HSA Research Review Series 001

HEALTH AND SAFETY AUTHORITY

A Review of Construction-Related Fatal Accidents in Ireland

1989-2016

Our Vision

Healthy, safe and productive lives and enterprises

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HEALTH AND SAFETY AUTHORITY

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HEALTH AND SAFETY AUTHORITY

NOTE

Where a work-related accident causes injuries that lead to death within a year of the accident, this is recorded as a fatal accident. For the purposes of classifying accidents by year in this report, in any case where an accident occurred in one year and led to death in the following year, the year of the accident is reported.

EXECUTIVE SUMMARY

Since the establishment of the Health and Safety Authority (HSA) in 1989, all work-related fatal accidents in Ireland have been investigated by HSA inspectors, who describe the nature of these accidents in written reports. Data from these reports have recently been coded in accordance with European Statistics on Accidents at Work (ESAW) methodology (Eurostat, 2013). Analyses are being undertaken of fatal accidents in several major economic sectors. Analyses are being undertaken of fatal accidents in several major economic sectors. This document features a descriptive analysis of these data regarding accidents involving construction activity.

Such activity was split between the work undertaken by companies:

- In the NACE rev. 2 economic sector F (Construction), and
- Construction work undertaken by companies outside the sector, such as farmers engaged in constructing farm buildings or County Council workers maintaining roads.

Between 1989 and 2016, a total of 1,616 work-related fatal accidents were reported to the HSA. Over a quarter of all these involved construction businesses (338) or other businesses engaged in construction activity (102). Since these represent such a high proportion of all fatal accidents, it is important to have a clear understanding of their causes and characteristics.

EXECUTIVE SUMMARY cont'd

Note that while this report focuses on fatal construction-related injuries it is known that occupational illnesses are also a major cause of harm to workers:

- Work-related illnesses can lead to long-term consequences such as ill-health, impairment or death.
- Construction workers may be exposed to dangerous substances such as asbestos, silica or diesel exhaust, as well as exposure to ultraviolet (UV) radiation from working outside.
- Illness due to working conditions is not considered in this document, which explores work-related injury only.

NACE F (Construction)

In NACE F (Construction), the total number of fatal accidents increased during the Celtic Tiger economic boom years around 1998-2007, before falling in the late 2000s:

- It is likely that this is partly due to the changes in construction activity during a period that included a building boom and bust.
- Rates of fatal accidents per 100,000 people employed declined between 1994 and 2011, which is a positive development.
- However both the number of accidents and the rate of accidents per 100,000 people employed have increased slightly since 2012.

Accidents were disproportionately likely to occur to smaller construction companies, particularly those featuring fewer than ten employees, compared with larger companies. However, ESAW methodology measures the size of enterprise by the local unit of work rather than the entire company, so larger companies may be underrepresented in the data. In general, the higher rate of fatal accidents involving smaller companies supports the observation that particular risks are associated with smaller sites, perhaps because formal safety management systems may be more robust on larger sites.

In general:

- All but one of the worker victims were male, and most worker victims (81%) were aged between 20 and 59 years.
- Non-worker victims were more age and gender diverse, featuring ten female (24%) and 31 male (76%) victims, and non-workers included children and elderly people.
- The age of worker victims rose over the period, perhaps reflecting a decline in the proportion of younger people working in the sector following the crash of the market in the late 2000s.
- Older workers from 50-64 years had higher rates of accidents per 100,000 people employed than younger workers.

Most victims were Irish, with the number of non-Irish victims rising from just 2% prior to 1997 to 12% between 2009 and 2016. Rates of fatal accidents per 100,000 people employed were highest for the Border (12.7) and Mid-West regions (11.9) for the period 1998-2016, and lowest for the Mid-East (5.5) and Dublin (6.5) regions.[1] All regions showed a decline in fatal accident rates after 2008 except the South-West region, which experienced an increase.

EXECUTIVE SUMMARY cont'd

The most common deviations (the "abnormal event" that led to the injury) for fatal accidents in construction were:

- falls from height (28%),
- losses of control of vehicles or handling equipment (14%), and
- collapses of objects from above, falling onto the victim (12%) and
- collapses of objects from below, dragging the victim down (12%).

This last deviation includes, for example, a ladder slipping from beneath the victim, and therefore resembles falls from height in its leading to injuries on striking the ground. Both deviations combined were responsible for 40% of all fatal accidents, indicating the significant risks to this economic sector of working at height.

"Contact – mode of injury" describes how the victim became injured, following the deviation. Vertical impacts resulting from falls were responsible for 40% of fatal accidents.

- Other important modes of injury include trapping/crushing under objects (11%) or between objects (5%), electrocutions (9%), strikes by vehicles (8%) and strikes by falling objects such as loose building materials falling from scaffolds (7%).
- These suggest that there are several important kinds of accident, often involving heights, electricity and vehicles.

Both Deviation and Contact – Mode of Injury indicate that falls from height of workers represent a major cause of fatal accidents. The proportion of all fatal accidents in Construction caused by falls from height has increased steadily since 1989, mainly because of declines in other kinds of accident, and represented 47% of all fatalities during the period 2009-2016. This suggests that falls from height, including collapses of surfaces from below, represent a continuing major cause of fatal accidents.

The material agent associated with deviation represents the object that was involved in the deviation, which led to the accident.

- For fatal accidents in construction, the two most common material agents associated with deviation were parts of buildings above the ground such as roofs or stairs (22%) and mobile structures above ground, including ladders or scaffolds (16%).
- These represent most of the accidents involving falls from height. Other important material agents were excavators (8%), excavations/trenches (7%) and electrical wires (6%).

A similar variable, material agent associated with contact – mode of injury, represents the object with which the victim came into contact, causing injury.

- While material agent associated with deviation emphasised structures at height leading to falling accidents, material agent associated with contact – mode of injury shows the high number of accidents involving impacts on the ground (42%), associated with similar accidents.

[1] NUTS 3 statistical regions of Ireland are defined as follows. Border: Cavan, Donegal, Leitrim, Louth, Monaghan and Sligo. West: Mayo, Roscommon and Galway. Midland: Laois, Longford, Offaly and Westmeath. Mid-East: Kildare, Meath and Wicklow. Dublin: Dublin City and county. South-East: Carlow, Kilkenny, South Tipperary, Wexford and Waterford. South-West: Kerry and Cork. Mid-West: Clare, North Tipperary and Limerick.

EXECUTIVE SUMMARY cont'd

- Other important material agents were excavators (7%), building materials (7%) and structural components like walls (6%).

While most victims were involved in construction activity, small numbers were also involved in related activities such as maintenance/repair (for example, of vehicles or tools) (4%) or setting up/preparing (for example, a crane on site) (3%).

- The clear majority of accidents occurred in construction sites of various sorts (83%), with a very small proportion involving public areas such as roads (5%) or industrial sites (4%), especially storage warehouses or maintenance workshops.
- Most accidents occurred during ordinary working hours between 8am and 6pm (85%). Non-worker accidents were more dispersed, with some accidents occurring during the night from 1-4am and also in the evening from 8-11pm. In some cases, these represent incidents where members of the public gained access to building sites outside working hours.

Accidents during construction activity in other sectors

There were 102 fatal accidents to people working in non-construction businesses but engaged in construction activity over the period 1989-2016. Most of these were involved in agriculture, forestry and fishing (44%), public administration, typically county or city councils (18%) or manufacturing (16%). Fatal accidents peaked in 1998, but the number has remained stable since then, averaging around three incidents each year.

In general:

- Most of the businesses involved were small, 59% featuring fewer than ten workers.
- Of victims working in agriculture, forestry and fishing, the majority were self-employed, while most victims in manufacturing, and all victims in public administration, were employees.
- The victims were slightly older on average than victims working in the construction sector, and almost half were between the ages of 40 and 59 years.
- The age of victims has risen over the period. From 1989-1997, only 34% of victims were aged 50 years or over; by 2009-2016 this had increased to 62%. Almost all victims were male (99%) and Irish (96%).
- As with fatal accidents in the construction sector, accidents outside the sector to people engaged in construction activity often involved falls from height (19%) or collapses of objects from below (30%). The latter frequently represent slipped ladders or collapses of asbestos roofs or skylights from beneath the victim.
- Other important deviations included losses of control of vehicles (13%) and collapses of objects from above, falling on the victim (11%).

EXECUTIVE SUMMARY cont'd

Contact – mode of injury, representing the way the victim came into contact with the object causing injury, was concentrated primarily around vertical impacts following falls (51%), strikes by moving objects including vehicles (12%) or falling objects (8%), and trapping/crushing under objects (9%) or between objects (6%).

- Falls were most common in agriculture, forestry and fishing, mainly reflecting falls by farmers who were constructing or repairing farm buildings.
- Strikes by vehicles were most common in public administration, probably because those workers were mainly engaged in civil engineering projects involving heavy vehicles, and less exposed to elevated environments.

Analysis of the material agents associated with deviation again show the importance of working from height on fatal accidents, with the most common material agents being parts of buildings above ground such as roofs or stairs, etc. (31%), and mobile structures above ground including ladders and scaffolds (13%). Accidents also involved excavators (9%) and building components such as walls (8%).

Similarly, material agent associated with contact – mode of injury showed that falls from height primarily concluding with impacts on the ground or floor (45%) were a major kind of accident. Other important material agents included excavators (8%) and building components like doors or walls (7%). The latter primarily involved collapses of these building components from above onto the victim, or from the side, crushing the victim.

Conclusion

By far the most common cause of fatal injury to both workers in construction and workers involved in construction activity in other economic sectors was falling from height. These accidents included both falls from height and many examples where the victim was standing on an object that collapsed, such as ladders, fragile roofs or skylights.

Other important causes of accident included losses of control of vehicles, such as excavators, and falls of objects (collapsing roofs, trenches, walls or building materials).

These relatively small number of causes were responsible for hundreds of fatal accidents, highlighting the opportunity to reduce the risk of fatality by focusing on particularly high-risk activity such as working at height.

A GENERAL DESCRIPTION OF FATAL ACCIDENTS IN CONSTRUCTION, 1989-2016

Introduction

Work-related accidents were responsible for over 1,600 deaths in Ireland between 1989 and 2016, with a significant number of these involving construction activity. Such activity was split between the work undertaken by companies in the construction economic sector and construction work undertaken by companies outside the sector, such as farmers engaged in constructing farm buildings or County Council workers maintaining a road.

Each fatal accident over this period was investigated by a HSA inspector and data were generated from inspectors' reports in accordance with European Statistics on Accidents at Work (ESAW) methodology.

This document describes the characteristics of victims, and the causes and circumstances of fatal accidents in:

Section 1: The NACE economic sector F (Construction).

Section 2: Other sectors where construction activity was being undertaken by the victim.

It is hoped that this will facilitate the targeting of resources to reduce work-related accidents in construction.

SECTION ONE: NACE F (CONSTRUCTION)

OVERVIEW AND TRENDS

The construction sector has one of the highest rates of fatal work-related accidents in Ireland. Between 1989 and 2016, a total of 338 fatal accidents were reported by the construction sector (NACE F), involving the deaths of 297 workers and 41 non-workers. Together, these represent over one fifth of all work-related accidents in Ireland since 1989 (Figure 1.1).

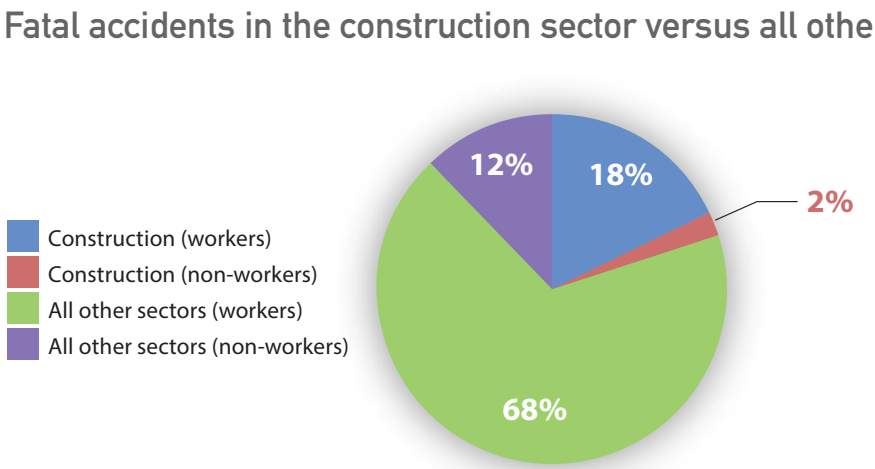

Figure 1.1: Percentage of all fatal accidents, worker and non-worker, in construction and in all other economic sectors, 1989-2016.

The trend in fatal accidents in construction changed significantly over the period 1990-2016 (Figure 1.2). From 1997 the number of fatal accidents rose steeply, remaining high during the early 2000s, and then fell again after 2008.

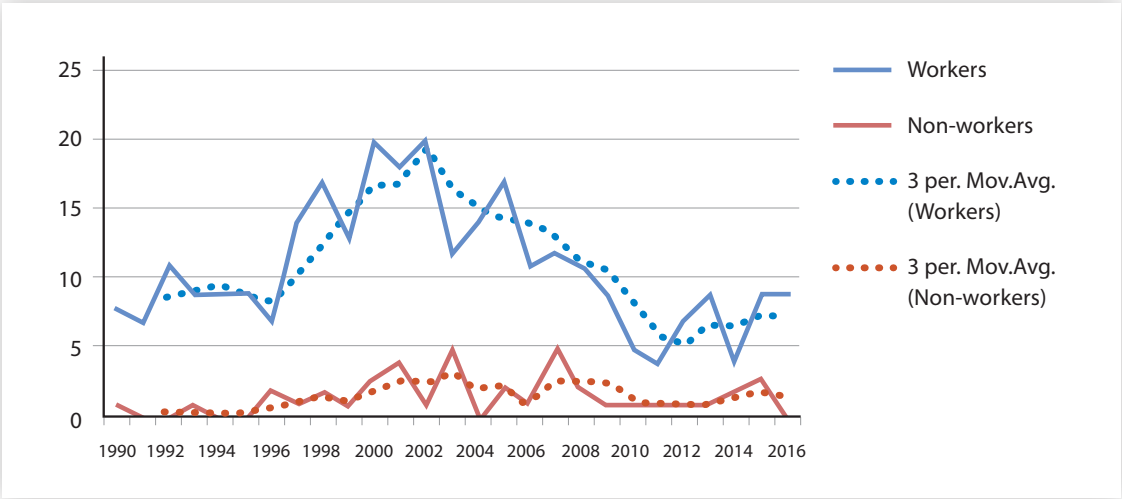

Figure 1.2: Total number of worker and non-worker fatal accidents each year in construction, 1990-2016, with three-year rolling averages.

OVERVIEW AND TRENDS cont'd

SECTION ONE: NACE F (CONSTRUCTION)

Much of this fluctuation was related to the changing size of the construction sector over the period, reflecting a steep rise and collapse of the property market.

Note: Data for 1989 represent only part of that year, so these accidents are omitted in tables and figures representing trends but included elsewhere.

To take this changing construction activity into account, the number of fatal accidents to workers was compared with the number of people aged 15 and over in employment in the sector for the years 1994-1997 (Labour Force Survey, CSO 1997) and annualised quarterly data for the years 1998-2016 (Quarterly National Household Survey, CSO 2017).

Figure 1.3 shows the rate of fatal accidents to workers per 100,000 people employed for the period 1994-2016. This illustrates that while the number of accidents rose during the economic boom years prior to 2009, the rate of fatal accidents to workers generally declined during the period. Over the entire period the general trend is one of declining fatal accident rates. However the rate of accidents per 100,000 people employed has increased since 2012.

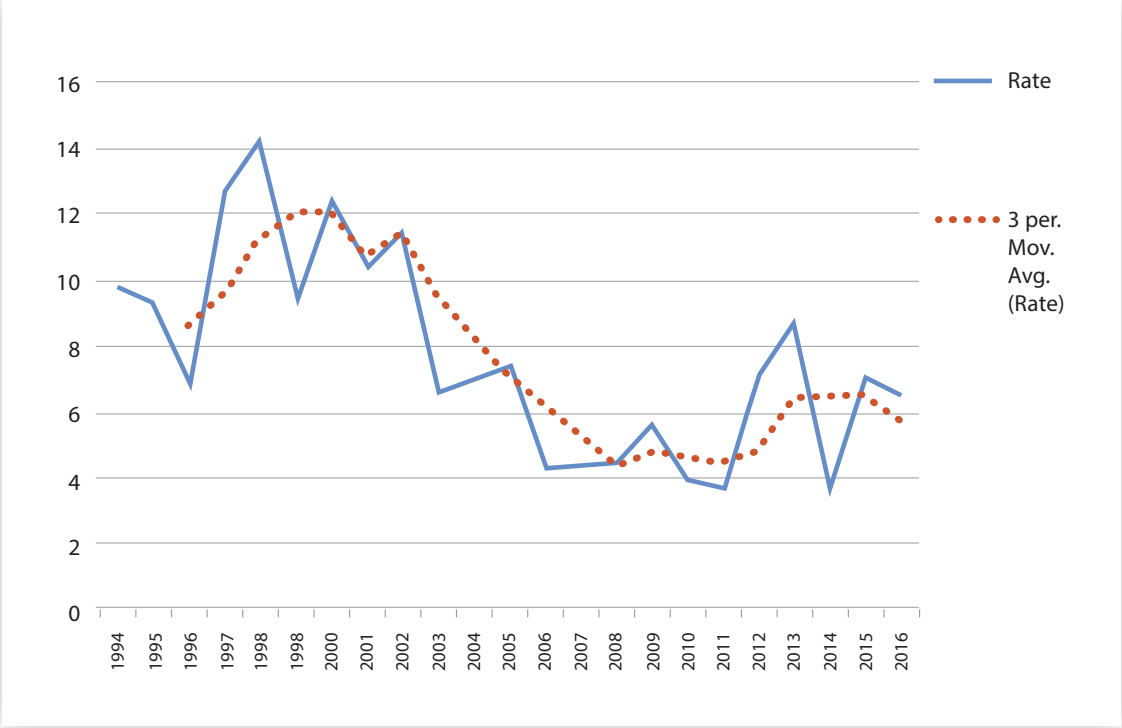

Figure 1.3: Rate of fatal accidents to workers per 100,000 people employed, 1994-2016.

Accident trends summary

The number of fatal accidents in construction each year rose in the Celtic Tiger boom years and fell steeply in the recession. However, the rates of fatal accidents per 100,000 people employed generally declined over the period.

