A Casebook of Occupational Fatalities related to Truss-out Bamboo Scaffolding Works
This guide is prepared by the Occupational Safety and Health Branch, Labour Department.

This edition December 2017

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A Casebook of Occupational Fatalities related to Truss-out Bamboo Scaffolding Works
<table>
<thead>
<tr>
<th>Case</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Case 1</td>
<td>A worker fell from a truss-out bamboo scaffold while dismantling an unauthorized metal cage and metal racks</td>
<td>4</td>
</tr>
<tr>
<td>Case 2</td>
<td>A scaffolder fell from a height while erecting a truss-out bamboo scaffold (I)</td>
<td>7</td>
</tr>
<tr>
<td>Case 3</td>
<td>A scaffolder fell from a height while erecting a truss-out bamboo scaffold (II)</td>
<td>10</td>
</tr>
<tr>
<td>Case 4</td>
<td>A scaffolder fell from a height while erecting a truss-out bamboo scaffold (III)</td>
<td>13</td>
</tr>
<tr>
<td>Case 5</td>
<td>Two scaffolders fell from a height while erecting a truss-out bamboo scaffold (IV)</td>
<td>17</td>
</tr>
<tr>
<td>Case 6</td>
<td>A scaffolder fell from a height while erecting a truss-out bamboo scaffold (V)</td>
<td>21</td>
</tr>
<tr>
<td>Case 7</td>
<td>A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (I)</td>
<td>24</td>
</tr>
<tr>
<td>Case 8</td>
<td>A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (II)</td>
<td>27</td>
</tr>
<tr>
<td>Case 9</td>
<td>A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (III)</td>
<td>31</td>
</tr>
<tr>
<td>Case 10</td>
<td>A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (IV)</td>
<td>34</td>
</tr>
<tr>
<td>Case 11</td>
<td>A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (V)</td>
<td>37</td>
</tr>
<tr>
<td>Case 12</td>
<td>A worker fell from a truss-out bamboo scaffold while engaged in water seepage repair work</td>
<td>40</td>
</tr>
<tr>
<td>Enquiry</td>
<td></td>
<td>43</td>
</tr>
</tbody>
</table>
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, nor will suitable measures be implemented to prevent recurrence of such accidents.

Truss-out bamboo scaffolds are commonly used in building repairs and maintenance. In recent years, many serious fall-of-person industrial accidents have resulted from the erection, use and dismantling of this particular type of bamboo scaffolds. This casebook features a number of fatal accidents related to truss-out bamboo scaffold works. It can be used for experience sharing purpose to help prevent the recurrence of such accidents. It is hoped that workers and managers involved in such work activities will learn the lessons from the casebook. Safety training institutes will also find the casebook useful for conducting case studies.

Occupational Safety and Health Branch

Labour Department

March 2007
Case 1

A worker fell from a truss-out bamboo scaffold while dismantling an unauthorized metal cage and metal racks.
**Scenario**

The deceased person and his partner were awarded a renovation contract of an upper floor domestic flat. The works included dismantling an unauthorized metal cage and metal racks at the balcony and replacing corrugated asbestos canopies with new ones. Truss-out bamboo scaffolds were erected on the external walls outside the balcony of the flat to serve as working platforms for the works. At the time of the accident, the metal cage and some metal brackets had been dismantled. The deceased person was going to remove the remaining metal racks affixed on the outer side of the metal fence on the balcony. He stayed on the ledger platform and used a portable electrical cutter to cut the metal racks. While working, the deceased person lost his balance and fell a vertical distance of about 20 meters from the scaffold to the top of a flat roof structure on the 1/F of the building.

**Case Analysis**

- The ledger platform from which the deceased person worked was formed by several bamboos supported by metal brackets and another metal cage at the balcony on the floor below. It was about 600 mm to 750 mm wide. 2 to 4 bamboo ledgers were erected on the sides of the ledger platform to serve as guardrails. The vertical distance between the ledgers ranged from 500 mm to 750 mm. The base of the ledger platform was not boarded. No toe-board was erected at the sides of the ledger platform. Nylon sheets were laid on the ledger platform and extended up to the second ledger. These nylon sheets were fastened to the bamboos by metal wires.

- One of the nylon sheets that extended up had detached and fell to the platform. A void space of 750 mm high and 950 mm wide was thus exposed. The deceased person was seen squatting on the working platform near this unprotected void space to cut the metal rack just before the accident.

- The deceased person wore no fall protection equipment while working. Safety harness, fall arrester and independent lifeline were not provided at the work location. No safety net was erected underneath where the deceased person was working.
Lessons to Learn

(a) Risk assessment should be conducted prior to the commencement of the renovation works on the external wall. Safe working procedures should be developed and implemented.

(b) The truss-out bamboo scaffold should be suitably designed, constructed and maintained for the workers to carry out work safely at a height.

(c) The ledger platform should be closely planked and provided with suitable guardrails and toe-boards to prevent the worker from falling for a height of more than 2 metres.

