


Guidelines on the Design and Construction of Bamboo Scaffolds


屋宇署
BUILDINGS DEPARTMENT

Guidelines on the Design and Construction of Bamboo Scaffolds

First issue : May 2006
This revision : April 2025

CONTENTS

LIST OF DIAGRAMS

A Introduction

1. The Guidelines on the Design and Construction of Bamboo Scaffolds (Guidelines) provide good practices for the design and construction of bamboo scaffolds commonly used in Hong Kong. Recommended practices on the design, erection, maintenance and dismantling of bamboo scaffolds are given. Detailed standards of design and construction of some types of simple bamboo scaffolds, including double-layered, truss-out and signboard bamboo scaffolds are given in Section 2 of Part B of these Guidelines with typical examples for each of these types of bamboo scaffolds. When the recommended standards are not followed for the design and construction of these types of simple bamboo scaffolds or when other types of bamboo scaffolds not covered in Section 2 of Part B of these Guidelines are used, the bamboo scaffolds should be designed by a professional engineer with due consideration given to the safety and stability requirements as specified in the Code of Practice for Bamboo Scaffolding Safety (Code) issued by the Labour Department.

2. These Guidelines aim to ensure the structural safety and stability of bamboo scaffolds during their lifetime. Attention should be drawn to the design of building projection, building recess and free-form building profile to enable the erection of bamboo scaffolds for the carrying out of external wall works and external maintenance. In this connection, apart from the main system of the bamboo scaffolds, technical requirements for the putlogs, nylon strips, drilled-in anchors and steel brackets are also given.

3. For matters relating to labour safety, reference should also be made to the Code. The Code provides practical guidance for the compliance of the requirements under the Factories and Industrial Undertakings Ordinance and Construction Sites (Safety) Regulations regarding structural safety and stability of bamboo scaffolds when workers work in the bamboo scaffolds. If bamboo scaffolds in use come under the control of the Construction Sites (Safety) Regulations administered by the Labour Department, requirements as specified in the Code should be complied with.

4. Compliance with these Guidelines does not confer immunity from the relevant legal requirements.

5. The construction and workmanship of the bamboo scaffolds should be in accordance with these Guidelines and the Code.

6. The following definitions apply in these Guidelines:

"Competent person" is defined in paragraph 2.3 of the Code.

"Professional engineer" means an engineer of structural or civil discipline. He/She should be a corporate member of the Hong Kong Institution of Engineers or equivalent and should have adequate training and experience, and be able to justify how the bamboo scaffolds he/she designed can safely resist the combinations of dead load, imposed load and wind load in accordance with recognised engineering principles.

"Trained workman" is defined in paragraph 2.4 of the Code.

B Design and Construction of Bamboo Scaffolds

1. Material Specification

Bamboo Members

1.1 The commonly used bamboo types are Kao Jue and Mao Jue. They should be 3 to 5 years old and air-dried in vertical positions under indoor condition for at least 3 months before use. The nominal length of both Kao Jue and Mao Jue is 6 m.

1.2 All bamboo members should be free from visual defects, and meet the following requirements on the cross-sectional dimensions:

Kao Jue The nominal external diameter should be not less than 40 mm.

Mao Jue The nominal external diameter along the unlapped length should be not less than 75 mm with a nominal minimum thickness of 10 mm.

Nylon Strips for Knotting

1.3 Nylon strips of adequate strength, stiffness and durability should be used for knotting in bamboo scaffolds.

1.4 The minimum ultimate strength of the nylon strips should be not less than 0.5 kN per strip while the nominal width is 5.5 to 6.0 mm with a nominal thickness ranges from 0.85 to 1.0 mm.

1.5 All knots should be tightened with at least 5 rounds of nylon strips. The ends of the nylon strips should be crossed and twisted to form a single twisted end which passes through the knot twice to give one round turn for proper anchorage.

Lateral Restraints

1.6 To prevent the vertical bamboo members from buckling, effective lateral restraints should be provided to the posts of the outer layer of double-layered bamboo scaffolds.

1.7 An effective lateral restraint takes the form of putlog which consists of a metal tie and a bamboo strut. A mild steel bar of at least 6 mm diameter with a yield strength of 250 N/mm^2 and a minimum elongation at fracture of 15% or a bundle of mild steel wires with equivalent tensile capacity and mechanical properties should be used. It should be anchored to the permanent structure with the use of an anchor bolt together with a properly installed bamboo strut.

1.8 The free-standing portion of bamboo scaffolds at the top should be tied back to the permanent structure.

Drilled-in Anchor Bolts

1.9 High quality drilled-in anchor bolts should be used in the installation of steel brackets and putlogs for the construction of bamboo scaffolds. All anchor bolts should be installed onto the permanent structure. The installation details and procedures of anchor bolts should be in strict accordance with the manufacturer's recommendations.

1.10 To ascertain the quality of anchor bolts and their supporting structural elements, representative samples of the installed anchor bolts should be tested. Details of the strength test (except the sampling rates) should make reference to Appendix B of Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers (PNAP) APP-169. Test anchor bolts should be selected randomly at different locations of the bamboo scaffolds, with the sampling rates as follows:

(a) for steel bracket (at each layer): 10% and $\geq$ 5 numbers

(b) for putlog: 5% and $\geq$ 5 numbers

1.11 The anchor bolts should be of heavy-duty type with at least 12 mm diameter and a tensile capacity greater than 7 kN.

