Recurring accidents: *slips, trips and falls*

Tony Fishwick looks at a set of common accidents and how to guard against them

THIS article focuses on preventing accidents and injuries caused by slips, trips and falls (STFs), sometimes called 'moving around' accidents. These types of accident occur in all categories of industry, commerce and academia and at frequencies that are unacceptably high – but more on that later – and have a variety of causes, of which poor engineering is a significant one. Conversely, good engineering can be shown to be one of the most successful ways of avoiding them. At process, and other, engineering facilities they occur with much the same frequency as at universities, in offices and virtually anywhere else where men and women gather to earn their daily living. They result in serious injuries and, sometimes, fatalities.

the causes of slips, trips and falls

There is a vast range of causes for these accidents, but they can be conveniently grouped together under a fairly small number of headings. The main ones include:

- **falls from height** – for example, from ladders or scaffolding; through holes in flooring; down stairways; and through insecure roofing. Many of these result from poor engineering work.
- **falls on the same level** – these can be caused by wet or icy surfaces; loose carpets, rugs or mats; obstructions in the walkway; trailing electrical cables; and uneven surfaces. Usually, these have their origins in human behaviour but poor engineering can sometimes play a part.

Country or region	STF as % of total accidents	Year
United Kingdom[2]	29	2011
European Union[3]	23	2005
Australia[4]	21	2010
US[5]	24	2007
France[6]	24	2007

Table 1 – Proportion of total accidents caused by slips,trips and falls

- **falls into holes** – these include into pits or temporary excavations, or into process vessels. Often, these occur as a result of ineffective guardrails or other examples of poor engineering.
- **inadequate safety procedures** – for example, not issuing permits to work; failure to install adequate safety measures or to provide suitable personal protective equipment (PPE); and installing and operating unsafe equipment.
- **not following safety procedures** – such as not wearing PPE, not observing the terms of permits to work or creating an unsafe situation by rushing to finish a job.

the legal requirements

In Great Britain, the legal requirements are set out in guidance issued by the Health and Safety Executive[1].

The Health and Safety at Work Act 1974 requires employers to ensure the health and safety of all employees, and anyone

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who may be affected by their work, so far as is reasonably practicable. This includes taking steps to control STF risks. Employees have a duty to not put themselves or others in danger and to use any safety equipment provided.

The Management of Health and Safety at Work Regulations 1999 require employers to assess risks (including STF risks) and, where necessary, take action to address them.

The Workplace (Health, Safety and Welfare) Regulations 1992 require floors to be suitable, in good condition and free from obstructions. People should be able to move around safely.

Analogous legislation exists in industrially developed nations throughout the world.

the size of the problem – accident statistics

Slips, trips and falls (STF) are a major contributor to the overall range of accident causes across the world (see Table 1).

The broad similarity in the rates of STFs across regions that vary so greatly in location, climate, population density, ethnic background and other social factors further illustrates the universal significance of this category of accident. Figures for other individual countries follow a similar pattern as exemplified by Ireland (23% in 2011) and Canada (17% in 2011). Consideration of how this picture might vary from industry to industry shows that, in fact, there is only a fairly small difference between sectors (see Figures 1 and 2)[7].

In the last two decades, a great deal of effort has been invested trying to reduce the frequency of 'conventional safety' accidents. These are accidents that occur for general reasons, such as manual handling, and include STFs.

The success of these initiatives in the general sense can be demonstrated by the downward trends in both major injuries and in those resulting in more than three days' absence from work as defined by Great Britain's Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). Thus, in reporting year 2008/9, the total number of major injuries in the UK was 27,594, falling to 26,061 (2009/10) then 22,433 in 2011/12 – down by 19%.

Over the same period of time, the number of accidents resulting in more than three days' lost time were 104,301 (2008/09), 95,369 (2009/10) and 88,371 (2011/12) – down by 15%.

The number of STF-related accidents resulting in more than three days' lost time, fell from 25,000 (2008/09) through 23,000 (2009/10) to 21,000 (2011/12) – down by 16%, which is in line with the overall trend.

However, the number of major injuries caused by STFs have remained broadly the same – 9,500 (2008/09), 10,700 (2009/10) and 9,000 (2011/12). Major injuries include fatalities, so it is of great concern that they have not fallen at the same rate as the less serious ones.