CHARACTERISTICS OF VICTIM AND EMPLOYER

The following are some of the characteristics of the victims of fatal accidents, and of their employers.

Size of enterprise

Most of the businesses experiencing a fatal accident were small; over half of all accidents occurred to businesses with fewer than ten employees.

- Only 1% of employers had 500 employees or more (Figure 1.4).

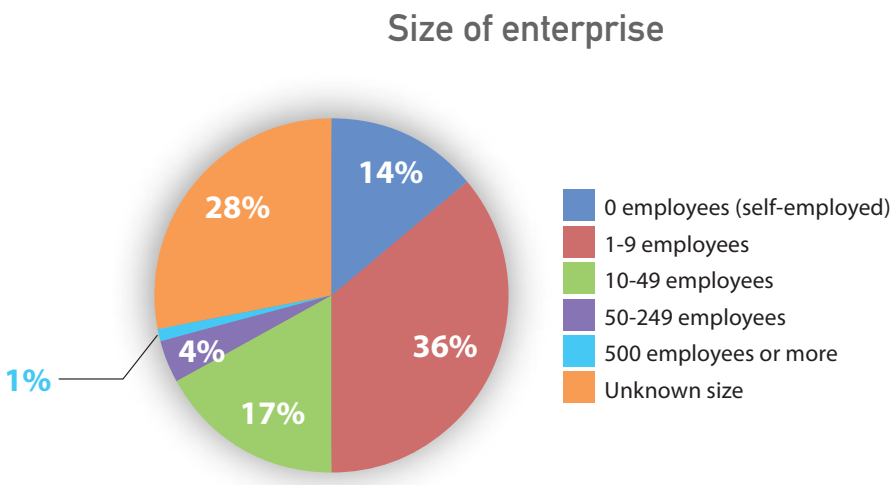

Figure 1.4: Percentage of fatal accidents occurring in each size of enterprise of employers, 1989-2016.

Note: ESAW methodology defines the size of enterprise as the "number of employees working at the local unit" of the workplace, that is the "geographically identified location where the job is mainly carried out or can be considered as to be based". In most cases the local unit of work is the entire enterprise, but in a few cases the employer may have more employees working at a separate unit of work. As a result, some large businesses may be coded as small businesses in these data, reflecting the small size of the local unit of work.

Unknown size of enterprise was entered for 28% of accidents: most of these represent accidents in the 1990s for which the size of enterprise data were unavailable.

- The number of people working in each size of enterprise category in construction is available for the period 2008-2015, allowing the creation of worker fatal accident rates per 100,000 people employed (Eurostat, 2017).
- This shows that smaller companies with fewer than ten employees had higher fatal accident rates per 100,000 (7.2) than companies with 10-49 employees (4.9) or companies with 50 or more employees (1.5) (Figure 1.5). However, this should be interpreted with caution due to the note above on ESAW methodology regarding size of enterprise: companies are coded for the size of *the local unit of work*, not for their entire workforce.

CHARACTERISTICS OF VICTIM AND EMPLOYER cont'd

SECTION ONE: NACE F (CONSTRUCTION)

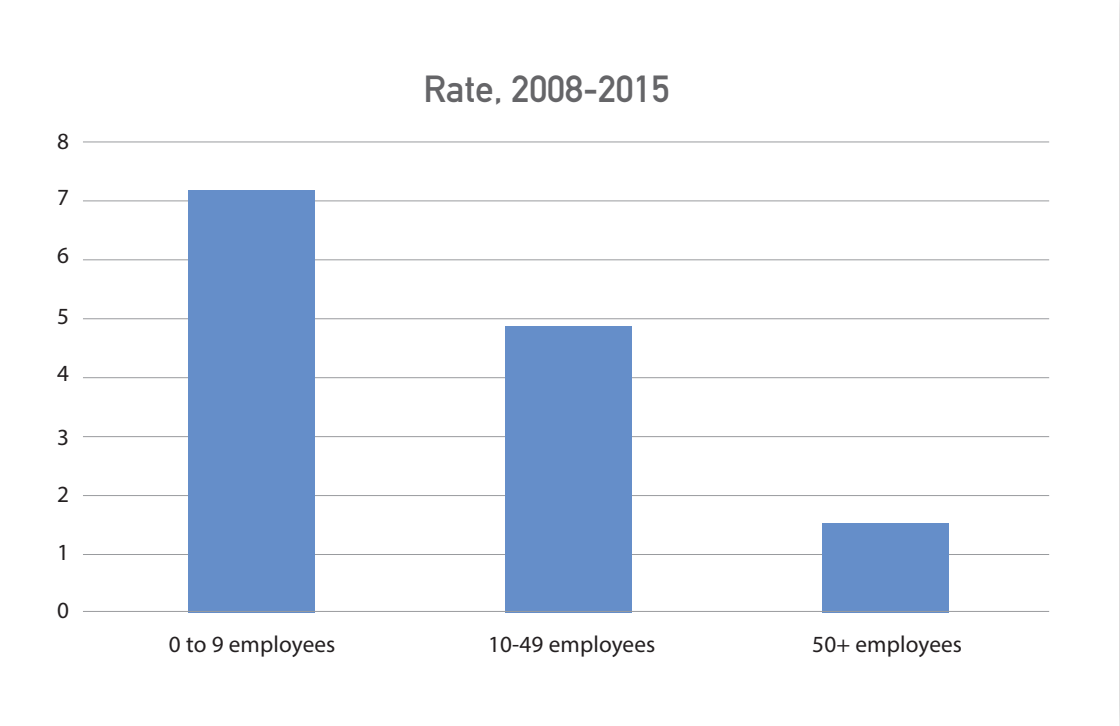

Figure 1.5: Rate of fatal accidents per 100,000 people employed in each size of enterprise, 2008-2015.

EMPLOYMENT STATUS

Most victims were employees (59%) or self-employed (26%) (Figure 1.6).

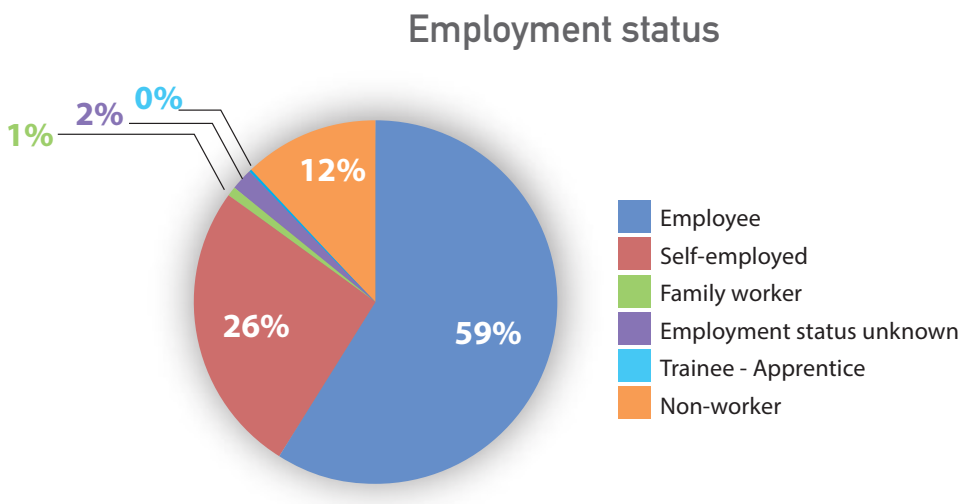

Figure 1.6: Percentage of fatal accidents occurring to victims of each employment status, 1989-2016.

Rates of fatal accidents per 100,000 people were generated for self-employed and employed people using Quarterly National Household Survey data from 1998-2016 (Figure 1.7). This shows that the rate of fatal accident was similar for employees and self-employed people.

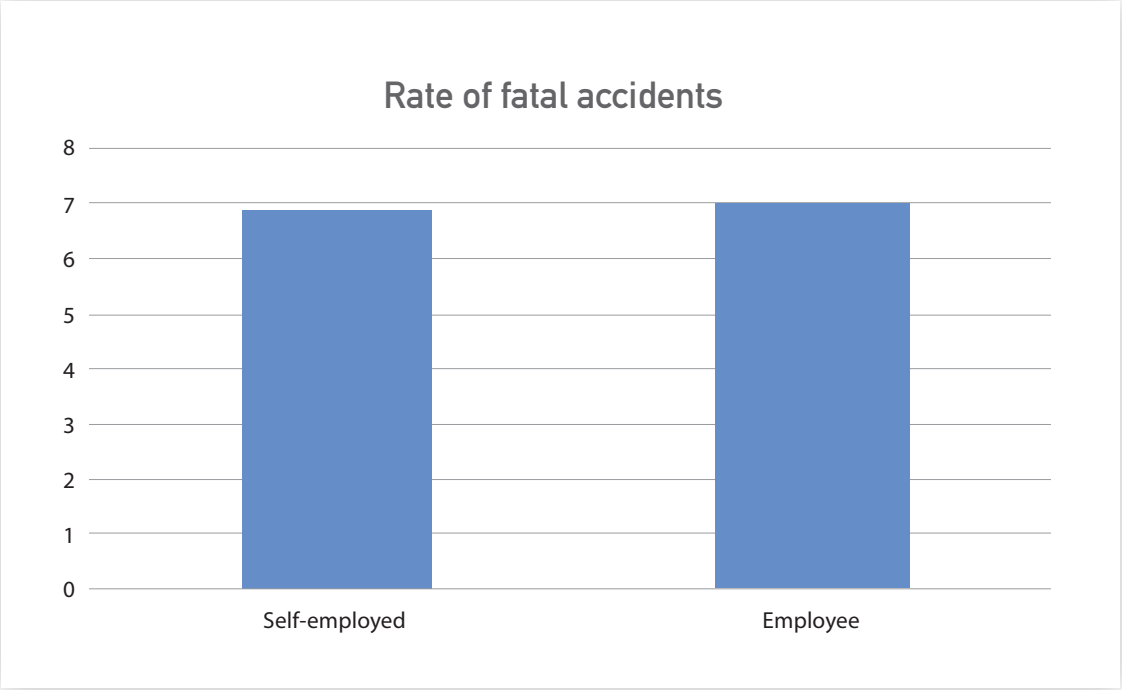

Figure 1.7: Rates of fatal accidents occurring to victims of each employment status, 1998-2016.

EMPLOYMENT STATUS cont'd

SECTION ONE: NACE F (CONSTRUCTION)

Both groups experienced a broad decline in accident rates over the period 1998-2007, followed by a small increase since 2012. (Figure 1.8).

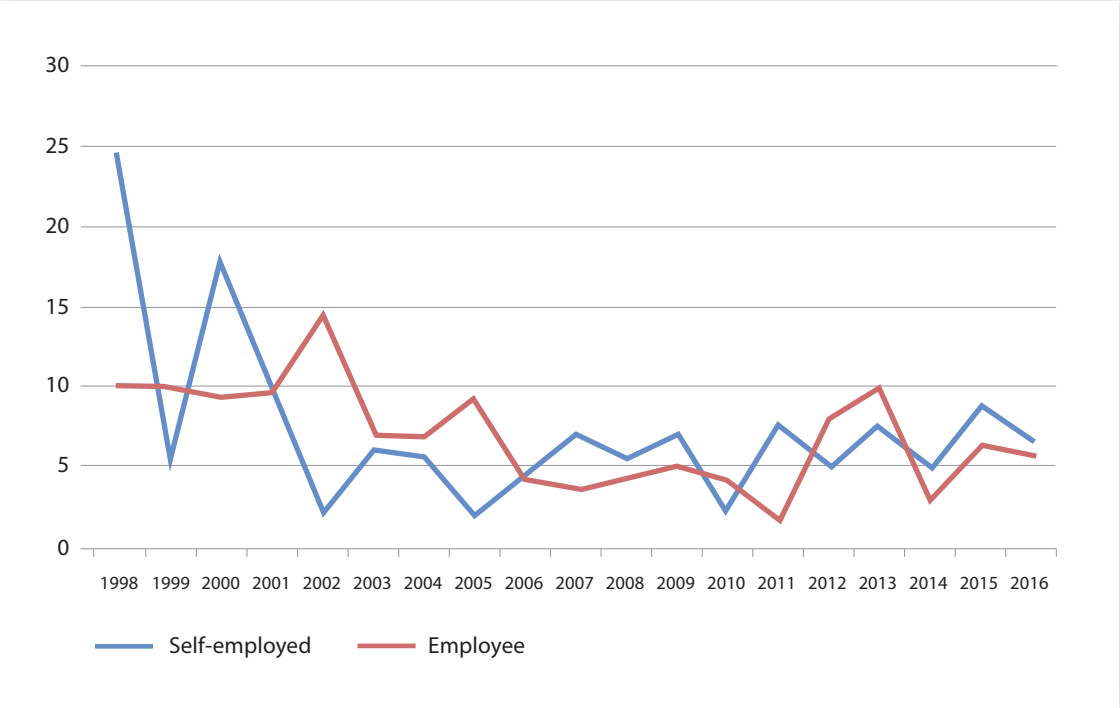

Figure 1.8: Trend of rate of fatal accidents per 100,000 people employed in construction, self-employed and employed, 1998-2016.

Most victims were between the ages of 20 and 60 years (Figure 1.9). Non-workers had a more dispersed age range, including children and very elderly people.

AGE OF VICTIM

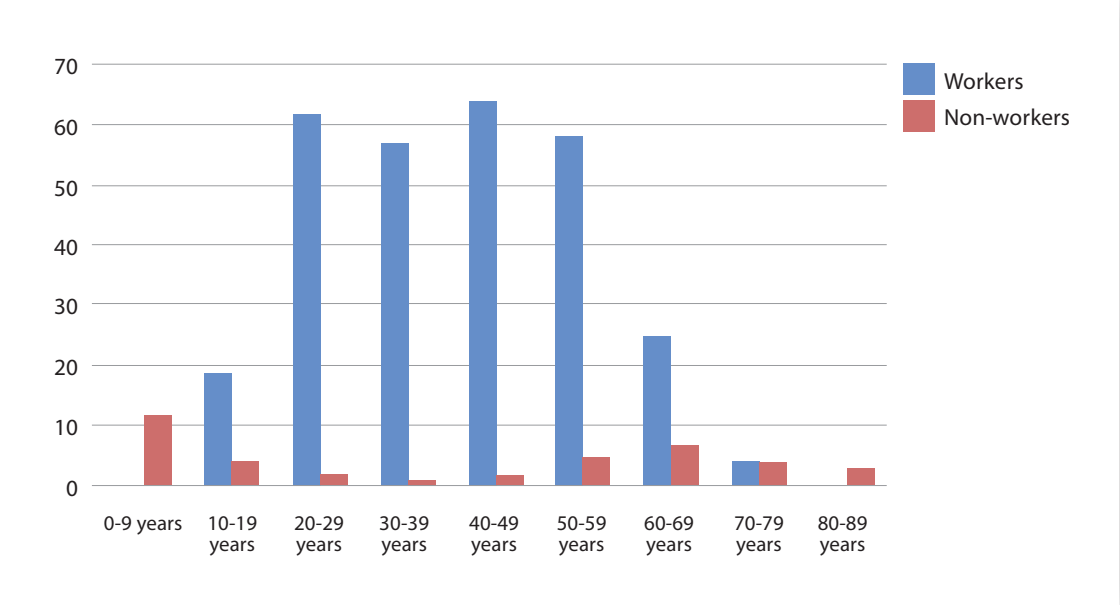

Figure 1.9: Number of fatal accidents in each age group of victim, worker and non-worker, from 1989-2016.

- The age of victims has changed considerably over time, with generally older victims in the period 2009-2016 following the end of the construction boom (Figure 1.10).
- Since the end of the Celtic Tiger economic boom era in 2008, the percentage of victims belonging to the 0-29 years group and the 30-49 years group have fallen, while the percentage of victims belonging to the oldest group of 50 or more years has risen steeply, from 27% to 52%.

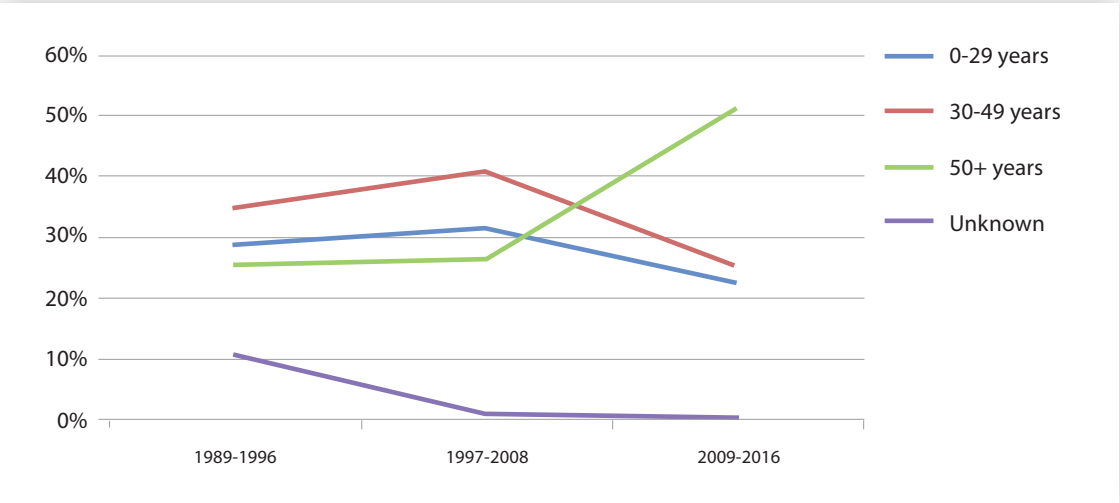

Figure 1.10: Percentage of worker and non-worker fatal accidents in three time periods occurring to each age group.

AGE OF VICTIM cont'd

SECTION ONE: NACE F (CONSTRUCTION)

The construction sector changed rapidly during the housing boom and bust, and Figure 1.11 shows the proportion each age group made of the total working population from 1998-2016, using Quarter 2 data for each year (Eurostat, 2017). (Note that the number of workers over 65 was low and missing for several years, so this group has been omitted.) This shows that the proportion of younger workers in construction plunged during the economic crisis following 2008, suggesting that the increasing age of victims over the period may be due to the increased age of workers in the construction sector in general, as younger workers left the sector.