Steel Brackets

1.12 Steel brackets for double-layered bamboo scaffolds commonly used for construction, demolition and renovation works should be made of Grade S275 80×80×6 equal angle, while those for truss-out bamboo scaffolds commonly used as working platforms/means of access for external repair and maintenance works should be made of Grade S275 40×40×5, 30×30×5 and 25×25×5 equal angles for imposed loads of 500 kg, 400 kg and 300 kg respectively, or suitably designed in accordance with the Code of Practice for the Structural Use of Steel 2011. Steel members should be jointed with 5 mm fillet welds all round. The steel brackets are preferably galvanised or painted with 2 layers of anti-corrosion coat.

2. General Forms

2.1 This section provides detailed standards of design and construction of some general forms of bamboo scaffolds, including double-layered, truss-out and signboard bamboo scaffolds.

2.2 When the recommended standards given in this section are not followed or when other types of bamboo scaffolds not covered in this section are used, they should be designed by a professional engineer.

2.3 For bamboo scaffolds for demolition works, irrespective of their size, the bamboo scaffolds should be designed by a professional engineer, to ensure the bamboo scaffolds are capable to withstand the wind load acting on the protective screen.

Double-layered Bamboo Scaffolds

2.4 The inner layer, at about 200 – 250 mm from the building face, is known as the finishing scaffolds. The outer layer, at about 600 mm from the inner layer, is known as the working scaffolds. Working platforms are erected between the inner and outer layers.

2.5 Posts are main vertical bamboo members resting on either solid ground or steel brackets for supporting the scaffolds. Standards are secondary vertical bamboo members and ledgers are horizontal bamboo members in the plane of each layer. For the outer layer, Mao Jue or firs are erected as the posts at a maximum

distance of about 1.3 m apart. The posts are connected with horizontal ledgers for fixing their position. Kao Jue are erected as standards at a distance of about 650 mm between two Mao Jue or firs. The vertical distance between two ledgers is of about 600 to 750 mm.

2.6 Bracings formed by two pieces of Kao Jue fixed in an 'X' shape at an angle of 45° to 60° from the horizontal are used for keeping lateral stability. Bracings should be provided to both outer and inner layers. Each bracing member must be tied to the posts, standards and ledgers of the bamboo scaffolds. This forms the basic configuration of a double-layered bamboo scaffolds.

2.7 For the inner layer, all posts, standards and ledgers are Kao Jue. Transoms are erected to connect the inner and the outer layers. These transoms are also used to support the working platform.

2.8 Alternatively, posts may be spaced at a distance of 2.6 m. Such an arrangement should be substantiated by a professional engineer. Diagram 1 indicates the basic and alternative arrangements for reference.

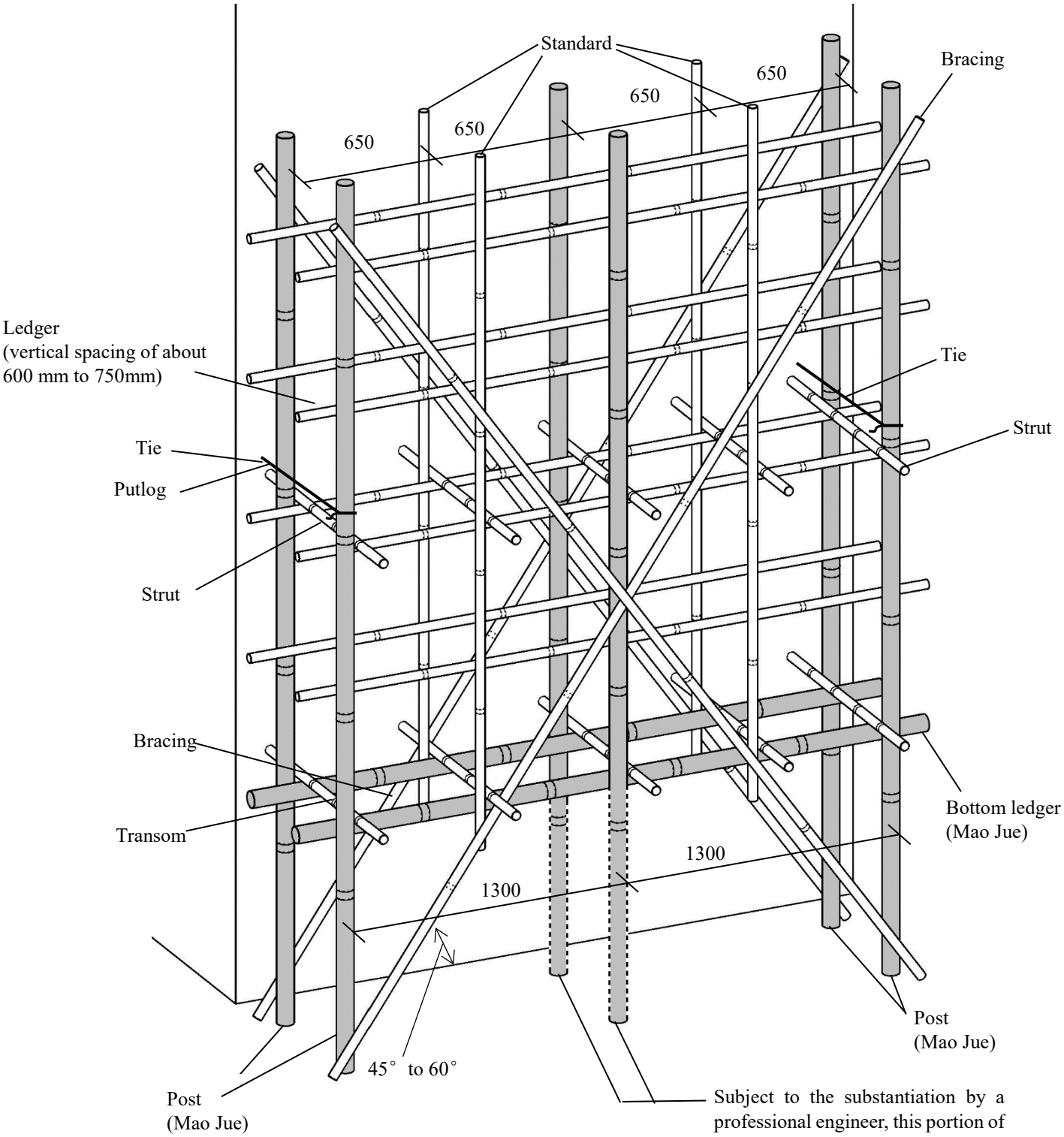
2.9 Diagram 2 shows the details of putlog and catch-fan. The putlog should be fixed to the post at the outer layer at one end and to the permanent structure at another end with the use of an anchor bolt and a mild steel bar of at least 6 mm diameter pre-fixed to the permanent structure. Catch-fans should be provided at 15 m vertical intervals in general or at 10 m vertical intervals for demolition works, which are connected to the working platforms. The horizontal span length of the catch-fan should be not less than 1.5 m from the outer layer of the bamboo scaffolds. The outer edge of the catch-fan should be tied securely to the standards or posts with a 6 mm diameter steel guy wire at a horizontal spacing of not more than 2.6 m. If other alternative supporting arrangement instead of steel guy wire is adopted, the catch-fan and its support should be designed by a professional engineer. The catch-fans must be covered with galvanised zinc sheets for debris collection and removal. For a huge catch-fan, additional ties in the form of hanging pole and raker are required.