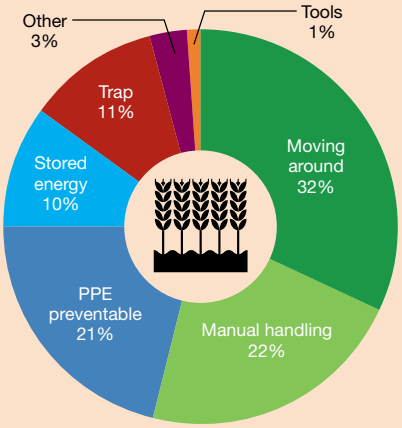
One theory as to why this might be the case is that STF accidents are sometimes regarded as trivial. The statistics provide ample evidence that, in reality, this is far from the case. Figures 3 and 4[7] show that such accidents continue to be significant in areas of commerce and the process industry. The case studies that follow provide practical evidence to support this.

practical steps for the prevention of STFs

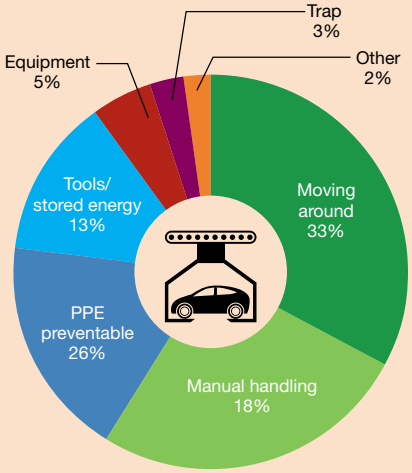
The case studies highlight the wide variety of types of STF accidents. The potential means of preventing them are equally wide

Figures 1–4: Causes of STF accident injuries

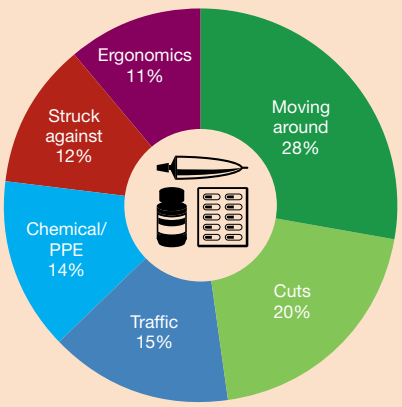
1. At a food manufacturer (2006)



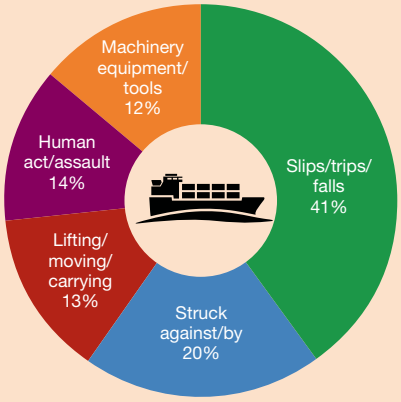
2. At a transport engineering company (2005)



3. At a light chemical manufacturer (2012)



4. At a shipping line (2012)



Notes: a) Stored energy includes items falling onto people
b) Traps include trapped inside vessels

ranging. The Health and Safety Executive[1] provides guidance on the subject and places preventative measures into groups. In summary, these are:

- **Prevent floor contamination** – use floor matting; fix leaks immediately and use designs to minimise leaks; ensure that plant is safely maintained.
- **Use the right cleaning materials** – leave floors dry after cleaning; exclude pedestrians until floors are dry; have effective cleaning schedules.
- **The flooring and general work environment** – replace loose, damaged and worn flooring; use non-slip floor material where spillages are likely to occur; provide adequate lighting; ensure that slopes and steps are clearly visible; keep walkways and work areas clear of obstructions.
- **Use the right footwear** – consider the use of non-slip footwear; take account of employees' views, ie comfort and fit; and if it is supplied as personal protective equipment, then it must be free of charge.

To these, we can add:

- **Engineered solutions** – use guardrails around holes, and safely designed platforms and bridges for work at height; ensure systems of work are designed and implemented to avoid obstructions and other potential hazards; make sure temporary manhole covers are of sufficient strength; aim for leak-free design of equipment and provide spillage catch trays; ensure staircases have handrails; design plant items that provide easy access to valves, instruments and other components.
- **Procedural considerations** – Adhere to terms of permits to work, vessel entry requirements and regulatory conditions for example, for ladder work.
- **Human behavioural considerations** – Keep the workplace tidy; wear the prescribed safety clothing; attend promptly to spillages; always hold the handrail when descending stairs.

In January, HSE published updated guidance on working safely at height – an activity that leads to some of the most serious accidents[8]. This includes simple dos and don'ts, targeted advice for different business sectors, guidance on workers' responsibilities for working safely, and busting of persistent health and safety myths.

Avoid repetitions – ways and means

The late, highly respected, safety leader Trevor Kletz examined the subject of why accidents recur[9]. Essentially, his thesis

Case studies

These case studies have been chosen to show the many ways that STFs can occur and the varying, often serious, consequences.