(d) Sufficient information, instruction, training and supervision regarding the safety of work at heights should be provided to the workers.
Case 2

A scaffolder fell from a height while erecting a truss-out bamboo scaffold (I)
Scenario

The owner of an upper floor domestic flat planned to demolish the unauthorized canopies on the external wall of the building. Two truss-out bamboo scaffolds were to be erected for carrying out the demolition work. After completing the erection of the truss-out bamboo scaffold facing the street, the deceased person and his co-workers proceeded to erect the second scaffold facing the flat roof of the building. This scaffold was erected about 2 metres below the canopy. It was constructed of four ledgers rested on two metal brackets. Each bracket was fixed to the wall with one expansion anchor bolt. At the time of the accident, a raft like ledger platform of 1.95 m long and 0.45 m wide was erected. The deceased person was working from the partially-erected scaffold while his co-workers all remained inside the premises. Suddenly, one of the supporting brackets detached from the wall causing the ledger platform to tilt outwards. The deceased person thus fell a distance of 19 m from the collapsed ledger platform to the flat-roof on the 1/F of the building.

Case Analysis

- The expansion anchor bolt that fixed the metal bracket to the wall was 60mm long and 13mm in diameter. The sleeve of the expansion anchor bolt was 40mm long. A hole of about 95mm deep 20mm in diameter was drilled in the wall. Four nylon strips, each of 170mm long, 6.5mm wide and 0.95mm thick, were wrapped onto the sleeve of the expansion anchor bolt. The anchor bolt together with the nylon strips were then inserted into the hole and screwed home causing its tail to expand and fixed the bracket to the wall.

- A bamboo raker was fixed on one side of the scaffold. The metal bracket on this side of the scaffold remained intact after the accident.

- The building wall was made up of brick and plaster. The overall thickness of the wall was 290mm and the external plaster was 32 mm thick. The expansion anchor bolt was embedded in the layer of bricks for a depth of no more than 10mm. Moreover, the tail of the anchor bolt was only slightly expanded. The gripping force created was not strong enough to hold the metal bracket firmly in position.

- The expansion anchor bolt was not a suitable bolt for brick wall.
• The diameter of the drill hole was greater than the diameter of the expansion anchor bolt. The gripping force of the expansion anchor bolt was reduced although nylon strips were inserted to fill the void.

• Fall protection equipment, namely safety harness, fall arrester and independent lifeline, was not used by the deceased person while he was erecting the truss-out bamboo scaffold.

• There was no risk assessment conducted in respect of the erection of truss-out bamboo scaffolds on the external wall of a building.

• The deceased person held a two-way permit issued by the People’s Republic of China. It was believed that the deceased person had not attended the relevant mandatory basic safety training and held a valid certificate for working on a construction site.

• There was no competent person available on the site to supervise the erection of the truss-out bamboo scaffolds.

Lessons to Learn

(a) Every truss-out bamboo scaffold should be properly designed by a professional engineer of structural engineering discipline and relevant working procedures drawn up.

(b) Construction material of the building wall should be examined prior to the erection work. Selected anchor bolts should be used. Metal brackets for supporting the scaffold should be securely fixed to the building wall with three or more anchor bolts. Anchor bolts should be installed in accordance with the installation procedures specified by the manufacturer. The depth and the size of the drill hole should also be appropriate to fit the diameter of the bolt.

(c) Erection of the truss-out bamboo scaffold should be carried out by trained workmen with adequate training and experience and under the supervision of a competent person who was appointed by the contractor for this purpose.

(d) Suitable fall arresting equipment, namely safety harness, fall arrester and independent lifeline should be provided and worn by workers who were at risk of falling from a height. An effective monitoring system should be implemented to ensure that the workers make full and proper use of the safety equipment.

(e) Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.
Case 3

A scaffolder fell from a height while erecting a truss-out bamboo scaffold (II)
Scenario

A section of the sewage pipe of a domestic building was blocked outside an upper floor flat. For workers to reach the section of the blocked sewage pipe for repairs, a truss-out bamboo scaffold was required to be erected outside the bathroom of the flat. The deceased person and his co-worker were responsible for the erection of this truss-out bamboo scaffold. They first erected a bamboo frame across the window opening of the bathroom. Then, they hung a 7-rung rope ladder from the bamboo frame to provide access and foothold for installing the metal brackets. After the rope ladder was secured in position, the deceased person climbed down the ladder to perform the erection work while his co-worker stayed inside the flat to pass him tools and bamboo poles. While the deceased person was fixing a ledger onto the metal bracket that was installed on the left hand side of the rope ladder, the left rope of the rope ladder suddenly snapped between the 3rd and 4th rung. The deceased person lost his balance and fell a vertical distance of 18m to the podium on the 4/F of the building.

Case Analysis

- The rope ladder involved in this accident was hand made by the deceased person. It was composed of 7 wooden rungs, fixed to two hemp ropes and metal wires. It was 4.12 m long and the diameter of the rope was 15 mm. It had been used for about 3 months before this accident occurred.

