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Occupational accidents in Swedish construction trades

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The purpose of this study is to analyze accidents occurring in the Swedish construction industry, focusing specifically on the situation in the individual trades. The article includes all occupational accidents with at least 1 day of absence from work that were reported to the Swedish Social Insurance Agency for the year 2016. The results, focusing on accident cause, injured body parts as well as accidents per weekday, month and age, show that although the trades share commonalities regarding occupational accidents, a number of trade-specific problem areas stand out. With this in mind, conclusions are drawn regarding the situation in each respective trade and suggestions are made for future studies focusing on accidents in construction industry trades.

Keywords: construction industry; occupational accidents; occupational safety

1. Introduction

The construction industry is often regarded as one of the most hazardous industries worldwide when it comes to workers' safety. In Sweden, this is no exception, with construction typically ranking as one of the most accident-prone industries in the country [1]. While most of the international studies tend to focus on accidents occurring in the construction industry as a whole, a number of studies have investigated the safety situation in the specific trades that comprise the industry sector. For example, focusing on accidents related to falls from heights in the Danish construction industry, Kines [2] showed that the carpentry trade group had particularly high injury rates compared to other trades in the industry. Also focusing on carpenters, Gilkey et al. [3] identified this group as being extra exposed to risks resulting in lower back pain, with the work task 'standing walls' being particularly risky. Investigating 143 injury reports from the US construction industry, Choi [4] found that the four trade/occupational groups with the highest injury rates were laborers, carpenters, iron workers and operators. Choe and Leite [5] likewise found in their study of the US construction industry that different construction-related occupations had different hazard types as well as sources of injury. A conclusion was drawn that it is important to create an awareness of the specific nature of the various hazards and risks in relation to specific trades and related occupations.

In line with this, the purpose of the present study is to analyze accidents occurring in Swedish construction focusing specifically on the individual trades that comprise the industry. The article is organized in the following way: a

brief account is given of the overall structure and organization of the Swedish construction industry, followed by the methods and materials used. After this the results are presented, divided into five separate headings focusing on accidents with absence from work, injured body parts, accidents per weekday, accidents per month and, finally, accidents and the age of the injured parties. In the last section, a number of conclusions are drawn regarding the situation in the specific trades as well as the limitations of the present study.

2. The Swedish construction industry

The Swedish construction industry employed around 311,000 people in 2014, which corresponds to 6.6% of the total workforce in the country. Out of these, 59% were blue-collar workers while 20% were white-collar workers and 21% were self-employed [6]. Since the early 2000s, about 8% of the employees have been women but the proportion varies depending on the type of work. On the blue-collar side, women comprised approximately 1% in 2012 while the proportion was 30% in work requiring higher education. The proportion of foreign-born workers in the construction industry in 2014 amounted to 10.9%, which was slightly lower than the average in the Swedish labor market as a whole (15.3%). However, the proportion of foreigners increased 146% in the construction industry compared to 51% in the other industry sectors between 2005 and 2014, which indicates that the proportion of foreigners increases more rapidly in the construction industry compared to the other industry sectors (blue-collar and

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Table 1. Number employed in the construction industry 2016: trade and age.

Trade	Age group (years)									Total
	16–17	18–19	20–24	25–34	35–44	45–54	55–59	60–64	≥65	
Construction and civil engineering	368	3346	18,102	46,417	41,270	43,205	16,876	13,643	8287	191,514
Sheet-metal roof covering	37	188	868	1860	1337	1667	646	462	395	7460
Electrical installation	50	1211	6217	10,974	8489	9370	3358	3059	1866	44,594
Ventilation	27	129	927	2351	2090	2498	962	788	364	10,136
Plumbing	43	565	2818	5784	4856	5908	2291	1791	1072	25,128
Painting	33	411	2066	4250	3947	4663	1827	1544	1136	19,887
Glazing	6	25	208	536	580	687	270	195	178	2685
Machine contracting	4	75	322	940	849	1064	442	422	440	4558
Other	77	509	3215	9340	9140	8622	3127	2325	1849	38,204
Total	645	6459	34,743	82,452	72,558	77,684	29,799	24,229	15,587	344,166

white-collar workers alike). Additionally, some 3000 foreign nationals employed by foreign companies regularly conduct work in Sweden, i.e., another 1% [6].

In 2014, there were 96,700 companies active in the industry, which corresponds to 8% of the total number of companies in the country. A large proportion of these (88%) were small companies with a maximum of four employees working extensively with rebuilding and repairs, often as subcontractors in projects led by larger construction companies. Traditionally, the major contractors have had their own expertise in, e.g., carpentry and masonry, but it has become more and more common that subcontractors are hired to conduct these tasks [7]. It is also not uncommon that long chains of subcontractors are formed in a given construction project, consisting of smaller companies or self-employed individuals.