2.10 To safeguard structural stability of bamboo scaffolds under extreme weather conditions, putlogs should be provided at a horizontal spacing of not greater than 3 m. At a height less than 100 m above ground, the vertical spacing of putlogs should be

not greater than 6.3 m. At a height of 100 m or more, the vertical spacing of putlogs should be not greater than 4.2 m. For bamboo scaffolds greater than 15 m in height, it should be customised and designed by a professional engineer. The typical arrangements of putlogs as shown in Table 1 should be followed.

Height above ground (m)	< 100	100 ~ 500
Wind reference pressure (kPa)	2.86	3.72
Maximum horizontal spacing of putlog (m)	3	
Putlog arrangement (horizontal spacing × vertical spacing) (m×m)	3 × 6.3	3 × 4.2
Covered area per putlog (m^2)	18.9	12.6

Table 1 – Typical putlog arrangements for double-layered bamboo scaffolds



Note: All dimensions shown are in mm.

Diagram 1 - Arrangement for double-layered bamboo scaffolds

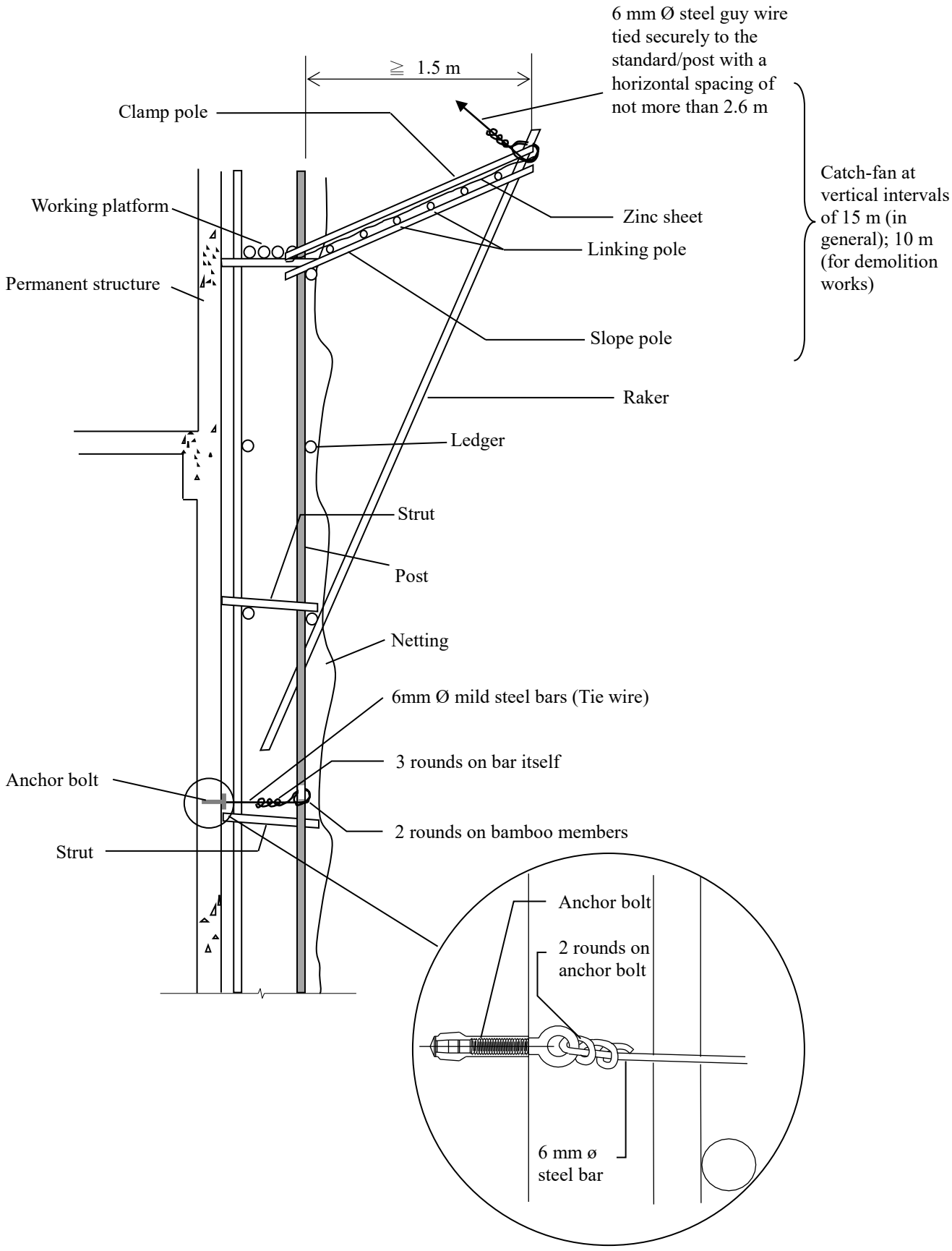


Diagram 2 - Details of putlog and catch-fan for double-layered bamboo scaffolds

Truss-out Bamboo Scaffolds

2.11 Truss-out bamboo scaffolds are commonly used for the repair of external drain pipes, spalled concrete, loose external rendering, removal of external unauthorised building works, etc. The overall height of a truss-out bamboo scaffold should not exceed 6 m. Reference should