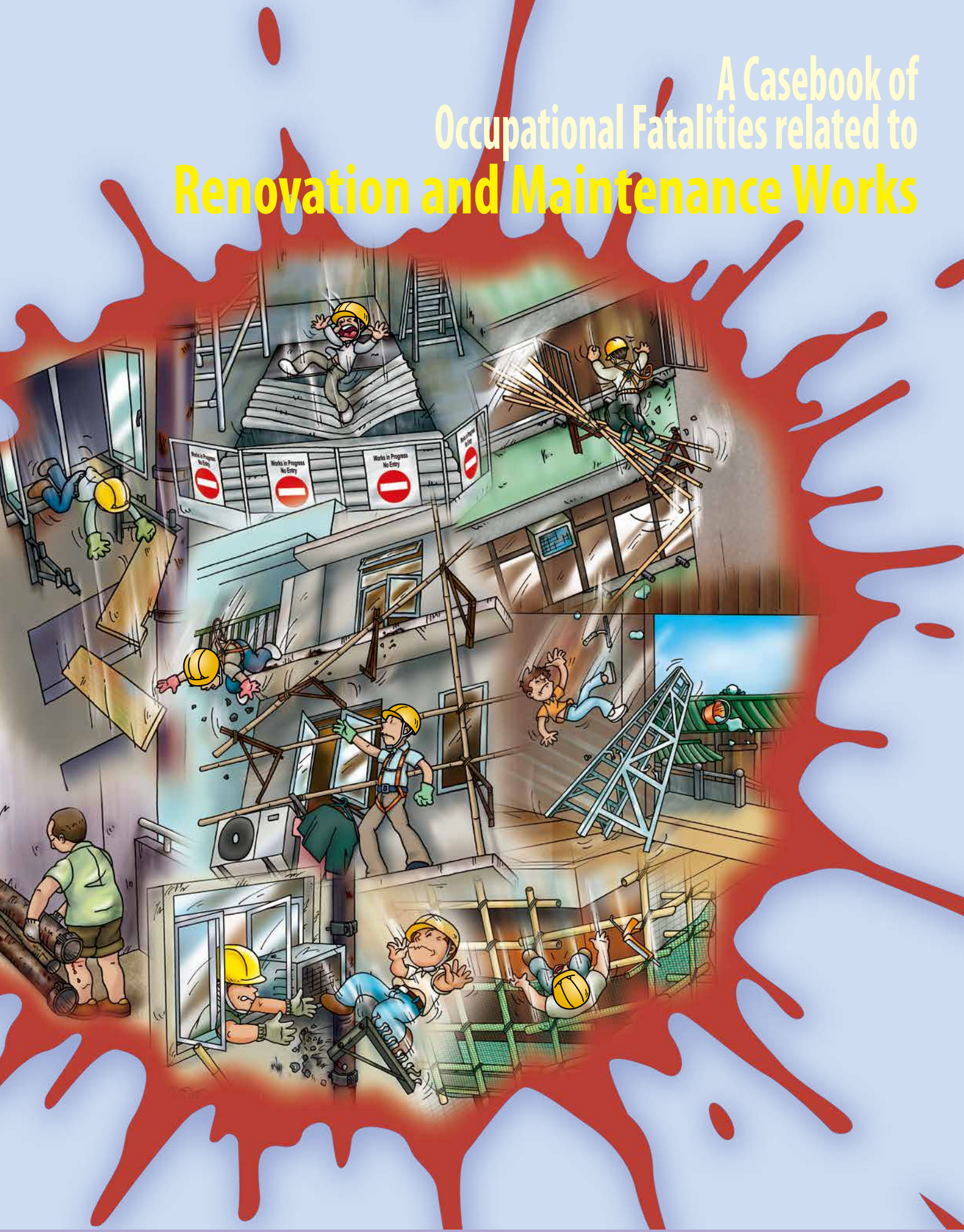
A Casebook of Occupational Fatalities related to Renovation and Maintenance Works



Safety at work

Occupational Safety and Health Branch
Labour Department

This Booklet is prepared by
the Occupational Safety and Health Branch, Labour Department

First edition	October 2006	
Second edition	September 2018	(This edition has been amended mainly to add chin straps to the safety helmets worn by the workers in the illustrations.)

A Casebook of Occupational Fatalities related to Renovation and Maintenance Works