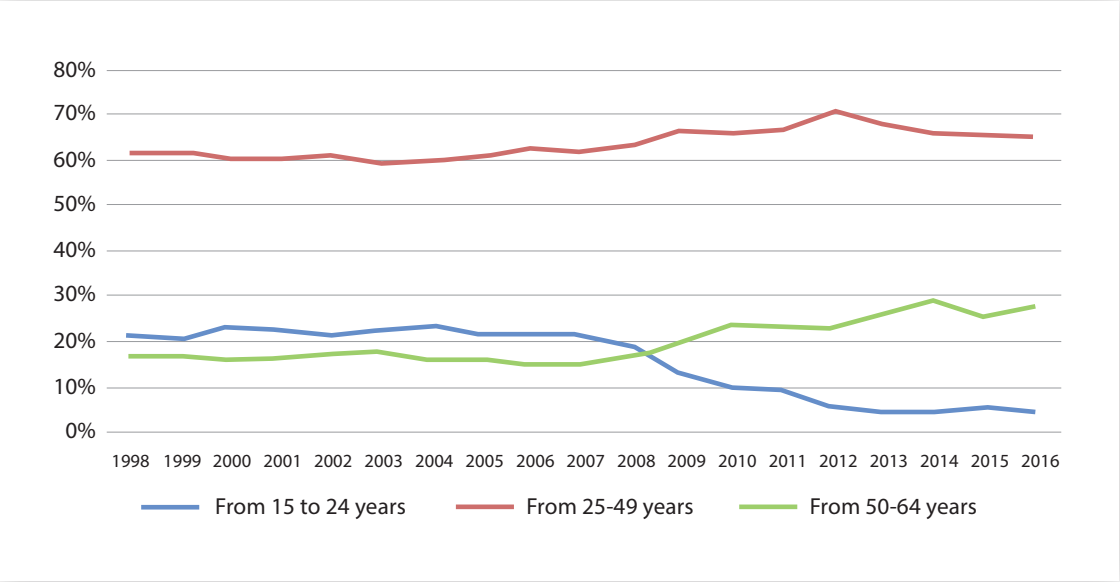

Figure 1.11: Trend of rate of fatal accidents per 100,000 people employed in construction, self-employed and employed, 1998-2016.

Rates of fatal worker accidents per 100,000 employed were generated for each of the three age groups in this period (Figure 1.12). This shows that fatal accident rates generally declined for each age group, with considerable year-to-year fluctuation. This decline seems to be less pronounced for the oldest group, 50-64 years.

AGE OF VICTIM cont'd

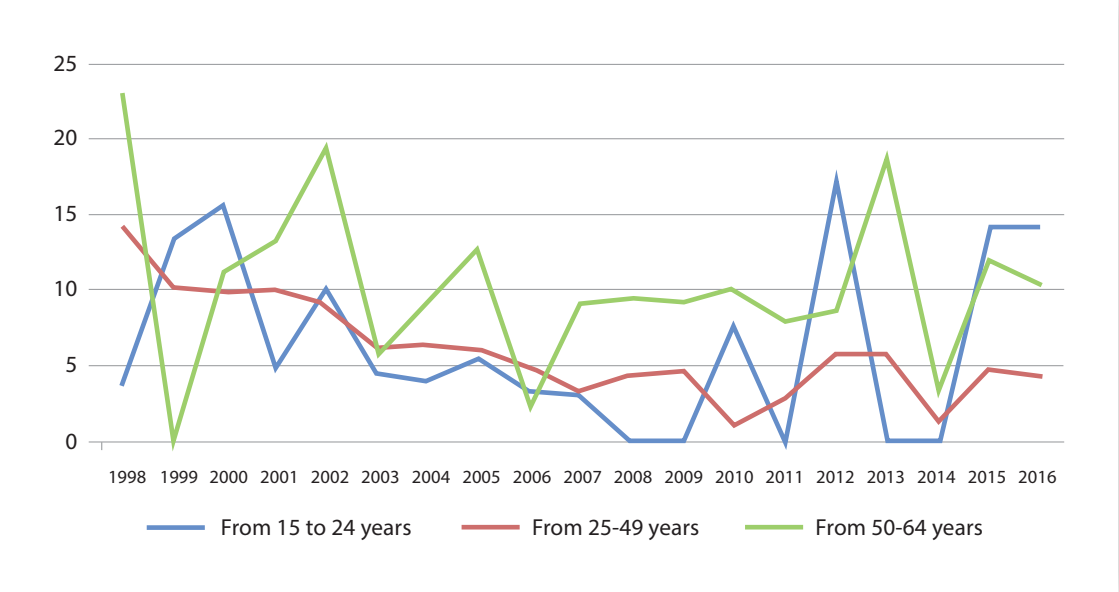

Figure 1.12: Rate of fatal accidents per 100,000 people employed in construction, for each age group in Quarter 2, 1998-2016.

The same data are summarised in Figure 1.13 for the two time periods 1998-2008 and 2009-2016. This confirms that each age group experienced decreases in fatal accident rates in the post-boom period, however, this decrease was most noticeable for the 15-24 and 25-49 age groups. The decrease for the 50-64 age group was negligible.

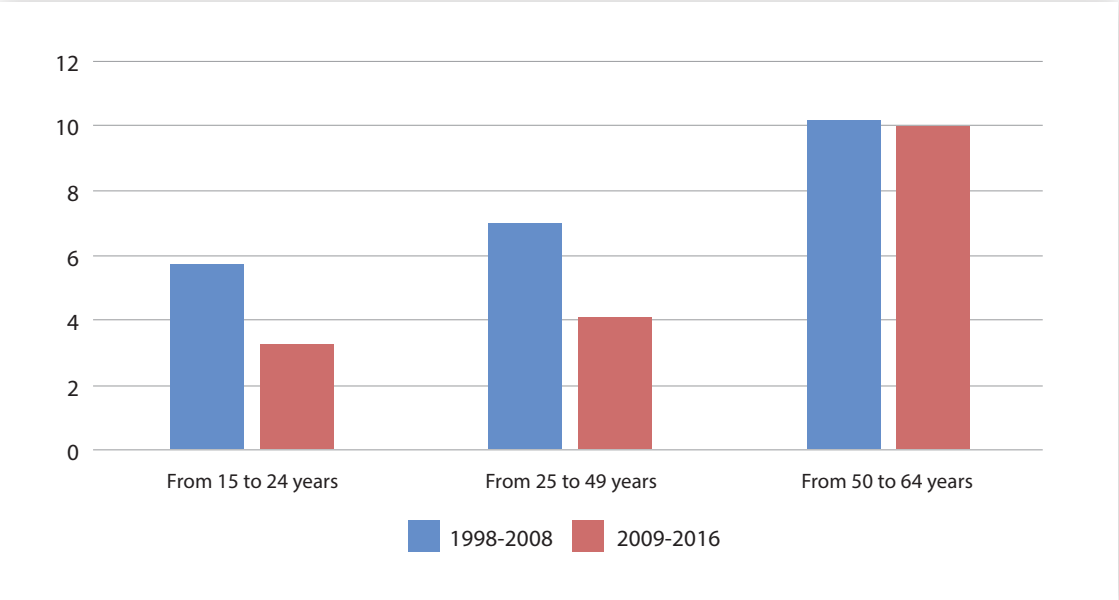

Figure 1.13: Rate of fatal accidents per 100,000 people employed in construction for each age group in Quarter 2, 1998-2008 and 2009-2016.

SEX

SECTION ONE: NACE F (CONSTRUCTION)

All but one worker fatal accident occurred to men. Among non-workers, 31 occurred to male victims and 10 to female victims (Figure 1.14). Workers in the construction sector are disproportionately male; only 5% of all workers were female between 1998-2016.

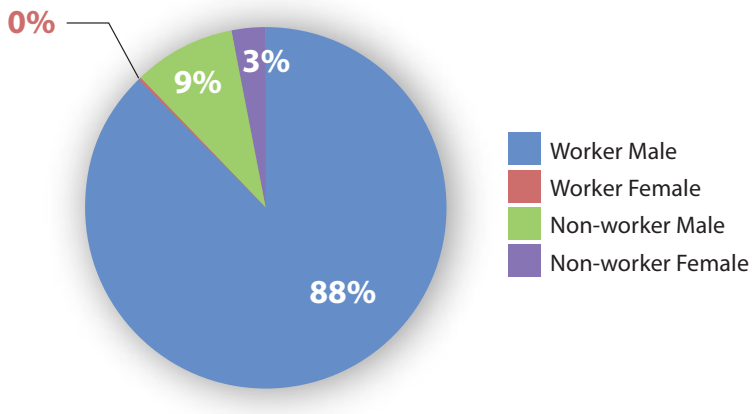

Figure 1.14: Percentage of fatal accidents occurring to workers and non-workers, male and female, 1989-2016.

NATIONALITY

The majority of accidents happened to Irish nationals. There were no non-Irish victims before 1995. The proportion of non-Irish workers increased over the years, and in the period 2009-2016 represented 12% of all accidents (Table 1.1a).

Table 1.1a: Nationality of fatal accident victims in three time periods, 1989-1996, 1997-2008 and 2009-2016.

	National	Non-national from EU	Non-national outside EU	Nationality unknown
1989-1996	65	1	0	0
1997-2008	192	11	2	1
2009-2016	58	8	0	0

- Data representing the nationality of people working in the construction sector are available from 2007 (CSO, 2018) and allow us to generate rates of fatal accidents for Irish and non-Irish workers.
- Table 1.1b shows that the rate of fatal accidents for non-workers increased in the period after 2010. However, very low numbers of accidents to non-Irish workers – zero in some years – mean that these numbers fluctuate and should be interpreted with caution.

Table 1.1b: Rate of fatal accident per 100,000 people employed in construction, Irish and non-Irish, in two time periods, 2006-2010 and 2011-2016.

	Irish	Non-Irish
2006-2010	6.7	3.6
2011-2016	6.6	8.1

REGION OF ACCIDENT

SECTION ONE: NACE F (CONSTRUCTION)

Rates of fatal accidents were generated at the NUTS-3 statistical region of Ireland for the period 1998-2016 (CSO, 2017). This showed differences in the rate of fatal accident per 100,000 people employed in different regions of Ireland, with areas around Dublin and Leinster generally showing lower accident rates than other parts of Ireland (Figure 1.15).

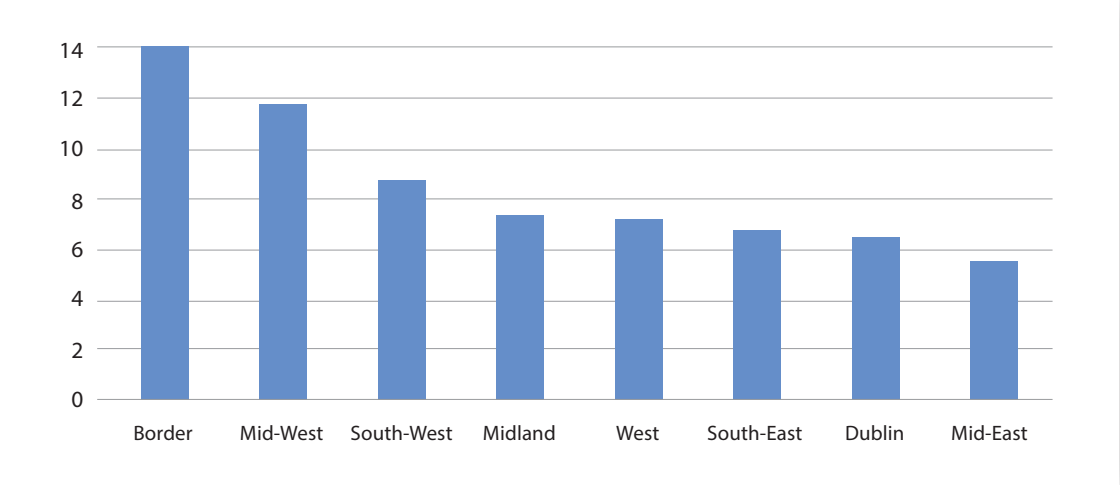

Figure 1.15: Rate of fatal accidents in construction per 100,000 people employed in each NUTS-3 region, 1998-2016.

This pattern has changed over time.

- Figure 1.16 shows the rates of fatal accident per 100,000 people employed in construction in two periods: 1998-2008 and post-boom 2009-2016.
- Rates declined in all regions except the south-west, where they increased in the second period.
- In general, parts of the east and south-east had lower accident rates in both time periods.

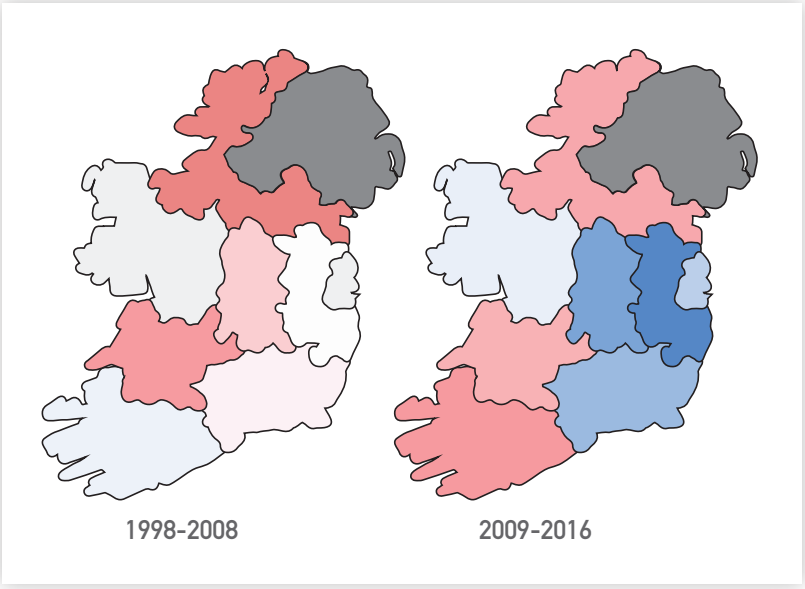

Figure 1.16: Rate of fatal accidents in construction per 100,000 people employed in each NUTS-3 region, in two time periods: 1998-2008 and 2009-2016. Red indicates higher rates; blue indicates lower rates.

COMPARISON WITH OTHER EUROPEAN COUNTRIES

Eurostat publish data on fatal injury rates per 100,000 workers in construction for each of the EU Member States (Eurostat, 2018). Unfortunately, there are currently some important differences between the methodologies of Member States, making it difficult to facilitate proper comparisons. Readers can explore data from Eurostat's online table Fatal Accidents at Work by NACE Rev. 2 Activity (hsw_n2_02), but should interpret the results with caution.

Victim characteristics summary

- Most victims of fatal accidents in the construction sector were male Irish nationals, aged between 20 and 60.
- The proportion of non-Irish victims has increased slightly since 1989, and the average age of victims has also increased, probably reflecting a sharp decline in participation by younger workers after 2008.
- Most accidents occurred in smaller enterprises, and workers in such smaller enterprises appear to have had higher rates of fatal accidents also.
- Most victims were employees, but employees had similar fatal accident rates to self-employed people.

CAUSES AND CHARACTERISTICS OF ACCIDENTS

SECTION ONE: NACE F (CONSTRUCTION)

This section explores the causes and characteristics of accidents, using the most relevant ESAW variables. These variables help to create a picture of the most common types of accidents.

DEVIATION

Deviation represents the "abnormal event" that directly led to the injury, for example the loss of control of a machine or the collapse of a building component. Every accident is assigned just one deviation. If several abnormal events occur, only the last one is recorded. Table 1.2 shows the most common deviations in construction for the period 1989-2016.

- A small number of deviations were responsible for most accidents.
- 28% of all victims fell from a height and a further 12% were dragged downwards due to the collapse of an object beneath them, typically ladders or collapsing roofs.
- 14% of accidents involved the loss of control of vehicles.
- 12% involved the collapse of material from above, for instance, of roofs, walls or stored building materials.
- Nearly 10% of victims were electrocuted.

The item "presence of the victim or of a third person in itself creating a danger" typically represents a situation where the victim has entered a dangerous location, for example, walking behind a reversing digger.

In Table 1.2 below, "Other" represents 33 fatal accidents spread among nine less common deviations, as well as nine cases where the deviation was unknown. The latter may occur where, for example, a victim is found following an accident that is not witnessed.

Table 1.2: Most common deviations leading to fatal accidents, 1989-2016.

	Number	Percentage
Fall of person – to a lower level	94	28%
Loss of control (total or partial) – of means of transport or handling equipment, (motorised or not)	48	14%
Slip, fall, collapse of Material Agent – from above (falling on the victim)	42	12%
Slip, fall, collapse of Material Agent – from below (dragging the victim down)	41	12%
Electrical problem – leading to direct contact	29	9%
Slip, fall, collapse of Material Agent – on the same level	16	5%
Presence of the victim or of a third person in itself creating a danger for oneself and possibly others	15	4%
Slipping – Stumbling and falling – Fall of person – on the same level	11	3%
Other	42	12%
Total	**338**	**100%**

DEVIATION cont'd

SECTION ONE: NACE F (CONSTRUCTION)

The data in Table 1.2 are summarised in Figure 1.17 below.

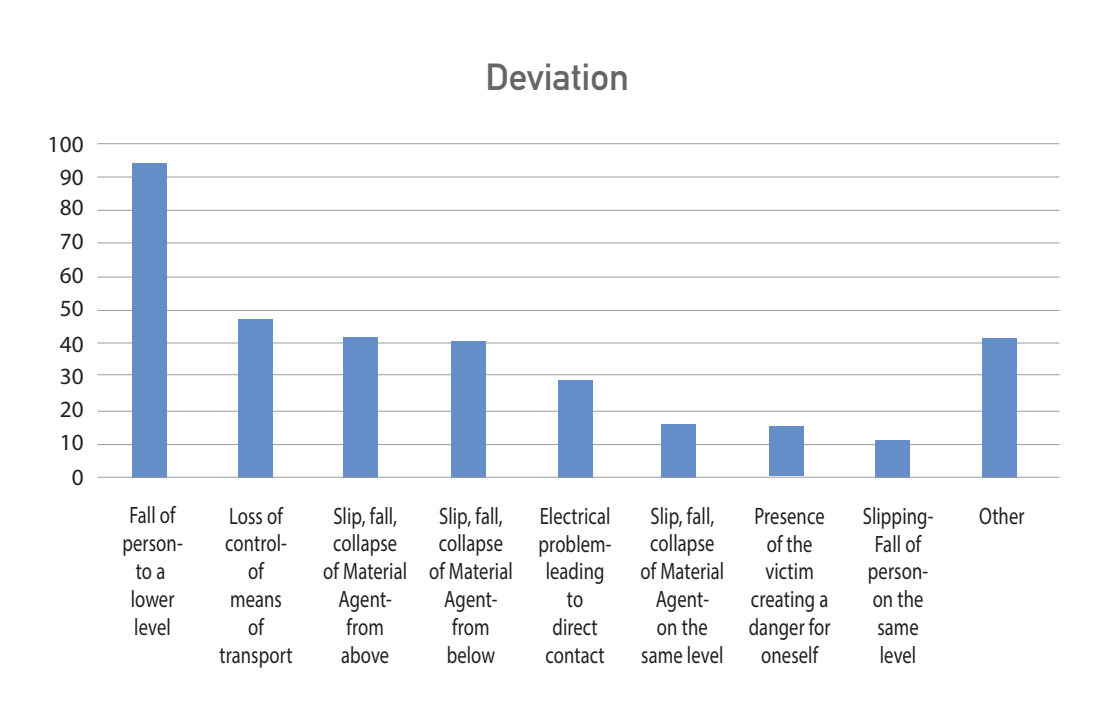

Figure 1.17: Number of fatal accidents caused by each of the most common deviations, 1989-2016. This pattern has changed over time.