be made to the Code and the "Guide on Construction and Work Safety of Truss-out Bamboo Scaffolds" issued by the Labour Department. Notification to the Labour Department before erection of truss-out bamboo scaffolds is required by making use of the "Notification Form for Truss-out Bamboo Scaffolds" specified in the "Guidelines on Safety Enhancement and Notification Arrangement for Truss-out Bamboo Scaffolds" published by the Construction Industry Council.

2.12 Diagram 3 shows the typical arrangement of truss-out bamboo scaffolds. Since they are light duty scaffolds, Kao Jue will generally suffice. The rakers, standards and parallel ledgers must be supported by steel brackets fixed to the permanent structure.

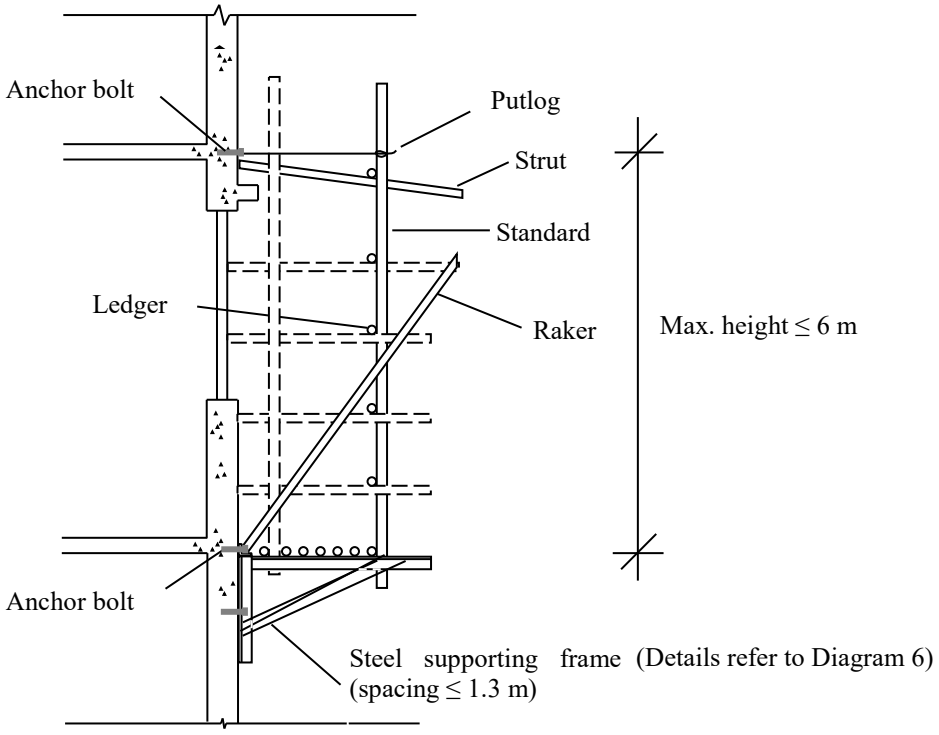


Diagram 3 - Truss-out bamboo scaffolds

Bamboo Scaffolds for Signboards

2.13 Diagram 4 shows the typical bamboo scaffolds for signboards. They are usually of cantilever construction with a maximum span to height ratio of 4:3. The whole bamboo scaffolds are supported by steel wires or hanging poles fixed to the permanent structure. The bamboo scaffolds must not obstruct the traffic flow underneath. Reference should be made to the "Guide on Erection & Maintenance of Advertising Signs" published by the Buildings Department.

2.14 If the projection of the bamboo scaffolds for signboard is more than 5 m, it should be designed by a professional engineer.