A fall through a fragile roof

A worker was helping to replace a roof when he stepped backwards onto a fragile roof light and fell approximately 7 m to his death. No safety precautions had been taken and no safe system of work was in operation. The equipment to prevent falls through fragile materials such as guard rails and safety harnesses is readily available but in this case was not used.

A fatal fall through a hole

A reactor loop structure was shut down for modification. This required the removal of a section of floor grating, leaving a hole in the floor. Handrails, using scaffold poles, were erected round three sides of the hole but, on the fourth side, only a rope was used to allow equipment to be lowered without obstruction. Three workmen were on the platform when they were joined by two others. One of these two fell through the hole – a fall of about 10m – and was killed. Again, a poor engineering solution – a rope – was used instead of an adequate guard system. A handrail should have been used, even though it would have required an engineered design to achieve it.

A slip on ice

Two individuals slipped on ice and fell. No grit or salt had been applied to the affected areas. Furthermore, no subsequent action was taken. Falls of this nature often result in broken bones.

Fragile temporary manhole cover

Work was being carried out on the top of a silo. The work required removal of the cover from a manhole so that a pressure vent could be installed. A temporary cover was fitted over the manhole. It was made from stainless steel plate but only 1 mm thick. Although it was hammered down round the edges to secure it, when a man leaned on it, it buckled and caved in. He fell 11 m into the silo and died.

Improvisation results in fatalities

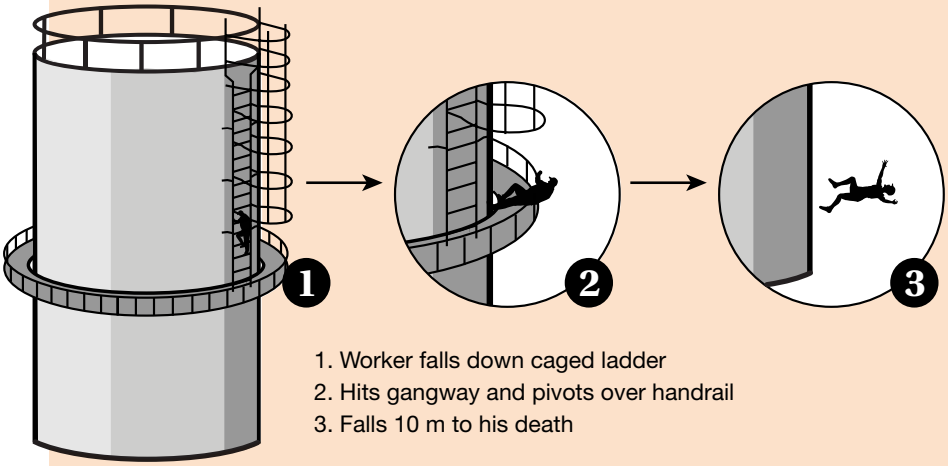
A man fell 21 m to his death after his clothing got caught on a steel beam as he pushed it over the edge of a building. He should have had it lowered by a crane. In a separate incident, a contractor was working on the demolition of a cooling tower when he fell from a platform and was killed. He had been attempting to cross to another platform when a poor-quality board bridging the gap gave way under his weight. A properly-engineered support between the two platforms should have been used.

Spilt cooking oil causes serious burns

Staff in a fast food outlet were cleaning up once trading had ended. The cook was walking over a floor that had just been mopped when he slipped and fell. He instinctively reached out to break his fall and pulled over an electric deep fat fryer. It spilled its contents, 35 l of boiling oil, onto him and onto the floor. Surrounded in oil, he could not get up. Each time he tried, he fell back again until another employee pulled him clear. He suffered extensive burns to his ankles, legs, buttocks and chest, and needed skin grafts. The company was fined £60,000 with £16,000 costs. Poor floor maintenance and cleaning, inadequate footwear and low slip resistant floor tiles were found to be the causes of the accident. The company took steps to rectify these matters in all their outlets.

Figure 5: A fatal fall from height

A worker fell from a ladder, through the gap between the bottom of the fixed ladder cage and the handrail of an elevated platform. The platform was about 10 m above ground. The worker pivoted over the handrail as he fell. He later died from his injuries. The procedures for use of ladders were not fully followed and this resulted in a failure to design and install a safe system. To prevent a recurrence, the gap was enclosed with rope netting.



