An Analysis on Occupational Fatalities Casebook

Volume 3









Occupational Safety and Health Branch
Labour Department

safety at work

Occupational Safety & Health Council

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FOREWORD

Workplace accidents are not just causing sufferings to the victims and their families. They also incur costs arising from work stoppages, insurance claims, medical and rehabilitation expenses.

It is recognized that most workplace accidents are preventable. Very often, the scenarios and causes have common phenomena. Unless the causes of workplace accidents are properly understood, lessons will not be learned and suitable improvements will not be made to secure the future safety and health protection of those who may be affected by a work activity. The responsible persons of workplaces need to understand why events happened, and act to make sure that they do not happen again.

This casebook gathers a collection of fatal accident at work cases edited in a way for experience sharing on accident prevention. It aims at providing precious lessons to those who are exposed to work activities and the management personnel, as well as case studies for safety training institutes.

Case 1 A worker was trapped under a toppled formwork panel

Scenario

On a construction site, a sub-contractor undertook the construction of a concrete retaining wall. The retaining wall was constructed section by section involving activities of formwork erection, reinforcement-bar fixing, concreting and formwork removal. The formwork of a section consisted of two sets of wooden panels (one large and one small) in straight alignment at the front.

On the day of the accident, a gang of five workers were assigned to remove the formwork after concrete curing. They arrived at the site and removed the vertical walings, bolt anchors and platforms of the small wooden panel. An excavator was arranged to hold the panel through a pair of rope slings. After the timber studs upon which the small panel was resting had been knocked off and the small panel was caused to detach from the concrete wall surface, the large panel suddenly toppled and struck a worker. He was later certified dead in hospital.

Case Analysis

The toppled large panel had a dimension of 2.7m x 6.1m, and weighed 460 Kg. Right before the accident, this panel stood freely leaning against the retaining wall without anything to secure it in position.

The workmen did not adopt a proper way to maintain the stability of the large panel, e.g., rigging the panel under a lifting appliance before hammering off the timber studs. There was no training of any kind provided to the team of workers in performing formwork dismantling.

As supported by the findings aforementioned, the accident reflected the inadequacies of the safety management system. There were :

- No planning and documented work methods to guide the workers to work in the correct way.

- No provision of training to enhance the skill and safety consciousness of the workers to carry out formwork dismantling safely.

Lessons to Learn

A safe system of work in formwork dismantling should be provided and maintained to enhance safety at work. The system should include the following major areas :

1. Safety planning with risk assessment be conducted.

2. Method statement be prepared and safe working procedures developed.

3. Safe working procedures be implemented.

4. Adequate information, instruction, training be provided to persons engaged in the work.


安全施工程序及方法
Safe Working Procedures And Methods

Case 2 A glass panel installation worker fell through the void of a canopy

Scenario

On a building construction site, a metal canopy with glass panels was to be constructed at the 1/F level of the building. On the day of the accident, a sub-contractor employed a team of workers to install glass panels for the metal canopy. THe team was divided into two groups. One group from the team was responsible for the lifting of glass panels to the top of the canopy whereas the other group stood on the canopy for receiving the glass panels and securing them onto the openings of the metal frames. The deceased person (D/P) was among the workers working on the canopy.

In the evening, workers on the canopy were taking a short break. At that moment, while the D/P was walking on the metal frame of the canopy, he suddenly fell through a void of the metal frame to the ground and sustained the fatal injury.

Case Analysis

Observations

1. The canopy was a cantilever structure with a horizontal length of 34.8 m, extends outwards by 3 m, and was erected at a height of 8.4 m from the ground.

2. The canopy was a metal frame structure with voids of different dimensions to be covered by glass panels.

3. Only 11 glass panels had been placed in position, leaving 17 voids of dimensions 1 m to 1.4 m by 2.3 m on the canopy.

4. There were eight wooden planks resting on the canopy. Three of them were placed together on the canopy to form a platform of size 4 m x 0.7 m. On one side of this platform, there was a void (1.4 m x 2.3 m) on the metal frame. The other side had another void of 2.3 m x 0.5 m.

5. A fibre rope of 28.6 m in length and 19 mm in diameter was tied to a concrete column at the 1/F. The other end was loosely placed on the floor slab of the 1/F. It was intended to serve as a horizontal independent lifeline for the attachment of safety belts.

6. Five general-purpose safety belts were kept in a toolbox on the 1/F. Their lanyards ranged from 1.1 m to 1.3 m.

Factors Contributing to the Fall of the D/P

1. Before the accident, the D/P was seen walking on a 0.4m wide metal member of the canopy frame, and then fell through a void beside the platform. He was wearing a general-purpose safety belt but the lanyard of his safety belt was not attached to any anchorage.

2. The function of the independent lifeline for anchoring safety belts was also defeated. The rope was intended to mount on two columns and serve as a horizontal independent lifeline. This was not done at that time.

3. Furthermore, there were drawbacks on this horizontal lifeline. All workers could not use it at the same time. The length of the lanyard would restrict a worker's movement on such a large canopy of dimension 34.8 m x 3 m.

4. The platform placed over the canopy was not a safe one as it had no guardrails and toe-boards.

5 There was a method statement specifying the use of a proper working platform for the installation work. A bamboo scaffold had once been erected for this purpose. However, it was dismantled for the purpose of carrying out pavement work underneath. The contractor had not re-assessed the situation, thus reflecting an inadequacy in the safety management system.

Lessons to Learn

1. A safe system of work for the glass panel installation work should be developed, implemented and reviewed from time to time. The safe system of work should include:

   i. assessment of the work processes involved;

   ii. identification of hazards associated with the work processes;

   iii. establishment of well-defined safe working methods and procedures;