In the construction industry one finds roughly two-thirds of the workforce in the span between 25 and 54 years of age (Table 1). The age groups below and above constitute roughly 10 and 20%, all with rather small variances within the different trades. Machine contracting workers seem to work a little longer in life compared to other trades, and in sheet-metal roof covering work there is a slightly higher percentage of young people (age 16–19 years) than in other trades. In the machine contracting business this can probably be explained by a lighter physical challenge in their work situation compared to the other trades.

3. Materials and methods

This article includes occupational accidents that have been reported to the Swedish Social Insurance Agency and covers all of the trades that comprise the Swedish construction industry. When an accident occurs, the employer in question sends a form to the agency's loading center, which scans and records certain information from the form before it is transmitted to the Swedish Work Environment

Authority (SWEA), i.e., the government agency responsible for health and safety-related matters in Swedish working life. It should also be noted that in the Swedish occupational injury statistics, a distinction is made between occupational accidents and occupational diseases.

The article covers all reported occupational accidents that resulted in at least 1 day's absence from work in 2016, regardless of whether the accident in question was approved for work injury compensation or not at a later examination. The data reported for each occupational injury contain details of the injured individual, his or her employer, the work situation, the extent of injury and underlying reasons for the accident occurring. It is important to note that foreign workers who are registered in their country of residence, and thus insured in their home country, are not included in the statistics collected for this article. Conversely, those Swedish workers who were injured while conducting work in another country are included in the statistics.

The concept of occupational injuries also includes road accidents, such as accidents when traveling to, from and between workplaces. Road accidents that occurred outside work hours on the way to or from work, however, are not included and are therefore not analyzed in this article.

In order to calculate incidence rates there must be data available on the number of employed individuals. These data are derived from Statistics Sweden's Register-Based Labor Market Statistics, which is an annual survey based on, among other things, employers' control data and the self-declarations of those who are self-employed. The incidence rate used in the present study is the number of accidents leading to at least 1 day of absence from work per 1000 employees.

The group classification in the statistics is based on the so-called SNI2007 code, which is based on the type of employment structure in the workplace. This amounts to eight separate trades as well as a group of unspecified 'others' in which those employees who cannot be directly

tied to a trade according to the classification system are grouped. The trades in question are as follows:

- Construction and civil engineering: 191,514 people were employed in the construction and civil engineering industry in 2016. This trade includes construction of buildings, roads, railways, bridges and tunnels. The trade also includes demolition and site preparation and all other occupational groups not specified in the other seven categories. The number of occupational accidents with at least 1 day of absence from work in 2016 was 2221.
- Sheet-metal roof covering: this trade employed 7460 people. The trade covers the manufacturing of roofing sheet metal details and assembly of such details. Other types of roofing work can be found in the construction and civil engineering group. The number of occupational accidents in sheet-metal roof covering work was a total of 117.
- Electrical installation: this trade employed 44,594 people. The trade covers electrical installation in buildings and industrial plants. The number of occupational accidents in electrical installation was 421.
- Heat and air-conditioning installation: 10,136 people worked with the installation of heat and air-conditioning devices, i.e., ventilation. The number of occupational accidents in ventilation was 111.
- Installation of heating and sanitary equipment: 25,128 people worked with the installation of heating and sanitary equipment, i.e., plumbing. The number of occupational accidents in plumbing was 252.
- Painting: 19,887 people were employed in painting work. The number of work accidents in painting was 156.
- Glazing: 2685 people worked with glazing-related tasks. The number of occupational accidents in glazing work was 35.
- Renting of construction or demolition equipment with an operator: 4558 people were employed in companies whose main business is the renting of construction or demolition equipment with an operator, i.e., machine contractors. The number of occupational accidents in machine contracting was 45.

4. Results

4.1. Occupational accidents in different trades

In this section, occupational accidents occurring in the year 2016 are presented and divided into headings covering the following areas: accident cause, injured body parts and accidents per weekday, month and age, respectively. Further, each subsection consists of two tables in which the occupational accidents are divided according to severity. The first table presents occupational accidents that had

been estimated to result in 1–14 days of absence and the second presents accidents that had been estimated to result in more than 14 days of absence.

4.1.1. Accidents with absence from work

A closer analysis of the trades shows that for construction and civil engineering the most common occupational accidents with 1–14 days of absence from work are *Loss of control of hand tool or equipment* and *Bodily movement with physical overload*. For sheet-metal roof covering work, the most common accidents are *Loss of control of hand tool or equipment* and *Fall from the same level* (Table 2).

The trades of electrical installation, ventilation and plumbing show the same pattern where *Loss of control of hand tool or equipment* is the most common cause.

For painting, *Loss of control of hand tool or equipment* is likewise common, but also *Fall from height* and *Bodily movement with physical overload* are overrepresented. Glazing is topped by *Loss of control of hand tool or equipment* and *Falling material/failure of material*, but here the number of employees is so small and the number of accidents so few that there is no statistical significance. Machine contracting is most affected by *Fall from height*, but *Loss of control of vehicle* is also overrepresented.

