5	1.149	17,46	9,57
2016	43.21-5	1.971	13,43	11,16
2017	43.21-5	1.905	13,50	8,40
2018	43.21-5	1.805	12,33	7,76
2016	43.30-4	1.170	8,55	8,55
2017	43.30-4	923	8,29	6,50
2018	43.30-4	869	8,39	3,45
2016	43.99-1	1.794	12,60	**11,15**
2017	43.99-1	1.559	13,08	**7,70**
2018	43.99-1	1.571	12,43	**14,00**

*per 1,000 links, **per 1,000 accidents

Source: BRAZIL 2016-2018 (Adapted).

The construction, in addition to having a significant number of accidents, has more serious accidents. In 2016, according to raw data from the AEAT 2018 tables, 284 deaths were recorded, 12.41% of the total Brazilian deaths due to accidents, with a lethality rate of 7.26, approximately double the Brazilian average. In 2018, there were 263 deaths in construction with a case fatality rate of 8.8 (BRASIL, 2018). Thus, it is important to understand which sections and classes have a greater impact on the total number of accidents, to pay greater attention to the most critical classes in order to improve the scenario of Brazilian accidents. Table 3 presents the scenario of accident statistics and indicators in the period from 2016 to 2018.

According to Table 3, the three classes with the highest incidence of accidents in the three-year period under analysis were classes 42.11-1 – Construction of Highways and Railways –, reaching a value of 23.77 per 1,000 contracts in 2016, from a total of 3,570 accidents, followed by class 42.21-9 – Works for Generation and Distribution of Electricity and for Telecommunications –, with an incidence of 23.57 in 2016 and 4,052 accidents and class 41.10-7 – Development of Real Estate Developments –, reaching values of 22.32 in 2016 with 4,096 accidents in that year. The construction of buildings, class 41.20-4, was the one with the highest number of accidents, reaching 11,917 in 2016, but its incidence was 14.2 in that year, a value lower than some classes due to the greater number of links. The average Brazilian incidence in 2016 was 14.26 (BRASIL, 2017). The other classes, not presented in Table 2, do not have incidence values higher than those mentioned above. From the incidence of the number of accidents, it is possible to make comparisons between the classes and understand which of them deserve greater attention, such as, for example, the three presented above.

The three classes with the highest lethality in the last three years were class 42.11-1 – Construction of Highways and Railways –, with a maximum value of 15.63 deaths per thousand accidents in 2018 and an average rate of 35 deaths annually, followed by class 43.99-1 – Specialized Services for Construction Not Previously Specified –, with a lethality of 14, in 2018, and an annual average of 18 deaths and class 42.21-9 – Works for Generation and Distribution of Electricity and for Telecommunications –, with a maximum lethality rate of 11.24 in 2017 and an average of 36 deaths annually. It is worth noting that the class with the highest average number of deaths annually was class 41.20-4, construction of buildings, with an average of 74 deaths in the 2016-2018 triennium, but its lethality rate is lower due to the higher number of accidents in this class (BRASIL, 2018).

Another point that deserves to be highlighted is that the highest lethality rates are not found among the 9 classes presented in Table 3, since the lethality rate is the result of the ratio, times thousand, between the number of deaths and the number of accidents. There are classes that have a less expressive number of deaths, but also have a reduced number of accidents, resulting in greater reasons, such as, for example, class 43.11-8, demolition and preparation of construction sites, which recorded 2 deaths in 2017 out of a total of 41 accidents, resulting in a lethality rate of 48.78 (BRASIL, 2018). Therefore, a careful analysis of lethality must be made, not only taking into account its absolute value.

4. Conclusions

The number of occupational accidents is closely linked to the number of workers involved in construction and to the country's economy, since the number of accidents followed annual variations similar to the number of persons involved in the sector, and the number of employed persons was influenced by the economic period. Thus, the idea that the construction sector has been showing decreases in the number of annual accidents should be rethought, because even though there has been an improvement in accident prevention, its main cause is still linked to the number of workers involved.

It can also be inferred that the classes that make up the largest sources of annual accidents in construction were: 41.10-7 – Development of Real Estate Projects; 41.20-4 – Construction of Buildings; 42.11-1 – Construction of Highways and Railways; 42.21-9 – Works for the Generation and Distribution of Electric Energy and for Telecommunications and 43.99-1 – Specialized Services for Construction Not Previously Specified, since they are the classes that presented the highest number of accidents, the highest incidence rate and a high lethality rate.

With the most critical classes delimited, it is necessary to take measures in order to mitigate the number of accidents and their severity, for example, strictly supervising the use of individual and collective protective equipment, following the guidelines of Regulatory Standard 18, which deals with safety and health conditions at work in the construction industry and launching accident prevention strategies such as training, seminars and meetings with workers. Informality and underreporting of the sector also need to be taken into account for a more accurate analysis of the problem, since this is a striking characteristic of construction, being a possible theme for future studies.

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