- The rope ladder was made of nature fibre and was not rigid. It would swing when the deceased person stretched his body out for the erection work. This rope ladder could not provide a firm foothold for the deceased person while he was working from it. As the deceased person had to use both of his hands to handle bamboo poles and hand tools for the erection work, he was exposed to a high risk of fall from a height.

- The section of the left rope between the 3rd and the 4th rung was 100 mm shorter than the the same section on right rope. Broken hemp fibre were also found on other part of the rope. When the deceased person leaned his body leftward to installed a ledger, unbalance tension on the left rope was created. The left rope finally broke as a result.
• A set of full body harness was found inside the flat. However, the deceased person only wore a waist type safety belt. Moreover, the snap-hook of the lanyard was only attached to the D-ring of his safety belt and not to a suitable anchorage. In fact, there was no suitable anchorage point or independent lifeline and fall arrester for the worker to attach the safety belt or harness. Safety net was also not provided on the site.

**Lessons to Learn**

(a) Safe means of access and egress should be provided for the workers engaged in erecting truss-out bamboo scaffolds.

(b) Suitable and secured anchorage and fall arrester should be provided for the workers to attach their safety belts continuously while making access and egress and during the erection of truss-out bamboo scaffolds.

(c) Workers engaged in erection of truss-out bamboo scaffolds should make full and proper use of a safety harness, and fall arrester attached to a secure anchorage or independent lifeline.

(d) Risk assessment should be conducted prior to any scaffolding work. Safe working procedures in respect of the erection of scaffolds should be developed and implemented.

(e) Erection of truss-out bamboo scaffolds should be carried out by trained workmen and under the supervision of a competent person.
Case 4

A scaffolder fell from a height while erecting a truss-out bamboo scaffold (III)
Scenario

A contractor was awarded a contract to carry out renovation work in an upper floor unit in of a domestic building. The works included replacing the old windows with new aluminum ones, replacing water pipes and drainage pipes, removing existing partition walls, repartitioning of the premises and making of furniture. As window and pipe replacement works could not be done internally, truss-out bamboo scaffolds had to be erected on the external wall of the unit. A team of four workers, including the deceased person, was assigned to erect two truss-out bamboo scaffolds. The truss-out bamboo scaffold for the window replacement work was erected just below the windowsills and the other one for the pipe work was erected at a lower position just above the windows of the floor below.

In the morning on the day of the accident, erection of the truss-out bamboo scaffold for the window replacement work had been completed. The deceased person and his team of workers proceeded to erect the second truss-out bamboo scaffold for the pipe work. One of the workers hung a rung ladder out from a window opening. He then climbed down the ladder to drill holes and fixed two metal brackets onto the external wall of the building to act as supports for the scaffold. At the time of the accident, he had already tied four ledgers onto the two metal brackets and proceeded to place the fifth ledger in position. At this juncture, the deceased person joined in to assist. While both workers were working from the partially erected ledger platform, the expansion anchor bolts that fixed the metal brackets to the external wall suddenly detached. The first worker managed to hold on to a rack beside him and eventually returned to the unit unharmed. However, the deceased fell together with the 2 metal brackets and the five ledgers onto the street. He was later certified dead.

Case Analysis

- Four drill holes were found on the building external wall at positions of 1500 mm below the windowsill for the installation of the metal brackets. The average diameter of three of the holes was 14 mm. The diameter of the other hole was 16.80 mm. Three of the holes had a depth that ranged from 37 mm to 48 mm while the depth of other hole was 80 mm.

- The two metal brackets found fallen onto the street were each attached with one expansion anchor bolt. The length of the expansion anchor bolt was 70 mm and diameter of its external sleeve was 13 mm.
• The base material of the building external wall was weak plaster. Its strength for holding expansion anchor bolts was dubious. The sizes of the drill holes were bigger than the diameter of the external sleeves of the expansion anchor bolts. Moreover, the inner part of the two drill holes for holding the metal brackets had partially collapsed. The holding capacity of these two holes was significantly reduced. When the deceased person and his co-worker worked from the ledger platform, the expansion anchor bolts could not withstand the pull out force that was induced by the weight of two persons and thus detached from the wall.

• Only one fibre rope was hung outside the window from inside the unit. This rope was tied to a bundle of seven bamboo poles that was placed vertically beside the window. No independent lifeline and fall arrester was installed. No alternative suitable anchorage was available. Although both the deceased person and his co-worker had worn a safety harnesses, there was no suitable anchorage and fall arrester for them to anchor their harness. There was also no safety net erected beneath their working position.

• The worker who drilled holes on the building wall was not a trained workman. He had not received formal training on scaffolding works and possessed no valid scaffolding certificate. Moreover, his certificate of mandatory basic safety training for construction work had expired and he had not renewed it.

• The base material of the external building wall was not ascertained. The anchor bolt might not be a suitable one for the brick wall. Assessment of the associated risks and hazards was also not conducted.

Lessons to Learn

(a) The base material of the building wall should be carefully examined to ensure it is suitable for the use of expansion anchor bolt. Holes for holding the expansion anchor bolts should be of suitable size and the expansion anchor bolts should be properly installed and securely fixed on the building wall.

