

## TECHNICAL NOTE 011

# Lateral Loads on Falsework - Is Cross-Bracing Really Not Required At All?



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### Keywords

Lateral stability provision, horizontal disturbing forces, environmental loads, sloping formwork soffit, dynamic concrete pumping forces

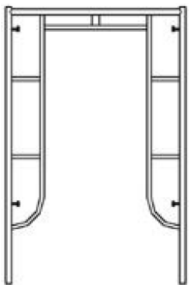
### Synopsis

It is noted in recent design calculations prepared by some proprietary falsework suppliers (and their designers) that lateral stability provision to the falsework was considered not necessary – This was **NOT** an occasional overlook since some designers went as far as arguing that no such consideration was required because the wet concrete so supported by the falsework could only create gravity load.

Correcting the above fallacy, this note explains what lateral loads are present in falsework systems, and reiterates the importance of having adequate lateral stability provision. It must be stressed that it is not sufficient just to consider the strength of falsework. If the falsework were laterally unstable, collapse could occur well before the design load is reached.

### 1.0 Introduction

Conventional falsework system could be formed by an assemblage of proprietary scaffold frames. The individual scaffold frame (see diagram below) has certain in-plane stiffness because of its 'portalised' shape.



Individual frames

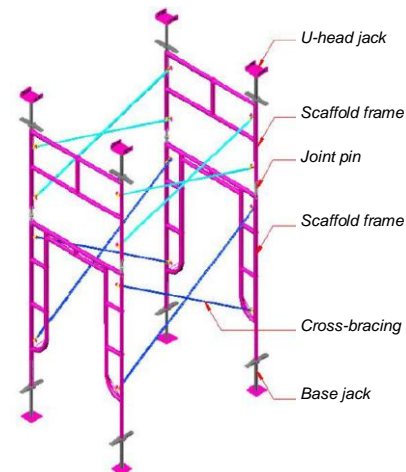
However, it must be noted that the portalised shape of the individual frames is intended to ensure that the frames are robust enough for handling on site. There is no lateral load resistance published by suppliers for this type of frame that one can use for calculating lateral stability provision.

When considering the out-of-plane direction (ie, into-paper-direction), this individual frame is simply unstable. That is, lateral support must be provided to these

individual frames to ensure their stability.

A scaffold frame assemblage might look something like the following 3D image. The cross-bracing shown in the 3D image is meant for controlling the buckling effective length of the legs of the scaffold frames in the out-of-plane direction. Again, there is no lateral load resistance published by suppliers that

one can use for calculation of lateral stability provision. The cross-bracing does **NOT** form part of the lateral stability system, although it does provide some inherent lateral rigidity.



Scaffold frame assemblage

### 2.0 Lateral Loads on Falsework System

The following lateral load effects must be considered by designers when designing for lateral stability.

#### 2.1 Horizontal Disturbing Forces, $F_H$

$F_H$  shall be calculation in accordance with Cl. 19.2.9.1 of BS 5975, which is taken as the greater of:

- i) **2.5%** of the applied vertical loads considered as acting at the points of contact between the vertical loads and the supporting falsework; or
- ii) The forces that can result from erection tolerances (normally taken as **1%** of the applied vertical load), plus sum of other imposed loads, including wind, out of vertical by design, concrete pressure etc.

#### 2.2 Environmental Loads – Wind

The basic wind pressure and topographical factors shall be derived according to Hong Kong Code of Practice on Wind Effects 2004. The following points should be noted:

- i) For temporary structure, falsework system not to remain in position for more than one year, wind pressure can be multiplied with a reduction factor of **0.7**.
- ii) Design wind coefficients,  $c_f$ , and wind exposed area,  $A_{er}$ , for formwork and falsework are stated in Cl. 17.5.1.14 to 17.5.1.17 of BS 5975.