For the whole group, the most common occupational accidents, with 1–14 days of absence from work, is *Loss of control of hand tool or equipment* followed by *Bodily movement with physical overload*.

For work accidents with more than 14 days of absence, you get a different picture than for the shorter absence (Table 3). The most common causes of the occupational accidents are *Bodily movement with physical overload* and *Fall from height*. *Loss of control of hand tool or equipment* is still common for all trades and *Falling material/failure of material* are, although not most common, still prevalent for sheet-metal roof work and for ventilation. Within machine contracting, *Fall from the same level* is also prevalent.

4.1.2. Injured body parts

Overall, there are relatively few cases of injuries being sustained to the teeth or the hip. In those cases where injuries were sustained to the teeth, they occurred most commonly within the trade of plumbing. As for hip-related injuries, sheet-metal roof covering work has the highest rate (Table 4).

The most commonly injured body parts overall are hand/wrist, fingers, leg (including the knee) and foot/ankle/toe, as well as those being categorized as other, unclear or unspecified body parts. As for the first two categories taken together, hand-related injuries are most common within sheet-metal roof covering work followed by ventilation, plumbing and construction and civil engineering – all with more than 1 accident per 1000

Table 2. Occupational accidents: trade and deviation for 1–14 days of absence from work per 1000 employees.

Trade	Deviation														Total
	Electricity, fire, explosion	Leakage, emanation	Falling material/failure of material	Loss of control of machine	Loss of control of vehicle	Loss of control of hand tool or equipment	Loss of control of handled object	Loss of control, other	Fall from height	Fall from the same level	Bodily movement with no physical overload	Bodily movement with physical overload	Physical violence, assault, trauma	Other, unclear	
Construction and civil engineering	0.09	0.17	0.80	0.41	0.45	1.57	0.53	0.07	0.77	0.81	0.52	1.10	0.04	0.02	7.36
Sheet-metal roof covering	0.13	0.27	1.47	1.21	0.54	1.61	1.07	0.00	0.94	1.61	0.80	1.07	0.00	0.00	10.72
Electrical installation	0.52	0.31	0.63	0.11	0.34	1.35	0.49	0.11	0.85	0.43	0.70	0.78	0.07	0.02	6.70
Ventilation	0.39	0.59	0.49	0.10	0.10	1.18	0.99	0.39	0.49	0.79	0.79	0.89	0.00	0.00	7.20
Plumbing	0.12	0.08	0.92	0.16	0.08	1.83	0.64	0.12	0.56	0.44	0.80	1.07	0.00	0.00	6.81
Painting	0.10	0.05	0.35	0.05	0.10	1.36	0.20	0.05	1.16	0.45	0.35	0.80	0.10	0.00	5.13
Glazing	0.00	0.37	1.12	0.37	0.00	1.12	0.74	0.00	0.37	0.00	0.37	0.74	0.00	0.00	5.21
Machine contracting	0.00	0.00	0.66	0.00	1.32	0.44	0.88	0.22	1.54	0.22	0.22	0.22	0.00	0.00	5.70
Other	0.10	0.10	0.55	0.34	0.26	0.86	0.29	0.03	0.52	0.34	0.29	0.58	0.05	0.03	4.35
Total	0.16	0.18	0.74	0.33	0.37	1.44	0.52	0.08	0.76	0.67	0.53	0.96	0.04	0.02	6.80

Table 3. Occupational accidents: trade and deviation for more than 14 days of absence from work per 1000 employees.

Trade	Deviation														Total
	Electricity, fire, explosion	Leakage, emanation	Falling material/failure of material	Loss of control of machine	Loss of control of vehicle	Loss of control of hand tool or equipment	Loss of control of handled object	Loss of control, other	Fall from height	Fall from the same level	Bodily movement with no physical overload	Bodily movement with physical overload	Physical violence, assault, trauma	Other, unclear	
Construction and civil engineering	0.03	0.02	0.41	0.35	0.27	0.54	0.23	0.08	0.64	0.63	0.14	0.86	0.01	0.02	4.23
Sheet-metal roof covering	0.00	0.00	0.80	0.67	0.13	0.40	0.40	0.13	1.21	0.40	0.54	0.27	0.00	0.00	4.96
Electrical installation	0.04	0.00	0.27	0.04	0.07	0.20	0.07	0.04	0.65	0.47	0.18	0.67	0.02	0.00	2.74
Ventilation	0.00	0.00	0.69	0.10	0.10	0.30	0.20	0.00	1.09	0.39	0.49	0.39	0.00	0.00	3.75
Plumbing	0.16	0.12	0.16	0.20	0.16	0.44	0.16	0.00	0.36	0.52	0.28	0.60	0.00	0.08	3.22
Painting	0.00	0.05	0.25	0.15	0.15	0.25	0.10	0.00	0.65	0.45	0.00	0.65	0.00	0.00	2.72
Glazing	0.00	0.00	1.12	0.00	0.00	1.12	1.49	0.00	0.74	0.00	1.49	1.86	0.00	0.00	7.82
Machine contracting	0.00	0.00	0.44	0.00	0.44	0.22	0.22	0.00	0.66	1.10	0.66	0.44	0.00	0.00	4.17
Other	0.00	0.00	0.44	0.37	0.18	0.60	0.16	0.00	0.79	0.24	0.16	0.50	0.00	0.03	3.46
Total	0.03	0.02	0.39	0.28	0.21	0.47	0.20	0.06	0.66	0.54	0.18	0.74	0.01	0.02	3.82