Table of Contents

FOREWORD

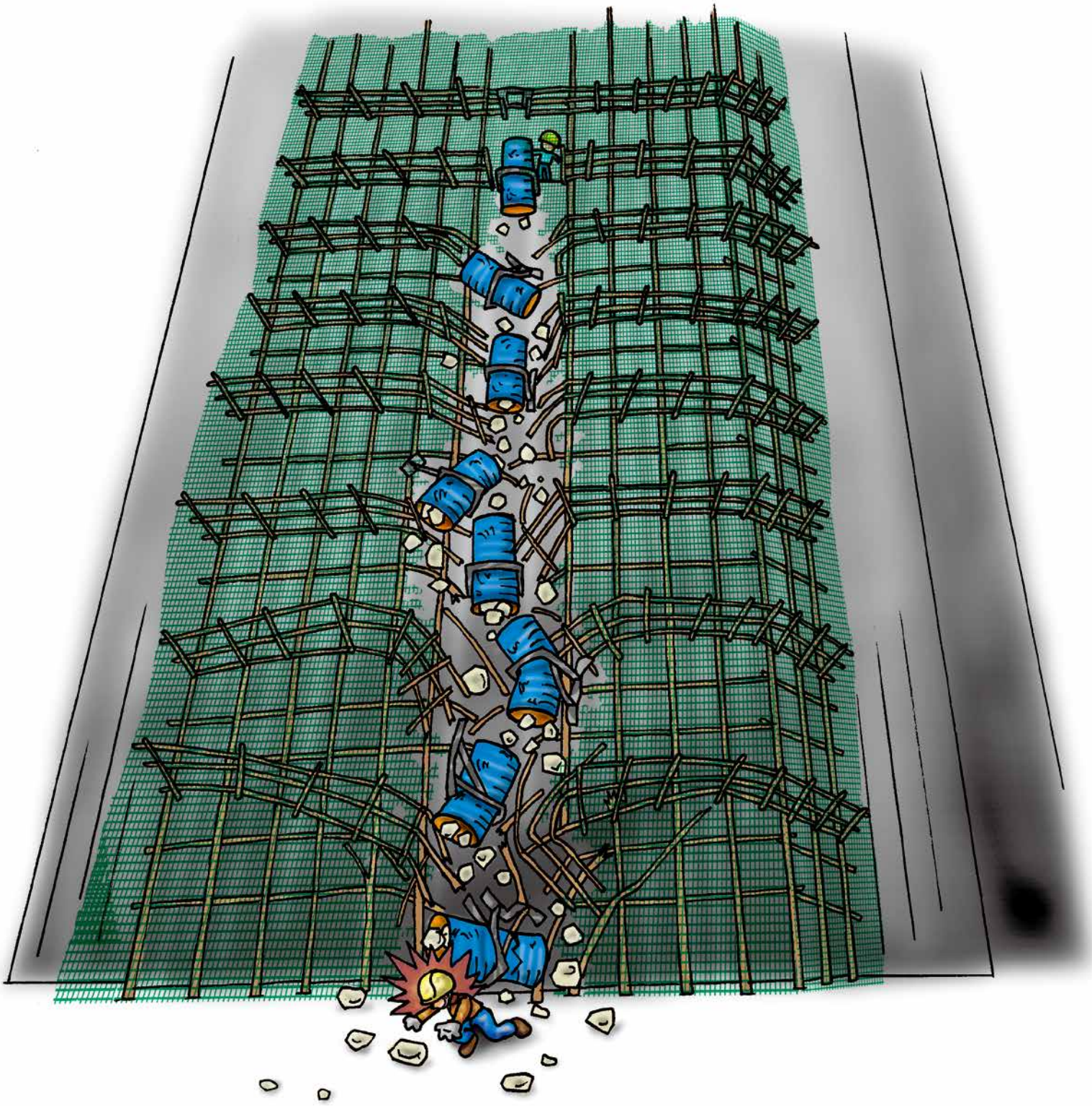
Workplace accidents not only cause sufferings to the victims and their families, they also incur costs arising from work stoppages, insurance claims, medical and rehabilitation expenses, etc.

Most workplace accidents are preventable. Very often, they share common scenarios and causes. Unless such scenarios and causes are properly understood, lessons will not be learned and suitable measures implemented to prevent recurrence of such accidents.

This casebook features a number of fatal accidents related to renovation and maintenance works. It can be used for experience sharing on accident causes and prevention and as case studies for safety training institutes. It also aims to provide lessons to those who are involved in such work activities and their managers.

Case 1

A foreman was fatally struck by a collapsed refuse chute



Scenario

In a building renovation site, refuse chutes were installed on the external walls of the building for removal of debris from the upper floors. At the time of the accident, waste mosaic tiles were being removed from the upper floors to the ground with the use of the refuse chutes. The accident happened when one of the refuse chutes collapsed. The refuse chute and debris fell and struck the deceased person who was working on the podium at the G/F level.

Case Analysis

The refuse chute was built of sections of uPVC pipes (a kind of plastic polymer) and was mounted onto the building external wall by a number of steel brackets. However, the vertical load of the refuse chute was only supported by the lowest bracket. The other brackets only provided lateral restraint to the refuse chute.

The refuse chute was not constructed in accordance with any engineering design. The installation workers were not trained and had no previous experience of installing refuse chutes. After installation, the structural stability of the refuse chute was not examined by a competent person.

The collapsed refuse chute was about 50 metres long and 25 centimetres in diameter. It extended from 16/F to LG 2 level where debris was discharged and collected.

uPVC pipe was not a suitable material for use as refuse chutes. It was too brittle to resist impacts of waste mosaic tiles fallen from upper floors. Moreover, its diameter was too small and there was a risk of large pieces of debris blocking the pipe resulting in accumulation of waste materials inside the chute.