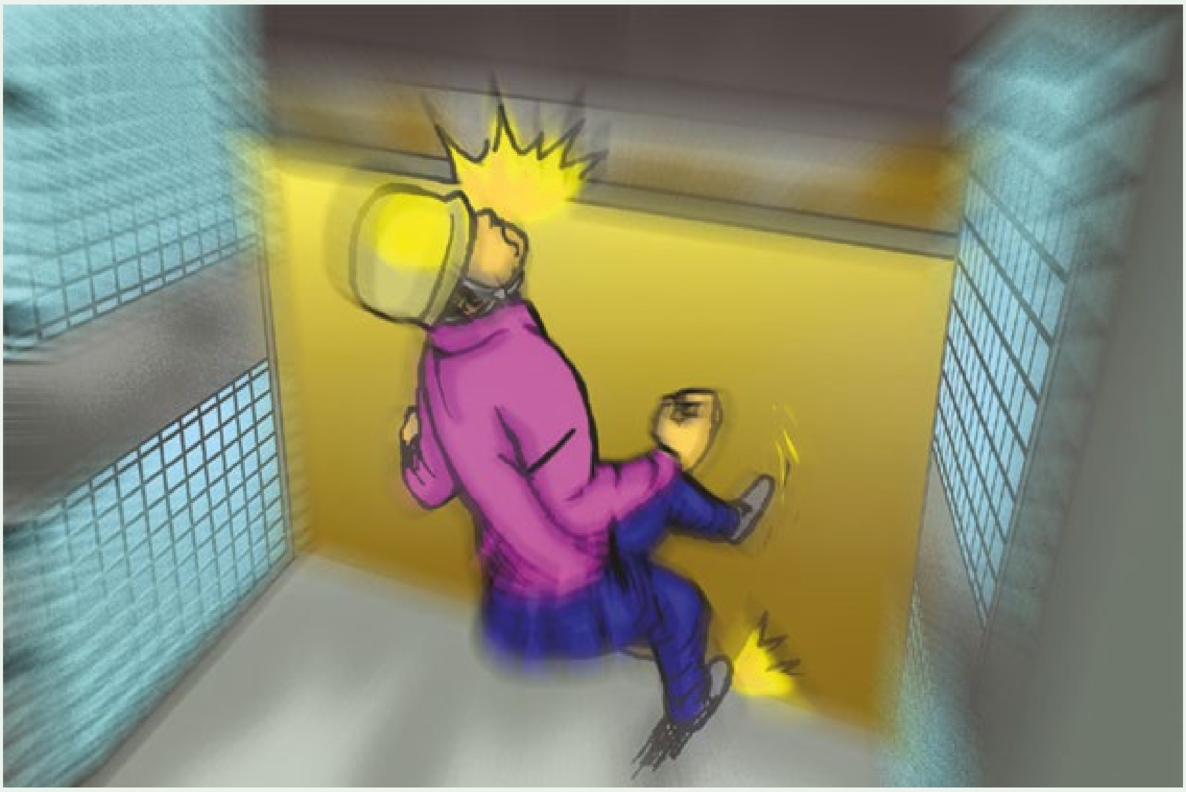
   iv. implementation of the system and monitoring its effectiveness; and

   v. reviewing and, if necessary, revising the system with contingency plans to cope with changing environment.

2. Proper working platforms with safe means of access and egress, suitable guardrails and toe-boards should be provided for workers working at height.

Case 3

Case 3 A worker fell from 22/F to the ground floor through the hoistway



Scenario

On the day of the accident, a sub-contractor undertook the delivery of air-conditioner parts to the upper floors of a building under construction. Nine workmen, including a team leader and a hoist operator, were assigned to do the job. A material hoist installed along the external wall of the building was used to assist in the transportation work. The team leader was responsible for giving instructions to others through two sets of walkie-talkies with independent channels.

The operator stationed at the hoist control room on the ground floor. The other workers were split into Teams A & B. Team A, comprising the deceased person (D/P) and two workers, loaded the air-conditioner parts into the material hoist at lower floors and Team B, comprising four workers, collected them at upper floors. The accident happened while Team A was working at the 22/F. The D/P was standing alone at the hoist landing place, waiting for his team members to transport the air conditioner parts to him. The hoist platform suddenly ascended and trapped the D/P's head. The D/P lost balance. He fell over the unfenced edge of the landing place, through the hoistway and landed on the ground.

Case Analysis

The Control System of the Material Hoist

The hoistway frame of the material hoist had been erected from the ground floor to the 48/F level along the external wall of the building. The control system of the hoist was installed inside a shelter on the ground floor, comprising:

i. *a main power supply unit*

ii. *a central control unit*

iii. *a pendant remote control device*

iv. *a visual warning panel*

v. *an audible signalling unit*

The Central Control Unit

The circuit of the central control unit governed the upward and downward movements of the hoist platform, the circuit of the interlocking devices of the landing gates, and the monitoring system on the 'open' or 'close' status of gates at landing places.

Movement of the hoist platform between designated floors could be set prior to the hoist operations.

On the control panel of the unit, there were the following features :

- ***'AUTO' button*** – by pressing this button, the hoist platform would move to a designated floor. On completing a loading or unloading operation and by pressing this button again, the hoist platform would retum to its previous location. A new designated floor could be selected for another operation.

- ***'Jog up / Jog down' button*** – pressing them would allow fine adjustment of the alignment between the level of the hoist platfrom and that of the landing place when the platfrom reached a designated floor.

- ***'Emergency' button*** – pressing it would bring the travelling hoist platform to a stop and deactivate the functions of the 'AUTO' button. Designated floor numbers had to be re-set to resume the hoist operation.

- ***Touch-Screen*** – for entering designated floors that the hoist platform would travel in the operation.

Pendent Remote Control Device

It had four buttons provided for 'emergency stop', 'jog up', 'jog down' and 'auto start'. Once connected to the central control unit by a connecting cable, the functions at the central control unit would be overridden by the remote control.

Visual Warning Panel

It was installed near the central control unit and linked with the circuits of the micro-switches in the interlocking system of the landing gates.

A landing gate in open position during hoist operations would disengage the micro-switch of the interlocking system, thus lit a red-light bulb in the panel to alert the operator on gate-open status.

The Landing Place and the Gate of the Hoist

The landing place of the hoist on the 22/F was a platform at the windowsill where loading and unloading were carried out.

The landing gates at the landing place were in the form of two swing doors made of wire-mesh and metal frames. Closing of the gates would activate a micro-switch linking to the circuit of the hoist control system and gates-monitoring system.

The design allowed the hoist platform to ascend or descend only after all gates at each landing place had been completely closed with all the micro-switches fully engaged by the gate latches. Opening of any gate would disengage the related micro-switch and stop the hoist platform from moving. At the same time, the red light at the visual warning panel would turn on and a warning message would appear on the screen of the central control unit.

Communication System between the Hoist Operator and Other Workmen

Two pairs of walkie-talkies of independent channels were used for communication purposes. The team leader possessed one unit from each set, while the hoist operator and Team B possessed the others.