Note: the interpretation of ESAW coding may be complicated, as several deviations are related and lead to similar accidents. For example, a construction worker who falls from scaffolds is coded with a deviation of "fall of person – to a lower level". A worker who is climbing a ladder when the ladder slips, dragging the victim down, is coded "slip, fall, collapse of Material Agent from below". This means that a total of 40% of the fatalities were falls from a height: 28% "fall of person – to a lower level" and 12% "slip, fall, collapse of material agent from below".

This will be further explored in conjunction with the contact – mode of injury variable below.

A brief analysis of deviations by age group shows that by far the most common cause of fatal accident for workers aged 50 years or more was falls from height. While this deviation was important for other age groups, Figure 1.17a shows that it stands out for older workers, causing 35 (40%) of all the fatal accidents for that group. However, caution should be taken in interpreting this without further analysis.

DEVIATION cont'd

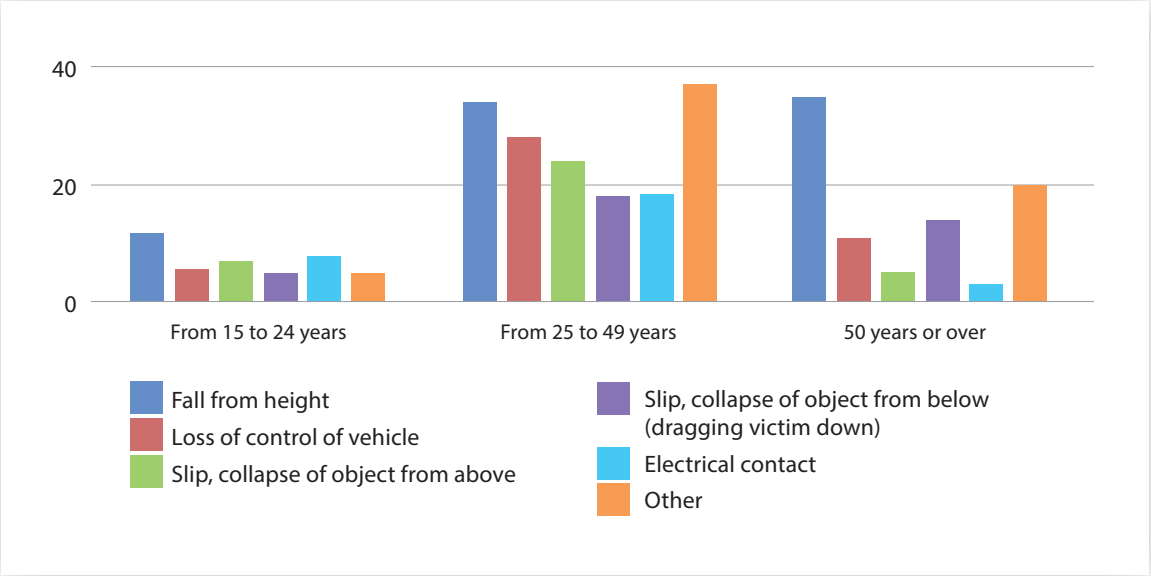

Figure 1.17a: Number of fatal accidents to workers caused by each of the most common deviations, for three age groups, 1989-2016.

CONTACT – MODE OF INJURY

SECTION ONE: NACE F (CONSTRUCTION)

While deviation represents the cause of the accident, "contact – mode of injury" describes the way the victim became injured, for example, struck by falling object, drowned, crushed, etc. Table 1.3 shows the most common modes of injury.

Mode of injury shows again that a large proportion of victims were killed by falls (40%). These include cases where the victim fell freely, such as from a roof, and where the victim was standing on something that collapsed or slipped like a ladder or skylight.

Table 1.3: Most common modes of injury for fatal accidents, 1989-2016.

	Number	Percentage
Vertical motion, crash on or against (resulting from a fall)	134	40%
Trapped, crushed – under	38	11%
Direct contact with electricity, receipt of electrical charge in the body	30	9%
Struck – by rotating, moving, transported object, including vehicles	26	8%
Struck – by falling object	25	7%
Trapped, crushed – between	18	5%
Buried under solid	11	3%
Drowned in liquid	8	2%
Other	48	14%
Total	**338**	**100%**

Figure 1.18 breaks down mode of injury into broad categories.

- By far the most common mode of injury leading to a fatal accident is impact following falls (41%), primarily falls from height but also a small number of falls on the same level, for example, the victim slipped and struck the ground.
- Close to a fifth of accidents involved the victim being struck by a moving object, most prominently vehicles and falling objects.
- A further fifth of victims were trapped or crushed. 12% experienced electrocutions, burning injuries or contacts with hazardous substances; most of these were electrocutions.

CONTACT – MODE OF INJURY cont'd

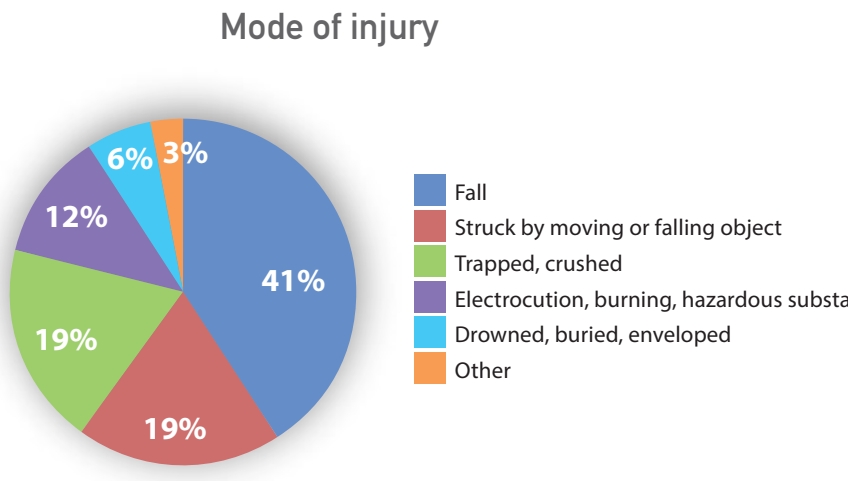

Figure 1.18: Percentage of fatal accidents involving each of the most common broad categories of mode of injury, 1989-2016.

This pattern has changed somewhat over time. Figure 1.19 shows the percentage of all fatal accidents belonging to each broad mode of injury in three time periods: pre-boom 1989-1996, economic boom 1997-2008 and post-boom 2009-2016.

- The proportion of all accidents caused by falls and by strikes (primarily by vehicles or falling objects) increased over the periods.
- The proportion of deaths from drowning also slightly increased, while deaths due to electrocutions decreased.
- Note again the exceptional prominence of falls from height as a mode of injury in fatal accidents.
- Close to half of all fatal accidents since 2009 were caused by falls from height, illustrating the continued dangers posed by working at heights.

CONTACT – MODE OF INJURY cont'd

SECTION ONE: NACE F (CONSTRUCTION)

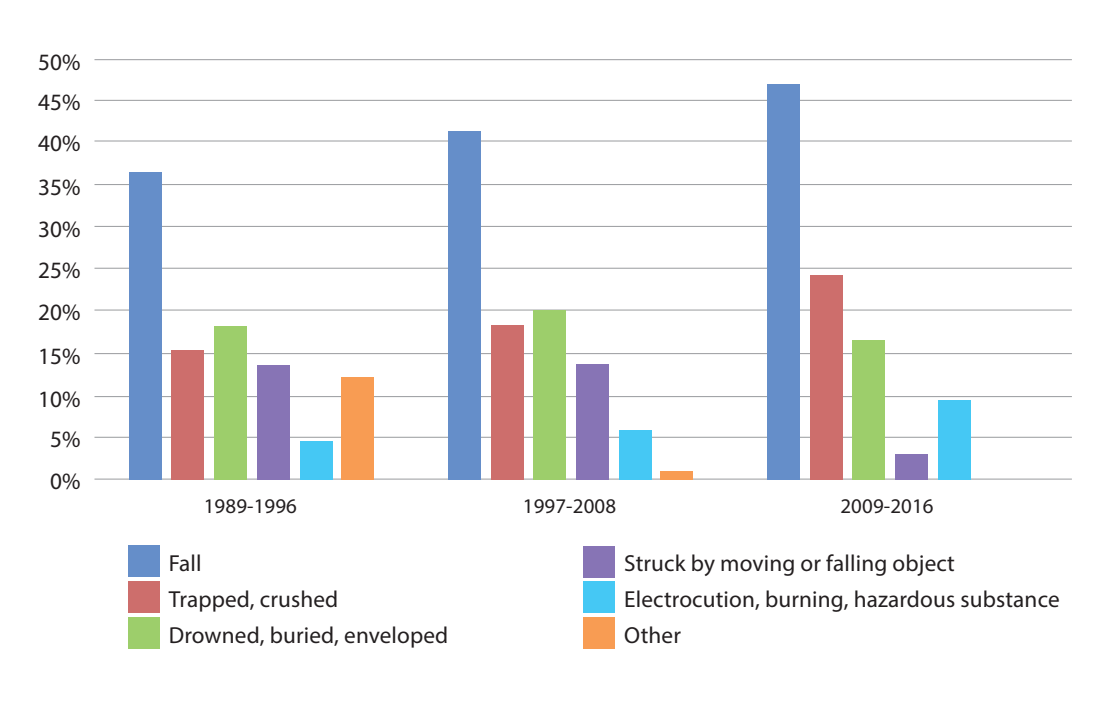

Figure 1.19: Percentage of all fatal accidents in three time periods, 1989-1996, 1997-2008 and 2009 -2016 by mode of injury.

Note: In many cases the deviations lead to similar modes of injury. For example, accidents with the deviation of "fall of person – to lower level" generally led to the mode of injury "vertical motion (from fall)", representing cases such as a builder losing balance on a roof and falling to the ground.

However, the relationship between deviation (the cause of the accident) and the mode of injury (the means by which the victim became injured) is sometimes surprising; someone may fall from height into machinery and have a mode of injury of "crushing", or fall from height into electrical wires and have a mode of injury of "direct contact with electricity".

Below, Table 1.4 will explore the relationship between deviations and the modes of injury they lead to.

- The most prominent relationship is between the deviation of "fall of person – to a lower level" and the mode of injury of "vertical motion (from fall)", which describes 91 fatal accidents, indicating once more how serious the risk from falling injuries is in construction.
- The mode of injury of "vertical motion (from fall)" also follows the deviation of "slip, fall, collapse of material agent – from below" in 36 cases, representing falls due to slipping ladders, collapsing roofs, scaffolds, etc.

CONTACT – MODE OF INJURY cont'd

- Another important deviation is the loss of control of a vehicle, which typically led to modes of injury of trapping/crushing (25) and also strikes against the victim, that is, the driver of a vehicle struck the victim.
- The deviation "slip, fall, collapse of material agent – from above" was associated with trapping/crushing modes of injury (14), such as where a shelf of building materials collapses from above and crushing the victim, and also the "struck – by falling object" mode of injury (19). An example of the latter is a loose concrete block falling from a scaffold and striking the victim on the head.
- Collapses of material agent on the same level led to 10 fatal accidents due to burial under solid material, typically situations where the victim was in a trench or excavation that collapsed. The deviation of "electrical problem – leading to direct contact" naturally led to the mode of injury of "direct contact with electricity", that is, electrocution.
- The deviation "presence of the victim creating a danger for oneself" was mostly related to strikes by vehicles, again reflecting the nature of cases where the victim has entered a dangerous area such as behind a reversing vehicle.

Table 1.4: Deviations by modes of injury for fatal accidents, 1989-2016.

Deviation	Contact – Mode of Injury								
	Vertical motion, crash on or against (resulting from a fall)	Trapped, crushed – under	Direct contact with electricity	Struck – by vehicles	Struck – by falling object	Trapped, crushed – between	Buried under solid	Other	Total
Fall of person – to a lower level	91	0	0	0	0	0	0	3	94
Loss of control (total or partial) – of means of transport	1	16	0	11	1	9	0	10	48
Slip, fall, collapse of Material Agent – from above	1	14	0	0	19	3	1	4	42
Slip, fall, collapse of Material Agent – from below	36	1	0	0	0	1	0	3	41
Electrical problem – leading to direct contact	0	0	29	0	0	0	0	0	29
Slip, fall, collapse of Material Agent – on the same level	0	4	1	0	0	0	10	1	16
Presence of the victim creating a danger for oneself	0	1	0	9	1	3	0	1	15
Other	5	2	0	6	4	2	0	34	53
Total	**134**	**38**	**30**	**26**	**25**	**18**	**11**	**56**	**338**

The data in Table 1.4 are summarised for the most common deviations and modes of injury in Figure 1.20. This shows again that the mode of injury "vertical impact resulting from a fall" derives mainly from the deviations "fall from height" and "fall of material agent from below".

CONTACT – MODE OF INJURY cont'd

SECTION ONE: NACE F (CONSTRUCTION)

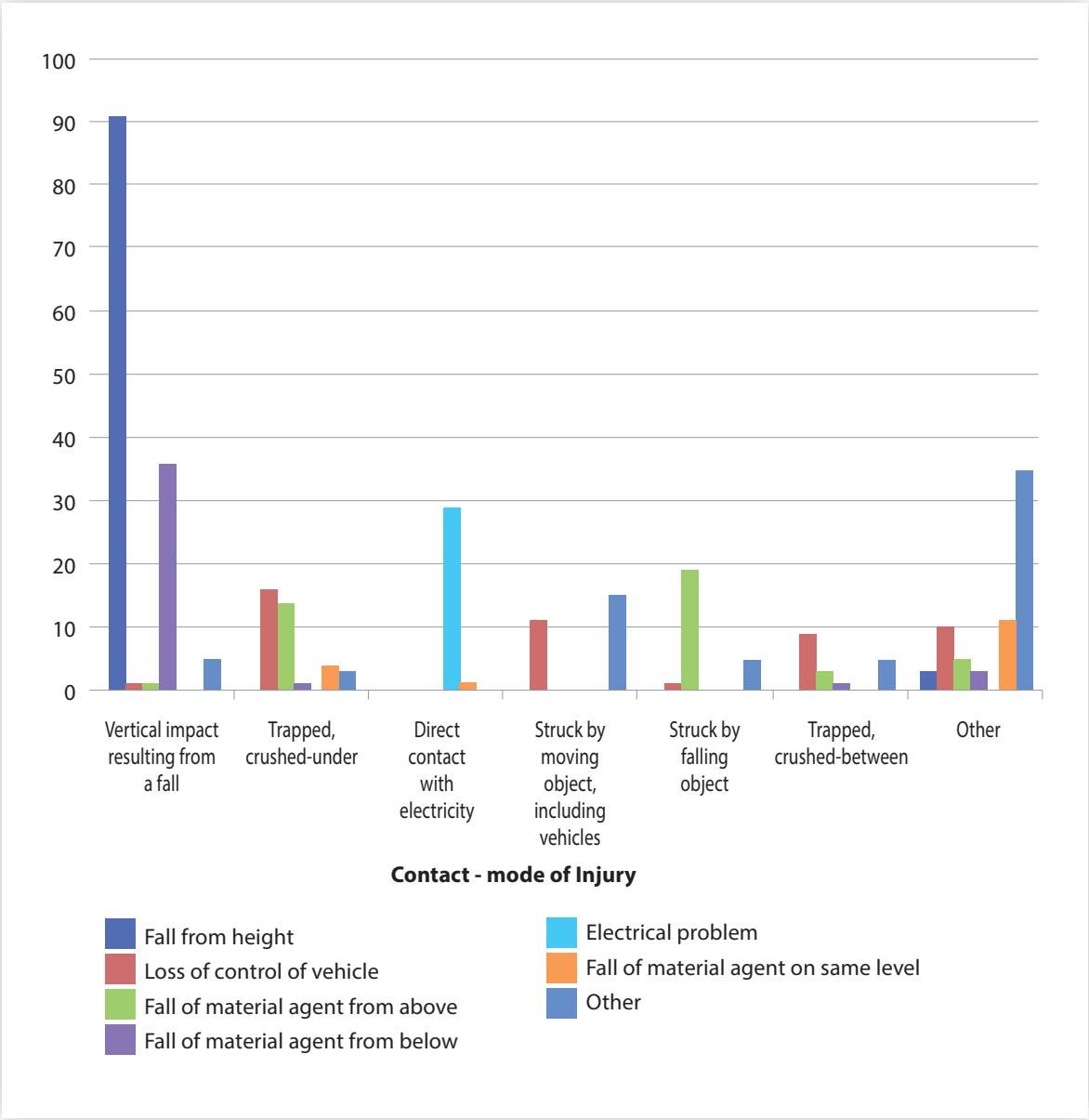

Figure 1.20: Number of fatal accidents involving the most common modes of injury by the most common deviations, 1989-2016.

Summary of deviation and modes of injury

The single most common kind of accident involved falls from height or collapses of ladders, etc. leading to vertical impacts. Other major kinds of accident included strikes by vehicles and crushing injuries following the loss of control of a vehicle; strikes and crush injuries from objects falling from above; electrical problems leading to electrocution; and collapses of trenches or excavations leading to crushing or burial.

SPECIFIC PHYSICAL ACTIVITY

Specific physical activity describes the activity the victim was undertaking at the exact moment of the accident.

For almost a third of all accidents no data are available for this variable as the activity of the victim immediately prior to the accident was unknown. Furthermore, in a great many cases the specific physical activity has no relation to the accident. For example, a worker may be using handheld tools when a trench collapses or may be walking across a building site when struck by a vehicle. As a result, data for specific physical activity are not described here.

For those cases where data do exist, the most common specific physical activities were walking/moving, working with hand-held tools, presence (meaning that the victim was simply present and not involved in any particular activity) and driving a means of transport.