There was no precautionary measure taken to ensure that the mosaic tiles were broken into smaller pieces before dumping into the refuse chute. The workers were not provided with suitable training, information and instruction on the safe use of the refuse chute for debris removal.

It was believed that some of the waste materials dumped into the refuse chute were too large. They blocked and accumulated inside the chute. As the lowest bracket could not support the additional load, the chute detached from the external wall and collapsed.

Lessons to Learn

a Refuse chutes should be properly designed, constructed and examined by a professional engineer before putting into use. The chutes should also be properly maintained.

b Refuse chutes should be installed in a way that is safe and without risks to the workers.

c Suitable and sound material should be used for constructing refuse chutes.

d Necessary precautions should be taken to prevent workers from being struck by falling materials and objects.

e Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.

Case 2

A cleaning worker fell to the ground while working on a stepladder

Scenario

A team of workers, including the deceased person, were assigned by the cleaning contractor to carry out cleaning work at a temple. Aluminum folding stepladders were used by the workers to clean the windows at high levels. When the accident happened, the deceased person was riding on an aluminum folding stepladder to clean the windows above the entrance of the main hall. He accidentally lost his balance and fell to the ground together with the toppled folding stepladder. The deceased person sustained serious head injury and passed away on the following day.

Case Analysis

The entrance to the main hall of the temple had a doorway of 3.7 metres high. Above the entrance, there was a row of windows. The top edge of the windows was 4.5 metres from the ground.

The aluminum folding stepladder used by the deceased person was fitted with steps on one side only (the front section). A pail was placed on top of the folding stepladder and there were 11 steps below. The top of the folding stepladder where the pail rested was 3.1 metres above ground. When the folding stepladder stood fully opened on the ground, the front and back sections were 1.56 metres apart at the base.

The folding stepladder had two restraining devices to limit the opening of the front and back sections. However, the rivets and washers fitted at the connecting points of the two restraining devices were missing. It was observed that the connecting point of one of the restraining devices was reconnected by tying up with a piece of metal wire. A strut was also tied by a length of electric cable to the front and back sections of the folding stepladder to restrict the opening distance.

Slip-resistant rubber pads fitted to the base of the ladder were all missing. As the floor of the temple hall was laid with ceramic tiles, a stepladder with no slip-resistant rubber pads would be insecure and unsafe when placed on the slippery floor for the cleaning work at a height.

Lessons to Learn

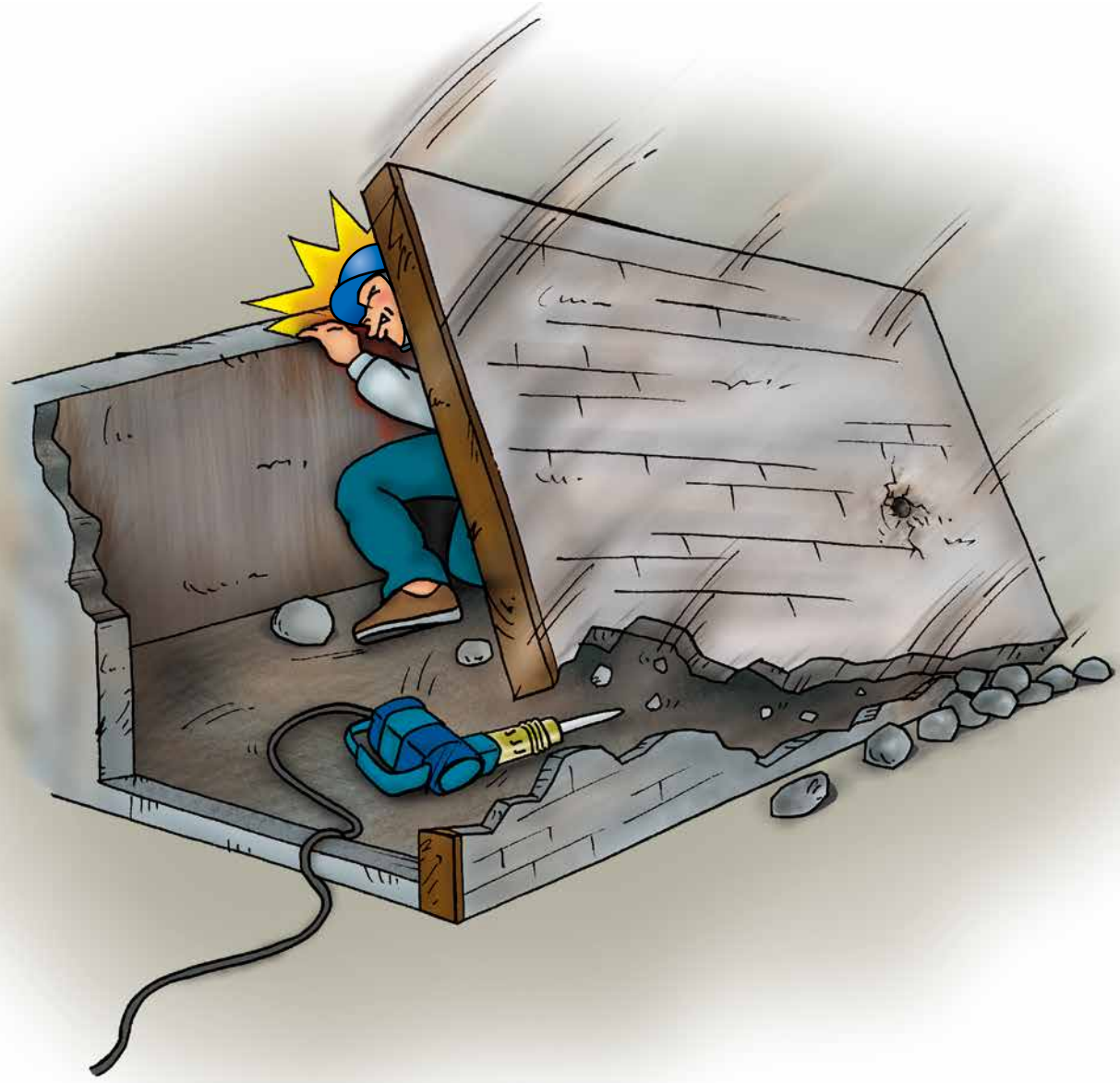
a Suitable working platforms should be provided to workers for window cleaning work at heights.

