Specialist Foundation Engineering in Europe
Analysis of accident occurrences from 1998 to 2008

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Basics

The European Federation of Foundation Contractors (EFFC), that now represents over 450 companies in 17 countries, agreed when founding the federation in 1989 to award maximum priority to the topic of occupational health and safety. It was therefore an obvious next step to set up a Health & Safety Working Group (EFFC H&S-WG).

Efforts made by this working group to acquire statistics on accident occurrences in specialist foundation engineering from public sources showed little success. Most countries do not have any data on accidents in foundation engineering and a benchmarking between different countries could not be carried out due to the lack of information or non-comparable data. The EFFC H&S-WG therefore committed itself to collecting and analysing accident records provided by member companies. In doing so, it has been able to fall back on experiences gathered in Germany since 1992 in a similar accident analysis carried out by the Institute for Statutory Accident Insurance and Prevention in Civil Engineering (Tiefbau-Berufsgenossenschaft), in cooperation with the Foundation Engineering Department of the Federation of the German Construction Industry (Hauptverband der Deutschen Bauindustrie). After making minor alterations to the used report sheet for specifying accident details, it was possible to use this sheet for the EFFC-wide survey.

The collection and evaluation of data commenced on a European scale in 1998, after completion of a test phase. The Institute for Statutory Accident Insurance and Prevention in the Construction Industry (BGBau) participated in both the nationwide and European project right from the start. There have been several reports on the results (e.g. in TIEFBAU 1/1995, 6/1998, 9/2001 [http://www.baumaschine.de/portal_tbg.html]).

During the period between the last publication and the end of 2008 details have been sent in on some further 1,500 accidents, meaning that the following analysis has been prepared using nearly 4,000 reports from 13 countries[1].

[1] Austria, Belgium, Czech Republic, Denmark, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, Switzerland, United Kingdom

Fig. 1 A standard situation on construction sites in urban areas – featuring substantial accident potential

Data acquisition

The EFFC bids all member associations and companies to regularly provide information on all accidents that occur in specialist foundation engineering. In a specially prepared report sheet information is to be given on

Time of accident
Duration of shift
Age and occupation of the injured person
Place of accident, applied engineering methods and machines
Type of injuries
Activity at the time of the accident and
Description of accident

In most cases this is implemented by simply marking one of the given options. The report sheet is available in different languages and can be downloaded under http://www.foundationworld.org.uk/jsp/effc.jsp?lnk=632.

The report is on a completely voluntary basis and is anonymous. This data collection within the federation does therefore not allow the benchmarking hoped for (e.g. comparisons of “country A with country B“, “year X with year Y“ or “sector I with sector II“). These analyses do, however, allow the detection of key accident hazards and point out workflows that are particularly prone to accidents, thus creating a basis for essential and effective protection measures.

In most member countries it is common practice to only record and report accidents that resulted in an absence of more than 3 days. The fact that one in seven of the accident report sent in describes an accident occurrence with an absence from work of less than 3 days shows that, sometimes, also such minor accidents were reported. It would be a good thing if also near-accidents, and those involving just a short absence from work could be analysed in future, as this would provide a more comprehensive picture of the accident occurrences.

After 14 % of the accidents recorded the injured person was absent from work for just a short period of up to max. 3 days. 48 % involved an accident with an injury-related absence of 4 days to 2 weeks, and in 38 % of the reported cases the absence from work was longer than 2 weeks. 19 of the reported accidents involved fatal injuries.

Evaluations

Sectors

The accident reports show that member companies of the EEFC are active in all sectors of specialist foundation engineering. The data collection and evaluation is therefore significant for the entire branch.

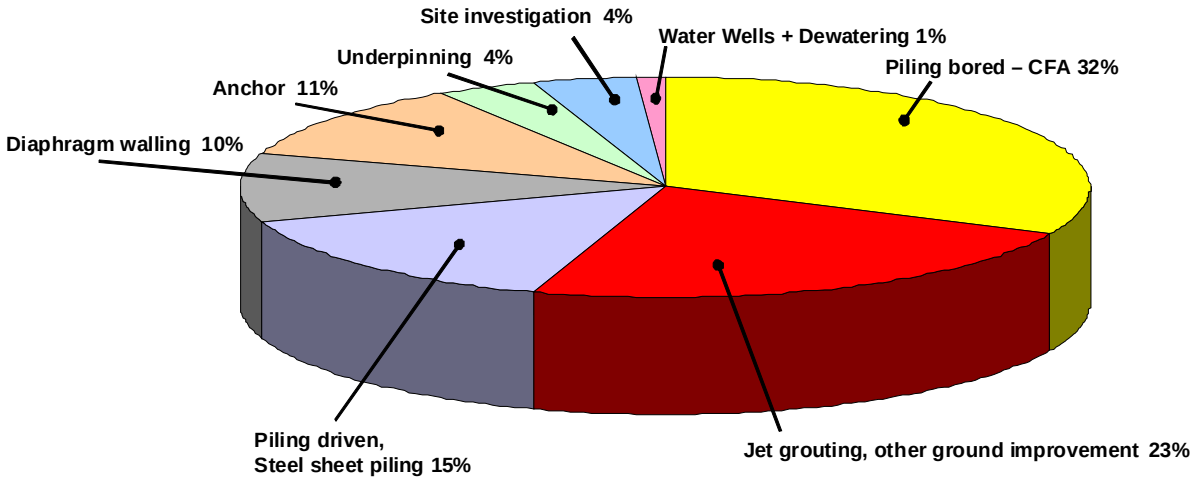

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Fig. 2: Work processes (Share of the reported accidents)

Time of accident

The distribution of accidents over the days of the week, the hour the accident took place and the shift duration up to the accident occurrence were investigated.

Weekday

There are an above average number of accidents at the beginning of the week. As it is to be assumed that the number of working hours carried out on Mondays is likely to be less than on the following days (travel time to site?) the accident frequency on this day is major issue that requires further analysis (see also “time of day”).

