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PERSPECTIVES

Understanding Scaffold Failures: Causes & Prevention

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INTRODUCTION: OVERVIEW OF SCAFFOLD COLLAPSES & FAILURES

A scaffold is a simple and temporary structure, erected to facilitate the construction or remediation of a main structure, but it may not be given the attention in its design and/or construction that it deserves. To compound the matter further, it is not uncommon that a scaffold is used to support a temporary roof canopy with a small span or a large temporary roof structure spanning from one side of a building to another to facilitate construction by protecting workers, construction materials, and newly installed items from the elements.

Insurance claims related to scaffolding failure frequently result in large financial losses and unnecessary project delays (**Figure 1**). This paper explores common factors that contribute to such losses, and the following information may be of particular interest to insurers handling such claims and lawyers involving in arbitration or litigation related to scaffolds or anyone needing to answer questions such as:

- Why did a scaffold/temporary structure collapse?
- Who is responsible for the collapse of a scaffold/ temporary structure?
- What caused a scaffold/temporary structure to fail?
- Could you provide a second opinion on the collapse of a scaffold?

***Figure 1** - A collapsed temporary roof structure supported by scaffold.*

CAUSES OF SCAFFOLD COLLAPSE

The causation of a loss associated with a scaffold collapse can be viewed from both design and construction perspectives. A scaffold structure itself is commonly designed by a Professional Engineer, who may be retained by the manufacturer or supplier/installer. Such scaffolds are not normally designed to support other structures like a temporary roof or canopy in addition to the expected loads from the scaffold decks/ platforms and construction workers (i.e., construction live load). In the absence of certification to support additional loads from a temporary roof/canopy structure, the contractor may retain a Professional Engineer to review and sign off on the installation of the scaffold. The same professional is often retained to design and sign off on the temporary roof/canopy as well. Commonly observed issues contributing to a loss relating to the engineering service include, but are not limited to:

- Wind load acted on the scaffold, and/or the temporary roof/canopy was not captured correctly and underestimated.
- Snow load was not considered in the design of the temporary roof structure or the canopy atop the scaffolding as impractical snow removal means was incorporated into the design.
- The fasteners used to secure the scaffold to the main structure were not appropriate, being either too shallow or too large relative to the backing support. If the fasteners were installed with insufficient penetration into the backing support and/or with inadequate edge distance, they cannot deliver the shear and withdrawal capacities as intended. For example, 1/2” diameter or larger lag bolts should not be installed into the narrow face of a 2x stud.
- Due diligence was not exercised when conducting a field review to verify the construction of the scaffold and the temporary roof/canopy. Was it really the case that not a single deficiency could be found during the field review? Was it true that the installation of these structures was conducted 100% in accordance with the construction documents?

- Omission or mis-installation of scaffold locking pins might have not been captured by the design professional when conducting field reviews (**Figures 2 & 3**).

Figure 2 *- Typical scaffold locking pins.*

Figure 3 *- Omission of scaffold locking pin.*

Commonly observed issues contributing to a loss pertaining to construction practice include, but are not limited to:

- Undersized sole board (also known as sole plate),[1] omission of sole plate, or improperly positioned sole plate (**Figure 4**).
- Out-of-plumb adjustable base plate,[2] resulting in an eccentric loading condition.
- Omission of locking pins between verticals (**Figure 3 or 5**).
- Deviation from construction details, which is particularly the case with the anchorage of scaffold:
  - o The use of unspecified fasteners.
  - o Excessive anchor spacing.
  - o Inadequate penetration of fasteners into the backing support members.
  - o Attachment to unspecified elements (e.g., plywood).
  - o Insufficient edge distance for the fasteners (i.e., the fastener is too large relative to the width of the member).

It is worth noting that the decoupling of the verticals shown in **Figure 5** was observed in multiple locations on a site in the aftermath of a loss. Such decoupling is directly attributable to the omission of a locking pin. However, neither the contractor nor the engineer who conducted a subsequent field review noticed the missing pin.