(b) Truss-out bamboo scaffolds should be designed by a competent person and erected by trained workmen who possessed a valid scaffolding certificate and relevant training and experience.
(c) Risk assessment should be conducted prior to the erection of a truss-out bamboo scaffold. Safe working procedures should be developed and implemented, including the installation of safety nets or the provision of safety harnesses, fall arrester and suitable and secure anchorage to prevent workers from falling from a height.

(d) Sufficient information, instruction, training and supervision as may be necessary to ensure safety at work should be provided to the workers.
Case 5

Two scaffolders fell from a height while erecting a truss-out bamboo scaffold (IV)
Scenario

A contractor entered into a verbal agreement with the unit owner of an industrial building to renovate the premises of his upper floor unit. The works included painting of the unit, repairing the unit floor, dismantling air ducts and metal sliding door and replacing the windows with new aluminum ones. Three truss-out bamboo scaffolds at different levels were to be erected on the external wall of the building facing a rear lane for carrying out the dismantling of air ducts and metal sliding door and the replacement of windows. A gang of four workers was responsible for erecting the scaffolds. The gang leader stayed on the ground floor to cut the bamboos into shorter lengths so that they could be transported to the premises by the lift. The two deceased persons were responsible for erecting the scaffolds on the external wall of the building. The fourth worker stayed in the unit to pass bamboos to the two deceased persons. At the time of the accident, erection of the first scaffold had been completed and the second scaffold was also partially completed. The two deceased persons were at the material time standing on the ledger platform of the second truss-out bamboo scaffold to install metal brackets for the third scaffold. While they were working, two of the three metal brackets that supported the ledger platform suddenly detached from the wall. The ledger platform tilted and collapsed as a result. The two deceased persons lost their balance and fell to the ground floor. They were rushed to hospital for treatment but were certified dead upon arrival.

Case Analysis

- The airducts, metal sliding door and metal windows were all erected on the same wall of the premises that faced a rear lane.

- The first scaffold was supported by three metal brackets and each bracket was fixed onto the building wall with one expansion anchor bolt. Ledgers were laid on top of the brackets and fastened onto them with nylon strips.

- The second scaffold was erected at the location of the metal sliding door. It was also supported by three metal brackets and each bracket was fixed onto the building wall with one expansion anchor bolt. The two brackets at the two ends of the bamboo poles were installed onto the building wall in an inverted manner. The horizontal member of the bracket thus became the lowest part instead of being the uppermost part as it was commonly installed. Ledgers were laid on the brackets inside their triangular voids. The third bracket was installed at the middle of the Ledgers. It was installed horizontally on top and in parallel to the ledgers. Its loading capacity was thus drastically reduced. The effective supports to the second scaffold were the two brackets at both ends which was 2.2 m apart.
• The first scaffold was on the right side of the second scaffold while the third scaffold was on its left side. At the time of the accident, the two metal brackets of the third scaffold were being installed.

• The building material around the drill holes of the detached brackets of the second scaffold was weak plaster. Its strength for holding expansion anchor bolts was dubious. The diameter of the anchor bolt was 12.3mm and the diameters of the drill holes of the detached brackets were over 14mm. The holes were oversized. This resulted in the drastic reduction of the pull out resistance of the anchor bolts. The concrete embedded the undetached bracket was cracked significantly. Rust stain of steel reinforcement was also observed. The rusting of the reinforcement bars would cause spalling and cracking of concrete surface, thus reducing the holding capacity of the anchor bolts.

• The two brackets at the two ends of the second scaffold were 2.2 m apart. As the bracket at the middle of the scaffold was improperly installed, effective support of the scaffold was provided by the two brackets at the two ends of the scaffold only. When the two deceased persons stood close to the left end of the scaffold to install the brackets for the third scaffold, the anchor bolt at this end could not withstand the pull out force that was induced by the weight of two persons and thus detached from the wall together with the bracket at the middle of the scaffold.

• No overloaded deformation to the brackets was observed. The main cause of the collapse of the second scaffold was the sudden detachment of the metal brackets which were improperly installed.

• The two deceased persons were not provided with suitable fall protection equipment while working from the partially completed scaffold. Although two waist-type safety belts were kept on the premises, no fall arrester was found. No independent lifeline or suitable anchorage was installed and no safety net was erected at the place where the two deceased persons were working.

• Only one of the two deceased persons possessed a green card which was expired. Both of them had not received formal training on scaffolding work and held no scaffolding certificate of competence. Moreover, the other two workers of the gang possessed no valid scaffolding certificate too. Thus, the scaffolding work was not carried out by trained workmen and under the supervision of a competent person.
Lessons to Learn

(a) A safe system of work for the erection of truss-out bamboo scaffolds should be provided and maintained. The system should include:

- risks assessment in connection with working at a height;
- prior examination of building wall material to ensure it is of adequate strength;
- development of safe working procedures for the proper installation of the metal brackets, and
- provision of sufficient information, instruction, training and supervision as may be necessary.