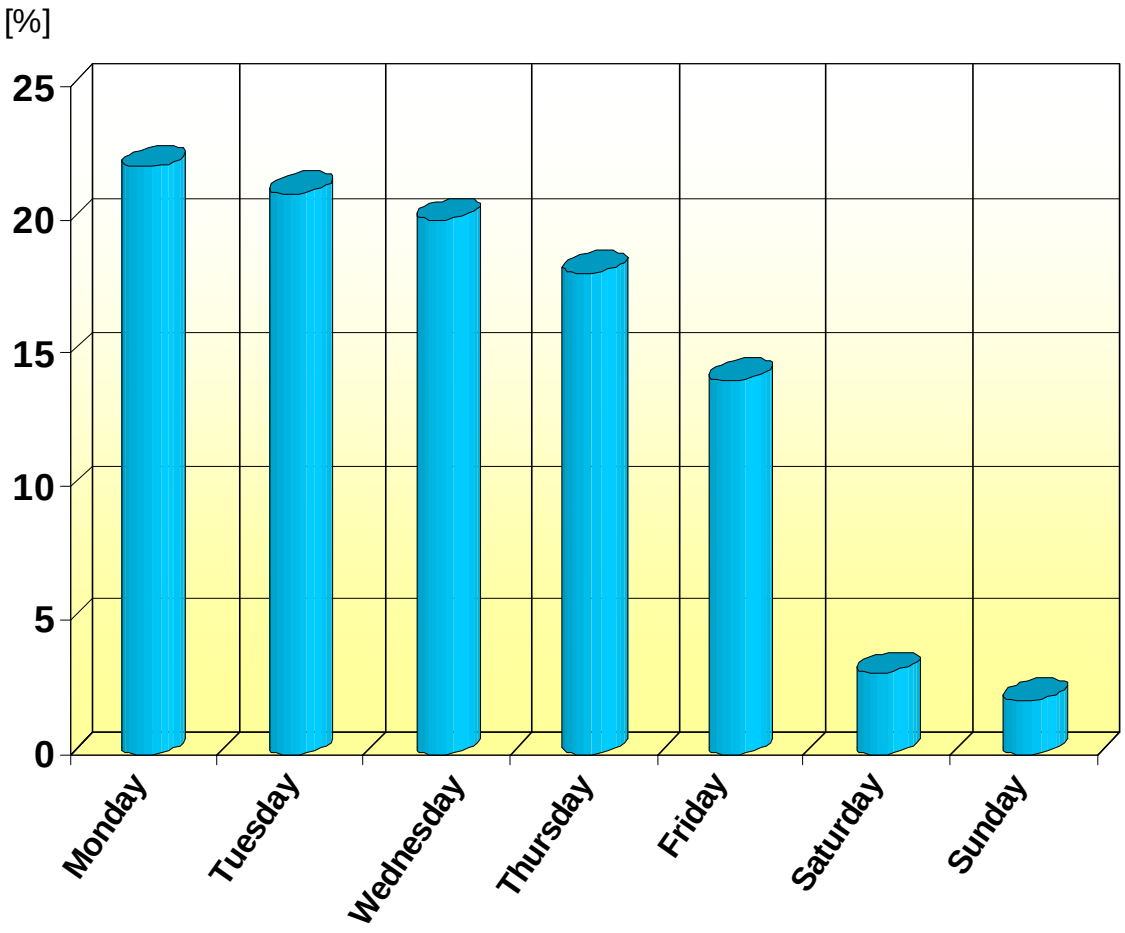

Fig. 3: Accidents on day of the week

Time of day

In all previous analyses it has shown that there is a particular frequency of accidents in the hours between 10 a.m. and 12 Noon. The hourly evaluation now available clearly shows that a well above-average number of accidents occur during the two hours before midday. It would appear to be proving true that effects such as “wanting to or having to finish the work before the midday break“ or increasing carelessness and failing concentration clearly increase the risk of an accident.

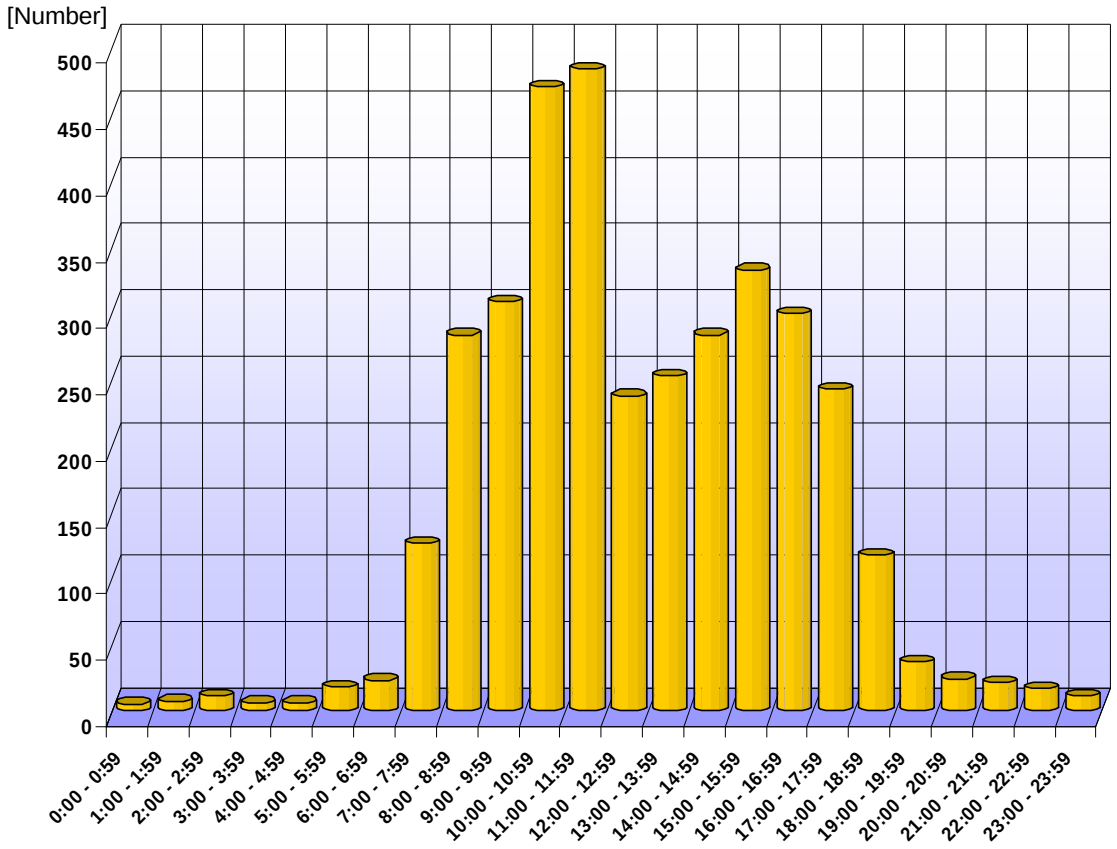

Fig. 4: Accident hour (weekly average)