The two sets of walkie-talkies were not inter-communicable; nor was there any interference between them.

Safety Measures Adopted by the Site Management

The hoist had been certified to be in safe working order by a registered professional engineer. Random check had been carried out on the hoist in the morning of the day of the accident.

Investigation showed that there was no mechanical failure associated with the hoist.

Training had been provided to the team leader, the hoist operator and the workers on the safe use of hoist. The workers had been told not to tamper with the micro-switches provided at the landing gates and to check their functions before starting work.

Inadequacies in Safety System Attributing to the Cause of the Accident

However, the arrangements adopted for operations of the hoist at the time of the accident were inadequate:

Landing Gates at 22/F

The monitoring system for the landing gates had been defeated by a strip of paper tampering the micro-switch at the gates on the 22/F. However, nobody admitted having knowledge of this paper.

Communication between the hoist operator and other workers

As the control room was inside a shelter, the hoist operator could not see the hoistway and hoist platform during operation of the hoist. He only relied on instructions given by other workers through walkie-talkies, and the visual signals at the visual warning panel. Therefore, it was of utmost importance that clear and precise instruction was given to him before he pressed the appropriate control button.

However, in the accident, the oral communications were unclear.

- *Over-simplified and incomplete instructions were used. Parties in communication did not identify themselves.*
- *The hoist operator was told to rely solely on the signals on the hoist control unit and the visual warning panel, just for the saving of battery life of the walkie-talkies.*

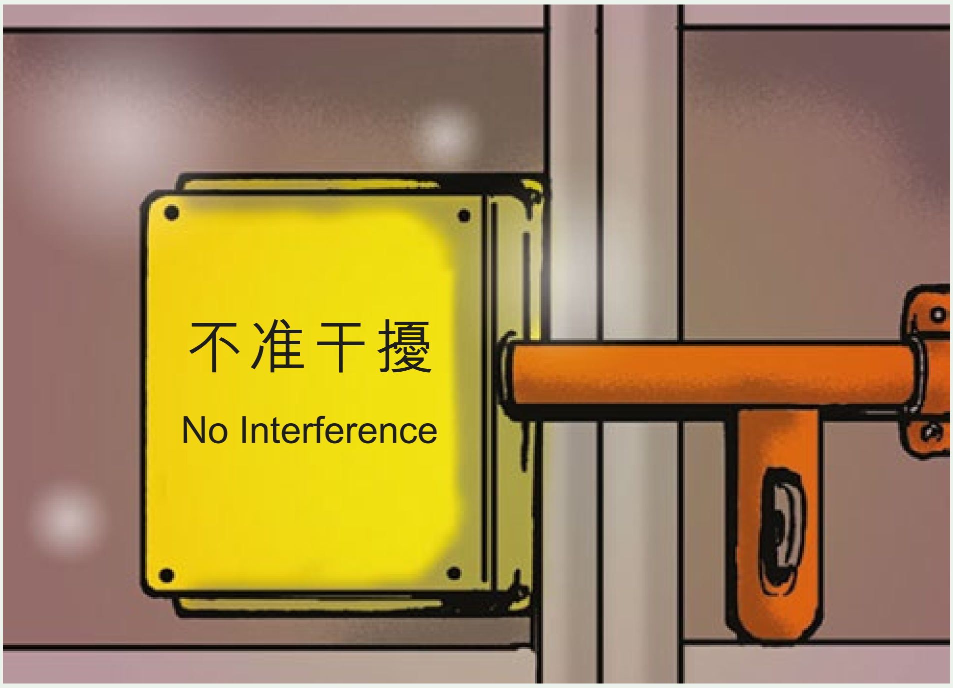
Summary on causes of the accident

Summing up, the accident was caused by inadequate monitoring, communication and supervision on hoist operations that led to ineffective safety performance at work, thus, the tampering of the micro-switches at the landing gates went undetected, and mistakes through inadequate communications could not be avoided.

Lessons to Learn

1. Safety devices such as the micro-switches installed at the landing gates should be inspected before every use in order to eliminate any interference or tampering to the safety system.

2. Effective signalling arrangement for giving and receiving instructions among the parties should be established and used by all workers.


不准干擾
No Interference

Case 4 A welder fell from a tilted catch fan to the ground

Scenario

In a building construction project, the concreting work of several buildings had been completed. Before the finishing work at the external walls of the buildings started, the deceased person (D/P) and a worker were employed by a sub-contractor to dismantle the catch fans erected horizontally at the external walls of the buildings.

On the day of the accident, the D/P and his co-worker carried out the dismantling work. They went out to a catch fan at the 4/F external wall of one of the buildings. The D/P was responsible for cutting off the bracings suspending the catch fan by an oxy-acetylene flame cutting torch while the co-worker was to arrange for the transportation of the dismantled bracings by a tower crane.

At the beginning of the cutting operation, the D/P hooked the lanyard of his safety belt to members of a bamboo scaffold erected at the external wall. After cutting the upper end of a bracing, he detached the lanyard of his safety belt and squatted on the catch fan to cut the lower end. After he had finished the cutting of a bracing, he moved to the other end of the same catch fan, and hooked his safety belt to an independent lifeline provided there. He then cut off the upper anchor bolt of the remaining bracing. After the cutting, the D/P unhooked the safety belt and walked on the catch fan. Suddenly, the catch fan partially collapsed and tilted down. The D/P lost his balance, fell to the ground, and sustained fatal injury.

Case Analysis

The Scene

The catch fan involved in the accident was erected at the 4/F external wall of the building and was more than 10 metres above ground. After the accident, the catch fan partially collapsed and rested on members of a double-row bamboo scaffold erected at the same external wall.

One bracing was still attached to a cantilever of the partially collapsed catch fan.

There was an independent lifeline with one end fixed at an upper floor of the same building. A fall arrestor was fitted to the independent lifeline for anchoring the lanyard of safety belt.

The Catch Fan

A catch fan was a temporary metal structure to protect persons on the open ground from being struck by construction debris and wastes that might fall from height during construction.

Its frame was made of metal U-channels welded together to serve as a cantilever anchored to the wall.

Further anchorage was provided through bracings at each end of the metal frame to secure the catch fan to the external wall.

Wooden boards were placed on the top of the metal frame to complete the structure of the catch fan erected outside the building.