employees in both categories. Leg-related injuries (including the foot and adjacent parts), in turn, occur frequently within machine contracting followed by construction and civil engineering and sheet-metal roof covering. Other body parts with lower but consistent rates in all of the trades are the back and the head.

Furthermore, sheet-metal roof covering work stands out in terms of having a markedly higher rate regarding head injuries, as well as having the highest rate regarding

injuries sustained to the whole body or multiple body parts. Plumbing and electrical installation have considerably higher rates regarding injuries to the eye (0.92 and 0.74, respectively) compared to the other trades.

Injuries leading to more than 14 days of absence from work are overall rarely sustained to the neck/throat, the eyes as well as the teeth or the hip (Table 5). Few injuries also involve the whole body or several separate body parts. The most commonly injured body parts across all of the

Table 4. Occupational accidents: trade and injured body part for 1–14 days of absence from work per 1000 employees.

Trade	Body part															Total
	Head	Eye	Teeth	Neck/throat	Back	Chest, abdomen, pelvis	Shoulder	Arm, including the elbow	Fingers	Hand/wrist	Hip	Leg, including the knee	Foot/ankle/toe	The whole body or multiple body parts	Other, unclear or unspecified body part	
Construction and civil engineering	0.35	0.44	0.13	0.22	0.67	0.21	0.19	0.30	1.03	1.04	0.06	0.80	0.79	0.18	0.93	7.36
Sheet-metal roof covering	0.67	0.40	0.00	0.00	0.54	0.13	0.54	0.40	2.28	2.01	0.27	0.94	0.54	0.54	1.47	10.72
Electrical installation	0.25	0.74	0.02	0.22	0.61	0.04	0.20	0.27	0.92	1.12	0.07	0.54	0.52	0.25	0.94	6.70
Ventilation	0.49	0.20	0.10	0.00	0.49	0.00	0.30	0.20	1.38	1.38	0.10	0.30	0.49	0.30	1.48	7.20
Plumbing	0.24	0.92	0.20	0.04	0.40	0.16	0.16	0.12	1.07	1.27	0.04	0.44	0.40	0.12	1.23	6.81
Painting	0.20	0.40	0.05	0.10	0.45	0.15	0.20	0.15	0.80	0.65	0.00	0.60	0.50	0.20	0.65	5.13
Glazing	0.37	0.00	0.00	0.00	0.37	0.00	0.00	0.37	1.49	0.37	0.00	0.37	0.74	0.00	1.12	5.21
Machine contracting	0.22	0.22	0.00	0.00	0.66	0.00	0.44	0.00	1.10	0.66	0.00	0.88	0.88	0.00	0.66	5.70
Other	0.37	0.13	0.03	0.08	0.29	0.03	0.10	0.13	0.86	0.76	0.08	0.29	0.39	0.21	0.60	4.35
Total	0.33	0.46	0.10	0.17	0.58	0.15	0.19	0.25	1.03	1.04	0.06	0.66	0.65	0.20	0.93	6.80

Table 5. Occupational accidents: trade and injured body part for more than 14 days of absence from work per 1000 employees.