Also an individual evaluation for each weekday shows a similar development.

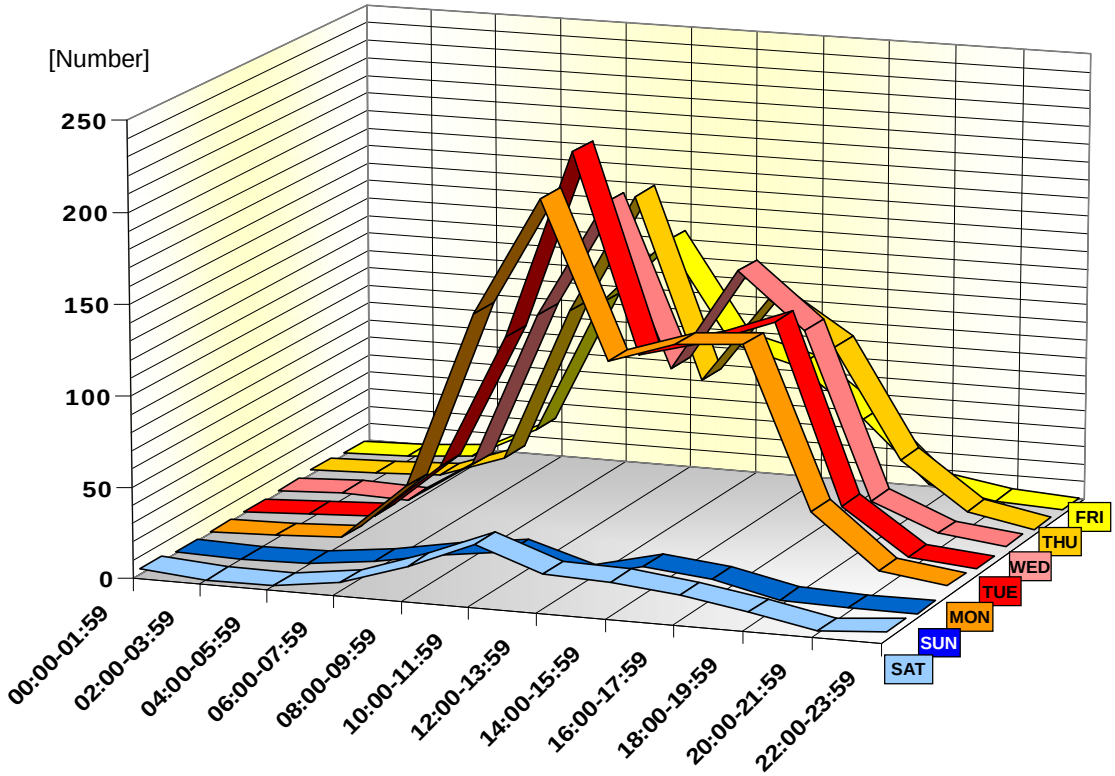

Fig. 5: Accident hour / weekdays

Shift duration

As the reports give the time the work commenced and the time of the accident it is possible to determine the duration of the shift up to the accident occurrence. Any breaks taken are not deducted (as these have not been reported). The accumulation in the 4th working hour is consistent with the results on the accident hour. An increase in the accident frequency is again determined as the shift progresses.