b Stepladders should be of sound construction and properly maintained.

c Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers. As far as practicable, the work carried out at heights should be closely supervised by a competent person.

Case 3

A worker was struck by a brick wall under demolition



Scenario

A contractor was appointed to demolish an unauthorized structure on the roof of a residential building. During the demolition, a worker was breaking a brick wall with a portable electric concrete breaker. The wall suddenly collapsed and struck the worker. Unfortunately, he was fatally trapped between the collapsed brick wall and a parapet nearby.

Case Analysis

The brick wall to be demolished was undermined before the accident in that more than half of its footing had been removed. The contractor planned to pull down the wall with a rope.

A hole was found on the collapsed wall. Its diameter matched with the diameter of the bit of the portable electric concrete breaker found on the site. It was believed that the deceased person was trying to break the wall with an electric concrete breaker. The stability of the undermined brick wall was thus overcome by the external force and collapsed as a result.

There was no risk assessment conducted before the demolition work. The undermined brick wall was left unattended and no temporary structure was erected to support it. The surrounding area was not fenced off and there was no warning notice posted.

The deceased person was not provided with any safety information, instruction, training and supervision.

Lessons to Learn

a A safe system of work should be developed for the demolition of the brick wall. Top down demolition method should be adopted.

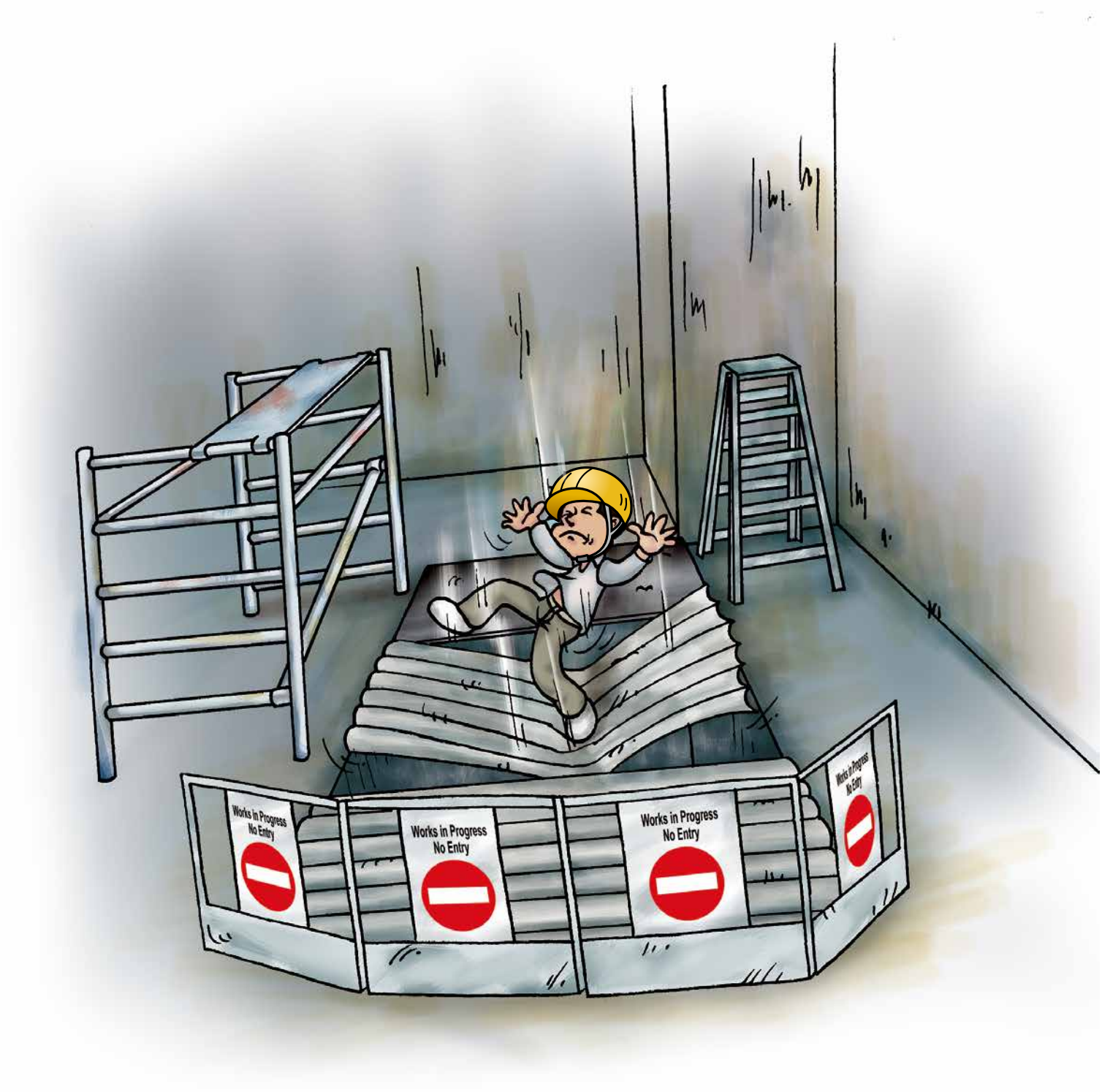
b Places liable to be dangerous should be clearly demarcated and fenced off. No person should enter the area without prior permission.