Material agents

ESAW methodology includes three variables called material agent:

- Material agent associated with the specific physical activity.
- Material agent associated with the deviation.
- Material agent associated with the contact – mode of injury.

In each case, the material agent is a physical object that is associated with another variable: specific physical activity, deviation, or mode of injury.

- For example, a worker is driving a front loader. The specific physical activity is "driving a means of transport" and the material agent associated with specific physical activity is "portable or mobile machines for construction sites".
- The driver accidentally swerves close to a bank, causing the vehicle to overturn. The deviation is "loss of control of means of transport", and the material agent associated with the vehicle is still "portable or mobile machines for construction sites".
- The driver attempts to leap from the front loader but is crushed between the vehicle and the ground. The mode of injury is "trapped/crushed between" and the material agent associated with mode of injury is "surfaces at ground level – ground and floors", reflecting the contact with the ground.

MATERIAL AGENT ASSOCIATED WITH THE DEVIATION

SECTION ONE: NACE F (CONSTRUCTION)

Table 1.5 shows the most common material agents associated with deviation. The high proportion of accidents involving falls from height are indicated by the first two material agents: parts of buildings above ground (for example, roofs) and mobile structures above ground (for example, ladders or scaffolds).

Other prominent material agents are mobile machines for extracting materials (for example, excavators), trenches, electrical wires, mobile machines for construction sites (for example, dump trucks), building materials and heavy vehicles like lorries.

Table 1.5: Most common material agents associated with deviation for fatal accidents, 1989-2016.

	Number	Percentage
Parts of building, above ground level – fixed (roofs, terraces, doors and windows, stairs, quays)	73	22%
Structures, surfaces, above ground level – mobile (including scaffolding, mobile ladders, cradles, elevating platforms)	55	16%
Portable or mobile machines – for extracting materials or working the ground – mines, quarries and plant for building and civil engineering works	28	8%
Excavations, trenches, wells, pits, escarpments, garage pits	25	7%
Systems for energy transmission and storage (mechanical, pneumatic, hydraulic, electric, including batteries and accumulators)	21	6%
Portable or mobile machines (not for working the ground) – for construction sites	17	5%
Building materials – large and small: prefabricated shells, formwork, girders, beams, bricks, tiles, etc.	17	5%
Building components, structural components – doors, walls, partitions etc. and intentional obstacles (windows, etc.)	16	5%
Vehicles – heavy: lorries, buses, coaches (passenger transport)	13	4%
Other	73	22%
Other	**338**	**100%**

Table 1.6 below shows the relationship between deviation and the material agent associated with deviation. The deviations "fall of a person – to a lower level" and "slip, fall, collapse of material agent – from below" are associated primarily with parts of buildings and structures above ground like roofs, scaffolds and ladders.

- Losses of control of transport cases are naturally associated mostly with excavators (17) and other construction vehicles (8). In a few other cases, losses of control of transport involve contacts with external objects like trenches (3) or building materials (2), leading to the accident.
- Collapses of material agents from above involve collapsing trenches, loose building materials or building components such as walls.
- Collapses from below generally involve roofs, ladders or scaffolds, dragging the victim down.

NOTE: Many material agents have long descriptions. To simplify tables in this section, these descriptions have been shortened. For example, "parts of building, above ground level – fixed (roofs, terraces, doors and windows, stairs, quays)" is labelled simply "roofs, stairs, etc." below.

MATERIAL AGENT ASSOCIATED WITH THE DEVIATION cont'd

Table 1.6: Deviation by material agent associated with deviation for fatal accidents, 1989-2016.

Deviation	Material Agent associated with Deviation								
	Roofs, stairs, etc.	Scaffolds, ladders, etc.	Mobile machines for extracting materials	Excavations, trenches, etc.	Systems for energy transmission and storage	Mobile machines for construction sites	Building materials	Building components, – doors, walls, etc.	Other
Fall of person – to a lower level	45	36	0	4	0	1	0	1	7
Loss of control of means of transport or handling equipment	2	0	17	3	1	8	2	0	15
Slip, fall, collapse of Material Agent – from above	2	1	1	5	0	1	8	12	12
Slip, fall, collapse of Material Agent – from below	19	13	0	0	1	1	0	0	7
Electrical problem – leading to direct contact	0	0	1	0	18	2	0	1	7
Slip, fall, collapse of Material Agent – on the same level	0	0	1	12	0	0	0	1	2
Other	5	5	8	1	1	4	7	1	36

These data are reproduced in Figure 1.21 below, showing the most common material agents associated with deviation, and the deviations in question. Falls from height are broadly associated with parts of buildings above ground, mostly roofs, and temporary structures above ground like scaffolds and ladders.

MATERIAL AGENT ASSOCIATED WITH THE DEVIATION cont'd

SECTION ONE: NACE F (CONSTRUCTION)

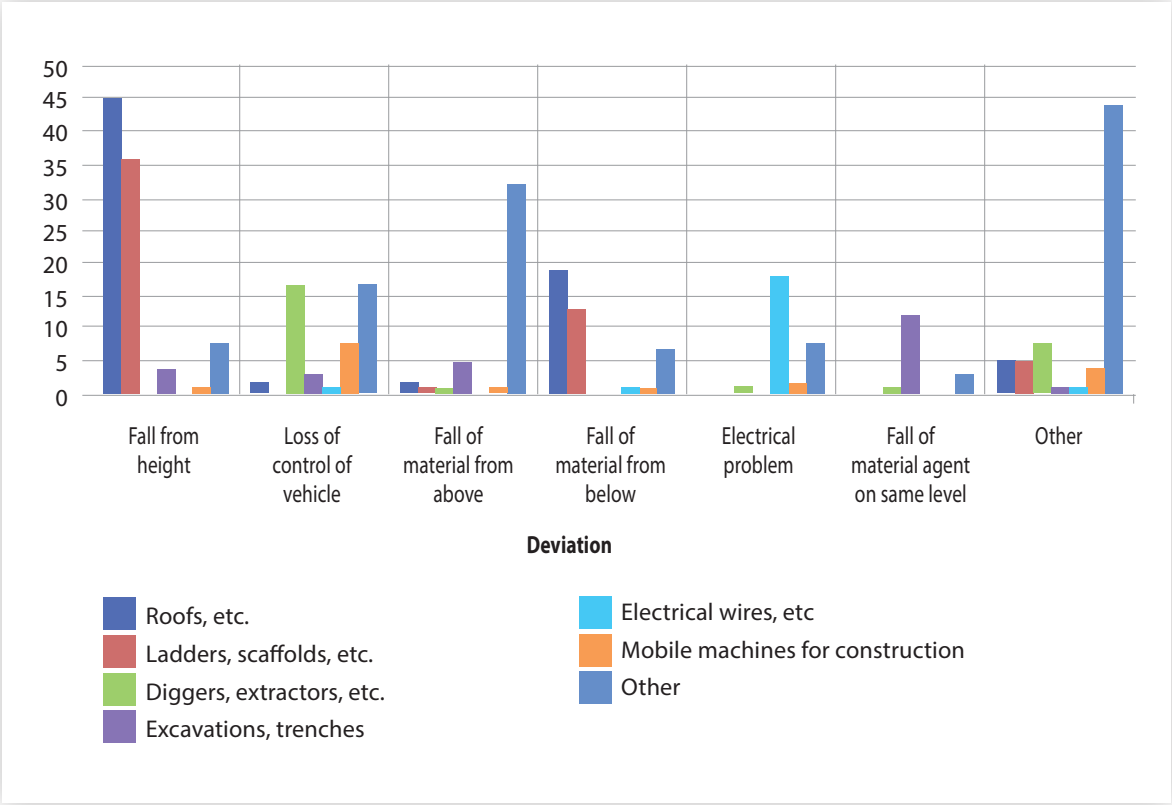

Figure 1.21: Number of fatal accidents involving the most common deviations by material agents associated with deviation, 1989-2016.

MATERIAL AGENT ASSOCIATED WITH CONTACT – MODE OF INJURY

Table 1.7 shows the most common material agents associated with modes of injury.

- The single most common material agent here is the ground/floor (42%), mostly representing the culmination of a fall from height.
- Other important material agents are mobile machines for extracting materials (excavators, etc.), building materials, parts of buildings like walls and systems for energy transmission (electrical wires, etc.).

Table 1.7: Most common material agents associated with contact – mode of injury for fatal accidents, 1989-2016.

	Number	Percentage
Surfaces at ground level – ground and floors (indoor or outdoor, farmland, sports fields, slippery floors, cluttered floors, plank with nails in)	143	42%
Portable or mobile machines – for extracting materials or working the ground – mines, quarries and plant for building and civil engineering works	24	7%
Building materials – large and small: prefabricated shells, formwork, girders, beams, bricks, tiles, etc.	22	7%
Building components, structural components – doors, walls, partitions etc. and intentional obstacles (windows, etc.)	19	6%
Systems for energy transmission and storage (mechanical, pneumatic, hydraulic, electric, including batteries and accumulators)	16	5%
Excavations, trenches, wells, pits, escarpments, garage pits	15	4%
Portable or mobile machines (not for working the ground) – for construction sites	14	4%
Vehicles – heavy: lorries, buses, coaches (passenger transport)	13	4%
Substances, materials – with no specific risk (water, inert materials. . .)	9	3%
Vehicles – light: goods or passengers	6	2%
Machine components, vehicle components: chassis, crankcase, levers, wheels, etc.	6	2%
Other	51	15%

Table 1.8 below explores the relationship between mode of injury and the material agent associated with it. This shows again that most of the accidents involving vertical impacts due to falls culminated in the victim striking the ground or floor (126), while a smaller number of fall victims (4) struck evacuations or trenches.

- Electrocutions mostly derived from contacts with "systems for energy transmission and storage" such as live wires.
- Crushing injures involved contact with many material agents including the floor, construction vehicles, building materials and parts of buildings and evacuations/trenches. Strikes by falling objects generally involved building materials like blocks or collapsing building components, for example, walls.

MATERIAL AGENT ASSOCIATED WITH CONTACT – MODE OF INJURY cont'd

SECTION ONE: NACE F (CONSTRUCTION)

- For instance, a builder walking near the edge of a trench stumbles and falls into the trench, experiencing a head injury. This has a mode of injury of "vertical motion, crash on or against (resulting from a fall)" and a material agent associated with it of "excavations, trenches, wells, pits".

- Meanwhile, if a member of the public who is walking past the entrance to a building site and is then struck by an excavator, the mode of injury is "struck – by rotating, moving, transported object, including vehicles" and the material agent associated with it is "mobile machines for extracting materials".

Table 1.8: Mode of injury and material agent associated with mode of injury for fatal accidents 1989-2016.

Contact – Mode of Injury	Material Agent associated with Contact – Mode of Injury							
	Ground, floor	Mobile machines for extracting materials	Building materials	Building components – doors, walls, etc.	Systems for energy transmission and storage	Excavations, trenches, wells, pits	Mobile machines for construction sites	Other
Vertical motion, crash on or against (resulting from a fall)	126	0	0	0	1	4	0	3
Trapped, crushed – under	2	7	3	6	1	4	3	12
Direct contact with electricity, receipt of electrical charge in the body	1	1	1	1	13	0	2	11
Struck – by rotating, moving, transported object, including vehicles	0	6	1	1	0	1	6	11
Struck – by falling object	0	0	9	6	0	0	0	10
Trapped, crushed – between	3	6	2	3	0	0	1	3
Buried under solid	0	0	0	0	0	5	0	6
Other	11	4	6	2	1	1	2	29

MATERIAL AGENT ASSOCIATED WITH CONTACT – MODE OF INJURY cont'd

These data are illustrated in Figure 1.22 below. This shows again the very high proportion of accidents involving falls from height that culminate on the floor or ground. These are responsible for 37% of all fatal accidents.

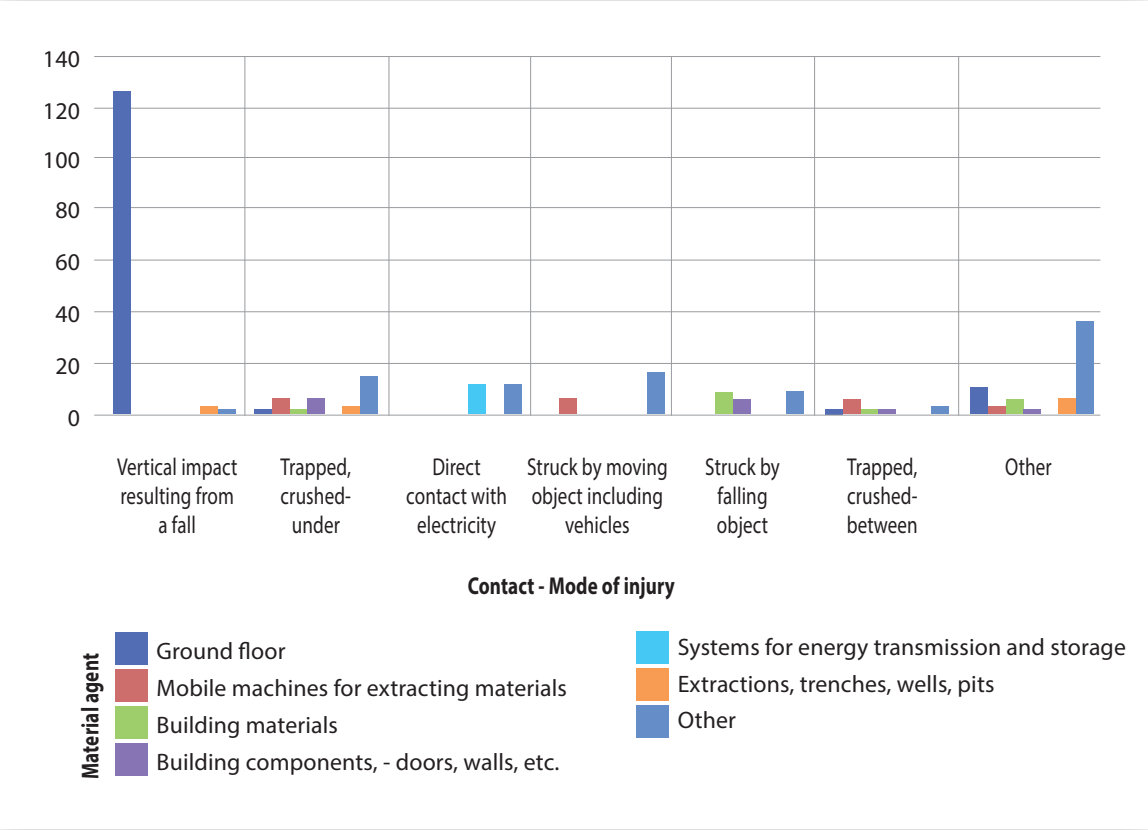

Figure 1.22: Number of fatal accidents involving the most common material agents associated with contact – mode of injury, by modes of injury, 1989-2016.

TYPE OF INJURY AND PART OF BODY INJURED

SECTION ONE: NACE F (CONSTRUCTION)

A relatively small number of types of injury were responsible for most fatal accidents. The type of injury was unknown for around a third of accidents, but otherwise concussions were the most common kind of injury, followed by multiple injuries (representing cases where more than one injury of equal seriousness was incurred). Traumatic shocks – mainly to victims of electrocution – bone fractures and internal injuries were also common.

Most injuries occurred to the head, torso or multiple sites. It is likely that accidents to other parts of the body are more survivable and thus occur infrequently in fatal accident data.

WORKING PROCESS

While specific physical activity describes the actions undertaken at the exact moment of an accident, working process describes in broad terms the general kind of work being undertaken. For example, a victim may have the specific physical activity of walking, while engaged in the working process of maintenance or repair. No working process is recorded for non-working victims.

Unsurprisingly, most fatal accidents occurred to victims working in construction activities: constructing new buildings (103), repairing or extending buildings (74), and civil engineering activities (31). Other victims were involved in excavations, maintenance/repair (for example, of work vehicles) or preparation of work.

Table 1.9: Working process of victims of fatal accidents in construction, 1989-2016.

	Number	Percentage
New construction – building	103	30%
Remodelling, repairing, extending, building maintenance – all types of constructions	74	22%
New construction – civil engineering, infrastructures, roads, bridges, dams, ports	31	9%
Excavation, Construction, Repair, Demolition – Not specified	27	8%
Excavation	15	4%
Maintenance, repair, tuning, adjustment	13	4%
Setting up, preparation, installation, mounting, disassembling, dismantling	9	3%
Other	25	7%
Non-worker	41	12%
Total	**338**	**100%**

WORKING ENVIRONMENT

SECTION ONE: NACE F (CONSTRUCTION)

Working environment describes the general type of location where the accident happened. In the case of construction activity, ESAW methodology stipulates that the type of building being built or repaired is irrelevant, rather all construction activity should be coded with a working environment reflecting the construction work being undertaken: building being constructed, building being demolished, quarry, etc.

Naturally, most fatal accidents in the construction sector have working environments reflecting building sites of some sort, however, accidents can also occur outside the site. Figure 1.23 shows that most accidents occurred on construction sites, however, a number (16) occurred in public areas – typically public roads – and "industrial sites" (14). These industrial sites were primarily areas for storage or loading/unloading, as well as repair or maintenance workshops.

Most non-workers experienced fatal accidents on construction sites, however, a relatively high proportion were also involved in road traffic accidents on public roads.