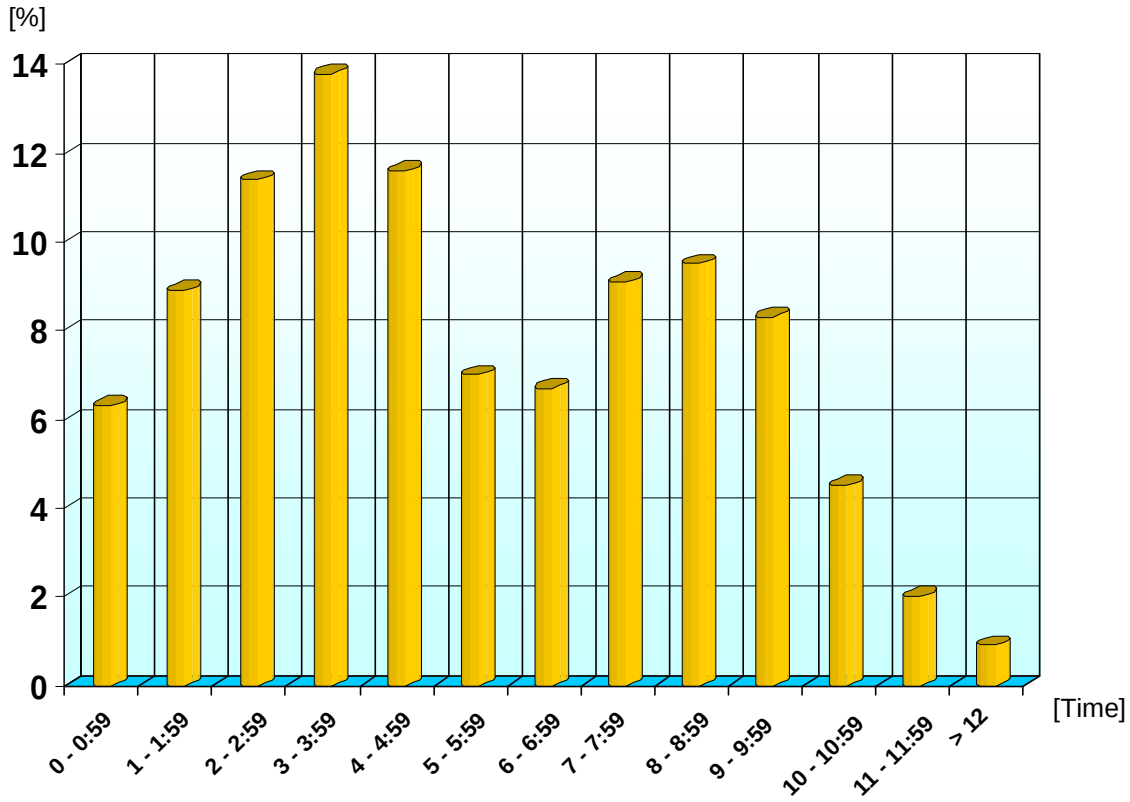

Fig. 6: Shift duration up to accident occurrence

The H&S-WG recommends that all EFFC member companies should investigate the accident occurrence in their own company in terms of the time of the accident and the duration of the shift and adopt appropriate counteractive organisational measures.

Place of accident

80 % of the reported accidents occurred on the actual construction site. Accidents in the contractor's yard and in the workshop accounted for 16 %. This clearly reveals that with the highly mechanised operations of specialist foundation engineering machine maintenance and servicing play a particularly important role. By employing qualified staff and appropriately equipping service departments the hazards revealed can be counteracted effectively.

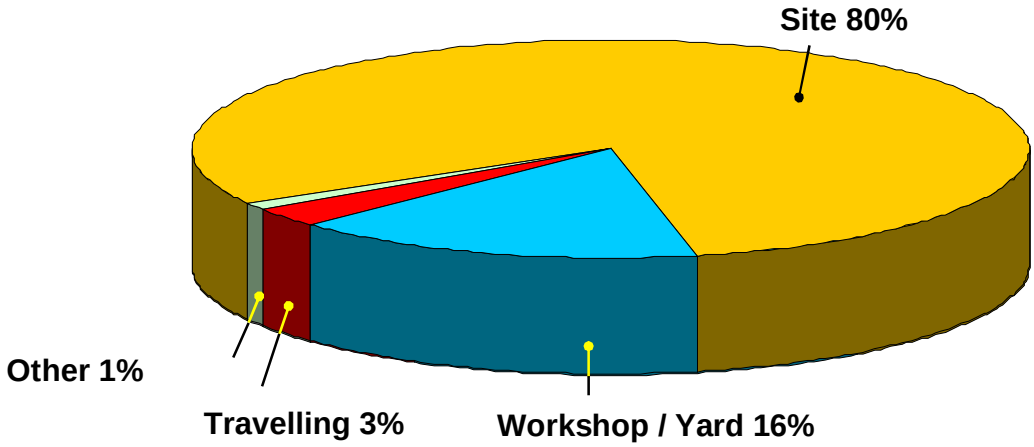

Fig. 7: Place of accident

Persons involved in accidents, accident outcome

Vocational groups

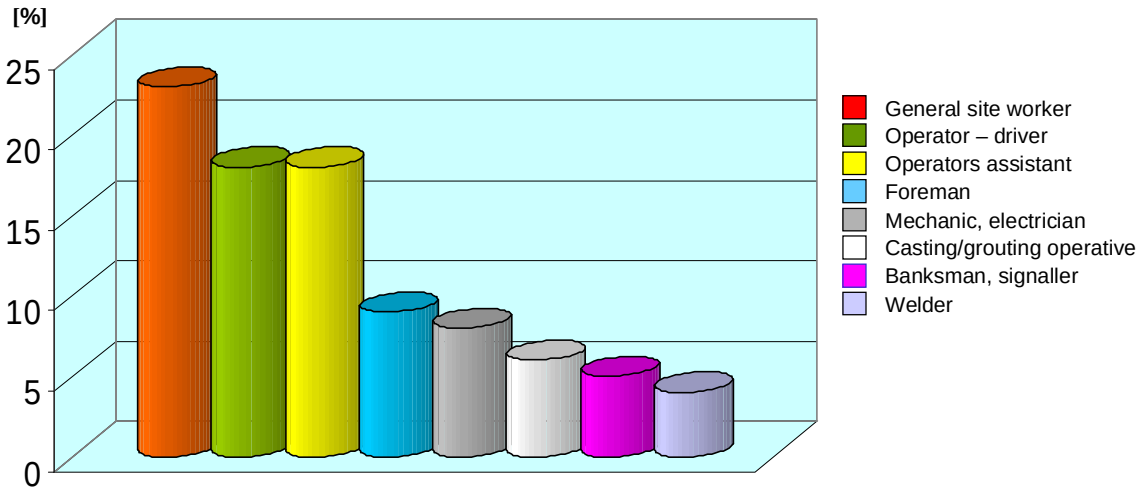

Fig. 8: Vocations of injured persons

Age structure

The analysis of the report sheets sent in shows the percentage of the different age groups involved in accidents. As there is no overall information on the age structure of persons employed in specialist foundation engineering (neither on a country-specific basis nor for Europe as a whole) it is not possible to evaluate this observation. Here again it is only possible to recommend corresponding investigations within the company or in cooperation with the association of the respective country.