The Job Method in the Dismantling Work

Dismantling of a temporary structure at height was a highly risky job. Thus, the principal contractor had conducted a risk assessment and worked out with the first- and second-tier sub-contractors a method statement covering the safety precautions with proper steps and procedures to ensure the stability of the catch fan during its dismantling and also the prevention against fall of persons carrying out the work thereon.

The method statement recommended that the tension members of a catch fan, i.e., the cantilever and the two bracings for securing a catch fan to an external wall, should only be removed after the catch fan to be dismantled had been securely suspended. A worker engaged in the dismantling work should wear a safety belt anchored to an independent lifeline.

However, in the accident, the proper job method had not been followed in dismantling work.

Inadequacies in the Safe System of Work

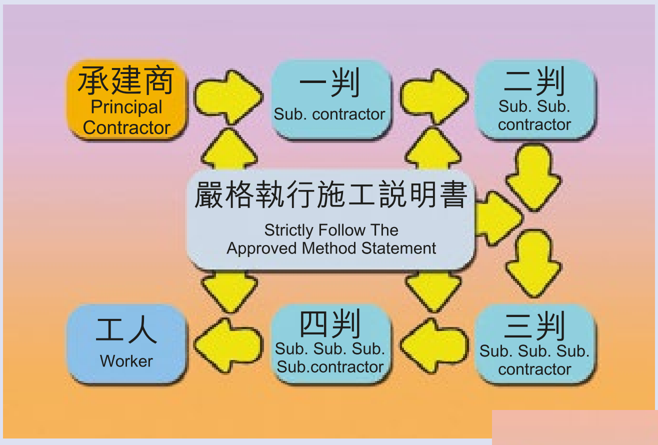
1. The method statement covering the safety precautions prepared by the principal contractor had not been conveyed to the third-tier sub-contractor who employed the D/P to do the job.

2. The safety precautions stated in the method statement were not implemented. The catch fan was not properly secured prior to its being dismantled. The D/P's safety belt was not anchored to the independent lifeline to prevent him from falling.

3. The workers lacked the knowledge and awareness in safety, such as how they could be adequately protected from falling from height in the job. Before the accident, the D/P had to attach and detach his safety belt frequently while still working in risky situations on the catch fan. Besides, the members of the bamboo scaffold which were not suitable for anchorage purpose were also chosen as an anchorage for the safety belt.

4. There was no specific safety training provided to the two workers before they started the dismantling work.

5. No person was present to supervise and monitor the performance of the workers whilst they were engaged in the dismantling work.



Lessons to Learn

A safe system of work regarding the dismantling of catch fan should be provided and maintained so as to ensure that all the hazards are eliminated and proper safe procedures are followed. The safe system of work should cover the following areas :

1. The method statement together with the safety precautions to be adopted in the work should be made known to all personnel involved.
2. All workers should be adequately informed of the associated hazards, clearly instructed and suitably trained of the proper working procedures, and the necessary safety precautionary measures to be adopted before starting the work.
3. All workers should be provided with suitable training from time to time to enhance their safety awareness and knowledge on the potential hazards associated with the dismantling of temporary structures.
4. The workers carrying out the dismantling operation should be under the supervision of a person who is competent in the job and fully aware of the potential hazards and proper working procedures designed for the work.
5. A monitoring mechanism should be established and maintained to ensure that the approved method statement for work safety is strictly followed.
6. The safe system of work should be reviewed from time to time to cope with changes in the site conditions.

Case 5 Two electricians sustained fatal injuries when a flashover occurred at a switch panel

Scenario

Together with some cable jointers of a contractor, two electrical engineers and two tradesmen worked in an electrical project to replace the extra high voltage transformers at substation S1. The project involved cable re-routing of the supply network for several substations in the same district. The re-routing work included the following major steps:

i . switching of circuit (isolation and earthing);

ii. cable identification and cutting in various substations;

iii. cable cross jointing;

iv. re-commissioning test; and

v. energisation of circuit and phasing out test.

One of the deceased persons (D/P1) was an electrical engineer who was responsible for planning, scheduling, arranging manpower, preparing operation switching log sheets and safety documents such as Sanction for Test (SFT) and Permit to Work (PTW). However the D/P1 was not in a position to issue or cancel any SFT and PTW. The other electrical engineer, being a senior authorized person, could do so after receiving instruction from the System Control Centre.

SFT would be issued for cable identification, spiking, cutting, core identification between substations, High Voltage DC Pressure Test and Primary Injection Test of the circuit between substations. It would only be cancelled with the D/P1 as a witness on completion of the work. Prior to the accident, several SFTs had been issued for these purposes.

About 10 minutes before the accident, the D/P1, as instructed by the System Control Centre, energised the circuit between two substations including substation S1. After that, he picked up a tradesman (another deceased person, D/P2) and drove to S1 for the purpose of a phasing-out test to verify the correct phase sequence of the newly formed circuit between substations.

While working in S1, a flashover occurred at a high voltage switch panel inside a switch room. As a result, the D/P2 suffered serious burns. The flashover also activated the carbon dioxide fire suppression system installed inside S1. The D/P1 was overcome by the gas. Both passed away later.

Case Analysis

Earthing Truck

The switch room at the lower basement of S1 was installed with 27 floor-mounted high voltage 11KV switch panels. The accident occurred at Panel 24, which had its outgoing cable connected to another substation.

Inside the lower compartment of Panel 24, there was an Earthing Truck (Truck) which was equipped with fault making earth switch for earthing the high voltage cable and for testing mechanism to facilitate cable tests. This Truck should have been removed from Panel 24 before the 11KV feeder circuit between substations was energised. However, for unknown reasons, it remained engaged in the feeder circuit of Panel 24 after the completion of the High Voltage DC Pressure Test.

Shortly before the accident, the D/P1 and D/P2 were trying to carry out the phasing out test at Panel 24. However, the test could not be carried out as access to the circuit spouts and the busbar spouts was blocked by the presence of the Truck. It was believed that right before the flashover, the D/P2, without knowing that the circuit had been energised, might have intended to remove the Truck from the lower compartment. The steps for removal included –

i. Switching of the three 'Phase Test Switches' from 'Test' position to 'EARTH' position.

ii. Switching of the 'Test Switch Phase Selector' from 'RY&B' position to the 'OFF' position.

iii. Switching of the 'Main Earth Switch' from 'EARTH' to 'OFF' position.