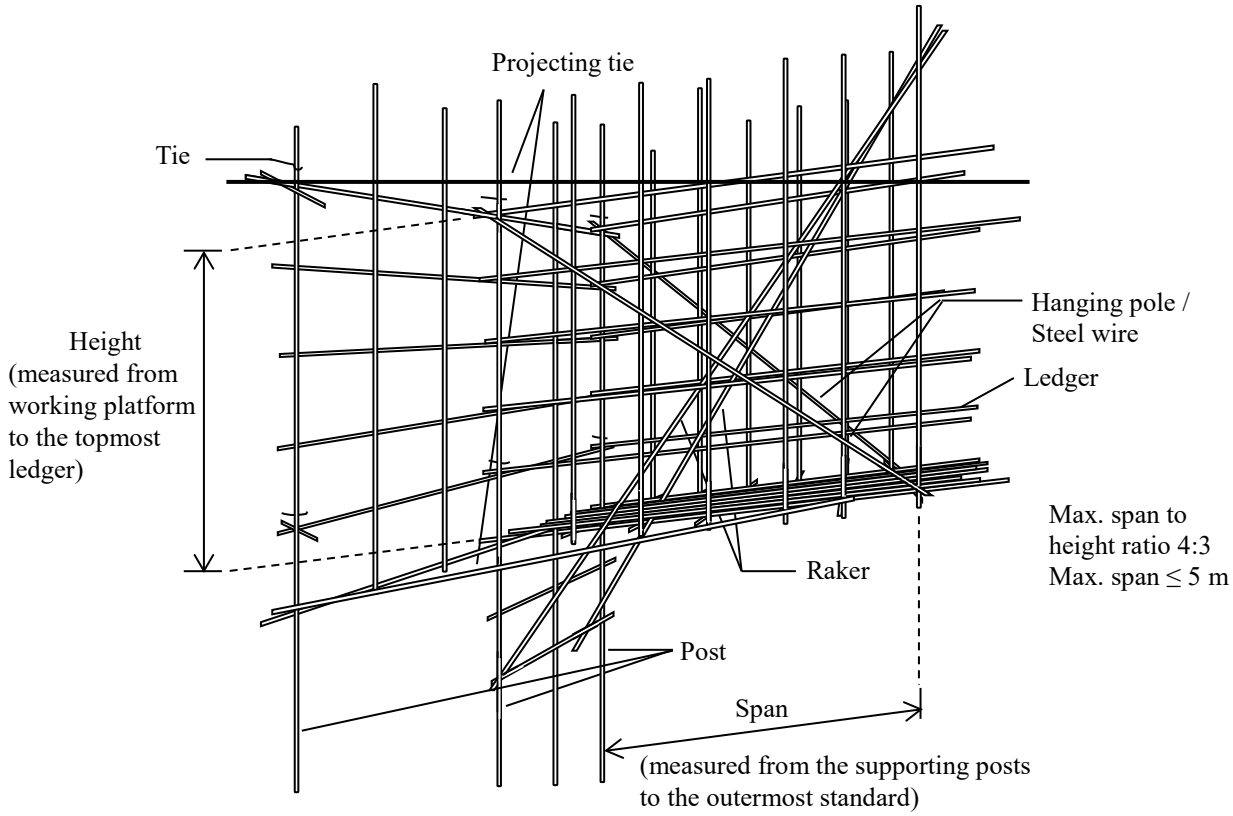


Diagram 4 - Bamboo scaffolds for signboard

3. Steel Brackets

3.1 Steel brackets are essential to the overall stability of bamboo scaffolds. Diagram 5 shows the details of a steel bracket for the support of posts of double-layered bamboo scaffolds. All steel brackets should be securely mounted onto the permanent structure with high quality anchor bolts and comply with the following requirements:

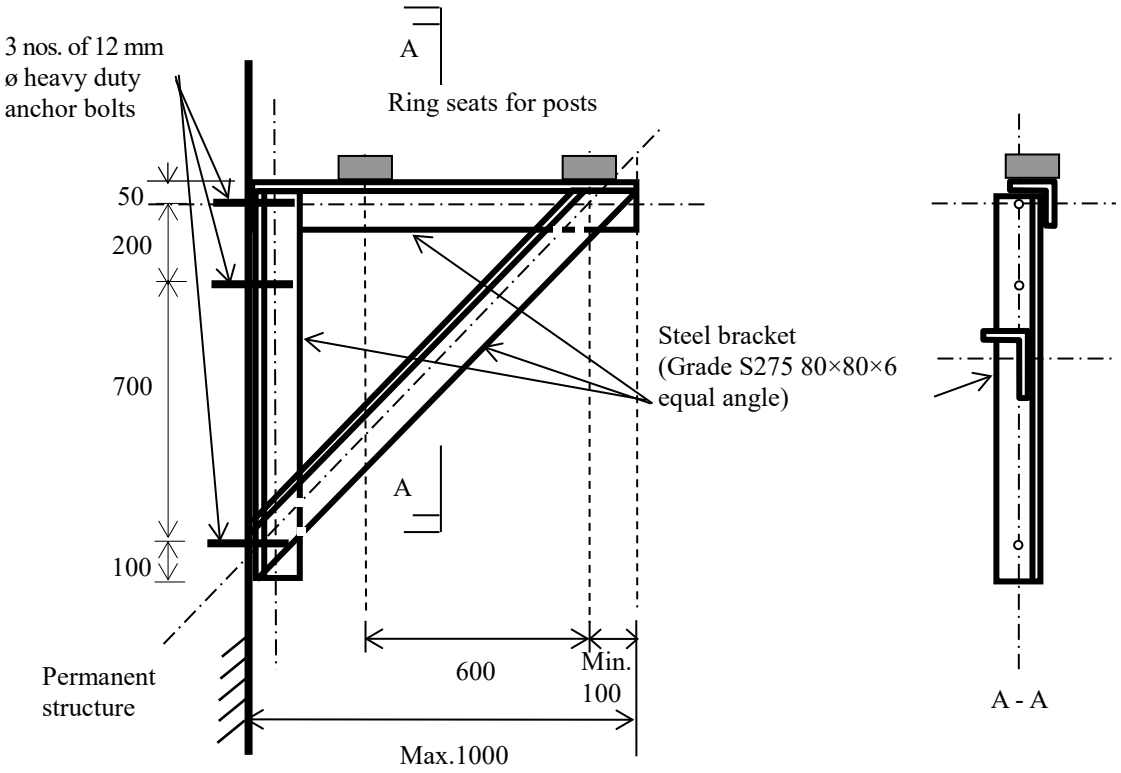
(a) The horizontal spacing between the steel brackets should be not more than 1.3 m unless designed by a professional engineer; and

(b) The concrete strength of the permanent structure to which the steel bracket is fixed should be not less than 25 N/mm^2.