(b) Metal brackets for supporting the truss-out bamboo scaffold should be properly installed. Anchor bolts should be fixed on strong building material, such as concrete. Drill holes for fixing anchor bolts should not be over-sized.

(c) Suitable personal protective equipment, including safety harness, fall arrester and a secure anchorage for the continuous attachment of the harness should be provided and used by workers engaged in the erection of truss-out bamboo scaffolds.

(d) Erection of truss-out bamboo scaffolds should be carried out by trained workmen who possessed valid certificate of competence and worked under the immediate supervision of a competent person.
A scaffolder fell from a height while erecting a truss-out bamboo scaffold (V)
Scenario

A flush water pipe outside the external wall of an upper floor domestic unit leaked. Two scaffolders, including the deceased person, were called to erect a truss-out bamboo scaffold to provide a working platform on the external wall of the premises for the pipe repairing work.

The deceased person was responsible for erecting the scaffold outside the premises and the other scaffolder was responsible for delivering to him the necessary materials and tools from the unit. To begin with the installation work, the deceased person gained access to the building external wall by climbing through a window opening. He had to pass through a laundry aïrer that was mounted on the external wall just below the window opening before he could land on a concrete slab. This concrete slab was a shed for the air conditioner installed at the unit one floor below. Just when the deceased person had installed six metal brackets onto the external wall, he tried to move back to the premises. While doing so, he probably lost balance and fell a vertical distance of 12m from his place of work to a podium at the 2/F level.

Case Analysis

- The window opening that the deceased person climbed through to the external wall measured 750 mm x 450 mm. The wall-mounted laundry aïrer was 1.8 m long, 0.5 m wide and was located 100 mm below the window opening. The concrete slab used by the deceased person as a foothold was 820 mm long, 370 mm wide and was located 1.4m below the window opening.

- Five metal brackets for supporting the scaffold platform were installed horizontally on the external building wall underneath the laundry aïrer and above the concrete slab that was used by the deceased person as foothold. The distance between the first and the fifth metal bracket was 4.9 m. The sixth metal bracket was 0.4 m further away from the fifth metal bracket and was installed vertically higher intending to secure a standard of the front scaffold. From the position of these metal brackets, the length of the proposed ledger platform was estimated to be 5.4 m long.
• The deceased person had worn a safety belt that was fitted with a fall arrester. The lanyard of the belt measured 1.1 m long. As there was no suitable anchorage point or independent lifeline installed for attaching his safety belt, he first attached his lanyard to the laundry airer. Since the movement of the deceased person was limited by the length of his lanyard, he had to detach and re-attach his lanyard from the laundry airer to other fixtures, such as the metal brackets he had just installed in order to proceed further with the installation work.

• Because of the length of the proposed ledger platform, the deceased person had to detach and re-attach his lanyard from one anchorage point to another from time to time during the whole installation operation. During the process of detaching and re-attaching his safety belt lanyard, the deceased person rendered himself totally unprotected against the risk of falling from a height.

• 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) Safety net or suitable fall protection equipment, including a safety harness, a fall arrester and a suitable anchorage system that can provide continuous protection throughout the period when the user is exposed to the risk of fall, should be provided to prevent the worker from falling from a height.

(b) Steps should be taken to ensure the workers make full and proper use of the fall protection equipment provided when working at a height.

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

(d) Erection of truss-out bamboo scaffolds should be carried out by trained workmen who possessed valid certificate of competence and worked under the immediate supervision of a competent person.
A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (I)
Scenario

An upper floor unit of a domestic building was undergoing internal renovation, including the installation of new aluminum windows. The work of erecting, maintaining and dismantling of scaffolds was sub-contracted to the employer of the deceased person. On the day of the accident, the deceased person was engaged in dismantling a truss-out bamboo scaffolds on the external wall outside the unit. A co-worker was assisting him in receiving and storing of dismantled scaffolding materials inside the premises. After successfully dismantled the scaffold frame above the ledger platform, the deceased person proceeded to dismantle the metal brackets. While doing so, one end of the ledger platform collapsed, and the ledger platform tilted as a result. The deceased person lost his balance and fell from the scaffold on the 16/F of the building to the car park below.

Case Analysis

- The ledger platform was supported by four metal brackets. After the accident, only three were still in position. The metal bracket on the right side of the ledger platform was missing. It was later found on the ground of the car park.

- The right side of the ledger platform collapsed. One ledger of the collapsed part was bent and buckled. The expansion anchor bolt for securing the missing bracket remained intact inside the external building wall. No apparent defect was found on this bolt. A nut for securing the bracket onto the anchor bolt was found on the windowsill outside the premises and near the collapsed side of the scaffold. All these suggested that the metal bracket fell to the ground of the car park had been manually detached from the anchor bolt.