c Temporary support should be used to stabilize the brick wall being demolished. Warning notice should be conspicuously posted if it is left unattended.

d Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.

Case 4

A worker fell through a floor opening to the floor below



Scenario

Electrical and air conditioning improvement works were being carried out in the plant rooms of a railway substation. An air duct passing through the floor between the upper floor plant room and the lower floor plant room had to be dismantled. After the air duct was removed, a floor opening of 3 metres x 1.8 metres was exposed. One piece of metal sheet and two pieces of corrugated sheet were then used to cover the floor opening. Prior to the accident, the deceased person and his supervisor were working in the lower floor plant room. The deceased person was asked to fetch a tool from the workers working in the upper floor plant room. After the deceased person had got the tool from a worker working in close vicinity of the floor opening in the upper floor plant room, he inadvertently stepped on the metal sheets covering the floor opening. He fell a vertical distance of 7 metres to the floor below when one of the corrugated sheets gave way.

Case Analysis

The size of the metal sheet and corrugated sheets were smaller than the size of the floor opening. They were thus placed over the opening across the shorter side. All of them were not securely fixed and could be easily displaced.

Temporary barriers were erected at the front side of the floor opening. The remaining three sides were not suitably fenced.

There was no warning notice posted to indicate the presence of the floor opening.

Lessons to Learn

a Floor openings should be properly fenced or covered to protect workers from falling.

b Materials used for covering the floor opening should be of adequate size, sound construction and securely fixed in position to prevent displacement.

c Warning notice to warn workers of the danger of falling through the floor opening should be prominently displayed in the upper floor plant room.

Case 5

A worker fell from a wooden stepladder while performing electrical maintenance work

Scenario

Electrical maintenance work was being carried out in a school building under renovation. The deceased person and his team of workers were responsible for installing electrical conduits on the ceiling of the school chapel. Before the accident happened, he rode on a 6-rung wooden folding stepladder to perform the levelling work. In the course of work, the deceased person lost his balance and fell to the ground with the toppled ladder. He sustained serious head injury and passed away afterwards.

Case Analysis

The ceiling of the chapel was 3.5 metres above ground. The floor surface of the chapel was flat and even.

The ladder was not properly maintained. The two metal hinges connecting the front and back sections were deformed and loosely mounted. Restraining device limiting the opening of the front and back sections of the ladder was found only on one of its two sides. Moreover, one of its four side rails was observed to be 15 millimetres short of the ground when the ladder was fully extended. These unstable conditions would result in swaying of the ladder when being used.

The 6-rung stepladder involved in this accident was 1.78 metres high when fully extended. The deceased person had to ride on at least the second topmost rungs of the ladder and fully stretch his hands to perform the levelling work. In this manner, there was no handhold for him to maintain his balance on the ladder. A reaching-out body posture could cause the uneven stepladder to sway and topple.

There was no suitable working platform provided for carrying out the levelling work at heights. Fall arresting equipment, such as safety harness, independent lifeline or other suitable anchorage, was also unavailable.

There was no risk assessment conducted prior to the levelling and conduit installation work. Safety precautionary measures to prevent the fall of person were not developed and implemented.

Lessons to Learn

a When work could not be safely done on the ground, suitable working platform with guardrails and toe boards should be provided.

b Stepladders should be regularly inspected and properly maintained to ensure that it is in a safe working condition.

c Risk assessment should be conducted and safe working method developed and implemented.

d Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers. As far as practicable, the work carried out at heights should be closely supervised by a competent person.