Trade	Body part															Total
	Head	Eye	Teeth	Neck/throat	Back	Chest, abdomen, pelvis	Shoulder	Arm, including the elbow	Fingers	Hand/wrist	Hip	Leg, including the knee	Foot/ankle/toe	The whole body or multiple body parts	Other, unclear or unspecified body part	
Construction and civil engineering	0.08	0.07	0.01	0.09	0.42	0.11	0.23	0.29	0.64	0.74	0.03	0.49	0.42	0.07	0.56	4.23
Sheet-metal roof covering	0.27	0.00	0.00	0.13	0.40	0.27	0.13	0.40	0.94	1.07	0.00	0.80	0.13	0.13	0.27	4.96
Electrical installation	0.11	0.02	0.00	0.02	0.29	0.11	0.22	0.18	0.18	0.34	0.07	0.36	0.31	0.09	0.43	2.74
Ventilation	0.00	0.00	0.00	0.00	0.30	0.20	0.10	0.20	0.59	0.59	0.00	0.49	0.69	0.10	0.49	3.75
Plumbing	0.00	0.00	0.00	0.00	0.24	0.12	0.16	0.24	0.52	0.92	0.04	0.32	0.16	0.16	0.36	3.22
Painting	0.05	0.00	0.00	0.00	0.20	0.05	0.05	0.25	0.45	0.30	0.00	0.65	0.20	0.00	0.50	2.72
Glazing	0.00	0.00	0.00	0.00	0.37	0.37	0.37	0.00	1.12	2.61	0.00	0.74	0.74	0.00	1.49	7.82
Machine contracting	0.22	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.44	0.44	0.00	0.88	1.32	0.00	0.66	4.17
Other	0.16	0.00	0.00	0.05	0.16	0.08	0.10	0.26	0.63	0.79	0.03	0.24	0.34	0.18	0.44	3.46
Total	0.09	0.04	0.00	0.06	0.34	0.11	0.19	0.26	0.56	0.69	0.03	0.46	0.38	0.09	0.51	3.82

trades are the same as for shorter absence, i.e., hand/wrist, fingers, leg (including the knee), foot/ankle/toe or those recorded as other, unclear or unspecified body part. Glazing has the highest combined rate regarding hand-related injuries including the fingers. In connection to this, electrical installation stands out in the sense that it has a comparably lower rate of serious injuries connected to the fingers in contrast to the rest of the trades.

Machine contracting has a comparably high rate connected to the foot/ankle/toe as well as to the leg or knee.

Taken together, machine contracting is consequently a high-risk trade when it comes to serious injuries sustained to the lower body.

4.1.3. Accidents per weekday

As expected, few accidents occurred during Saturdays and Sundays due to most construction work being done during Monday through Friday, i.e., during a standard working week. Overall, there are a higher number of accidents

Table 6. Occupational accidents: trade and weekday for 1–14 days of absence from work per 1000 employees.

Trade	Weekday							Total
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	
Construction and civil engineering	1.56	1.62	1.57	1.55	0.94	0.07	0.06	7.36
Sheet-metal roof covering	1.74	2.28	2.68	2.41	1.47	0.13	0.00	10.72
Electrical installation	1.39	1.77	1.39	1.23	0.78	0.09	0.04	6.70
Ventilation	1.48	2.17	1.28	1.09	1.09	0.10	0.00	7.20
Plumbing	1.51	1.51	1.43	1.31	1.03	0.00	0.00	6.81
Painting	1.36	1.01	0.75	1.16	0.85	0.00	0.00	5.13
Glazing	0.74	0.74	2.23	0.74	0.74	0.00	0.00	5.21
Machine contracting	1.76	0.66	1.10	1.10	1.10	0.00	0.00	5.70
Other	0.97	0.92	0.65	0.86	0.86	0.05	0.03	4.35
Total	1.45	1.53	1.40	1.38	0.93	0.06	0.04	6.80

Table 7. Occupational accidents: trade and weekday for more than 14 days of absence from work per 1000 employees.

Trade	Weekday							Total
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	
Construction and civil engineering	0.85	0.93	0.84	0.89	0.60	0.05	0.08	4.23
Sheet-metal roof covering	1.21	1.74	0.27	1.07	0.67	0.00	0.00	4.96
Electrical installation	0.58	0.56	0.52	0.67	0.34	0.00	0.07	2.74
Ventilation	0.59	0.69	0.79	1.18	0.49	0.00	0.00	3.75
Plumbing	0.72	0.68	0.68	0.76	0.24	0.12	0.04	3.22
Painting	0.65	0.70	0.35	0.50	0.45	0.05	0.00	2.72
Glazing	1.12	1.49	1.49	1.49	1.86	0.37	0.00	7.82
Machine contracting	0.66	0.66	1.97	0.00	0.66	0.22	0.00	4.17
Other	0.65	0.79	0.76	0.63	0.44	0.10	0.08	3.46
Total	0.77	0.85	0.75	0.80	0.52	0.06	0.07	3.82

occurring between Monday and Thursday followed by a decline on Fridays. Machine contracting, painting and other have their highest rates on Mondays while accidents in electrical installation, construction and civil engineering and ventilation peak on Tuesdays. Tuesday is also the day with the highest rate (1.53) overall. The accident rates of sheet-metal roof covering work and glazing are highest on Wednesdays, while plumbing has its highest accident rates on Mondays and Tuesdays. None of the trades' accident rates peak on Thursdays (Table 6).

A possible reason for the bigger decline of accidents on Fridays is that it is becoming more common in the construction industry to work longer hours from Monday to Thursday in order to have Friday off. It is therefore possible that fewer people work on Fridays, but the material does not show whether this is the case.