- The nylon strips that tied the ledgers to the fallen metal bracket were cut. As the co-worker who assisted the deceased person in receiving and storing dismantled scaffolding materials claimed that he last saw the deceased person working from the ledger platform near the collapsed end, it was believed that the deceased person, after cutting loose the nylon strips tied between ledgers and the bracket, proceeded to unscrew the nut and remove the bracket. Once the bracket was removed, the cantilever portion of the ledgers were unable to withstand the weight of the deceased person. A ledger thus buckled and the ledger platform partially collapsed. The scaffold tilted as a result. The deceased person lost his balance and fell together with the removed bracket onto the ground of the car park.
- Although the deceased person had worn a full body harness, the lanyard of his harness was not attached to any anchorage. One end of the lanyard was fastened to the D-ring of the harness and the snap hook of the lanyard was hooked to the right shoulder strip of the harness. In fact, no independent lifeline or other suitable anchorage was available at the place of work.

**Lessons to Learn**

(a) Suitable fall arresting equipment, including a full body harness and a fall arrester anchored to a suitable and secure anchorage should be provided for and used by the worker engaged in dismantling of truss-out bamboo scaffolds.

(b) If no suitable anchorage was available for use by the worker engaged in dismantling truss-out bamboo scaffolds, an independent lifeline connected to a secure anchorage should be provided. The strength and stability of the anchorage should have been checked by a professional engineer of the structural engineering discipline.

(c) All reasonable steps should be taken to ensure the worker engaged in dismantling the truss-out bamboo scaffold makes full and proper use of the fall arresting equipment provided.
A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (II)
scenario

A contractor was assigned to replace the windows and air-conditioners of an upper floor domestic unit. The scaffolding work was sub-contracted to a gang of self-employed scaffolders. Several truss-out bamboo scaffolds were erected on the building external wall to facilitate the replacement work. Upon the completion of the replacement work, the same gang of scaffolders was responsible for dismantling the scaffolds. The dismantling work started from the position outside the sitting room towards the bedrooms. At the time of the accident, the scaffolds outside the sitting room and the first bedroom were dismantled. The bamboo scaffold frame of the truss-out bamboo scaffolds outside the master bedroom and its adjacent bedroom were also dismantled leaving the ledger platform on the metal brackets. The deceased person was carrying out the remaining dismantling work alone from the ledger platform outside the master bedroom. Suddenly, one of the brackets supporting the ledger platform detached from the wall. The ledger platform tilted and the deceased person fell a distance of 28 m from the ledger platform to the podium floor of the building.

Case Analysis

- The master bedroom windows were set on two adjacent walls in a “L” shape. The longer wall was in the same plane of the living room and the other two bedrooms. The truss-out bamboo scaffold outside the master bedroom was also erected in a “L” shape and was supported by four metal brackets. Three brackets were fixed on the longer wall and the other bracket was fixed on the shorter wall.

- When the accident happened, the shorter portion of the truss-out bamboo scaffold outside the master bedroom had already been completely dismantled. The deceased was last seen working on the remaining longer portion of the scaffold.

- The metal bracket at the furthest end of this ledger platform outside the master bedroom was fixed onto the narrow side wall next to the window. The one in the middle was fixed onto the windowsill and the one nearer to the adjacent bedroom was fixed onto the wall fin. Each metal bracket was fixed onto the building wall with only one expansion anchor bolt.
• The furthest metal bracket was the one that detached and resulted in the accident. It was installed about 50 mm from the edge of the wall. When the metal bracket detached from the building wall, two pieces of building wall tiles and some cement plaster also detached. A rectangular-shaped void was thus formed. The corner of the windowsill above this void was found to be thicker and bulged out by 30 mm. A large crack was noted underneath this portion of the windowsill. The crack extended from the back of the drill hole of the expansion anchor bolt that fixed the detached bracket outwards to the wall surface.

• The upper part of the crack on the windowsill was covered by cement mortar that was used to seal up the newly installed window frame. An apparent new wall tile also covered up part of the crack on the side of the windowsill. This new wall tile was supposed to be used to replace the old one that was broken as a result of the crack. The crack was thus believed to have been formed prior to the completion of the new window frame replacement work.

• The material around the void was cement plaster. The expansion anchor bolt for fixing the metal bracket was believed to be wholly embedded in cement plaster that appeared to be strong. Furthermore, the drill hole was too close to the edge of the building wall. The loading capacity of the bolt was greatly reduced. Moreover, the large crack through the cement plaster that formed on the windowsill/building wall prior to the dismantling of the scaffold also reduced the loading capacity of the anchor bolt to a large extent. Once the cracked plaster was unable to take up the load, the whole block of cement plaster together with the anchor bolt and metal bracket would inevitably detach from the wall.

• The deceased person had not made use of personal protective equipment while working from the truss-out bamboo scaffold. Only a waist type safety belt was found at the bay window of the master bedroom. There was no independent lifeline or other suitable anchorage for the attachment of the safety belt. There was no other fall arresting device found in the vicinity of where the deceased person was working.

Lessons to Learn

(a) Suitable fall protection equipment, including safety harness equipped with fall arrester and a suitable anchorage for the continuous attachment of the safety harness, such as an independent lifeline, should be provided to every scaffold engaged in dismantling truss-out bamboo scaffolds at a height.

(b) The truss-out bamboo scaffold should be properly designed by a professional engineer of structural engineering discipline.
(c) Metal brackets for supporting the scaffolds should be properly positioned and securely fixed onto material with strong loading capacity. Fixing of metal brackets too close to the edge of a wall should be avoided.