It was probable that the flashover occurred when the D/P2 operated a handle to move the 'Blue-phase Test Switch' from the 'TEST' position towards the 'EARTH' position; that was analogous to bringing a live contact towards a fixed earth contact.

The D/P2 suffered from serious burns in the flashover, but he could manage to rush out of S1. The flashover triggered the automatic carbon dioxide fire suppression system. The D/P1 could not escape from S1 in time and got suffocated by the gas discharged. Before entering S1, they should have switched the operation mode of the fire suppression system from 'automatic' to 'manual'. However, this was not done.

Safety Monitoring

The clearance procedure of an SFT played an important role in ensuring safety at work. Before signing the clearance section of the SFT, the senior authorised person should have obtained from the D/P1 the safety keys for locks of the Truck to prevent the operation of the 'Phase Test Switches' and the disconnection of earth connexion at S1. He should go to check the status at both ends of the circuit. The clearance should be witnessed by a competent person who should also sign the SFT as a witness on completion of all safety precautions. However, these steps had not been performed. Had the senior authorised person obtained the safety keys and kept them before the signing of the clearance section of the SFT, nobody could have put the Truck in 'TEST' position and the Truck could still be removed from Panel 24 for High Voltage DC Pressure Test.

According to the senior authorized person, he had delegated his duty to the D/P1 before signing the clearance section of the SFT on the belief that the circuit distance between substations was long and he could delegate his duties under the company's rules. Under these circumstances, the requirement for clearance to be witnessed by another competent person would not apply.

There was nothing to monitor the operation mode of the fire suppression system. According to the procedures, the staff had to key in the operation status of the fire suppression system via telephone for the knowledge of the Security Control Centre. However, the Centre could not check the status and would only rely on the performance of the staff.

Lessons to learn

The effectiveness of a safe system in electrical work carried out in substations should be maintained by continual improvement in the following areas:

1. The company's safety rules and standards, execution of the safety documents, instructions and supervision on safety at work should be regularly reviewed and revised as when necessary.

2. Descriptive terms such as 'length' or 'distance' in the safety documents should be standardized, and understood by all.

3. Before clearance of the Sanction for Test, all reasonable steps should be taken to ensure that the removal of the temporary connection to the circuit main earth had been positively effected and verified by the recipient of such Sanction for Test. The verification should be witnessed by another competent person as a means of double-checking.

4. The safety procedures, including the giving of instructions and the reporting of completion of test in the process of delegating responsibilities by the recipient of the Sanction for Test to another person, should be reviewed to ensure that the removal or re-application of the circuit main earth would be properly carried out.

5. The access control procedures for entry to the substations should be reviewed to ensure that adequate monitoring was in place.

6. Safety keys for locks of the Earthing Truck should be removed and kept by the recipient of the Sanction for Test during the earthing operation, and warning notice should be displayed at the Truck for preventing any persons operating it.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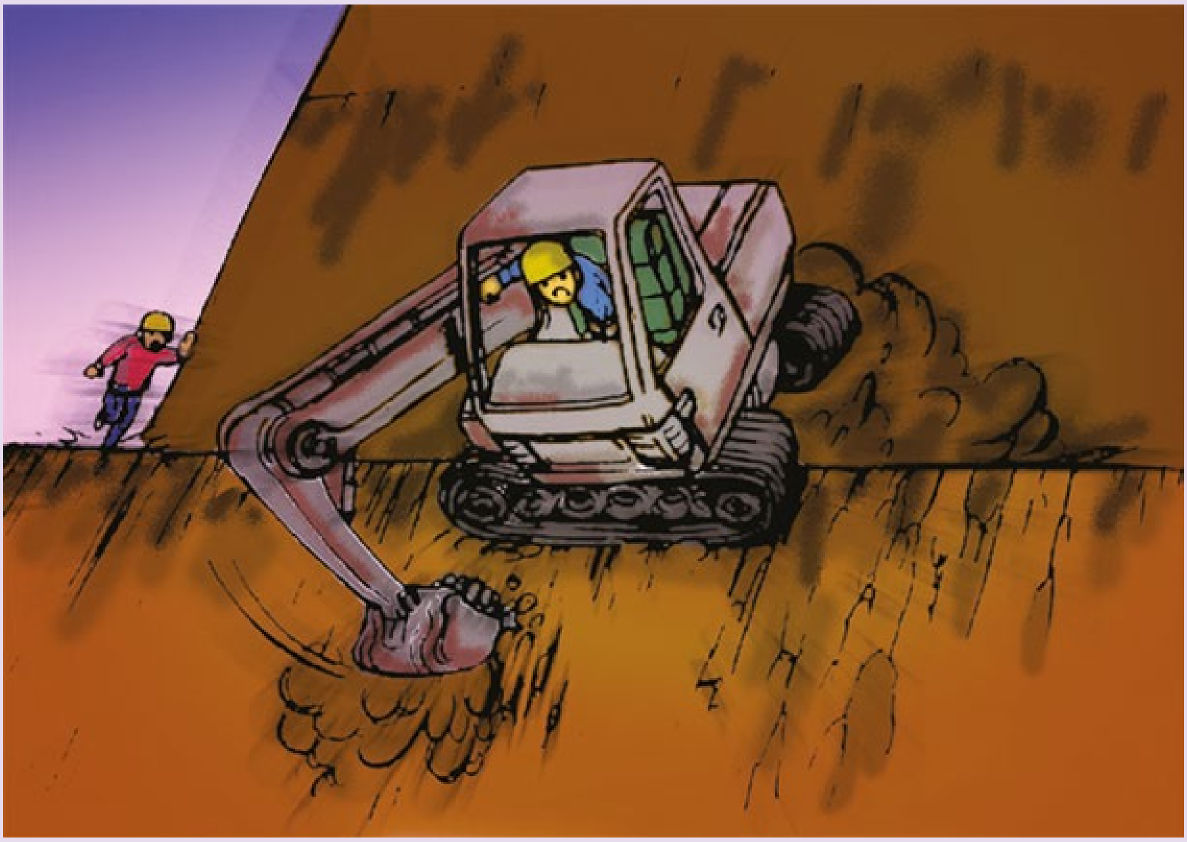
Case 6 A site foreman was trapped inside the crushed cabin of a toppled excavator



Scenario

A sub-contractor undertook slope maintenance and improvement work. A site foreman (the deceased person, D/P) was employed by the sub-contractor to carry out day-to-day site management and operations. On the day of the accident, he led a team consisting of an excavator operator and three labourers to carry out the slope work. Large boulders on the slope were first broken up into small pieces before they were transported out of the site.