Accidents resulting in at least 14 days of absence from work follow the same pattern, with higher rates during the beginning of the workweek, a decline on Fridays and very low accident rates during weekends (Table 7). Glazing, with a rate of 1.86 on Fridays, stands out since the accident rate is lower during the rest of the week. One reason for this may be that glaziers work when other trades do not. It is difficult to interpret since glazing is a small group.

Sheet-metal roof covering work also stands out because their accident rate is at its lowest on Wednesdays with a rate of 0.27, compared to 1.21 and 1.74 on Mondays and Tuesdays.

In contrast to accidents with short absence, where no trade had their highest accident rates on Thursdays, electrical installation, ventilation and plumbing have their highest accident rates on Thursdays when it comes to accidents with at least 14 days absence from work.

Roof-sheet metal covering work has the highest rate in short-term accidents (10.72) and glazing has the highest rate in accidents with longer absence (7.82), which implies that the severity of the injuries differ in different trades.

4.1.4. Accidents per month

The overall rate was lowest in January, July (i.e., vacation time in Sweden) and December, which may be explained by the fact that the number of hours worked during these months is likely to be lower than in the rest of the year. During September and November, the rate is the highest (Table 8).

The trade with the highest spread of rates over the year is glazing, with no accidents at all in a number of months

Table 8. Occupational accidents: trade and month for 1–14 days of absence from work per 1000 employees.

Trade	Month												Total
	January	February	March	April	May	June	July	August	September	October	November	December	
Construction and civil engineering	0.46	0.70	0.58	0.72	0.55	0.58	0.32	0.62	0.78	0.73	0.85	0.45	7.36
Sheet-metal roof covering	0.94	0.94	0.40	0.54	0.13	0.40	0.67	1.47	1.61	1.21	1.21	1.21	10.72
Electrical installation	0.58	0.65	0.70	0.70	0.49	0.52	0.38	0.47	0.70	0.52	0.63	0.38	6.70
Ventilation	0.39	0.69	0.49	0.30	0.49	1.18	0.00	0.79	0.39	0.69	1.18	0.59	7.20
Plumbing	0.56	0.76	0.40	0.60	0.72	0.44	0.20	0.88	0.48	0.52	0.64	0.64	6.81
Painting	0.45	0.15	0.40	0.30	0.55	0.60	0.20	0.35	0.65	0.55	0.50	0.40	5.13
Glazing	0.37	0.00	0.37	0.74	0.74	0.37	0.00	0.74	1.86	0.00	0.00	0.00	5.21
Machine contracting	0.44	1.10	0.22	0.44	0.00	0.66	0.66	0.22	0.66	0.66	0.22	0.44	5.70
Other	0.47	0.52	0.26	0.50	0.29	0.31	0.21	0.42	0.58	0.34	0.31	0.13	4.35
Total	0.49	0.65	0.53	0.64	0.51	0.55	0.30	0.60	0.73	0.64	0.73	0.44	6.80

but 1.86 accidents per 1000 employees in September. It is worth noting that the number of employees is small in this trade and individual accidents therefore have a major impact on the statistics. Other trades with a high spread of rate over the year are sheet-metal roof covering, ventilation and machine contracting.

The trades with the most evenly spread rates over the year are electrical installation and painting.

In relation to the other trades, sheet-metal roof covering and machine contracting stand out with relatively high rates in July.

Work accidents with more than 14 days absence are more evenly spread over the year than accidents with shorter absence (Table 9). July is the month with lowest rate and November the month with the highest rate. However, there are a lot of differences between the different trades. The highest rate is found for glazing in March and October at 1.12 accidents per 1000 employees, followed by machine contracting with a rate of 1.10 in October and sheet-metal roof covering with a rate of 0.94 in April. Four of the trades show no accidents at all with more than 14 days absence for at least one of the months.

Glazing and machine contracting are the trades with highest spread in rates over the year. Sheet-metal roof covering also shows a relatively high variation in rates, with a peak in April and no accidents with more than 14 days absence in October. For construction and civil engineering the rate is quite evenly spread over the year.

4.1.5. Accidents and age

Regarding accidents per 1000 employees there are significantly low numbers among the elderly workers above age 65 years. The highest numbers of accidents are found among young adults (age 16–24 years). It can be said that the numbers in general decrease with age, except for a rather small increase among the groups of age 55–64 years. In connection with this it is important to note that the group of age 16–24 years is a very small group (2%) of the total group of workers. Two trades that stand out are sheet-metal roof covering and construction and civil engineering, which have the highest numbers of accidents in many of the age groups. High numbers are found in both middle-age and elderly workers. Trades with rather low numbers are painting, glazing, machine contracting and those categorized as other (Table 10).