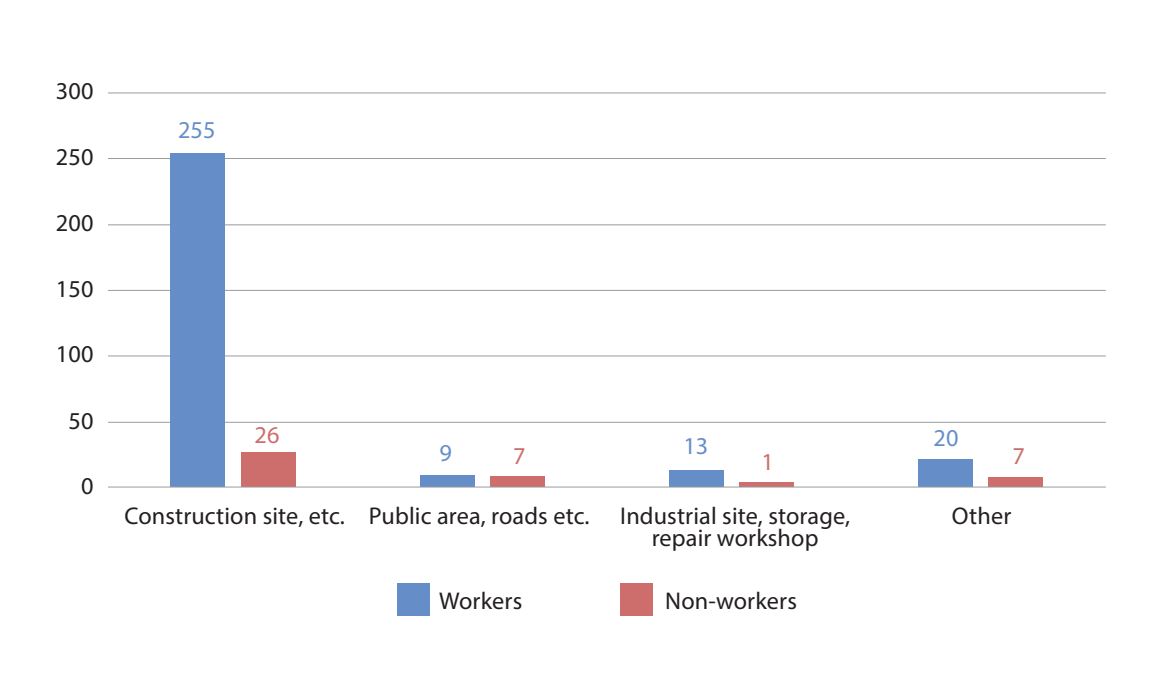

Figure 1.23: Number of fatal accidents occurring in each of the most common working environments, 1989-2016.

TIME OF DAY

Fatal accidents tended to reflect the hours of working activity, with most accidents (85%) occurring between 8am and 6pm (Figure 1.24). For workers, accidents declined for the hour between 1pm and 2pm, probably reflecting reduced activity during the lunch break.

- Non-workers had a slightly more dispersed pattern of injuries, with a small number of accidents occurring during the night from 1-4am and again in the evening from 8-11pm.
- In some cases, these represent incidents where members of the public gained access to building sites outside working hours.

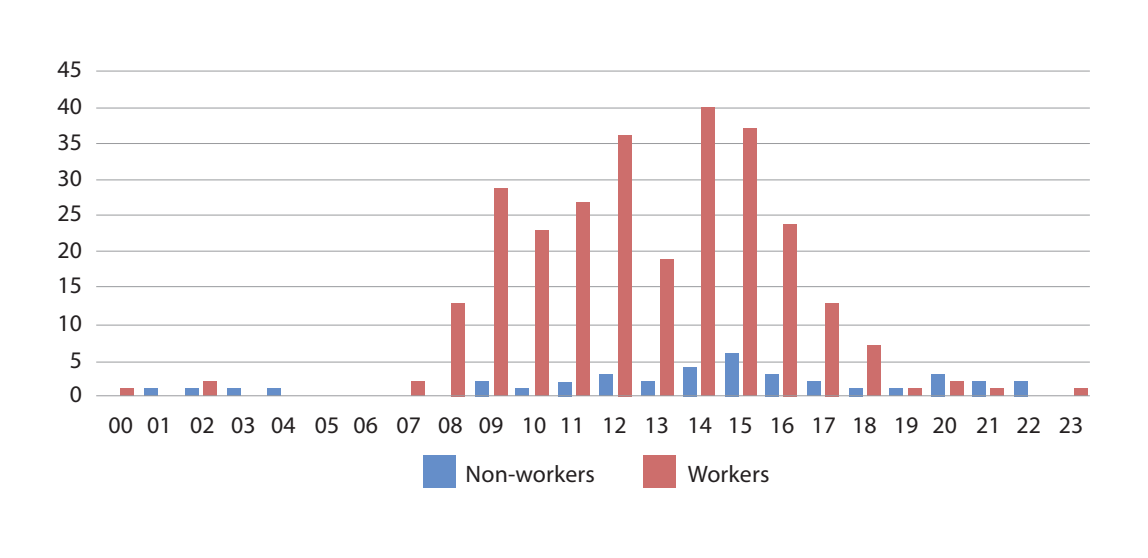

Figure 1.24: Number of fatal accidents occurring in each hour of the day, to workers and non-workers, 1989-2016.

The time of accident has changed little over the period 1989-2016, with most accidents clustering around the morning and early afternoon. This does not suggest that worker fatigue is one of the more important causes of accidents.

MONTH OF YEAR

SECTION ONE: NACE F (CONSTRUCTION)

Accidents were generally spread throughout the year, not showing a clear pattern (Figure 1.25).

- The highest number of accidents to workers occurred in August (12%), November (11%) and February and May (each 9%).
- The month with the fewest accidents was March (6%).
- However, it is difficult to identify any seasonal pattern to fatal accidents.

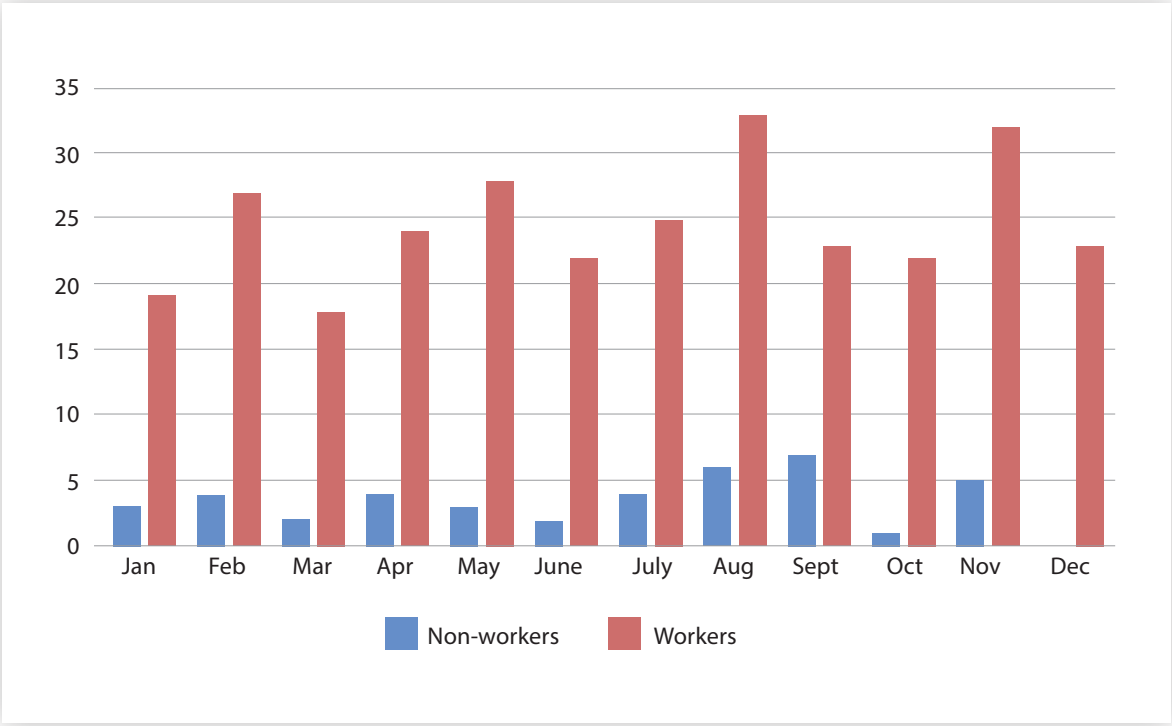

Figure 1.25: Number of fatal accidents occurring in each month of the year, to workers and non-workers, 1989-2016.

SUMMARY – SECTION ONE

SECTION ONE: NACE F (CONSTRUCTION)

Most fatal accidents in the construction sector since 1989 have occurred to Irish men, generally during office hours and especially around late morning or early afternoon. The victims were generally working in smaller businesses. The age of victims has increased over the period and this is probably due in part to a decline in the number of younger workers in the sector after 2008. However, rates of accidents have fallen for younger and middle-aged workers more than for older workers.

In general, the rate of fatal accidents per 100,000 workers has tended to decline since 1989.

- The single most common cause of accidents, responsible for around 40% of all deaths, was falling from height, including both cases where the victim fell freely or where the victim was standing on a structure like a ladder or roof that slipped or collapsed.
- Other important causes of accidents were losses of control of vehicles, often involving strikes by vehicles or crush injuries, slipping or collapsing of objects from above onto the victim, collapsing of trenches, electrocutions and drownings in liquid.

It is hoped that this information will facilitate the appropriate targeting of resources to continue to reduce fatal accidents in the construction sector.

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

OVERVIEW AND TRENDS

Construction activity giving rise to fatal accidents can be undertaken by businesses outside the construction sector. Civil engineering projects, including road construction or maintenance are often undertaken by county or city councils and coded to NACE sector O (Public administration and defence; compulsory social security). Farmers may also have accidents while undertaking repairs to farm buildings; while workers from companies that are primarily involved in manufacturing may also be involved on building sites in the construction process.

This section explores the characteristics of these accidents and makes some preliminary comparisons with accidents in the construction sector.

- A total of 102 fatal accidents of this kind occurred to workers from 1989-2016.
- Figure 2.1 below shows that most of these accidents occurred to people engaged in NACE sector A, Agriculture, forestry and fishing (44%), public administration (18%) and manufacturing (16%).
- A further 23 fatal accidents (23%) occurred to people working among nine other economic sectors.

Note: These accidents are primarily identified using the working process variable, representing the main type of work being undertaken by the victim at the time of accident. A few cases were excluded from this analysis after checking other variables; for example, farmers engaged in excavation – considered a construction activity in ESAW methodology – but who were actually working the land for farming.

Non-workers do not have any working process since they are not engaged in any work at the time of accident. Since identification of these non-workers is imperfect with the available variables, non-workers have been excluded from this analysis.

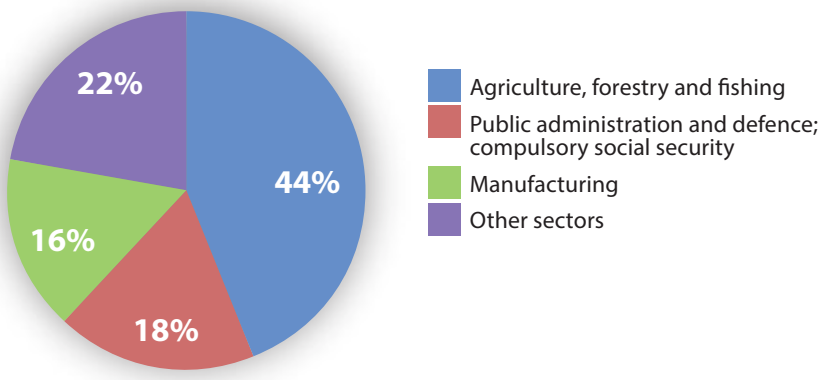

Figure 2.1: Percentage of all non-construction sector fatal accidents occurring to workers involved in construction activities in each NACE economic sector, 1989-2016.

OVERVIEW AND TRENDS cont'd

Figure 2.2 shows the number of these accidents in each year from 1990-2016, including a three-year rolling average. This shows a peak in the late 1990s, with 14 fatal accidents in 1998.

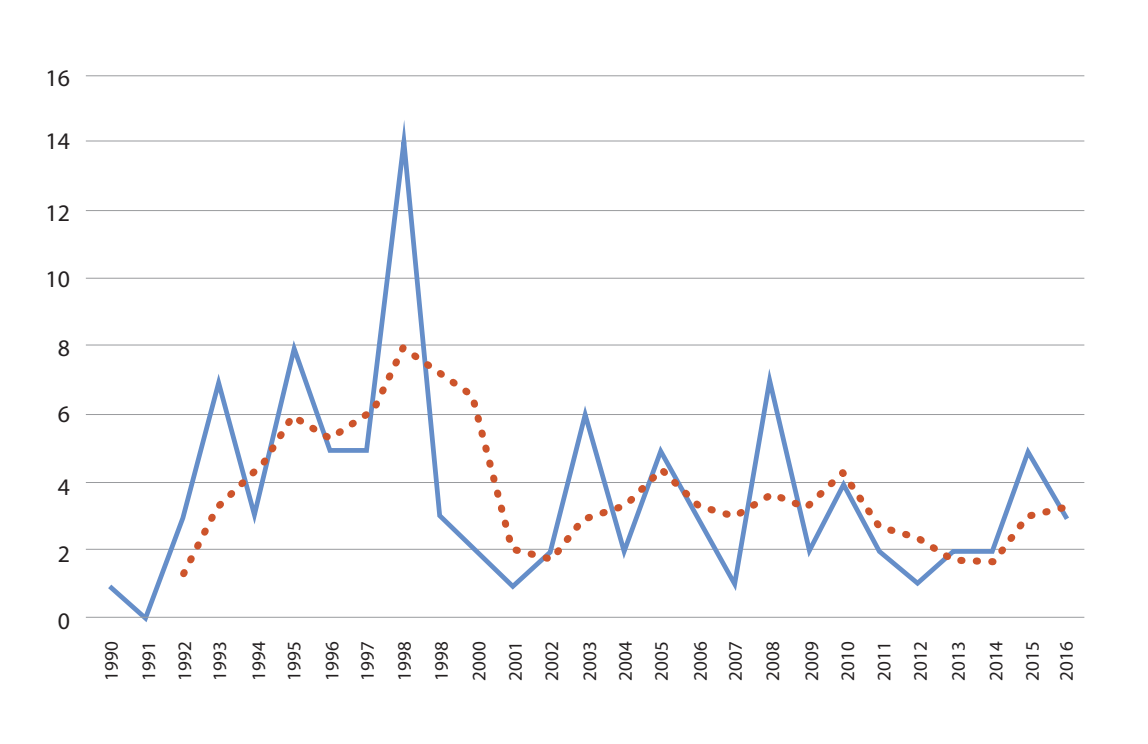

Figure 2.2: Number all non-construction sector fatal accidents occurring to workers involved in construction activities, by year, with three-year rolling average, 1990-2016.

It is difficult to generate meaningful rates per 100,000 people working for these accidents since they are spread across many economic sectors, for which most activity does not typically involve construction. However, Figure 2.3 compares the number of fatal accidents in construction activity outside the construction sector with the number of fatal accidents in NACE economic sector F (Construction) over the period. This shows that the large increase of construction fatal accidents during the building boom of the early 2000s did not have an equivalent increase in fatal accidents during construction activity outside the sector. Other than the one-year high in 1998, the number of accidents has averaged around three per year and remained stable over the full period.

Of the 14 fatal accidents taking place in 1998, 8 (57%) occurred to victims working in NACE A (Agriculture, forestry or fishing).

Note: ESAW methodology requires that the NACE economic activity of an employer is defined as "the most important kind of activity in terms of highest number of employees" at the local unit of work. For this reason, some workers who are primarily involved in construction activity are interpreted to work for manufacturing companies, where their local unit of business is involved mainly in manufacturing. Examples could include manufacturers of structural steel or precast concrete products. The victim may be involved in installing products on a building site, but the company is primarily involved in manufacturing these products and is coded as such.

OVERVIEW AND TRENDS cont'd

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

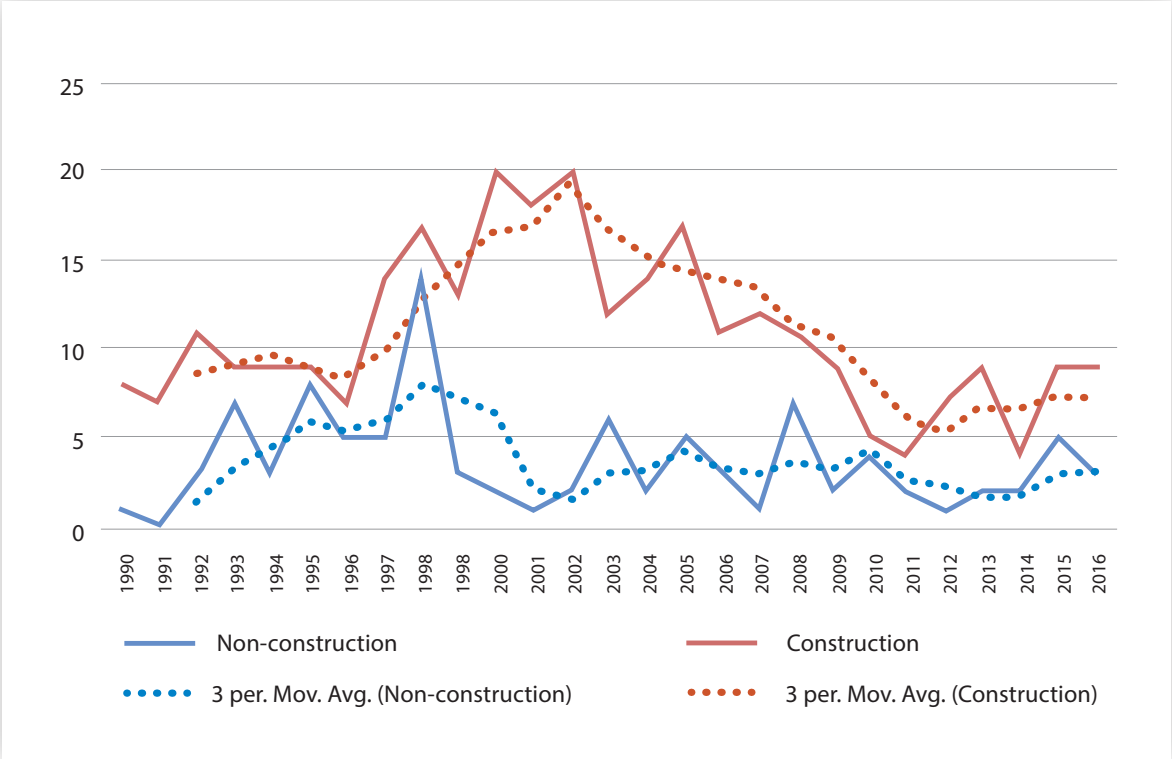

Figure 2.3: Number of non-construction sector fatal accidents occurring to workers involved in construction activities, by year, compared with construction sector accidents, 1990-2016, including three-year rolling averages.

CHARACTERISTICS OF VICTIM AND EMPLOYER

SIZE OF ENTERPRISE

As with construction sector, most fatal accidents occurring to victims involved in construction activity in other sectors involved smaller businesses.

- Figure 2.4 shows that 59% of these accidents belonged to companies with fewer than ten employees, while a quarter occurred to companies with unknown numbers of employees.
- Most self-employed people with no employees suffering fatal accidents were involved in agriculture, while most of those in businesses of ten or more employees were involved in civil engineering projects with local government employers.