3.2 All anchor bolts should be installed strictly in accordance with the manufacturer's recommendations.

3.3 For the typical I-shaped (Diagram 5) and T-shaped (Diagram 6) steel brackets for double-layered bamboo scaffolds and truss-out bamboo scaffolds respectively with 3 anchor bolt holes commonly used in the trade, reference should also be made to the "Guide on Construction and Work Safety of Truss-out Bamboo Scaffolds" issued by the Labour Department. Diagram 6 only shows one of the typical details of steel brackets for base support for truss-out bamboo scaffolds.

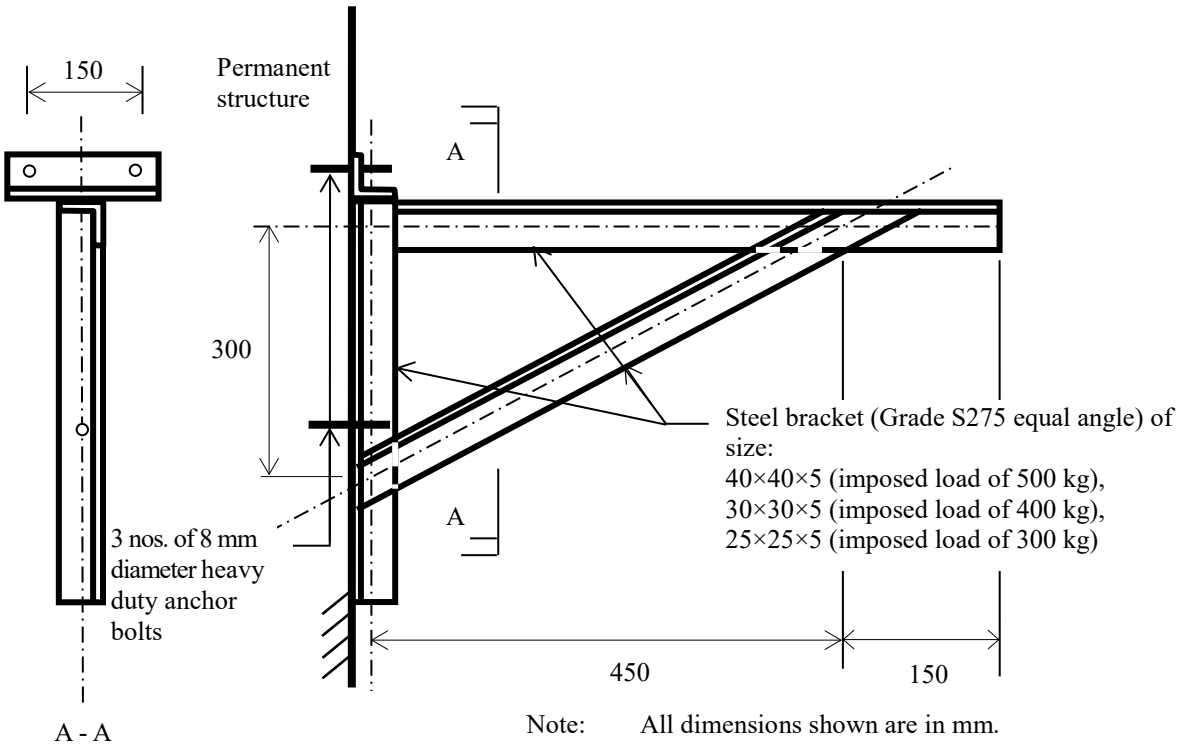
3.4 There may be occasions that the post of a bamboo scaffold does not rest on the steel bracket. The professional engineer should ensure that the load from the misaligned post can be effectively transferred to the steel bracket.



Notes:

1. All dimensions shown are in mm.
2. 5 mm fillet welds all round not shown

Diagram 5 - General details of base support for double-layered scaffolds



Note: All dimensions shown are in mm.

Diagram 6 - General details of base support for truss-out scaffolds

4. Customised Structural Design

Design Approach

4.1 Where the recommendations for typical bamboo scaffold systems in these Guidelines are not followed, the bamboo scaffolds should be designed by a professional engineer with due consideration given to the stability and safety requirements as specified in the Code. Reference should be made to the latest edition of the relevant codes of practice published by the Buildings Department. The wind forces on the bamboo scaffolds should be calculated in accordance with the Code of Practice on Wind Effects in Hong Kong 2019. The wind reference pressure can be adjusted to tally with the design life of bamboo scaffolds with a minimum of 2 years. No further adjustments for wind directionality and sheltering effect should be applied.

Engineering Justifications

4.2 The structural design of the bamboo scaffolds should be capable of resisting the combinations of dead load, imposed load and wind load in accordance with recognised engineering principles. Other practical considerations such as sway of the bamboo scaffolds and initial geometrical imperfection and dynamic effects should be properly accounted for.

Design Documents

4.3 A copy of supporting documents of structural design, including the bamboo scaffolds' layout plan, structural calculation, design drawings, method statements and material specifications. should be kept on site and made available for the purpose of erection, maintenance and regular inspections.

5. Site Supervision

5.1 The bamboo scaffolds should be erected, altered and dismantled by trained workmen under the immediate supervision of a competent person. The relevant qualification, experience and competence of the competent person and trained workmen should meet the requirements set out in paragraphs 2.3 and 2.4 of the Code.