When it comes to accidents leading to more than 14 days of absence from work there is a more even distribution among both trades and age than in the case of short-term absence (Table 11). There are not the same significantly high numbers among young age groups, but there are among elderly workers above 65 years of age. Sheet-metal roof covering and glazing stand out slightly in the high proportion of accidents compared to other trades. Regarding low numbers, electric installation, ventilation,

Table 9. Occupational accidents: trade and month for more than 14 days of absence from work per 1000 employees.

Trade	Month												Total
	January	February	March	April	May	June	July	August	September	October	November	December	
Construction and civil engineering	0.30	0.36	0.23	0.36	0.45	0.37	0.29	0.28	0.40	0.39	0.45	0.37	4.23
Sheet-metal roof covering	0.67	0.54	0.13	0.94	0.54	0.67	0.67	0.13	0.27	0.00	0.13	0.27	4.96
Electrical installation	0.20	0.25	0.29	0.29	0.22	0.11	0.07	0.25	0.36	0.20	0.31	0.18	2.74
Ventilation	0.30	0.39	0.30	0.30	0.20	0.30	0.49	0.10	0.30	0.39	0.49	0.20	3.75
Plumbing	0.24	0.24	0.24	0.44	0.28	0.20	0.16	0.32	0.12	0.44	0.40	0.16	3.22
Painting	0.20	0.40	0.30	0.20	0.30	0.00	0.20	0.40	0.25	0.20	0.15	0.10	2.72
Glazing	0.74	0.74	1.12	0.74	0.00	0.37	0.74	0.37	0.74	1.12	0.74	0.37	7.82
Machine contracting	0.44	0.00	0.22	0.22	0.00	0.44	0.44	0.22	0.00	1.10	0.22	0.88	4.17
Other	0.21	0.42	0.37	0.42	0.34	0.24	0.08	0.16	0.31	0.34	0.31	0.26	3.46
Total	0.28	0.35	0.26	0.36	0.37	0.29	0.24	0.26	0.35	0.36	0.39	0.30	3.82

plumbing and painting have relatively low numbers compared to other trades. In both the youngest (age 16–19 years) and the oldest (age >65 years) age groups there are several trades that do not have any accidents at all which lead to 14 days or more of absence from work.

5. Conclusions

5.1. Specific trades

Although many of the trades share commonalities when it comes to occupational accidents and the broader factors surrounding them, a number of problem areas stand out that ought to be a focus in future studies of trade-specific safety considerations in the Swedish construction industry.

5.1.1. Construction and civil engineering

Construction and civil engineering is the trade with the highest number of employees investigated in this study. Moreover, the trade is characterized by a wide range of tasks such as construction of buildings, roads and railways as well as demolition and site preparation. The most common causes of accidents with 1–14 days of absence from work are *Loss of control of hand tool or equipment* and *Bodily movement with physical overload*.

5.1.2. Sheet-metal roof covering

Sheet-metal roof covering work is one of the trades in this study standing out as particularly accident prone, with the highest accident rates resulting in short-term absence (10.72), compared to the other trades. The trade also has the highest accident rate among young adults (age 20–24 years). Along with machine contracting, the trade of sheet-metal roof covering work has a relatively high accident rate in July. *Loss of control of hand tool or equipment* and *Fall from the same level* are the most common causes of accidents, but when it comes to long-term absence *Fall from height* is the most common. The trade also has the highest accident rates for hip-related injuries and a markedly higher rate regarding head injuries, as well as having the highest rates regarding injuries sustained to the whole body or multiple body parts.

5.1.3. Electrical installation

Electrical installation has a relatively even spread of accidents over the year and comparably low accident rates. For example, the trade has a comparably lower rate of serious injuries connected to the fingers in contrast to the rest when it comes to longer absence. The most common causes of accidents are *Fall from height* and *Loss of control of hand tool or equipment*. However, electrical installation stands out along with plumbing for higher accident rates regarding the eyes.

Table 10. Occupational accidents: trade and age for 1–14 days of absence from work per 1000 employees.

Trade	Age group (years)								Total
	16–19	20–24	25–34	35–44	45–54	55–59	60–64	≥65	
Construction and civil engineering	12.39	13.31	8.60	5.69	5.79	7.70	7.48	0.84	7.36
Sheet-metal roof covering	13.33	23.04	11.83	7.48	9.00	7.74	8.66	2.53	10.72
Electrical installation	8.72	10.94	8.29	5.89	4.59	7.44	3.27	0.54	6.70
Ventilation	0.00	10.79	9.78	5.74	5.20	9.36	6.35	2.75	7.20
Plumbing	11.51	10.29	8.13	7.41	4.06	7.42	6.14	0.00	6.81
Painting	11.26	6.78	7.53	4.56	5.36	2.19	2.59	0.00	5.13
Glazing	0.00	9.62	7.46	8.62	1.46	7.41	0.00	0.00	5.21
Machine contracting	0.00	18.63	6.38	2.36	5.64	6.79	4.74	2.27	5.70
Other	5.12	6.22	5.57	4.38	3.60	2.88	3.87	1.08	4.35
Total	15.04	11.80	8.20	5.62	5.25	6.85	6.07	0.83	6.80

Table 11. Occupational accidents: trade and age for more than 14 days of absence from work per 1000 employees.