Case 6

A worker sustained laceration injury and subsequently died of infection

Scenario

Replacement of drainage pipes and other plumping work was carried out in a residential building under renovation. The deceased person and two co-workers were assigned to dismantle drainage pipes inside a light well. The two co-workers were dismantling the drainage pipes at upper levels. The deceased person stayed on the bottom of the light well to receive the dismantled pipes passed to him by his two co-workers. In the course of work, the deceased person's left leg was cut by the sharp edge of a broken pipe clamp. He did not clean and dress the wound properly soon after the injury and he did not consult any doctor for treatment. His wound was infected and he subsequently died a few days later.

Case Analysis

There was no risk assessment conducted prior to the drainage pipe replacement work. Precautionary measures for handling sharp objects had not been devised and implemented.

Suitable clothing and personal protective equipment were not provided to the workers. The deceased person wore only a pair of short jeans while working.

The deceased person did not clean and dress the wound properly soon after his left leg was cut. He only wrapped the wound up with a piece of cloth and he did not seek any medical treatment afterwards. The wound was infected by bacteria consequently which later caused his death.

Lessons to Learn

a Risk assessments should be conducted prior to the drainage pipe replacement work. Safe work procedures, including the precautionary measures to ensure sharp edges of dismantled pipes are safely handled, should be developed and implemented.

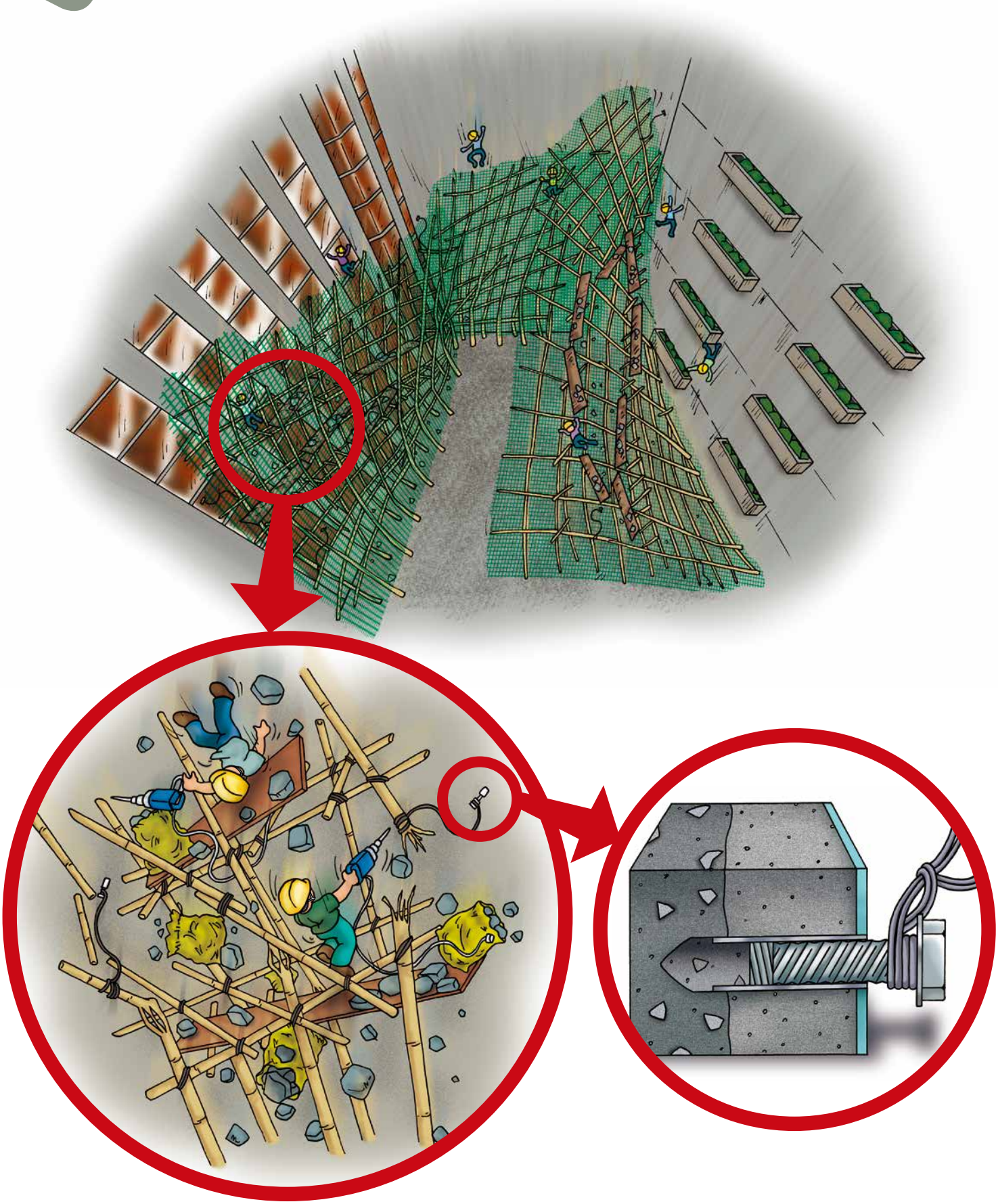
b Proper work clothing and personal protective equipment as were necessary should be provided to and used by the workers.

c Workers injured at work should have proper first aid treatment of the wound immediately and seek medical treatment as soon as possible.

d Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.