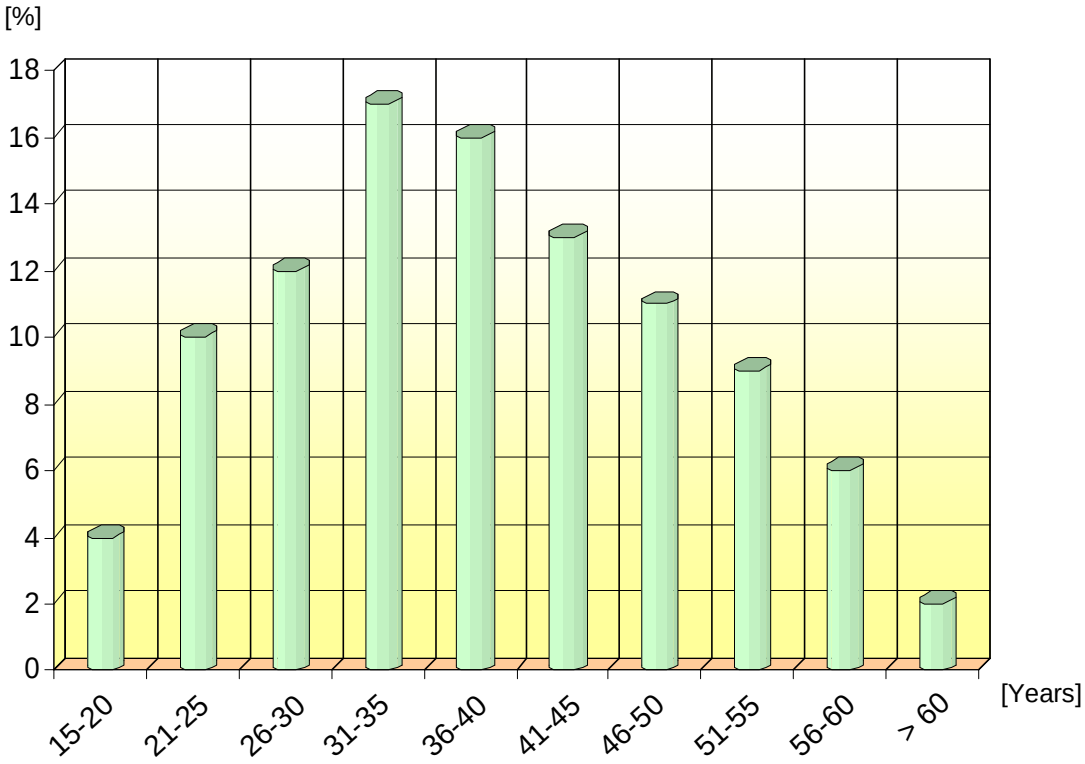

Fig. 9: Age structure (injured persons)

The consequences of an accident differ widely when comparing the respective age group –: whereas accidents of the age group of 31 to 40 years mostly come under the category “absent for 3 days to 2 weeks“, those over 40 years of age are much more frequently involved in accidents that cause an absence from work of more than 2 weeks.

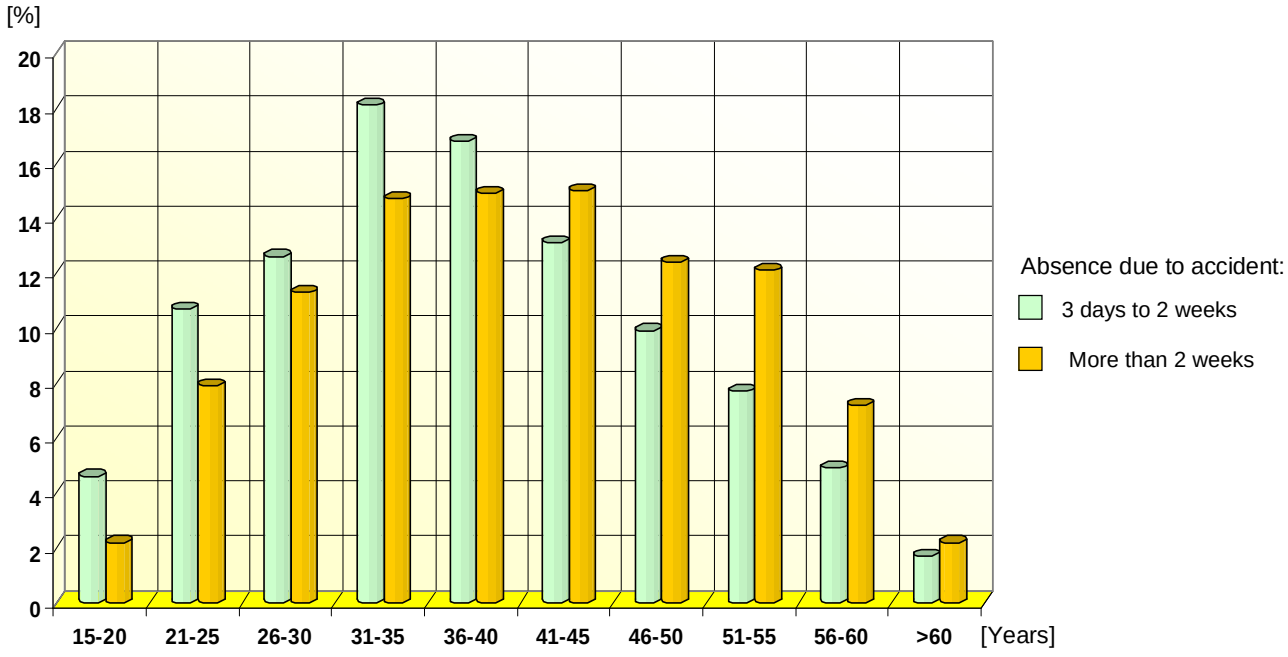

Fig. 10: Accident severity (absence due to accident)/age of injured persons

Injuries

Fig. 11 shows the injured body areas.

In 8 % of all the reported injuries eye injuries occur. This risk can be reduced substantially at minimum expense by wearing protection goggles at all times.

Technical measures are able to reduce injury hazards in specialist foundation engineering as well. However, in this specific construction sector it is most important to counteract residual risks that still prevail, in spite of the implemented technical measures, by providing personal protection equipment. Suitable protective equipment selected according to ergonomic aspects decisively reduces the risk of injury if the equipment is used on a consistent basis.