Shortly before the accident, the excavator operator attempted to remove a rock on the slope by an excavator. He parked the excavator on a ramp of the slope and extended its jib and bucket to move the rock. However, while trying to maneuvore the rock, one of the crawlers of the excavator moved out of the ramp edge. As the excavator could not maintain a stable balance on the slope, the operator gave up the lifting operation immediately. He slewed the driver's cabin to return the jib of the excavator to the front and attempted to drive the excavator slowly back to the ramp. However, the attempt was not fruitful. When the D/P observed that, he suggested to the operator that the crawler of that excavator could be raised by using the bucket to press hard on the slope at a location beyond the edge of the ramp and to slew the turntable of the excavator and move the crawler at the other side simultaneously so as to bring the other crawler back to the ramp.

The operator regarded the suggested method unsafe and did not follow. The D/P proposed to take over. After getting onto the excavator, the D/P used his own method to operate the excavator. When the bucket was operated to press on the slope, displacement of soil at the edge of the ramp occurred. When the D/P raised the jib again, the excavator operator shouted to the D/P to stop, but it was too late. The excavator toppled at that moment and rolled down the slope. Finally, the excavator crashed onto the rock and stopped. The D/P was trapped inside the driver's cabin and sustained fatal injuries.

Case Analysis

The Slope and the Ramp

- The slope had an angle of inclination from about 22˚ at the upper portion to about 42˚ at the lower portion.
- The ramp was a zigzag temporary access road running from the site entrance to the bottom of the slope according to contour of the slope. It had a length of 15.6 metres and width of 3 metres to 4.5 metres with the maximum width at mid-way between both ends.
- A barrier made of wooden boards was erected at the lower end of the ramp to stop excavated materials from rolling further down the slope.

The Excavator

- The crawlers of the excavator were 1.4 metres apart. Each crawler was 0.8 metre wide and 4 metres long.
- The hydraulic jib above the turntable of the excavator was about 8 metres in length with a bucket fitted at the end.
- The maximum working radius of the bucket in fully extended jib was about 9.8 metres.
- The excavator had a climbing capacity of 35˚.

The Operation of the Excavator at Place of Accident

- When the operator first operated the excavator, the right crawler of the excavator was parallel to the edge of the ramp. The angle of inclination at the place was ranging between 22˚ to 28˚.
- From the edge of the ramp down the slope, the angle of inclination of the slope increased to about 42˚ at the lower part of the slope. The rock to be lifted was at a distance of about 8.4 metres away from the down-slope edge of the ramp. The bucket in fully extended jib could not reach the rock to be lifted unless the excavator moved further beyond the edge of the ramp. Therefore, the degree of instability increased when the excavator moved beyond the down-slope edge of the ramp. It was then overhung at the steeper portion of the slope with an inclined angle of 42˚.
- While using the bucket to press hard on the slope, the soil underneath the ramp where the excavator was stationing was believed to have been disturbed. The dynamic force exerted by the excavator further increased the imposed load on the ramp. The soil was caused to further collapse, and finally the excavator toppled.

Training and Competency of Persons in Safety

- The excavator operator was holding valid certificates issued by the Construction Industry Training Authority in mandatory basic safety training and in competency for operating an excavator.

- The D/P was only holding a valid certificate in mandatory basic safety training issued by the Construction Industry Training Authority.

The investigation revealed the following inadequacies in respect of safety :

i. Safety awareness of persons employed on the site – both the operator and the D/P did not have enough safety awareness to handle situations encountered at work :

   • The operator had driven the excavator away from a safe position on the ramp for the bucket to reach out for the rocks, thus placing the excavator in a state of instability. Besides, he had not stopped the D/P from driving the excavator even he considered the method suggested by the D/P was unsafe.

   • The D/P should have stopped the excavator operator from work and consulted people who were competent in safe excavator operations, but he failed to do so. Instead, he took charge of the excavator from its operator who should be more competent in excavator operations.

ii. Emergency plan provided to persons on site – there was no specific emergency plan relevant to the working environment, such as the procedures for the rescue of plant or equipment on slope.

iii. A safe system of work in connection with the use of excavator on slope was not in place.

Lessons to learn

A safe system of work in connection with the operation of an excavator on a slope should be provided and maintained. The system should include, but not limited to, the following essential items :

1. An assessment of the associated hazards and risks in operating an excavator on a slope should be conducted. The assessment should cover the various parameters of the site conditions, potential problems relating to geotechnical data such as the soil conditions, angle of inclination of the slope and the safe proceduures for the movement and operation of the excavator or construction plants.

2. A procedure on the criteria for selection of excavators in terms of their size and capacity appropriate to the site conditions should be provided and implemented.

3. Safety measures required for the safe operation of an excavator on a slope should be well defined, formulated and implemented, including limitations in accordance with the instruction manual, such as the need for proper wedging and choking the crawlers.

4. An emergency plan to cater for emergency situations and proper steps and procedures to be followed should be devised. Safe methods to be adopted, plants to be provided and competent persons to be summoned for restoring the excavator back to safe positions on slope in case of emergency should be clearly laid down in the emergency plan.

5. A key personnel from the site management team should be appointed to supervise and monitor the site operations to ensure that all rules and procedures stated in the safe system of work are implemented and executed.

6. Steps should be taken to ensure that any person operating an excavator is in possession of a valid certificate for excavators issued by an approved training organisation and fully trained and competent to handle situations at time of emergency apart from normal excavator operation. In no circumstances should the method of pressing the ground, with a view to changing the excavator's position, with the excavator's bucket be carried out.

7. The system of work should be regularly reviewed, updated and properly maintained throughout the period of site operation.


安全挖掘及
施工說明書
Excavation Safety
Operation Manual


緊急應變計劃
Emergency Planning

Case 7

Case 7 A labourer fell from a bamboo scaffold while carrying out concreting work at the external wall of a building

Scenario

On the day of the accident, a building involved had been constructed to the 26/F level. Modification to extend the bay windows and lintels in certain units on the 10/F and below was in progress.

The modification work involved drilling, bar fixing, formwork erection, concreting, and formwork removal. Concreting of the bay windows and the lintels on 10/F was scheduled at that time.