Case 7

A worker was killed and sixteen injured when the bamboo scaffolds they were working from collapsed



Scenario

Renovation works were being undertaken on the external walls surrounding an internal courtyard of a building complex. To facilitate the works, four panels of double-row bamboo scaffolds were erected on walls from 2/F up to the roof.

In the morning of the day of the accident, more than 30 workers of different trades were working from these scaffolds. They were engaged in removing windowpanes and frames and hacking off mosaic tiles on the external walls. Tonnes of debris, including mosaic tiles, cement sand bedding, windowpanes and frames accumulated gradually on the working platforms and catch fans provided on the scaffolds. When work resumed after lunch, the bamboo scaffold from which most of the workers were working suddenly collapsed. The other three scaffolds also collapsed in succession onto the open courtyard. The workers fell together with the collapsed scaffolds. As a result, one worker died and sixteen workers injured.

Case Analysis

Two of the four scaffolds measured 35 metres wide and 37 metres high whereas the other two scaffolds were 16 metres wide and 37 metres high. Despite the large sizes of these scaffolds, they were not designed by a professional engineer. There were no proper construction details and design calculations. Working procedures in relation to the erection, inspection and maintenance of the bamboo scaffolds had not been developed and implemented.

The design and construction of the scaffolds were based on a preliminary loading assessment of the mosaic tiles layers to be removed from the walls only. However, mosaic tiles, cement sand

bedding, windowpanes and frames were removed all at the same time. The actual loading was therefore much greater than the original assessment.

The person in charge of the whole scaffolding work was an illiterate. He could not read scaffolding plans, design drawings, specifications and method statements of the scaffolding works. He did not give the scaffolders clear and sufficient information and instructions on the erection of the scaffolds. He had not inspected the scaffolds thoroughly before certifying them safe to be used. He had no knowledge that removing any ledgers would affect the stability of the scaffolds. His illiteracy rendered him incompetent for the work.

Winches and metal buckets were used for transporting debris to the roof level. To facilitate the movement of buckets, some ledgers were removed. The overall rigidity of the scaffold was thus lowered.

Galvanized wires and expansion bolts were fixed on the walls to restrain transverse movement of the scaffolds. However, no metal bracket was installed onto the building wall to act as an intermediate support to the scaffolds. There were also no sills or other structural supporting points on the walls for the scaffolds to spread the load.

Diameters of the galvanized wires used varied between 1.06 millimetres to 2.34 millimetres and were far below the standard requirement of 6 millimetres as stipulated in the Code of Practice for Bamboo Scaffolding Safety (Fourth Edition September 2017). Moreover, during the mosaic tiles hacking process, some of the galvanized wires were broken.

Some of the anchor bolts were not properly fixed and secured onto the building walls. The tails of the sleeves were not expanded

sufficiently. The embedment depth of some studs in the wall was reduced after mosaic tiles and cement sand bedding were hacked off. The frictional grip of the expansion anchor bolts was greatly reduced.

As the scaffolds were insufficiently supported, some ties were unable to restrain the load. Some galvanized wires broke and anchor bolts were pulled out. The load was thus transferred to the other ties that also failed. The progressive failure of all ties led to the collapse of the four scaffold panels in succession.

There was no safe system to co-ordinate the various work activities carried out simultaneously from the scaffolds. No clear instruction was given to the workers to ensure that there was no excessive loading on the bays of the scaffolds.

Lessons to Learn

a. The bamboo scaffolds should be designed and approved by a professional engineer who should be a corporate member under the constitution of the Hong Kong Institution of Engineers in the discipline of civil or structural engineering.

b. Effective communication between the bamboo scaffold designer and site workmen should be established and maintained. To ensure proper erection and subsequent maintenance of the bamboo scaffolds, complete and clear design drawings should also be provided to the site workmen concerned.

c. Sufficient information on the work activities and the relevant loading should be taken into account when designing and constructing the scaffolds.

d A competent person with adequate experience and knowledge should be appointed to supervise the erection, maintenance and inspection of the scaffolds so as to ensure all modifications and changes to them are proper and without risk to the stability.

e A safe system of work for coordinating the various work activities carried out from the bamboo scaffolds should be devised and implemented.

Case 8

A scaffolder fell from a height while dismantling a truss-out scaffold

Scenario

The drainage pipe on the external wall of an upper floor domestic unit was blocked. Two scaffolders, including the deceased person, were called in to erect a truss-out bamboo scaffold outside the unit to facilitate the clearing of the drainage pipe. The bamboo scaffold was erected in such a way that the two existing metal brackets of the laundry drying rack were used as part of the support for the scaffold.

After the blocked drainage pipe was cleared by a plumber, the scaffolders proceeded to dismantle the truss-out scaffold. The deceased person was responsible for dismantling the scaffold outside the premises and the other scaffolder was responsible for collecting the removed bamboo members inside the domestic unit. When the deceased person proceeded to remove the last bamboo member spanning the two metal brackets, one of the metal brackets suddenly detached from the external wall. The deceased person thus fell to the ground together with the metal bracket and was fatally injured.