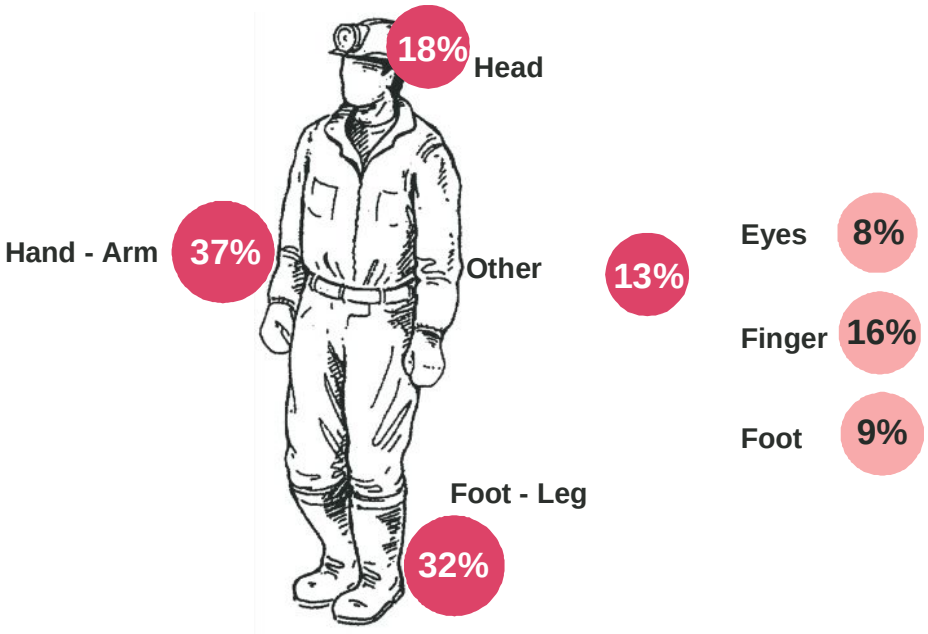

Fig. 11 Injured body area

27 % of the reported injuries resulted from jamming, 20 % were sprains/dislocations and 16 % were fractures.

"Accident causes"

"Accidents do not happen – they are caused by something!" It must be the objective of every accident review to determine the cause of such an event and the boundary conditions that had an impact on the negative occurrence "accident". It nearly always involves several, sometimes independent factors, and in most cases it is combinations of technical and organisational deficiencies and human error that cause disturbances in the workflow .... and accidents are particularly critical disturbances!

"Accident experience" is important for prevention work and it forms an essential basis for the implementation of hazard assessments. Accident prevention will be successful when accident causes that have proven to be relevant in the past can be successfully defined and ruled out for future projects.

The problem that arises with every collection of accident data on report sheets is that only a restricted number of options can be given for selection.

Also the point concerning the “main cause of the accident“ quickly proved to be less suitable for our project because a purely subjective conclusion of the person reporting the accident would block out queries regarding other accident causes.

In the report sheet (still) in use there are no longer questions on the cause or causes of the accident. Instead, details on the “description of the accident” are requested. There are 15 possible answers to mark and a field „Other“ in which other details can be entered, as required.

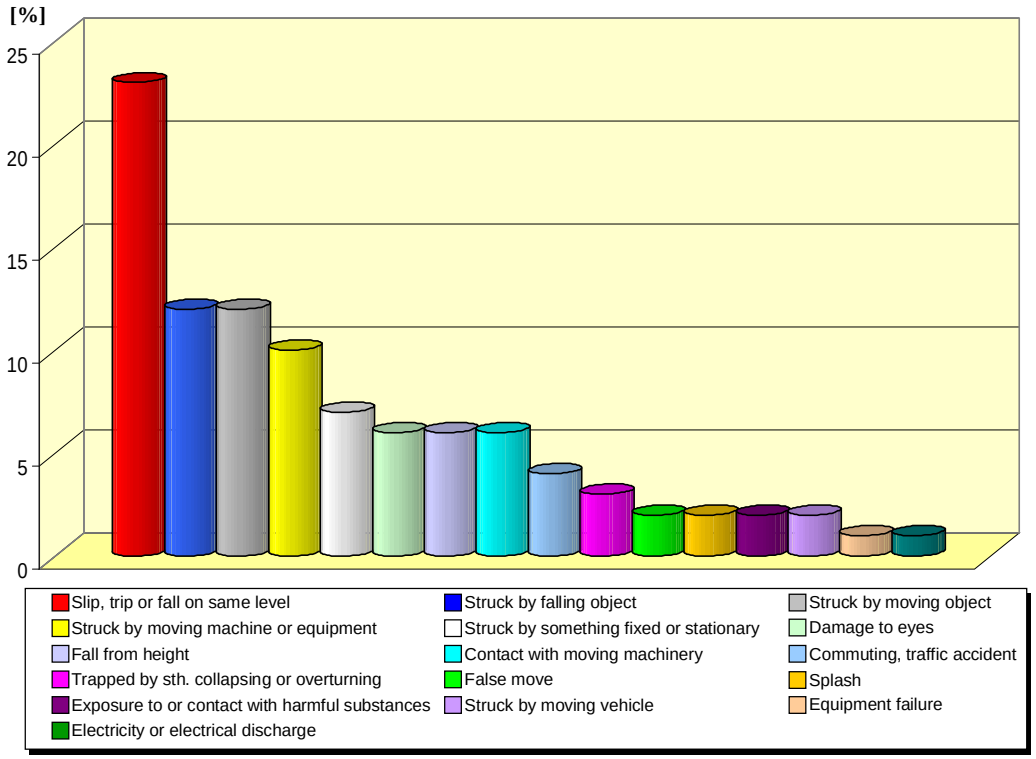

Fig. 12 Accident description (all sectors)

The key accident hazards become even more evident when the analysis of the data is carried out separately for the individual specialist foundation engineering sectors. For better clarity the chart given here only shows the seven terms most frequently named for each sector.