Trade	Age group (years)								Total
	16–19	20–24	25–34	35–44	45–54	55–59	60–64	≥65	
Construction and civil engineering	4.04	5.69	3.81	3.44	4.84	5.10	4.76	1.69	4.23
Sheet-metal roof covering	0.00	8.06	3.76	5.24	5.40	4.64	8.66	0.00	4.96
Electrical installation	1.59	2.09	3.01	2.24	2.24	4.17	5.56	1.61	2.74
Ventilation	0.00	1.08	3.83	4.31	3.60	4.16	5.08	5.49	3.75
Plumbing	1.64	2.48	3.98	2.47	4.06	3.93	1.68	1.87	3.22
Painting	0.00	1.45	2.12	3.29	3.65	2.74	4.53	0.00	2.72
Glazing	0.00	4.81	9.33	12.07	4.37	7.41	15.38	0.00	7.82
Machine contracting	0.00	6.21	4.26	4.71	5.64	4.52	2.37	0.00	4.17
Other	8.53	3.73	2.25	3.61	3.83	5.12	3.87	1.62	3.46
Total	3.53	4.29	3.49	3.39	4.26	4.73	4.66	1.54	3.82

5.1.4. Heat and air-conditioning installation

The most common cause of accidents resulting in short-term absence in ventilation is *Loss of control of hand tool or equipment*. When it comes to longer absence, *Fall from height* is a common cause of accidents. The trade of ventilation stands out with considerably higher accident rates with longer absence regarding elderly workers above age 65 years compared to the other trades.

5.1.5. Installation of heating and sanitary equipment

In the trade of plumbing, the most common cause of accidents is *Loss of control of hand tool or equipment*. However, injuries sustained to the teeth occur more commonly within this trade than others. Plumbing also has the highest accident rate regarding injuries sustained to the eyes.

5.1.6. Painting

Together with glazing and other, the trade of painting has comparatively low accident rates overall. For painting, *Loss of control of hand tool or equipment* is most common, but also *Fall from height* and *Bodily movement with physical overload* are overrepresented.

5.1.7. Glazing

The trade of glazing stands out as the most accident prone when it comes to accidents with longer absence (7.82), compared to all other trades. Glazier workers stand out with significantly higher accident rates within the age group of age 60–64 years regarding longer absence compared to other trades. However, the trade also stands out since their accident rate is higher on Fridays, with a rate of 1.86, and lower during the rest of the week compared to the other trades, where the pattern of serious accidents is the opposite. The most common causes of accidents resulting in absence are *Loss of control of hand tool or equipment* and *Falling material/failure of material*. When it comes to longer absence, glazier work has the highest rate regarding hand-related injuries including the fingers.

5.1.8. Renting of construction or demolition equipment with an operator

This trade (together with sheet-metal roof covering work) stands out with a relatively high accident rate in July when it is vacation time in Sweden. The most common causes of accidents are *Fall from height* and *Loss of control of vehicle*. Machine contracting stands out with *Fall from the same level* being a common cause of accident when it

comes to longer absence. Overall, machine contracting is a high-risk trade when it comes to serious injuries sustained to the lower body. Such injuries include legs (including the foot and adjacent parts), foot/ankle/toe as well as knee.

5.2. Concluding remarks


The Swedish construction industry is developing in the direction that larger companies are increasingly focusing on hiring employees at management levels while craftsmen, to a higher extent, are employed in small companies. When it comes to severe injuries, workers employed in small companies are more exposed compared to workers employed in large companies [8]. One reason for this might be that large companies have better routines and systems for introducing new employees in health and safety training compared to small companies [9]. Further, in small companies the owner most often is responsible for all matters, and health and safety can in that regard be considered less important compared to other issues [10]. In addition, small companies are often specialized in certain areas, e.g., sanitation, which entails that they work with other tasks and therefore face other risks compared to employees in large companies. Taken together, since it has been shown that employees in small construction companies are more exposed to occupational risks and also exposed to other risks compared to employees in larger companies [see, e.g., 10,11], it is particularly important to keep following the development of accident rates in different trades in the industry. The importance of focusing on the specific conditions that are prevalent in different trades and occupational groups has also received support in studies made in the Danish [e.g., 2] and US [e.g., 3,4] construction industries. However, for further studies, an accumulation of accident statistics in the different trades over a longer period of time is recommended since it would provide an opportunity to study accident trends. This would, e.g., make it possible to analyze the conditions in smaller trades more thoroughly given that the accident rates are sensitive to even a small number of accidents occurring during a given single year.

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