Note again that ESAW methodology defines the size of enterprise as the "number of employees working at the local unit" of the workplace, so some large businesses may be coded as small due to the size of the local unit of work in these data.

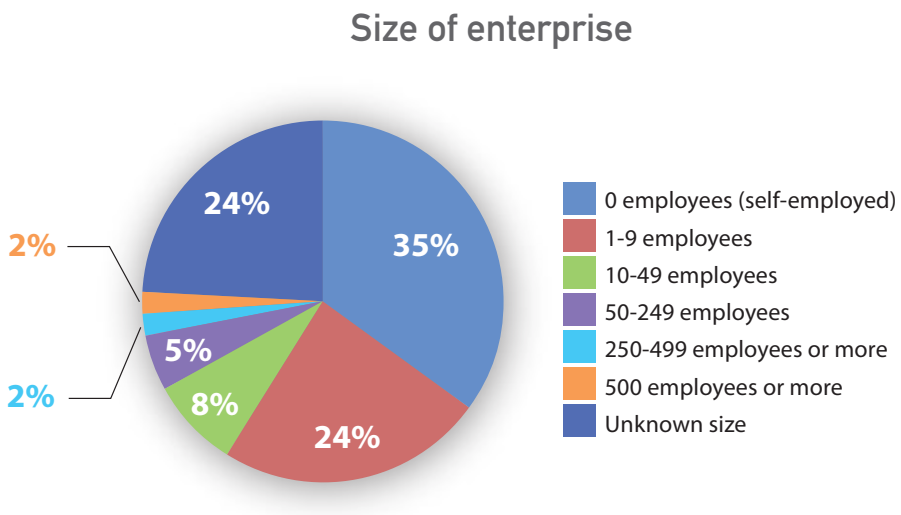

Figure 2.4: Percentage of fatal accidents to workers involved in construction activity but not employed in the construction sector in each size of enterprise, 1989-2016.

CHARACTERISTICS OF VICTIM AND EMPLOYER

EMPLOYMENT STATUS

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

Figure 2.5 depicts the employment status of victims in the three main economic sectors – NACE A (Agriculture, forestry and fishing), C (Manufacturing) and O (Public administration) – and all other sectors. This shows that the majority of victims in agriculture, forestry and fishing were self-employed, while victims in public administration were entirely employees.

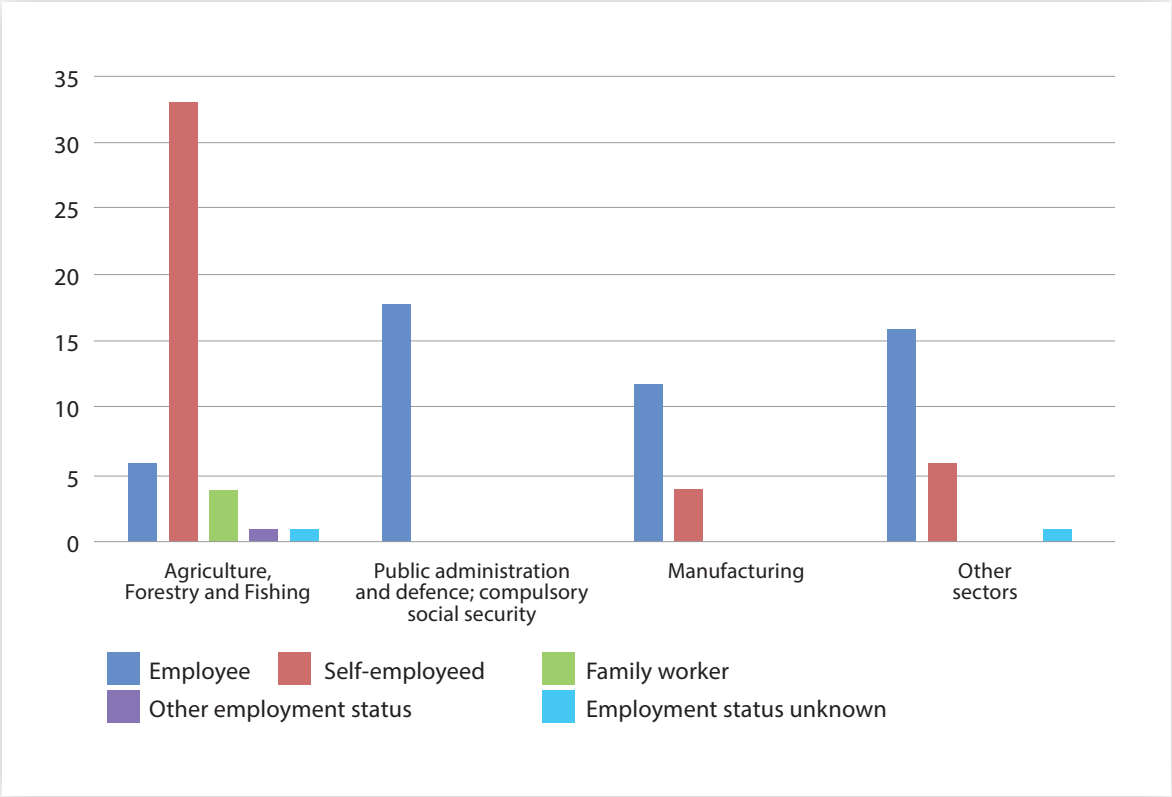

Figure 2.5: Number of fatal accidents to workers involved in construction activity but not employed in the construction sector by employment status, in major economic sectors, 1989-2016.

CHARACTERISTICS OF VICTIM AND EMPLOYER

AGE OF VICTIM

Almost half of all these victims were between the ages of 40 and 59 years (Figure 2.6).

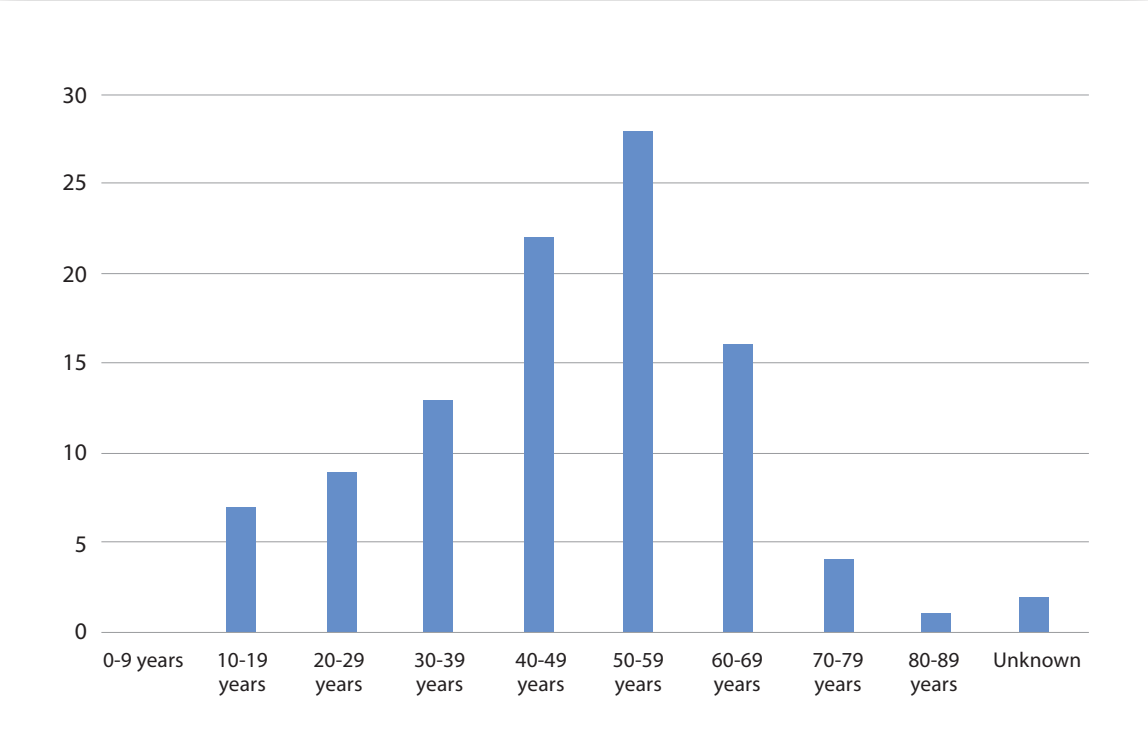

Figure 2.6: Number of fatal accidents to workers involved in construction activity but not employed in the construction sector in each age groups, 1989-2016.

CHARACTERISTICS OF VICTIM AND EMPLOYER

AGE OF VICTIM cont'd

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

This is compared with the age groups of worker victims in the construction sector in Figure 2.7 below, which shows that victims outside the construction sector were older on average than construction workers, and featured fewer young workers from 20-39 years.

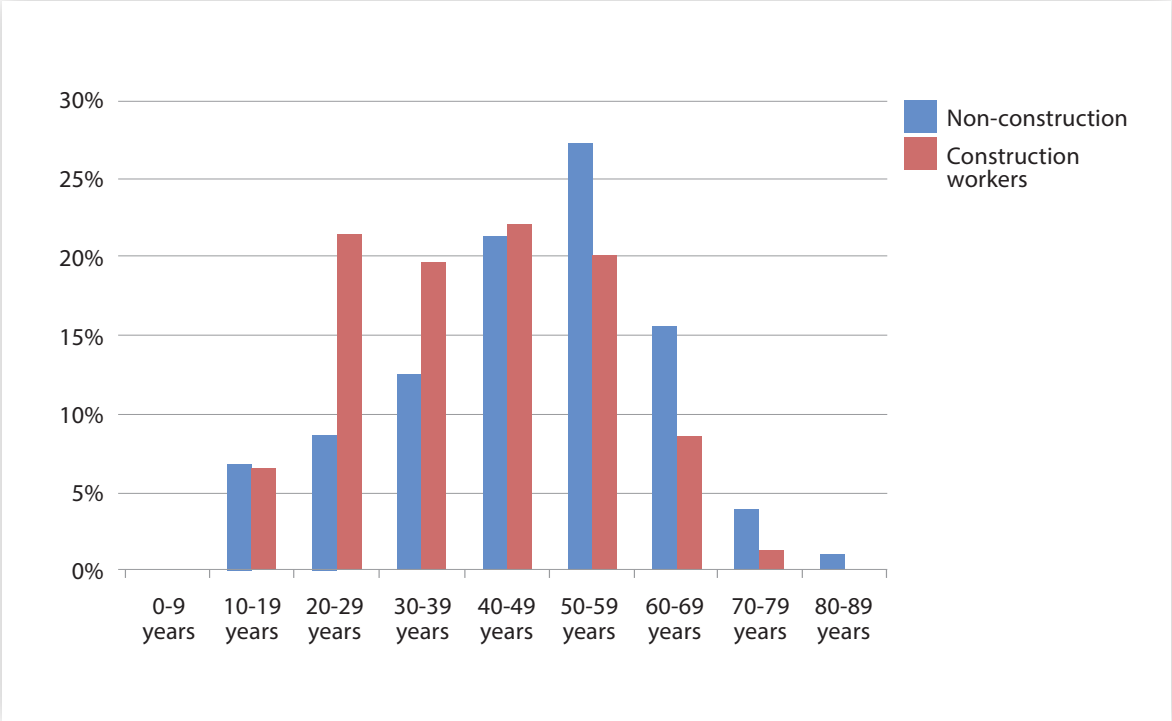

Figure 2.7: Percentage of all fatal accidents by age group of victims, workers involved in construction activity but not employed in the construction sector and Construction sector workers, 1989-2016.

In the construction sector, the age of victims tended to increase over the period, partly reflecting the increased age of workers in that sector.

- Figure 2.8 below shows that a similar process happened outside the construction sector.
- From 1989-1997, only 34% of victims were aged 50 years or over.
- By 2009-2016 this had increased to 62%.

CHARACTERISTICS OF VICTIM AND EMPLOYER

AGE OF VICTIM cont'd

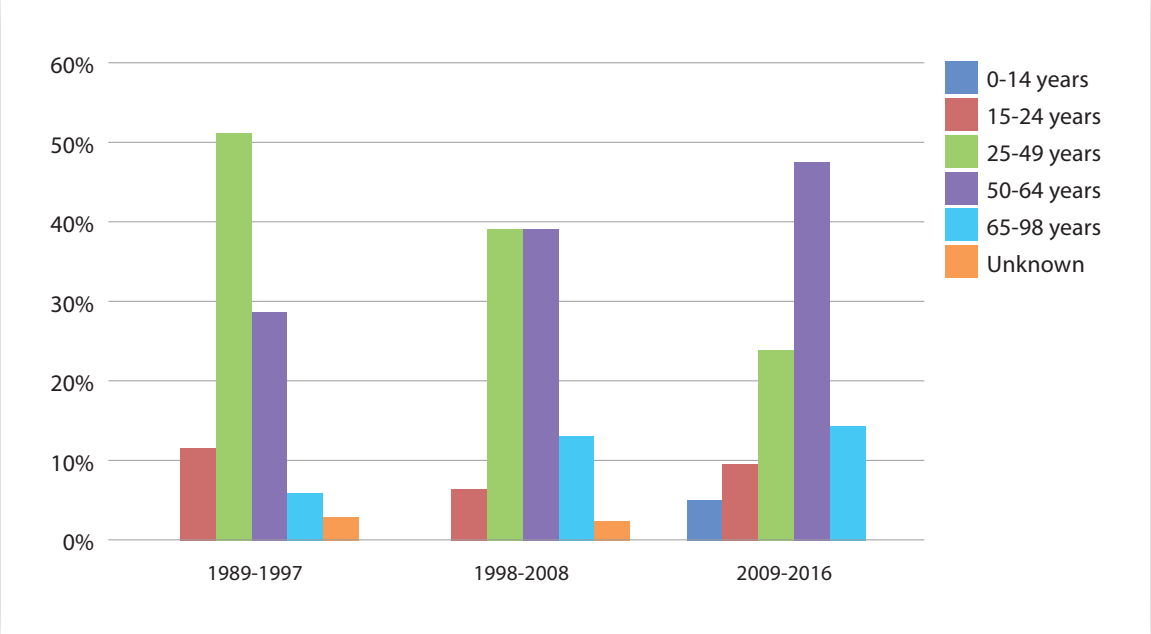

Figure 2.8: Percentage of all fatal accidents by age group of victims involved in construction activity but not employed in the construction sector, in three time periods, 1989-2016.

Rates of fatal accidents per 100,000 people employed aged 50 or more were generated for the three largest economic sectors, NACE A (Agriculture, forestry and fishing), C (Manufacturing) and O (Public Administration) for the period 1998-2016 (Eurostat 2017, 2018).

Figure 2.9 shows that the rate of fatal accidents for people aged 50 years or over fell for manufacturing and public administration, and increased only slightly for agriculture, forestry and fishing between 1998-2008 and 2009-2016. This suggests that the increased age of victims was probably primarily due to increased age of the working populations in these sectors.

Note: Eurostat switched from the statistical classification of economic sectors NACE rev. 1 to NACE rev. 2 in 2008, which makes it difficult to compare groups over time. Caution should be taken in interpreting these data.

CHARACTERISTICS OF VICTIM AND EMPLOYER

AGE OF VICTIM cont'd

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

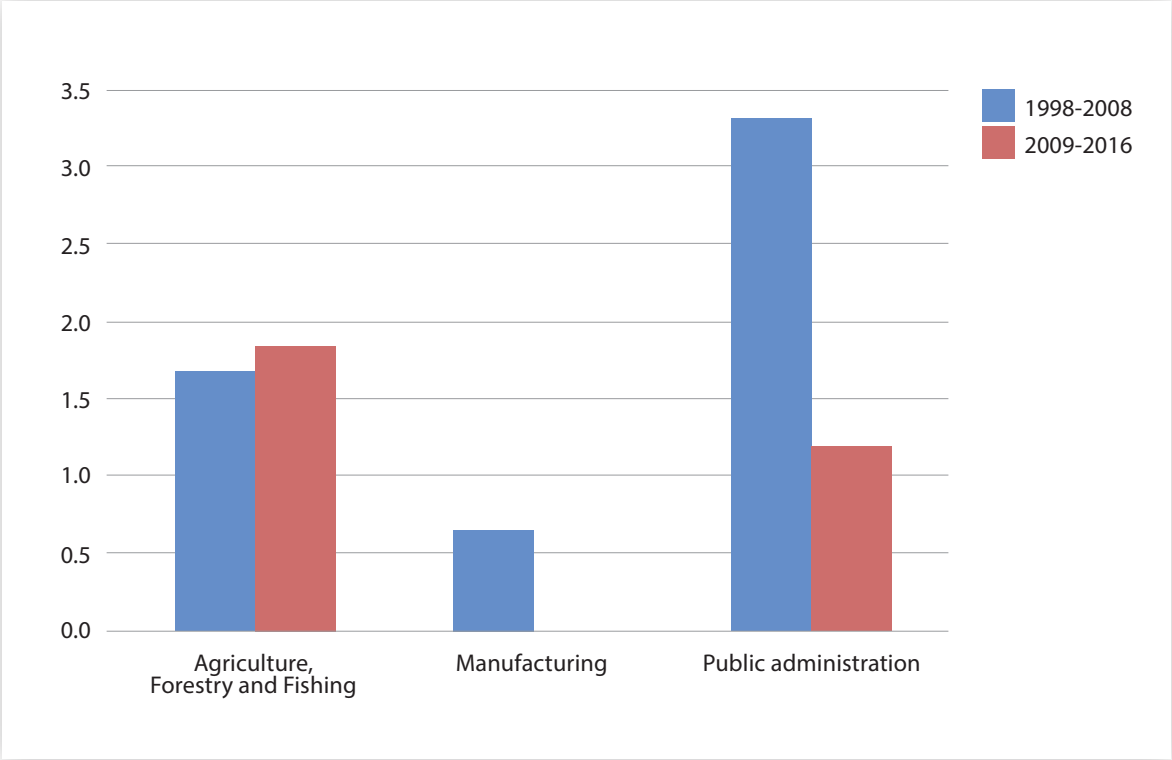

Figure 2.9: Rate of fatal accidents per 100,000 people aged 50 or over, employed in three economic sectors and engaged in construction activity, 1998-2008 and 2009-2016.

SEX AND NATIONALITY

As with fatal accidents in the construction sector, almost all accidents (101, 99%) occurred to male victims. The vast majority of victims were also Irish (96%).

CAUSES AND CHARACTERISTICS OF ACCIDENTS

DEVIATION

As with the construction sector, falls from height were a major cause of accidents in construction activity outside that sector, contributing 30% through the collapse of materials from below and 19% through falls (Table 2.1). Other important deviations were losses of control of vehicles (13%) and collapses of materials from above (11%).