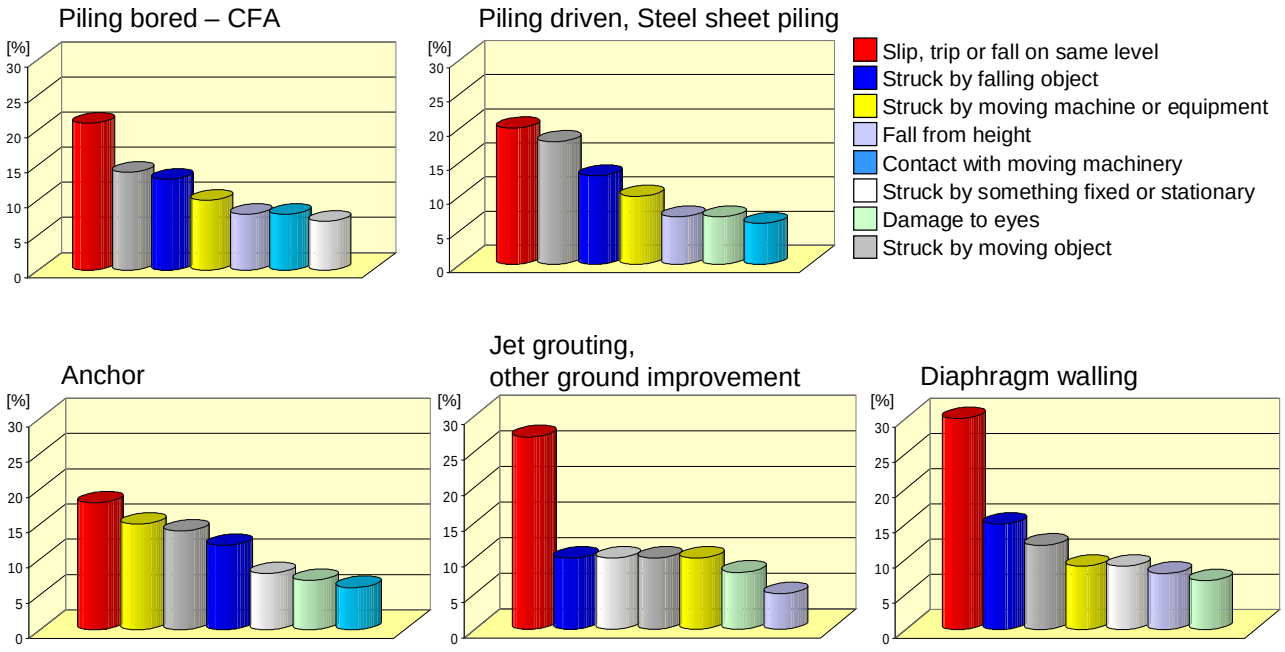

Fig. 13 Accident description (individual sectors)

Activity of the injured person at the time of the accident

Another way to describe an accident is to examine the activity carried out by the injured person at the time of the accident. The members of the Health&Safety Working Group of the EFFC agreed during the last revision that the question concerning the "activity of the injured person at the time of the accident" would provide much more conclusive information than the question concerning the "cause of the accident". In this way, work that is particularly prone to accidents can be determined, leading to the deduction of appropriate improvement measures. For this purpose, the report sheet gives 8 typical activities as options. There is an additional input field available under „Other".

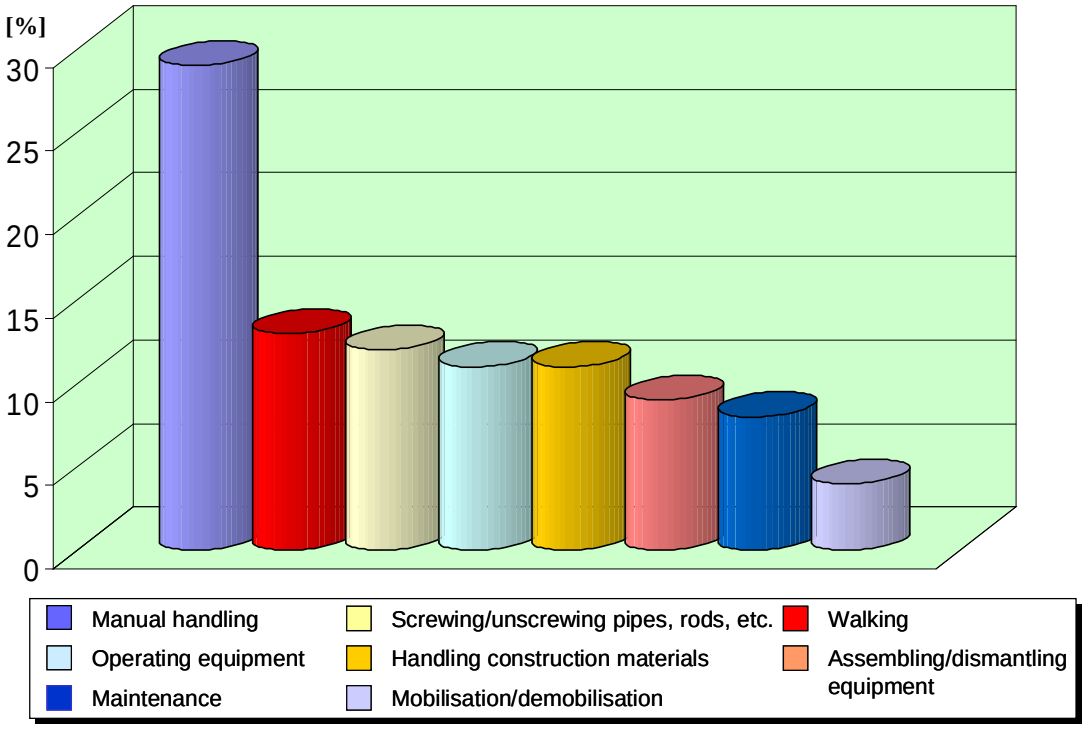

Fig. 14 Activity at the time of accident (all sectors)

A separate analysis of the accident occurrence for the different sectors is again expedient.