In the morning, a sub-contractor employed two workers and the deceased person (D/P) to carry out concreting work on the 10/F. One was the gang leader of the job. Concrete mix was first delivered to Unit D on 10/F. The work started from there, and then proceeded to other units. The gang leader was also responsible for transporting concrete mix in a wheelbarrow to the other two workers. One worker stayed indoor and poured the concrete mix for the bay window. As the D/P was responsible for concreting the lintels, he had to climb through a window opening to the bamboo scaffold erected at the external wall of the building to apply concrete mix to the lintels of the windows on 10/F and 9/F.

The accident happened after the indoor worker had completed his work at Unit C. Without waiting for the D/P to complete his job at the external wall of Unit C, the indoor worker moved to Unit B to continue the work.

When the gang leader was conveying some concrete mix between units, he could not find the D/P in Unit C. He immediately went to the bay window at Unit C to search for the D/P. He found the D/P lying on a wooden board resting on the scaffold members at the 8/F level. The D/P was sent to hospital and subsequently passed away.

Case Analysis

Observations

1. The work performed in Unit C
   - The bay window and the lintel were 0.54 m and 2.95 m respectively above the floor. Height of the window opening was 1.78 m.

   - The bay window and the lintel at each window opening protruded 500 mm from the external wall. Formwork was erected at the bay window and lintel to extend the protrusion to 675 mm. Wet concrete mix was found enclosed by the formwork.

2. The bamboo scaffold

- A double-row bamboo scaffold was erected at the external wall. The inner row of the bamboo scaffold, closest to the building, was 0.4 m from the external wall.

- The distance between the inner row and outer row of the bamboo scaffold was 0.9 m.

- The distance between any two standards at the inner row was 1.5 m, while that at the outer row was 0.75 m.

- The distance between any two ledgers at the inner row was 2.1 m and that at the outer row was 0.65 m. This arrangement on the inner row was to accommodate the protrusions of the bay window and the lintel.

- Two wooden boards were found on the ledgers at the 8/F and 9/F levels. Their sizes were 1.8 m x 0.5 m and 1.4 m x 0.13 m respectively. The one at the 8/F level was somewhere away from the vertical alignment of the bay window at Unit C.

3. Measures to prevent fall of persons

- There was no proper means of access and egress provided at the scaffold.

- There were no proper working platforms provided for the D/P to perform the work. Even though a witness expressed that the D/P was standing on two or three wooden boards of width 125 mm each to perform the work, the total width could not completely cover the void space between the two rows of scaffold. The inner ledger was not adequate to form a continuous guardrail. Furthermore, there were no toe-boards there.

- Although the D/P was wearing a full body harness, there was no suitable anchorage in the vicinity. Even if there were any such anchorage, it could not offer proper protection as the D/P had to move from one place to another during work, requiring a frequent detachment of the harness from the anchorage.

4. Safety performance of contractors

- The principal contractor only told the sub-contractor to provide working platforms for working on the bamboo scaffold. There was no supervision to ensure this.

- The gang leader assumed that the worker would erect his own working platforms.

- There was no safety plans nor method statement laid down for the job.

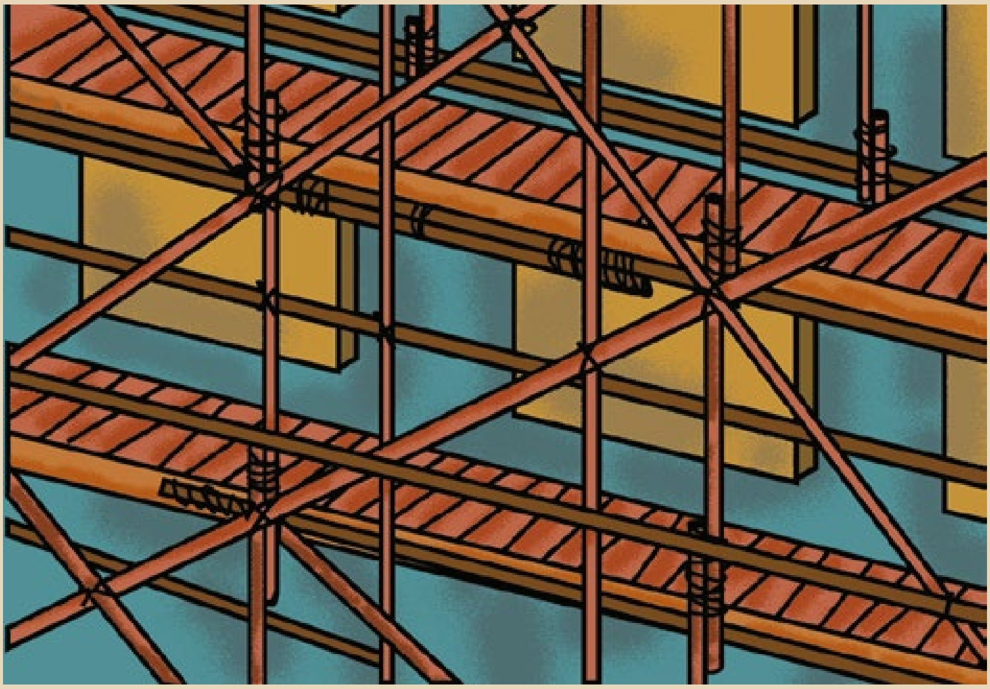
Causes of the Accident

Apparently, without adequate protection for working on the scaffold, the D/P fell from his place of work through the void between the scaffold members until he reached a wooden board at the 8/F level. The accident also reflected the failure in the safety management systems of the principal contractor and the sub-contractors in providing adequate and suitable safety measures for the workers and in monitoring the safety performance of the workers on the construction site.

Lessons to Learn

A safe system of work should be provided and maintained for the concreting work carried out at the external walls of the building. The measures should include, but not limited to, the following:

1. Planning on safety measures and method statements for the implementation on site.
2. Providing and maintaining suitable and adequate safe access to and egress from the workplace at the scaffold.
3. Providing and maintaining suitable working platforms.
4. Monitoring the safety performance of the contractors and workers.



Case 8

Case 8 A worker was electrocuted by a defective fluorescent light panel during fire services maintenance

Scenario

Maintenance of fire service installation of an industrial building was being done. The work included replacement of water pumps, inlet valves, fire alarms and hose reels at various locations of the building. The deceased person (D/P) was a worker employed by a subcontractor responsible for the work.