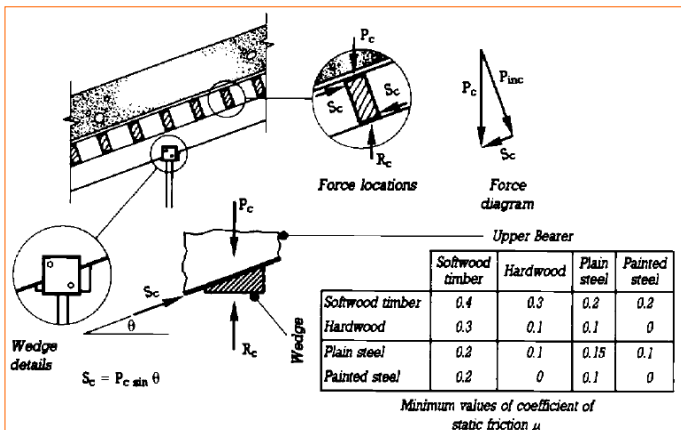


Images of falsework collapse during construction. It was reported that missing cross-bracing was the key reasons for the failure noted.

iii) When the area of the falsework bracing is unknown, the effective area of the horizontal and vertical members should be increased by **20%** to allow for the bracing and connections, unless specifically measured (see Cl. 17.5.1.12 of BS 5975).

### 2.3 Forces Owing to Sloping Formwork Soffit

When falsework supports a formwork soffit with longitudinal and/ or transverse crossfalls, sliding force resulted from gravity weight shall be considered (see diagram below).



Forces resulting from sloping soffit construction (extracted from Formwork – A good practice)

Further, the following points should be noted:

- Where base plates are supported on a sloping foundation, a concrete or steel wedge shall be added to provide a level surface for stable support.
- Stability against sliding for sloping soffit construction shall have a factor of safety not less than **2.0** (see Cl. 19.4.5.1 of BS 5975).

More detail can be found in Annex H of BS 5975: 2008.

### 2.4 Forces Owing to Actions of Concrete Pumping

When working on pumped concrete, dynamic force is generated by the concrete pump. This dynamic force can be visualised via the corresponding movements in the concrete delivery boom, pump hose, etc. If temporary blockage were created in the pump hose, pressure would be built up which, on



discharging, would generate great force causing the pump hose to whip violently. If the pump hose, etc, is resting on or somehow attached to the formwork / falsework, such lateral forces would be exerted on the falsework system (see Cl. 19.4.3.4e of BS 5975).

**NB** – There are reported cases where workers were killed by pump hose whipping.

### 3.0 Bracing & Lacing

In essence, all falsework systems must be suitably laced and braced to ensure lateral stability. Please feel free to discuss with the Technical Department if in doubt.

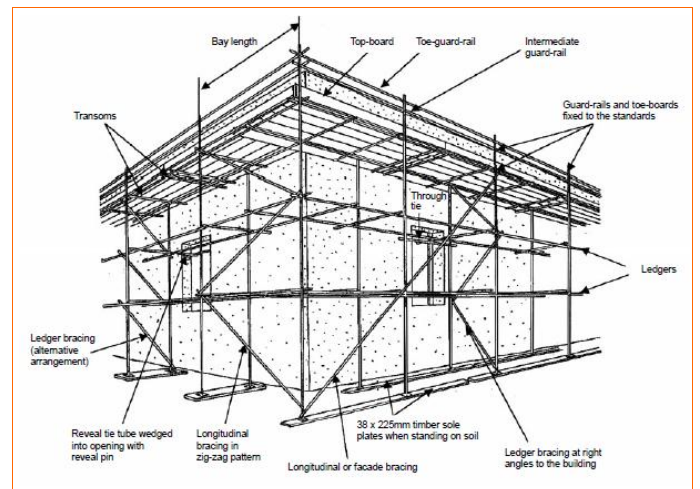


Image extracted from 'CODE OF PRACTICE FOR METAL SCAFFOLDING SAFETY'

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