(d) The strength and stability of the scaffolds should be checked and defects rectified before the commencement of the dismantling work.

(e) Reasonable steps should be taken by the management to ensure suitable personal protective equipment was provided and properly used by scaffolders working at a height.
A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (III)
Scenario

To facilitate maintenance work on the external wall of a residential building, a truss-out bamboo scaffold was erected outside a domestic unit at the 5/F level. The scaffold was supported by three metal brackets fixed on the building surface. One of the brackets was fixed higher up on the external wall and tied to the upper portion of the scaffold. The other two were fixed on a horizontal tie beam of the parapet at the balcony and supported the ledger platform. Each metal bracket was fixed in position by one expansion anchor bolt only.

After the maintenance work was completed, two scaffolders, including the deceased person, were called to dismantle the scaffold. The deceased person was responsible for dismantling the scaffold outside the premises and the other scaffolder was responsible for collecting and removing the dismantled parts of the scaffold inside the unit.

At the time of the accident, the deceased person had already dismantled the bamboo scaffold frame and the upper metal bracket. He was standing on the ledger platform consisting of six ledgers that rested on the two lower metal brackets and proceeded with the remaining dismantling work. When the deceased person moved on the platform towards one of the lower metal brackets, the bracket suddenly detached from the horizontal tie beam. The ledger platform tilted as a result. The deceased person lost his balance and fell a distance of 13m from the ledger platform to the ground.

Case Analysis

- The two lower metal brackets were each fixed onto the horizontal tie beam by one expansion anchor bolt near the bottom edge of the beam. The contact areas of the brackets with the beam were small. Such configuration would provide short moment arm and induced greater tension as well as bending moment to the anchor bolt.

- There was a thick layer of cement plaster on the surface of the horizontal tie beam. About two-thirds of the expansion anchor bolt were gripped by this layer of cement plaster. Only the remaining length of the anchor bolt was embedded in concrete material. The shear and tensile resistance of this type of plaster was weak. The vertical shear from the anchor bolt under load would cause a shear failure of the cement plaster.
• During the investigation, a lot of shrinkage cracks were found in the cement plaster on the tie beam. A large piece of cement plaster surrounding the drill hole of the pulled-out anchor bolt was found detached from the concrete tie beam.

• After the upper metal bracket was dismantled, the two lower metal brackets were the only support for the scaffold. As the cement plaster was not of adequate strength to withstand heavy load, when the deceased person moved closer to one of the metal brackets, his body weight caused the anchor bolt to detach from the beam when the cement plaster failed.

• The deceased person had worn a waist-type safety belt. However, there was no fall arrester, suitable anchorage point or independent lifeline available at his working position for him to attach his safety belt. Safety net or other fall arresting device was also not provided on the site.

• Both the deceased person and his co-worker had not undertaken formal training on scaffolding work. Though it was claimed that the deceased person possessed 20 year’s experience in bamboo scaffolding work, he still could not be regarded as a trained workman or competent person. At the time of the accident, there was no competent person available on site to supervise the scaffold dismantling work.

Lessons to Learn

(a) The truss-out bamboo scaffold should be properly designed by a professional engineer of structural engineering discipline and relevant working procedures should be drawn up.

(b) Risk assessment should be conducted prior to any scaffolding work. A statement of work stating the proper working procedures for the erection and dismantling of the truss-out bamboo scaffold should be developed and implemented.

(c) Anchor bolts should be securely fixed in strong building material, such as in a concrete wall. The anchor bolts should be fixed at an appropriate distance from the edge of the wall. Fixing of metal brackets to the bottom edge of the tie beam should be avoided.

(d) Suitable and secure anchorage should be provided for the continuous attachment of the safety belt worn by the worker engaged in dismantling of bamboo scaffolds.

(e) Dismantling of bamboo scaffold should be done by workers who were adequately trained and possess sufficient experience of such work. The scaffolding work should be done under the immediate supervision of a competent person.
Case 10

A scaffold fell from a height while dismantling a truss-out bamboo scaffold (IV)
Scenario

The drainage pipe on the external wall of an upper floor domestic unit became blocked. Two scaffolders, including the deceased person, were called 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 airer were used as part of the support for the scaffold frame.

After the blocked drainage pipe was cleared by a plumber, the scaffolders proceeded to dismantle the truss-out bamboo 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 ledger, 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 airer, there were other bamboo and racks support for the erected truss-out bamboo scaffold. However, at the final stage of the dismantling work, the two metal brackets became the only supports for the ledger platform.