On the day of the accident, the D/P was assigned by his employer to prepare materials for the work. At about 5:30pm, the D/P came to a flat of the building for inspection. At about 5:45pm, the staff inside the flat heard a loud "Bang". They found that the D/P was lying unconscious on the floor at the front exit with a wooden ladder between his legs. The D/P was sent to hospital where he was certified dead. The cause of death was electrocution.

Case Analysis

The front exit of the flat led to a corridor covered by false ceiling, except a small portion adjacent to the front exit where a hose reel together with its piping was installed. The false ceiling was formed by false ceiling panels and metal supporting grid. The metal supporting grid was suspended from the concrete ceiling by steel wires. It was not connected with a supplementary equipotential bonding conductor to earth.

There were five fluorescent light panels in the corridor controlled by a switch. The panels were suspended from the concrete ceiling by steel wires to a level just above the false ceiling. Some of the steel wires of the false ceiling panels were pressing against the steel casing of the lighting panels.

The power supply cable connected to the light panels was a 2-core cable without any earth core. Their steel casings were not connected with any circuit protective conductor either. The supply voltage was 220V a.c.

When tested, the light panel No.1 was found to be defective in that the line of the power supply was short-circuited with its steel casing. Since the steel casing was electrically common with the false ceiling, both the steel casing of the light panel and the metal supporting grid of the false ceiling became live when the light panel was on.

As the D/P was working alone, no one witnessed what had exactly happened to the D/P in the accident. However, it was believed that at the time of the accident, the steel casing of the light panel and the metal supporting grid of the false ceiling were both live due to the defective light panel. When the D/P was standing on the ladder to inspect the fire services installation, his body might come into contact with the casing of the light panel or the metal supporting grid of the false ceiling. When he touched other earthed metal part nearby, possibly the piping of the hose reel, a complete electric leakage circuit was formed. The leakage current passed through his body, leading to electrocution .

Lessons to Learn

1. The fluorescent light circuit and panel should be properly maintained to prevent leakage of electricity.

2. The steel casing of the fluorescent light panel should be effectively connected with a circuit protective conductor to earth.

3. The metal supporting grid of the false ceiling should be connected with a local supplementary bonding to earth.

4. Suitable working platform shall be used for work at height.

Case 9

Case 9 Bales of cotton collapsed and struck a porter leader

Scenario

A textile factory imported batches of cotton bales from overseas for its production work. The cotton bales were stored at its godown and would be removed to the workshop by the factory workers according to the daily production schedules.

On the day of the accident, a porter leader (the deceased person, D/P) informed the godown in-charge that he would handle some cotton bales by a forklift truck on 3/F & 4/F of the godown. Later, the godown in-charge found the D/P buried under some toppled cotton bales in the 3/F godown with his head injured. The D/P was certified dead afterwards.

Case Analysis

Findings at the Scene of the Accident

At the scene of the accident, there was a large stack of cotton bales in 5 rows x 6 columns x 6 bales high. Each cotton bale measured 1.4 m (length) x 0.77m (width) x 0.5m (height) and weighed 225 Kg. All cotton bales in the stack were oriented in a line with the short sides parallel to the wall.

About twenty cotton bales had fallen from the large stack to the ground. A forklift truck was found among the toppled stocks. Three cotton bales in one stack were on the fork of the truck. The D/P's body was about two metres away from the rear of the forklift truck. There were four cotton bales around his body when he was found by the godown in-charge.

Original Stacking of Cotton Bales

From record, the cotton bales were transported to the godown a month before the accident.

The 'main body' of the cotton bales was stacked with one side leaning against a wall of the godown and another side against a 'stack wall' which had been formed by lining up a row of cotton bales of 6-high with the long side contacting each other forming a 'stack wall' to support the 'main body' of the stack.

In stacking the cotton bales, the forklift truck would lift two to three bales in one go to top up the stack in sequence in a direction further away from the 'stack wall' and the wall.

De-stacking of Cotton Bales

The de-stacking of cotton bales should normally be done in a reverse sequence of the stacking process. The cotton bales at the top of the pile farthest from the wall and the 'stack wall' should be de-stacked first.

Competency of the D/P in the job

The D/P had been operating forklift trucks for 15 years but he had not received any formal training.

The D/P had been told by the management not to move any cotton bale out of the 'stack wall' before the removal of all cotton bales in the 'main body'.

Supervision on Performance of the Workmen

The godown in-charge would occasionally supervise the people working in the godown.

He had not seen the D/P de-stacking the 'stack wall' before the removal of all cotton bales in the 'main body'.

What Happened at the Time of the Accident

From the remaining rows at the scene of the accident, the row of cotton bales in a complete form of a 'stack wall' was missing. It was quite likely that the piles of cotton bales in the row forming the 'stack wall' had toppled at the time of the accident.

It was believed that the toppling was triggered when the D/P was removing some cotton bales from the 'stack wall'. In the course, the cotton bales forming the large stack displaced and started to topple. The D/P tried to escape from the toppling cotton bales but in vain. Thus, he was struck by the cotton bales falling onto him.

Factors Attributing to Cause of Accident

Unsafe Stacking Method

Basically, the stacking method was potentially hazardous. The 'stack wall' was not backed up by a strong support like a wall or a structure designed for that purpose. The cotton bales in the 'main body' might have exerted a great lateral force on the 'stack wall' if leaning against it. Any disturbance to the 'stack wall' would lead to toppling of the cotton bales that hit any person who was working nearby.

Inadequacy in Safety Management System

The unsafe stacking method reflected the inadequacy in the safety management system in the following aspects:

- *Failing to conduct risk assessment.*
- *Inadequate safety planning.*
- *Lacking detailed method statement and instructions.*
- *Inadequate safety supervision such that problems could not be detected and solved at an early stage.*
- *Lacking review on safety measures to be adopted.*

Lessons to Learn

A safe system of work on stacking and de-stacking of cotton bales from stacks should be provided, with the following areas attended to:

1. Conduct risk assessment to identify the hazards affecting the safety of the workmen in the job.

2. Devise detailed method statement regarding the safe working procedures and provide adequate instructions and training on the contents to the workmen.

3. Carry out supervision and monitoring on the effects of the implementation of the safe system of work.

4. Review the system periodically with improvements devised for any weakness detected in the system.

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 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.

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