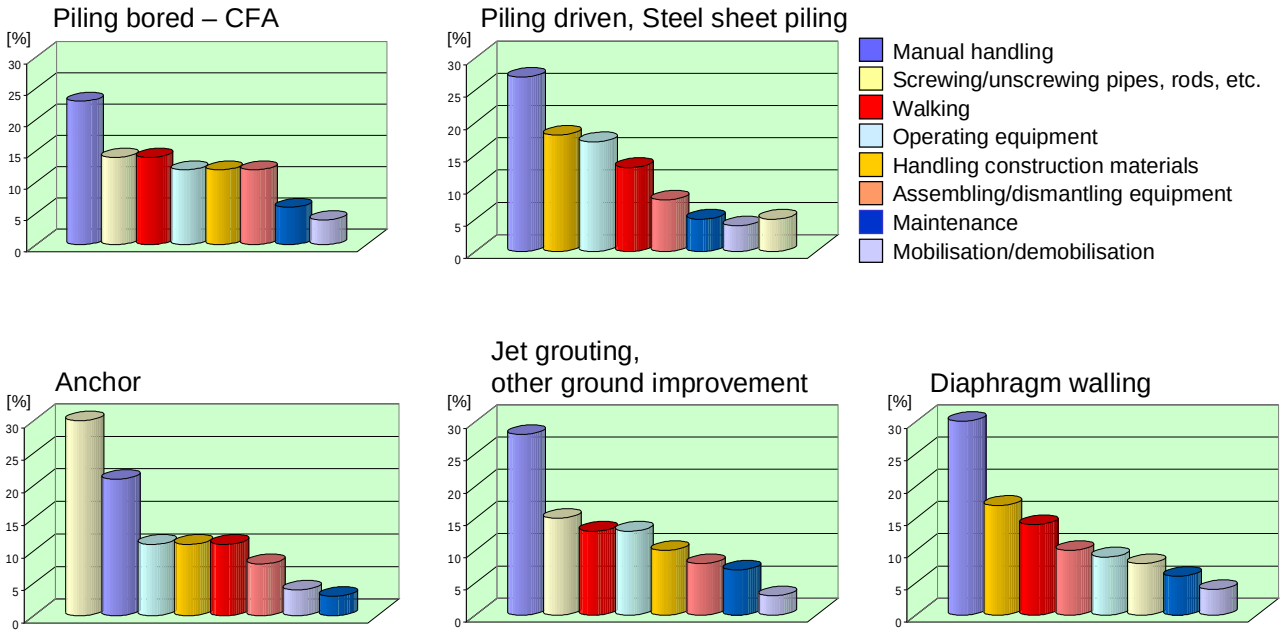

Fig. 15: Activity at the time of the accident (individual sectors)

Fig. 16 Diaphragm wall preparation during the construction of the Munich subway

Summary

The current analysis is based on approximately 4,000 accident reports from the specialist foundation engineering sector in 13 European countries. The report sheets have competed by EFFC member companies and associations on a voluntary basis. The accident reports from the years 1998 to 2008 have been collected by the BG BAU and analysed successively in coordination with the Health&Safety Working Group of the EFFC.

A comparison with the previously published analyses confirms trends that were apparent at that time. The conclusions can therefore be deemed as valid. These “EFFC figures” are therefore suitable for use as reference values for the analysis of company internal accident data or data collected on a nationwide basis.

After consulting the EFFC the Piling and Foundation Specialists Federation (PFSF) in Australia adopted this report sheet and used it as a basis for its own accident analysis. In many details the results of the 2007/2008 analysis in Australia coincide to a great extent with the EFFC results.

Unlike the EFFC, the PFSF not only examines accidents at work, but also “dangerous incidents“. The PFSF therefore correctly uses the term “Incident Reporting System“ and not “Accident report”, and only 8 % of the reports sent in describe an accident at work in which a worker was so severely injured that he was absent for at least 3 days. The broad coincidence of the results shows that the analysis forms a reliable basis for specific preventive measures, in spite of the different reporting methods (PFSF: 100% reporting of all hazardous incidents; EFFC: voluntary reports of accidents with injuries to persons).

The “Accident pyramid“ theory is confirmed. A disturbance in the workflow can remain without an incident or end in a minor accident, it can, however, also be the cause of a serious accident. Prevention must therefore set in at the bottom, with the aim to ensure a disturbance-free and thus safe and accident free working process.

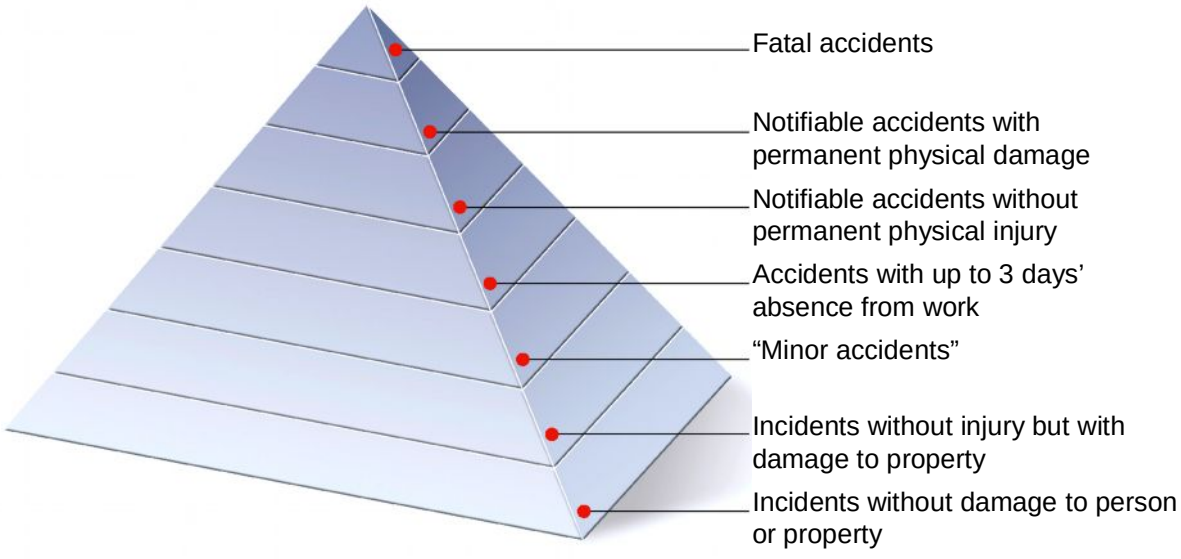

Fig.15 Accident pyramid (from H&S training)