- 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 fall arrester, 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) Dismantling of truss-out bamboo scaffolds should be carried out by trained workmen who possessed valid certificate of competence and worked under the immediate supervision of a competent person.
A scaffolder fell from a height while dismantling a truss-out bamboo scaffold (V)
Scenario

The unauthorized structure erected on the external wall of an upper floor domestic unit had to be removed. A truss-out bamboo scaffold was erected to facilitate the removal work. When the removal work had been completed, scaffolders were summoned to dismantle the truss-out bamboo scaffold. Two scaffolders, including the deceased person, proceeded to dismantle the scaffold on the external wall. Another two scaffolders remained on the ground to collect the dismantled bamboo members. At the time of the accident, the deceased person was working at the 3/F level. It could not be ascertained that he was at the material time working on the scaffold or on the cantilever slab adjoining the scaffold. His co-worker was staying on the cantilever slab one floor below. In the course of the dismantling work, the deceased person fell together with some bamboo members for about 10 meters to the street below and sustained fatal injuries.

Case Analysis

- The truss-out bamboo scaffold being dismantled was erected on four metal brackets that were fixed on the cantilever slab at the 3/F level, each by one anchor bolt only. After the accident, three of the metal brackets attaching to a horizontal bamboo ledger were found torn out from the cantilever slab and left suspended in the air between 3/F and 2/F.

- The surface of the cantilever slab was of cement plaster. The layer of cement plaster was over 50mm thick. The anchor bolts could only penetrate into the cement plaster but not the concrete. They were not of sufficient strength to withstand the weight of the scaffold and a worker working therefrom.

- Despite the deceased person had worn a full body safety harness, the safety harness was not equipped with a fall arrester that could be attached to a suitable anchorage. Furthermore, there was no suitable anchorage point or independent lifeline available at his working position.

- The employer had not provided the workers with suitable information, instruction and training concerning the safety of working at height.

- There was no other precautionary measure taken to prevent workers from falling from heights. The edges of the cantilever slabs were not securely fenced. When workers stretched out their bodies to pass the bamboo members to their co-workers on the ground floor level, they could easily lose balance and fall down to the street.
Lessons to Learn

(a) The building structure for supporting a truss-out bamboo scaffold should be carefully examined to ensure it is of good construction and adequate strength.

(b) The metal brackets supporting the truss-out bamboo scaffold should be securely fixed on the concrete structure of the building.

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

(d) 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.

(e) Dismantling of truss-out bamboo scaffolds should be carried out by trained workmen who possessed valid certificate of competence and worked under the immediate supervision of a competent person.
Case 12

A worker fell from a truss-out bamboo scaffold while engaged in water seepage repair work
Scenario

Water seepage was found at the upper and lower parts of the windows of the living room of a domestic unit on the 35/F of a residential building. To repair the defects, re-application of silicone sealant around the glazing parapet and enhancement of the waterproof construction on the floor of the flat roof immediate above this unit were also required. To facilitate the repair work, a L-shape truss-out bamboo scaffold was erected at the 35/F level outside the windows of the living room of the aforesaid unit. A ledger platform was provided and the bamboo scaffold frame was erected and extended nearly up to the floor level of the flat roof immediately above.

The deceased person and a co-worker were assigned the water seepage repair work. The work had already been carried out for two days. At the time of the accident, the co-worker was engaged in re-laying wall tiles around the window frames on the platform at the shorter side of the L-shape truss-out bamboo scaffold on the 35/F level, whereas the deceased person climbed up and rode on the top-most ledger of the truss-out bamboo scaffold to apply sealant to the base of the glazing parapet on the flat roof one floor above. While working, the deceased person lost his balance and fell a distance of about 84 m to the roof of a covered walkway.

Case Analysis

- The L-shape truss-out bamboo scaffold was a single lift one. It was erected on the external wall outside the windows of the living room of the unit on 35/F. The outer layer of bamboo scaffold frame had five ledgers and six standards which extended further up to nearly the level of the flat roof on the floor immediately above. The ledger platform was covered by a nylon sheet and the nylon sheet extended upwards around the edge to prevent falling material. The length of the L-shape bamboo scaffold was 3.1 m at its longer side and 1.7m at the other. The height of the bamboo scaffold frame was 2.6 m. The width of the ledger platform at its base was 0.7 m. A nylon catching net was hung from the uppermost ledger which covered most of the scaffold.

- The based of the glazing parapet on the flat roof one floor above was 0.73 m above the uppermost ledger of the scaffold. As the unit was unattended at the time of the accident, access to the flat roof through this unit for repairing the glazing parapet was not possible. Thus, the deceased person climbed up the bamboo scaffold frame and rode on the top-most ledger to perform the sealant application work.
Fall arrester, independent lifeline or secure and suitable anchorage point was not provided at the work location. Though the deceased person had worn a safety belt, his belt could not be safely anchored.

**Lessons to Learn**

(a) Risk assessment should be conducted prior to the commencement of the water seepage repair work. Safe working procedures should be developed and implemented.

(b) Suitably designed working platform should be provided to support the worker carrying out work at a height.

(c) When it was impracticable to provide a suitable platform, the worker working at a height should make full and proper use of fall protective protection equipment, which included a full body harness fitted with fall arrester and a suitable anchorage point or independent lifeline that can provide continuous protection throughout the period of work.

(d) Sufficient information, instruction, training and supervision regarding the safety of work at heights should be provided to the workers.
Enquiries

If you wish to enquire about this Guide Notes 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.