5.2 In respect of bamboo scaffolds for building works where a supervision plan is required to be lodged, in general, the technically competent persons (TCP) T1 and TCP T3 in the registered contractor (RC)'s stream are required to check that the actual site condition and works being carried out are in compliance with the method statements and precautionary and protective measures for the bamboo scaffolds, and that the bamboo scaffolds are adequately secured to the permanent structure at all times to prevent them from collapse, and the bamboo scaffolds, catch fans, catch platforms and safety nets are adequately installed so as to secure safety against falling objects. TCP T1 and T3 should report to the authorized signatory (AS)'s representative or AS for dealing with rectification whenever any non-conformities or irregularities are identified. TCP T3 in the stream of authorized person should also check that the provision and conditions of the bamboo scaffolds, catch fans, matscreens and heavy duty nylon mats, as appropriate, are satisfactory. TCPs should ensure no man-made damage to the bamboo scaffolds by other trades of works. In the event when damage or irregularity is noted, TCPs should immediately alert all parties/workers concerned not to use the scaffolds and arrange or instruct, rectification works promptly. The bamboo scaffolds should not be used unless they have been re-inspected by a competent person confirming that they are safe and in order.

6. Erection

6.1 Bamboo scaffolds should be erected by trained workmen under the immediate supervision of a competent person.

6.2 Works should be started from the bottom level to the top level and from the interior part to the exterior part. The height of the bamboo scaffolds erected at any side should be not greater than the topmost part of the permanent structure by one storey. The cantilever portion at top should be properly tied and secured against wind.

6.3 All vertical members of the bamboo scaffolds should be plumb.

6.4 The bamboo scaffolds should be effectively braced and tied back to ensure overall stability. The bracings should extend from the base to the top of the bamboo scaffolds. Each bracing must be tied to the posts, standards and ledgers of the bamboo scaffolds.

6.5 Unauthorised alteration of the bamboo scaffolds (including

putlogs) by scaffolders or workers of other trades is strictly prohibited. All lateral ties should be displayed with warnings tags showing "do not alter or remove this tie" bilingually to facilitate regular inspections.

6.6 Where the bamboo scaffolds are erected adjacent to a road or passageway, suitable protective screens and safety nets must be provided to envelop the bamboo scaffolds for the protection of vehicles or persons against falling objects. Detailed requirements on the screen and nets as stated in PNAP APP-23 – "Hoardings, Covered Walkways and Gantries (including Temporary Access for Construction Vehicles) - Part IX of Building (Planning) Regulations", PNAP APP-21 – "Demolition Works - Measures for Public Safety" and paragraph 3.3.2 of the Code of Practice for Demolition of Buildings 2004 issued by the Buildings Department should be complied with.

6.7 The permanent structure on which the truss-out bamboo scaffolds are to be erected should be examined to ensure that it can support the loads of the bamboo scaffolds. Strictest control should be exercised on the loads applied to the truss-out bamboo scaffolds.

6.8 All knottings between bamboo members should be tight and secure. Knottings for posts/standards and ledgers, ledgers and transoms/bracings/rakers, etc. should be tied by nylon strips. For post/standard, ledger and transom to be tied together, any two of them should be tied up first and then the remaining one should be tied up on top of them.

6.9 For connection between two bamboo members, the following length of overlap should be followed:

(a) 1.5 m to 2 m for posts/standards;

(b) at least 2 m for ledgers and bracings/rakers.

Besides, the distance between two knottings on the overlapping portion of the bamboo members should be not greater than 300 mm, and the tail of one bamboo member should be connected to the head of the other. Diagram 7 illustrates the proper connection of bamboo members for bracings/rakers, ledgers, posts/standards used in bamboo scaffolds.

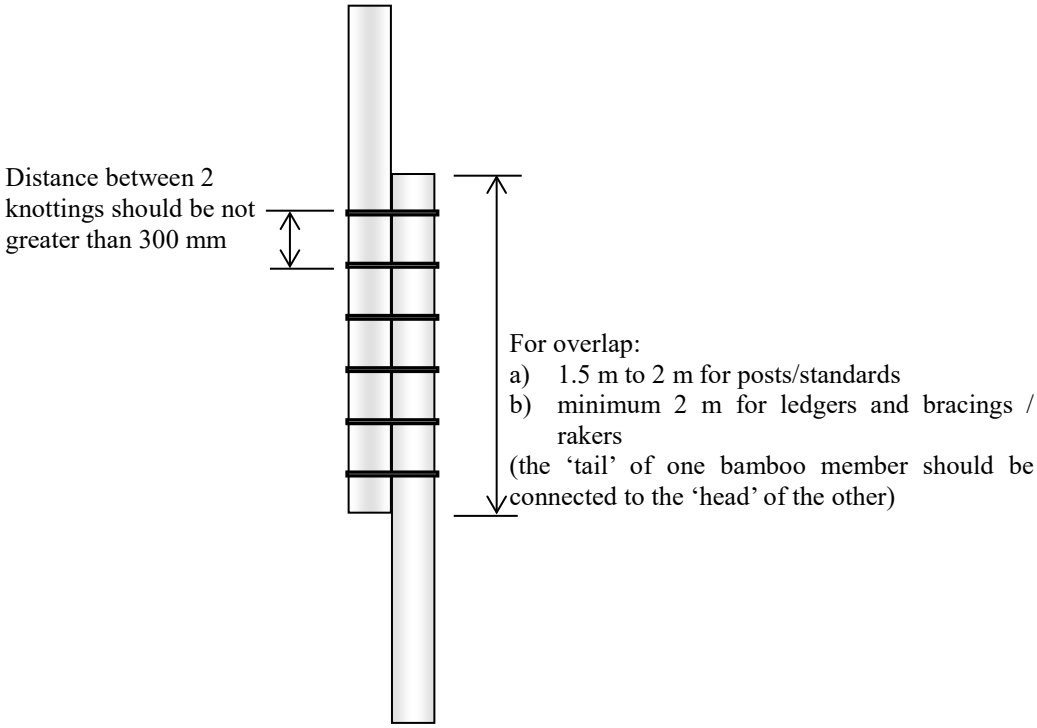


Diagram 7 - Proper connection of bamboo members for posts/standards, ledgers and bracings/rakers

6.10 All ledgers, bracings, rakers, ties, struts and transoms should not be used for hanging equipment, tool and materials.