1. Worker falls down caged ladder
2. Hits gangway and pivots over handrail
3. Falls 10 m to his death

was that organisations have little, or no, corporate memory. They fail to record and circulate the lessons learned from past accidents; experience and skills are lost as people retire and companies cut permanent staff to save costs; contractors are used for non-routine work without adequate training and supervision; supervisors are overloaded. To prevent repetitions, Kletz provided some helpful techniques. These include:

- describe accidents in safety bulletins;
- follow up accident investigation recommendations to ensure that they have been put into effect;
- never change a procedure until the reason is fully understood;
- try to learn about accidents in other organisations; and
- emphasise the importance of risk assessments.

The next question is "how to put all this into practice?" One widely used and effective technique is the toolbox talk.

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Toolbox talk (TBT)

A TBT is a short (5–30 minutes) informal way of educating the workforce and getting their views on specific health, safety and environmental topics including accident prevention. Typically, TBTs are presented by the first line supervisor to the work teams in the workplace, although this is not an exclusive protocol. They should be interactive and draw out the views and ideas of the team members. They are very effective for addressing specific activities that regularly lead to accidents, often of a similar nature. With regard to STFs, a good example would be the use of ladders. Falls from ladders arise from a variety of causes – poor securing (at top or bottom); hands slipping due to holding the side poles instead of the rungs; having the ladder at the wrong angle; broken rungs and others. Nor are standard pole-type ladders the only source of accidents. Falls also occur from step ladders and, as Figure 5 demonstrates, from ladders attached to items of plant and to other fixed structures.

Other activities that might benefit from the TBT approach include taking care over wet or greasy floors and ensuring that a structured, risk assessment-based protocol is in place for temporary engineered modifications such as guardrails round holes in flooring and open manholes. However, many STFs are individual 'one-off' events and, as such, not really amenable to use of the TBT approach. For these, greater benefit and reduction of accident rates might be gained from the use of techniques falling under the general headings of 'observe and learn' and 'think before acting'. A good example of this is key safe behaviour (KSB) analysis.

Observe and learn

In a KSB exercise, a group of people working in a particular workshop, office, process plant or other area observe the working practices and try to identify the main activities that affect, or might influence, safety. Relevant accident statistics are fed into the process. The selected activities are known as the key safe behaviours. The group then works together with the operators to assess the activities and to agree practical means of reducing the likelihood of causing an accident. Formal lists of activities and solutions are drawn up and agreed, and progress on implementation regularly monitored and recorded. The information is then assessed alongside ongoing accidents to see if their frequency is reducing. General untidiness in the workplace; attention to wet, greasy or icy areas on the floor; damaged carpets; using unstable structures to reach overhead or elevated objects; and inadequate footwear all figure among the activities that might benefit from KSB analysis.

Other useful techniques

There are a number of safety management techniques that fall under the heading of behavioural safety[10]. Some of these can be usefully applied to the reduction of STF accidents, for example:

- use mental imaging – visualise the worst accident that could happen, then put into effect the means to prevent it;
- implement safety training and observation programmes;

Figure 6: Unsafe use of ladders

Falls from ladders are the source of frequent accidents both at work and in the home. They result in about 14 deaths each year in Great Britain. This photo shows an example of an extremely unsafe use of a ladder in a domestic situation[11]. The ladder footings were totally inadequate. As far as is known, this did not result in an accident, but there are similar cases in industry that did. In one case, a fitter was using a ladder to work on a ventilation duct. The ladder had suction pads on its feet to stop it slipping, but the floor was smooth to facilitate cleaning so the feet slid backwards and the ladder slipped down the wall. The fitter fell off it and broke both wrists. Poor design and absence of a risk assessment contributed to this accident.

- consider 'safety self-management' – particularly helpful for people who work on their own.

conclusion

The efforts and resources that have been invested in the past two or three decades into reducing the incidence of conventional safety accidents have been very successful in terms of reducing total numbers of accidents. The same is true of some of the categories that make up that total. However, such improvement has remained relatively elusive in the case of STFs, especially those that are classed as major in RIDDOR legal terms. This is a continuing concern, as some of these accidents result in serious injuries or fatalities. This article has set out to present the information and data to illustrate this and to propose ways of reducing the frequency of accidents. In common with earlier articles in this series, a very important simple message to get across to people is that they should aim to be a 'what if' person, not an 'if only' person. In other words, think before you act and try to learn from previous accidents. Employers should proactively lead and assist in these objectives. tce

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Previous articles in this series can be found online at **www.tcetoday.com/lessonsrelearned**

The efforts and resources that have been invested in the past two or three decades into reducing the incidence of conventional safety accidents have been very successful in terms of reducing total numbers of accidents, but less so in reducing STFs.

Chemical Engineering Matters

The topics discussed in this article refer to the following lines on the vistas of IChemE's technical strategy document *Chemical Engineering Matters*:

Food and nutrition *Lines 11*

Health and wellbeing *Lines 11–14*

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