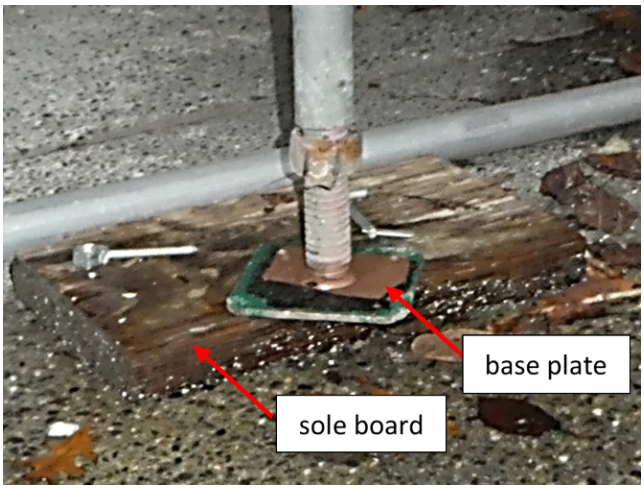

Figure 4 *- Improperly positioned sole board.*

[1] A sole board usually consisting of a timber member of adequate size used to distribute the load from the base plate to the ground.
[2] A metal plate with a screw jack for adjusting the standard's elevation. Standards are also called verticals, uprights, or legs.

Figure 5 *- Decoupled verticals due to omission of locking pin.*

The design of scaffold is normally conducted in accordance with applicable building codes, regulations, and standards. For example, in Canada the following documents are likely to be referenced currently:

- National Building Code of Canada 2020, or Provincial Building Code such as BCBC 2024, or Municipal Building Bylaw like 2019 Vancouver Building Bylaw (VBBL 12511).
- CSA Z797-2018 - Code of practice for access scaffold.
- CSA S269.2 - Access scaffolding for construction purposes.
- Various material codes (as applicable) like CSA O86-19 - Engineering design in wood.

It is likely the case that scaffolding is considered a temporary structure and, hence, is not given due diligence in the design and installation of this type of structure. However, the design professional should exercise an adequate standard of care in the design of scaffolds as well as in conducting field reviews to ensure that the construction was carried out in general conformance with the design documents. Elements such as locking pins, sole boards, base plates, diagonal braces, fasteners, etc., shall be confirmed for specifications, dimensions, plumbness, penetration, and minimum edge distance. Although it is not mandatory to have the design drawings peer-reviewed prior to being issued for construction, it is a good practice and prudent to do so as any potential errors existent in the original analysis and on the drawings may be minimized, if not eliminated, thereby lowering the risk of a loss.

ENVIRONMENTAL LOADS

Seismic design is not required for temporary structures like scaffolds; however, they should be designed for a minimum of 2% of the gravity loads (i.e., dead and live loads) as a service level (i.e., unfactored) lateral force. This load is to be used in lieu of seismic forces required by the appliable code in load combinations involving earthquake forces. As permitted by the applicable code or the relevant authority having jurisdiction, other environmental loads such as wind or snow loads may be reduced by applying a factor less than 1.0 or using a value corresponding to a higher annual probability of exceedance of, say, 1-in-30 instead of 1-in-50.

CONCLUSION & MINIMIZING SCAFFOLD FAILURES

Loss of temporary structures like scaffolds can be minimized by the design professional and the contractor should due diligence be exercised, including, but not limited to:

- Accurately capturing all the applicable design loads, particularly the wind load, when working on the design drawings.
- Sizing the fasteners appropriately in terms of their diameter and penetration to the main structure.
- Having the drawings reviewed by a qualified colleague or a 3rd party (known as “peer review”) before issuing for construction.
- Conducting field reviews carefully to ensure that the installation of the temporary structure(s) and their anchorage is carried out in general conformance with the design documents.
- Erecting the scaffold, including anchorage, in accordance with the design drawings, and using alternative fasteners only after obtaining the engineer’s approval prior to implementation.

By following these guidelines, the risk of failure in scaffolds/ temporary roof structures may be minimized.

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