Table 2.1: Most common deviations leading to fatal accidents to victims involved in construction activity but not employed in the construction sector, 1989-2016.

	Number	Percentage
Collapse of material agent from below	31	30%
Fall of person to a lower level	19	19%
Loss of control of means of transport	13	13%
Collapse of material agent from above (falling on the victim)	11	11%
Presence of the victim or of a third person in itself creating a danger	6	6%
Loss of control of machine	6	6%
Other deviation	16	16%
Total	**102**	**100%**

- Figure 2.10 shows the most common deviations for the three main NACE economic sectors responsible for accidents involving construction activity.
- Most accidents in agriculture, forestry and fishing were caused by collapses of material agents from below and falls from height, typically cases where farmers were involved in repairs or construction on the roofs of farm buildings.
- A frequent aspect of these accidents was the collapse of fragile roof surfaces such as asbestos roofs or Perspex skylights from beneath the victim.
- Falls from height were also common causes of fatal accidents in manufacturing. These probably mainly represent workers involved in construction activities like installation or structural steel erection on building sites, or in building maintenance/repair in their own factories. Note, however, that this is difficult to determine from the available data.
- Loss of control of vehicles was more common for public administration, as well as "presence of the victim or of a third person in itself creating a danger". These generally represented cases where drivers lost control of vehicles or workers strayed into dangerous areas (public roads, behind reversing construction vehicles, etc.) while the victim was involved in civil engineering projects.

CAUSES AND CHARACTERISTICS OF ACCIDENTS

DEVIATION cont'd

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

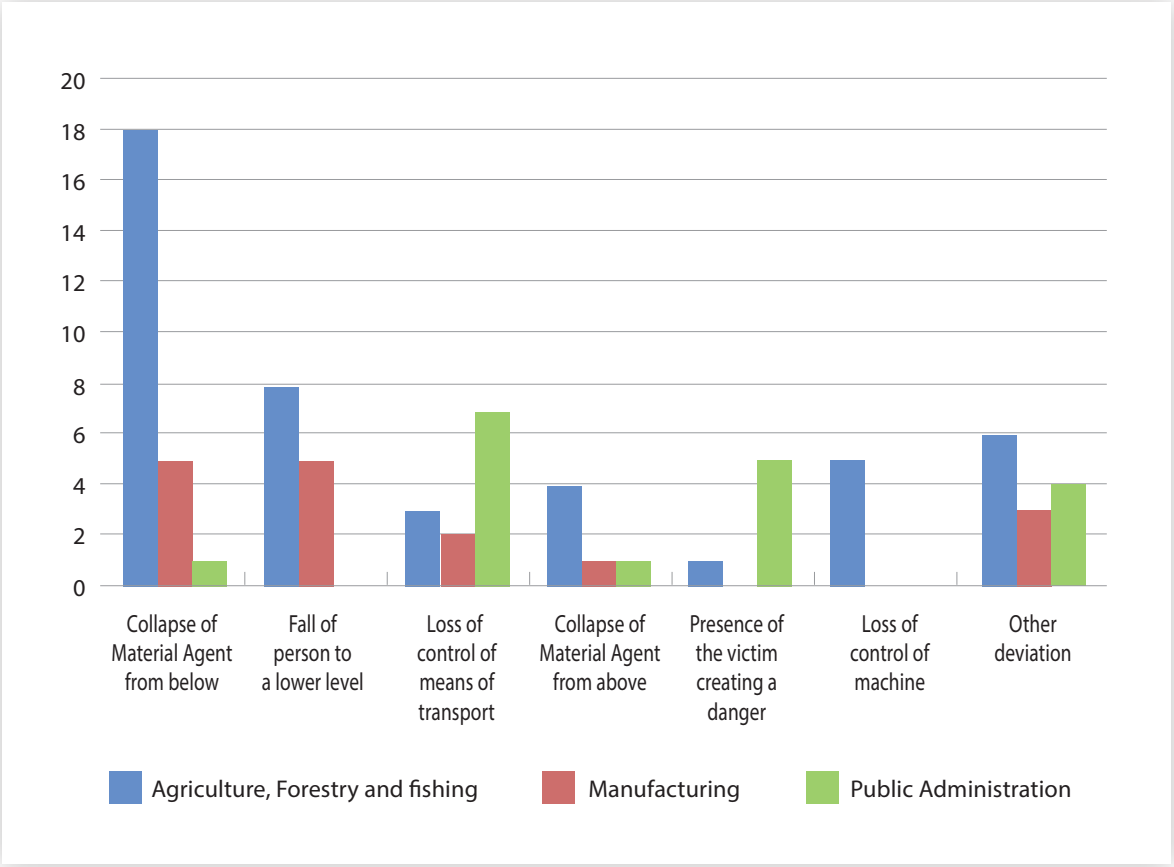

Figure 2.10: Number of fatal accidents to workers involved in construction activity but not employed in the Construction sector involving the most common deviations in selected economic sectors, 1989-2016.

A brief analysis of the deviations most common with workers of different ages shows little relationship between age and deviation (Figure 2.10a).

- For both workers above and below 50 years, collapses of material agents from below and falls from height were responsible for most accidents in each group.
- Six workers aged 50 or over suffered fatal accidents due to their own presence in a dangerous area, for example, on a public road or behind a reversing vehicle, while no workers under 50 years suffered such an accident.

However, caution should be taken in interpreting this result since the number of workers experiencing this deviation was extremely low.

CAUSES AND CHARACTERISTICS OF ACCIDENTS

DEVIATION cont'd

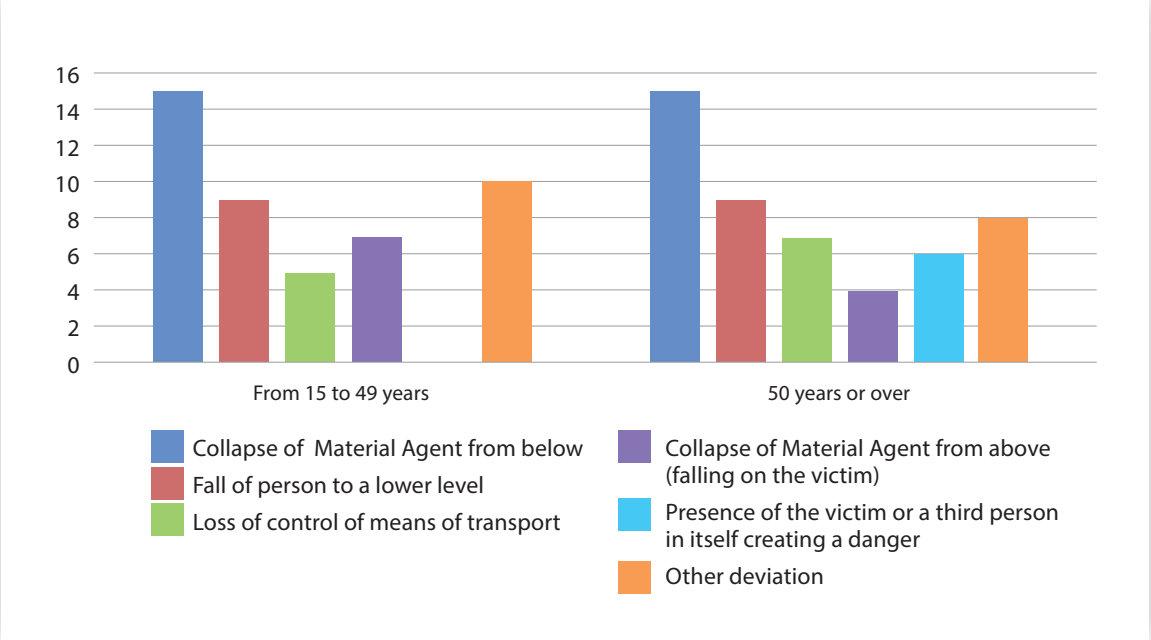

Figure 2.10a: Number of fatal accidents to workers involved in construction activity but not employed in the Construction sector involving the most common deviations for workers above and below 50 years, 1989-2016.

CONTACT – MODE OF INJURY

Table 2.2 showing the most common modes of injury illustrates again that most fatal accidents during construction activity outside the construction sector were caused by falls from height (51%), with fewer accidents caused by strikes by vehicles (12%), crushing under materials (9%) and strikes by falling objects (8%). This pattern is fairly similar to accidents in the construction sector, where 40% of victims fell from height.

Table 2.2: Most common modes of injury leading to fatal accidents to victims involved in construction activity but not employed in the construction sector, 1989-2016.

	Number	Percentage
Vertical motion, crash on or against (resulting from a fall)	52	51%
Struck – by rotating, moving, transported object, including vehicles	12	12%
Trapped, crushed – under	9	9%
Struck – by falling object	8	8%
Trapped, crushed – between	6	6%
Drowned in liquid	6	6%
Other	9	9%
Total	**102**	**100%**

The three major economic sectors with the highest number of construction-related accidents – NACE A (Agriculture, forestry and fishing), C (Manufacturing) and O (Public administration) – are depicted below with the most common modes of injury. This shows that impacts following falls from height were common causes of fatal injury in agriculture, forestry and fishing and manufacturing, while strikes by vehicles were more common with public administration.

This supports the earlier observation that farmers and manufacturing workers typically experienced injuries due to their work at heights on a building site, either from falls or from the collapse of fragile roofs, skylights, etc. Meanwhile accidents in public administration were more likely to involve strikes by vehicles, probably because these construction activities primarily involved civil engineering projects such as road construction or maintenance, with fewer high-elevation working environments.

CONTACT – MODE OF INJURY cont'd

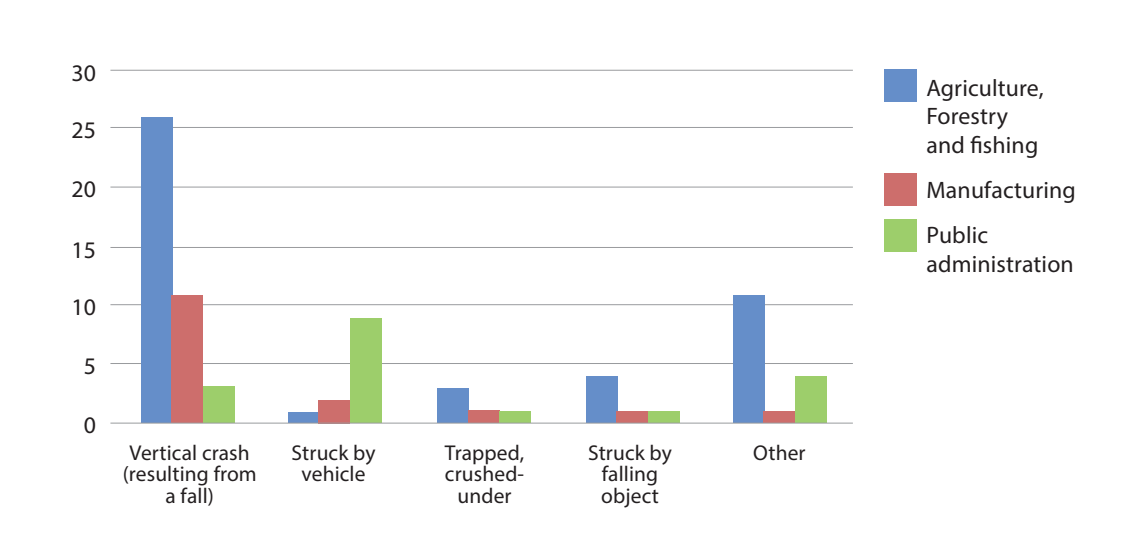

Figure 2.11: Number of fatal accidents to workers involved in construction activity but not employed in the construction sector involving the most common modes of injury in selected economic sectors, 1989-2016.

MATERIAL AGENT ASSOCIATED WITH DEVIATION

Comparing the most common deviations with the material agents associated with them highlights again the high number of accidents involving falls from height.

- Collapses of material agents from below and falls were associated mainly with roofs, but also mobile platforms including scaffolds and ladders.
- The collapse of roofs often involved sections of fragile roofs such as skylights or asbestos roofing material on farm buildings.
- Losses of control of vehicles were associated with mobile machines for extracting materials (for example, excavators), farming vehicles (primarily tractors), mobile machines for construction sites (for example, dump trucks), and cranes.

Table 2.3: Deviation by material agent associated with deviation for fatal accidents to victims involved in construction activity but not employed in the construction sector, 1989-2016.

Deviation	Material Agent associated with Deviation									
	Roofs, stairs, etc.	Scaffold, ladder, etc.	Vehicle for extracting materials	Doors, walls, etc.	Tractor, etc.	Building material	Mobile machines for construction sites	Cranes, etc.	Other	Total
Collapse of material agent – from below	23	5	0	0	0	2	0	0	1	31
Fall of person to a lower level	5	7	0	2	0	0	0	0	5	19
Loss of control of means of transport	0	0	4	0	2	0	2	1	4	13
Collapse of material agent from above	0	0	1	5	0	2	0	2	1	11
Presence of the victim creating a danger	0	0	3	0	0	0	1	0	2	6
Other deviation	4	1	1	1	2	0	0	0	13	22
Total	**32**	**13**	**9**	**8**	**4**	**4**	**3**	**3**	**26**	**102**

MATERIAL AGENT ASSOCIATED WITH CONTACT – MODE OF INJURY

Table 2.4 compares the most common modes of injury with the material agents associated with them. This shows unsurprisingly that most fall accidents lead to impacts on the ground or floor (46). Those victims who were struck by vehicles were primarily struck by vehicles for extracting materials (for example, excavators), and mobile machines for construction sites (for example, dump trucks). Vehicles were also involved in accidents featuring crush injuries.

Table 2.4: Contact – mode of injury by material agent associated with mod of injury for fatal accidents to victims involved in construction activity but not employed in the construction sector, 1989-2016.

Mode of Injury	Material Agent associated with Contact – Mode of Injury									
	Ground and floors	Vehicle for extracting materials	Doors, walls, etc.	Machine/ vehicle components	Building material	Tractor, etc.	Mobile machines for construction sites	Cranes, etc.	Other	Total
Vertical motion, crash on or against (resulting from a fall)	46	0	2	1	1	0	0	0	2	52
Struck – by rotating, moving, transported object, including vehicles	0	5	0	0	0	0	2	0	5	12
Trapped, crushed – under	1	2	3	0	0	1	1	0	1	9
Struck – by falling object	0	0	2	3	2	0	0	0	1	8
Trapped, crushed – between	1	0	0	0	1	3	1	0	0	6
Drowned in liquid	1	0	0	0	1	0	0	4	0	6
Other	0	1	0	2	0	1	0	0	5	9
Total	**49**	**8**	**7**	**6**	**5**	**5**	**4**	**4**	**14**	**102**

SUMMARY – SECTION TWO

SECTION TWO: CONSTRUCTION ACTIVITY IN NON-CONSTRUCTION SECTORS

Fatal accidents to victims involved in construction activity but employed outside the construction sector, tended to broadly resemble those within the construction sector. The age of these victims has increased since 1989, but this may be due to the aging of the working population in the relevant NACE economic sectors. The clear majority of victims were Irish and male.

Unlike accidents in the construction sector, accidents peaked in 1998 before falling and remaining relatively low during the Celtic Tiger period of high construction activity.

- Over half of the accidents in the 1998 peak occurred to workers in NACE A (Agriculture, forestry and fishing).
- While accidents in the construction sector mirrored the steep increase and decline of the housing market from 1997-2008, accidents involving construction outside that sector did not.
- Considering the high proportion of all accidents taking place in agriculture, forestry and fishing since 1989 (44%), it may be that these accidents do not clearly represent changes in the wider economy.
- Accidents to farmers engaged in repairing or constructing farm buildings typically involved falls from height, often due to collapses of fragile roofs or skylights beneath them. Fatal accidents to manufacturing workers also tended to involve falls from height.
- Workers in public administration more commonly experienced accidents involved vehicles. Such victims were typically struck by vehicles or experienced crush injuries, either due to the loss of control of vehicles by drivers or by entering a dangerous area (for example, walking behind a reversing vehicle).

CONCLUSION

In both the construction sector and also other sectors where workers were engaged in construction activity, most fatal accidents are caused by a relatively small number of deviations. For both groups, falls from height, including collapses or slips of roofs, ladders, etc. were major causes of accidents. Vehicles were also involved in a number of accidents, as were collapsing trenches, electrical contacts leading to electrocution, drowning and strikes from falling objects like building materials or collapsing walls.

It is hoped that this analysis will contribute to the efficient targeting of resources to reduce the number of these tragic accidents in construction activity.

REFERENCES

Central Statistics Office (1997) LFAA1: ILO Persons aged 15 years and over in employment (1988-1997) by Sex, Economic Sector and Year [Online] Available at: http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=LFAA1&PLanguage=0 [Accessed 26 October 2017].

Central Statistics Office (2017) QNQ40: Persons aged 15 years and over in Employment by Sex, NACE Rev 2 Economic Sector, Region and Quarter [Online] Available at: http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?Maintable=QNQ40&Planguage=0 [Accessed 26 October 2017].

Central Statistics Office (2017) QLF21: Person aged 15 years and over in Employment by Nationality, NACE Rev 2 Economic Sector and Quarter [Online] Available at: http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=QLF21&PLanguage=0 [Accessed 11 May 2018].

Eurostat (2013) European Statistics on Accidents at Work (ESAW) Summary methodology 2013 Edition, Luxembourg: Publications Office of the European Union, available: http://ec.europa.eu/eurostat/documents/3859598/5926181/KS-RA-12-102-EN.PDF/56cd35ba-1e8a-4af3-9f9a-b3c47611ff1c [Accessed 16 March 2017].

Eurostat (2017) Annual enterprise statistics by size class for special aggregates of activities (NACE Rev. 2) [dataset] sbs_sc_sca_r2, Eurostat, available: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sbs_sc_sca_r2&lang=en [Accessed 23 November 2017].

Eurostat (2017) Employment by sex, age and economic activity (1998-2008, NACE Rev. 1.1) - 1 000 [dataset] lfsq_egana, Eurostat, available: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsq_egana&lang=en [Accessed 16 November 2017].

Eurostat (2018) Employment by sex, age and economic activity (from 2008 onwards, NACE Rev. 2) - 1 000 [dataset] lfsq_egan2, Eurostat, available: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsq_egan2&lang=en [Accessed 2 March 2018].

Eurostat (2018) Fatal Accidents at work by NACE Rev. 2 activity [dataset] hsw_n2_02, Eurostat, available: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsq_egan2&lang=en [Accessed 9 March 2018].

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