6.11 The truss-out bamboo scaffolds should be supported by the permanent structure and are prohibited to rest on decorative features nor non-structural elements of the building.

6.12 Bamboo scaffold members on pedestrian walkway should be wrapped by colour contrast plastic ribbon with spongy infill at a level up to 2 m measured from the ground level. The protruding ends of horizontal bamboo members within 2 m measured from the ground level should be flat instead of tapering and warning signs should be provided for the attention and safe use of adjoining access by the visually impaired persons.

6.13 Bamboo scaffolds should not be placed or erected at the tactile guide paths provided for the visually impaired persons to avoid hazards.

6.14 Bamboo scaffolds should not be so placed or erected to reduce the clear width and clear height of any means of escape (e.g. required staircase, corridor, etc.) and means of access for firefighting and rescue (e.g. access staircase, emergency and

vehicular access, etc.), or obstruct the access and use of fire service installations and equipment (e.g. fire hydrant, hose reel system, exit signs, etc.). All means of escape and means of access for firefighting and rescue should be maintained at all times and be free from obstruction.

6.15 Protective nets, screens, tarpaulin/plastic sheetings installed to cover the façade of buildings under construction, demolition, renovation, repair and minor works should have appropriate fire retardant properties in compliance with a recognised standard.

6.16 In addition to the requirement stated in paragraph 6.6 above, in the event that floor sheets are provided below bamboo scaffolds to collect debris, they should be made of non-slippery material and be properly located and firmly fixed to avoid tripping and slipping. The collected debris should also be cleared frequently.

C Maintenance, Inspection and Dismantling of Bamboo Scaffolds

1. Maintenance and Inspection

1.1 Bamboo is a natural material and it expands and contracts as the moisture content changes. It should be in proper condition and free from visual defects before it could be reused. Bamboo should preferably be treated for termite-resistance. Proper workmanship, close supervision and frequent inspection are required to ensure the structural integrity of the bamboo scaffolds.

1.2 The bamboo scaffold works should be supervised by a competent person who should thoroughly inspect the bamboo scaffolds, including but not limited to their lateral ties, bracings, steel brackets, ledgers and posts, as follows:

(a) upon completion of the first erection of the bamboo scaffolds;

(b) at intervals of not more than 14 days after the first inspection;

(c) before a tropical cyclone or strong monsoon;

(d) after a tropical cyclone, heavy rain or storm;

(e) after any substantial addition or alteration of the bamboo scaffolds; and

(f) before commencement of dismantling the bamboo scaffolds.

1.3 More frequent inspection must be provided when:

(a) a tropical cyclone warning signal is announced;

(b) a strong monsoon signal is announced; or

(c) there are severe gusts, especially those occurring in April and May.

1.4 Contractors should take the following necessary measures to safeguard bamboo scaffolds safety preceding adverse weather conditions such as typhoons or strong monsoons:

(a) Sufficient ties of adequate strength are provided to secure the cantilever portion at the topmost floor;

(b) The height above the topmost floor should not be over-extended (maximum one floor);

(c) Adequate putlogs, ties, struts, bracing and steel brackets are provided to secure the scaffold framework;

(d) Protective screen should be removed and the scaffolds above the topmost floor should be lowered to not more than half of the floor height under safe circumstance when a tropical cyclone warning signal or a strong monsoon signal is announced; and

(e) No loose materials should be placed on/near any scaffolds, or near the periphery of the site.

1.5 The competent person should check the strength and stability of the bamboo scaffolds and ascertain that there are no defects and deterioration. Defects found during the inspection should be rectified immediately.

1.6 The competent person should record his inspection and findings in the inspection record form.

2. Dismantling

2.1 Bamboo scaffolds should be dismantled as soon as possible once the construction/renovation/repair/signboard/minor works are completed.

2.2 Dismantling work must be carried out by trained workmen under the immediate supervision of a competent person.

2.3 The bamboo scaffolds to be dismantled should be inspected and their strength and stability must be ensured prior to dismantling.

2.4 No components endangering the stability of the bamboo scaffolds should be removed. Unless necessary precautions have been taken, all the ties and bracings should be securely held in position.

2.5 Before dismantling the critical members, such as ledgers, ties,

struts, rakers, transoms or bracings, the stability of the bamboo scaffolds must be assured by fixing a similar piece of bamboo member at a lower level before removing that critical member.

2.6 No materials or debris should be stacked on the bamboo scaffolds. They should be cleared before dismantling.

2.7 The procedure of dismantling should be orderly and planned and should proceed generally from the top in horizontal sections. Bamboo scaffolds should not be dismantled in vertical sections from one end towards the other unless special consideration is given to ties and bracings.

2.8 Dismantling should start from upper level to lower level, from exterior to interior and from non load-bearing parts to load-bearing parts.

2.9 The affected area must be fenced off and adequate warning signs should be displayed in conspicuous locations. All necessary prior notifications should be issued to the nearby owners and occupiers of the affected area, and their consensus if applicable, should be obtained before dismantling.

2.10 Removed bamboo members must not be thrown, tipped or shot down from a height.

2.11 Scaffolders should follow the requirements on labour safety as stipulated in the Factories and Industrial Undertakings Ordinance, Chapter 59.