Case Analysis

In addition to the two metal brackets of the laundry drying rack, there were other bamboo supports for the erected truss-out scaffold. However, at the final stage of the dismantling work, the two metal brackets became the only supports for the scaffold.

Each metal bracket was mounted on the wall by two anchor bolts. The two metal brackets had been installed for a long time. Both the metal brackets and the anchor bolts were corroded. The pullout resistance of the corroded anchor bolts was drastically reduced.

The external building wall was constructed of red bricks and was covered by a thin layer of plaster. These structural materials

holding the anchor bolts were unable to withstand a heavy pullout force. When the deceased person came close to one of the metal brackets, his body weight caused the bracket to detach from the wall.

There was no suitable anchorage point or independent lifeline installed for attaching safety belt or harness. Safety net or other fall arresting device was also not provided on the site.

There was no risk assessment conducted before carrying out the scaffolding work. The scaffolders were not provided with sufficient information, instruction, training and supervision as were necessary to ensure work safety.

Lessons to Learn

a. Truss-out bamboo scaffolds must be carefully designed and adequately supported. The erected scaffold should be inspected by a competent person and certified to be in a safe working condition before use.

b. Existing building fixtures with unknown capacity should not be used for supporting a bamboo scaffold.

c. Risk assessment should be conducted prior to any scaffolding work. Safe working procedures in respect of the erection and dismantling of the scaffold should be developed and implemented.

d. Workers engaged in dismantling bamboo scaffolds should make full and proper use of a safety harness attached to a secure anchorage or independent lifeline.

e. Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.

Case 9

A worker fell from a height while erecting a truss-out working platform

Scenario

A contractor was awarded a contract to install 14 additional metal brackets to secure a 300-millimetres-diameter metal water pipe on the external wall of an industrial building and to paint it afterwards. The water pipe was located in the light-well of the building and ran from the roof on the 18/F to the ground floor for discharging rainwater.

A tailor-made truss-out working platform was fabricated to facilitate the installation of water pipe brackets onto the external wall. Two identical metal bracket supports, each with an inverted U-shape clamp, were to be clamped on the wall of the window opening giving from the lift lobby onto the light-well. Two large pieces of wooden boards would then be placed onto the metal bracket supports to form the platform deck. Metal tubes and wooden battens would also be installed to form the guardrails and toe boards. When installation of pipe bracket on a particular floor was completed, the working platform would be dismantled and re-installed on the next floor for the fixing of another pipe bracket.

On the day of the accident, installation of the additional water pipe brackets had been completed. The manager of the contractor, the deceased person and a co-worker were about to paint the metal pipe. They intended to make use of the truss-out working platform to carry out the painting work. While erecting the working platform on the 16/F, the deceased person fell through the window opening for a distance of 82 metres to the ground.

Case Analysis

The water pipe bracket installation and painting work were in fact performed by two different gangs of workers. The tailor-made truss-out working platform belonged to the gang of workers who were responsible for the pipe bracket installation work.

The deceased person had no previous experience in erecting this type of truss-out working platform.

To install the two metal bracket supports on the windowsill, the deceased person could simply stand on the floor in the lift lobby. But if he remained standing on the floor, he could not reach for a distance of 1260 millimetres to place the outer wooden board on the guides of the metal bracket supports. The deceased person therefore gained access on the windowsill to put the wooden board in place.

There was an independent lifeline installed. However, it was not tested, examined and certified safe for use by a registered professional engineer.

Fall protective equipment, including safety harness and independent lifeline, were not used by the deceased person when he was staying on the windowsill to perform his work.

There was no risk assessment conducted in respect of the suitability of using the truss-out working platform on the site.

The platform erection work was not supervised by a competent person.

Lessons to Learn

a Adequate steps should be taken to prevent workers from falling from heights, including the provision, use and maintenance of a working platform that is suitable for the environment and the work to be carried out (e.g. a suspended working platform in this case).

b Erection of the working platform should be carried out by competent workmen with adequate training and experience.

c Suitable fall arresting equipment should be provided and used by workers exposed to risks of falling from heights. An effective monitoring system should be implemented to ensure that the workers make full and proper use of the safety equipment.

d Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.

Enquiries

If you wish to enquire about this Casebook or require advice on occupational safety and health matters, please contact the Occupational Safety and Health Branch of the Labour Department through:

Telephone : 2559 2297 (auto-recording service available outside office hours)
Fax : 2915 1410
E-mail : enquiry@labour.gov.hk

Information on the services offered by the Labour Department and on major labour legislation is also available on our website at http://www.labour.gov.hk.

For details on the services offered by the Occupational Safety and Health Council, please call 2739 9000.

Complaints

If you have any complaints about unsafe workplaces and work practice, please call the Labour Department's occupational safety and health complaint hotline at 2542 2172. All complaints will be treated in the strictest confidence.

Published by the Labour Department

9/2018-2-B164