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Protection of urban areas during repair work, structure demolition, and construction

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Abstract
Focusing on recent practices, this paper introduces urban protection tools that are available in the construction industry. Over the course of the research, the current state of practice was determined based through a questionnaire and an interview survey which included nationwide general contractor companies and the project executive of a safety management company located in South Florida, respectively. The study showed that there are five tools which are most commonly used in construction practices including Hand Rails with Toe boards, Overhead/Walkway Canopy, Outrigger Debris Containment Netting System, Canopy Netting System, and Vertical Netting System (Cocoon System).

Keywords
Safety, construction site management, urban protection during construction

1. Introduction

High rise buildings have become a trend nowadays due to their economical, architectural and territorial advantages. Largest cities of the world are competing with each other in the unwritten contest for the highest building. Architectural agencies develop projects – one more intricate than another – every day, but with this "Build the Tallest Building" rush one could easily forget of one of the most important parts of the construction process – safety and protection of surroundings.

What to protect during high rise construction and reconstruction? Firstly and most importantly – pedestrian. Construction sites often may create unsafe conditions for workers of the site, visitors, and of course, pedestrians. Each year, about 100 pedestrians are killed in the United States due to construction site accidents in addition to many more people who are seriously injured. Some of the most severe injuries, and even fatalities most of the time are a result of falling objects or debris. The most common objects that may come loose are handheld tools, loose pieces of masonry, and other materials. Typically, injuries made to pedestrians are caused by events where pedestrians walk directly in front of the site, or they are too close to the work zone due to lack of barricading, when they obtain unauthorized access to the site, or visit the site without any proper attire (Bellottilaw 2018).

Often injuries are caused by the lack of safety precautions. Construction companies and site owners are obligated to provide safe means of passing to all citizens, and vehicles. When such precautions are not taken, the construction site becomes a zone of danger, and all the injuries around the site are caused by the negligence of operating parties (Bellottilaw 2018). The most commonly seen examples of negligence are failure to use access limiting barricades, post warning signs at construction sites, and failure to adequately secure construction sites (including watchmen and/or locking sites at night hours). Often it is a failure to use safety tools and devices when needed to prevent falling objects and debris (among such debris nets, toe boards and catch platforms).

Another important part of the urban landscape that needs a thorough protection is historical buildings. Valued for the ability to survive through time historical buildings need help to survive ever-changing present. Whether it is a reconstruction and remodeling of a nearby building, demolition of an existing structure, or a new high rise construction site, damage made to the shorter historical building could be permanent. It is a responsibility of both, the owner of the historical building, and the new construction site developer, to take a careful consideration of any potential damages could be made, and take necessary precautions. Early planning and control of the process could be of a great help to successfully avoid damages. Not only falling objects, but damage by dust, improper machinery operation, vibrations, fire, and water should be prevented. These issues are often overlooked during the construction process, when the project is undertaken.

What else to protect? Parking lots, existing shorter buildings, lakes, ponds and reservoirs, electrical wiring, trees, landscape, and vegetation - everything around the construction zone is potentially endangered by the process.

2. Review of Standards and Requirements

Main requirements for urban protection in construction zones are described by Occupational Safety and Health Administration (OSHA), and American National Standards Institute (ANSI). OSHA is part of the United States Department of Labor, created by Congress with the Occupational Safety and Health Act of 1970. According to OSHA requirements construction site owners must provide safe working conditions for both, workers and pedestrian traffic, and examine workplace conditions to make sure they conform to applicable OSHA standards (SGEIS 2011).

The following protection standards are applicable to nowadays construction processes. In every building or structure shall be so arranged and maintained as to provide free and unobstructed egress from all parts of the building or structure at all times when it is occupied. 1926.34 - Means of egress. Danger signs shall be used only where an immediate hazard exists, and shall follow the specifications illustrated in Figure 1 of ANSI Z35.1-1968 or in Figures 1 to 13 of ANSI Z535.2-2011, incorporated by reference in § 1926.6. Signaling by flaggers and the use of flaggers, including warning garments worn by flaggers, shall conform to Part VI of the Manual on Uniform Traffic Control Devices (1988 Edition, Revision 3, or the Millennium Edition), incorporated by reference in Sec. 1926.6. 1926.201 – Signaling (CFR 2018, OSHA 2018).

Safety nets must be installed as close as practicable under the surface on which employees are working, but in no case more than 30 feet below (Oshatrain 2018). When nets are used on bridges, the potential fall area must be unobstructed. As indicated in Oshatrain (2018), safety nets and safety net installations must be drop-tested at the jobsite including after initial installation and before being used, whenever relocated, after major repair, and at 6-month intervals if left in one place.

3. Research Methodology

In order to determine current state of practice the author has used following tools of research:

- Created a small questionnaire for construction managers on site;
- Conducted an interview with the manager of a safety subcontractor in South Florida;

Below is the questionnaire for construction managers of 10 nationwide construction companies, with the most popular answers marked bold. This tool has helped identify the current situation in the field:

1. The company I work for has a strong safety and urban protection policy.

   Strongly disagree | Disagree | Not Sure | ***Agree*** | Strongly Agree

2. Safety and urban protection is a priority when determining the construction work budget.

   Strongly disagree | ***Disagree*** | Not Sure | Agree | Strongly Agree

3. What are the most commonly used protection tools are implemented within the company I work for?

   Netting systems | Overhead / walkway | Man power (flaggers) | No protection used

The next step in the research included an interview with the manager of a safety subcontractor company in South Florida.

Q 1. What are the major aspects do safety managers analyze when creating a safety plan?

A.: The answer included the following aspects:

a) how close are pedestrian walkways to the construction site, and how busy are those during day and night hours;

b) whether or not there is a public transportation line passing by the site, this aspect increases the heaviness of pedestrian traffic;

c) whether or not the building will be used during construction/repair work (pools, amenity decks, etc.)

d) whether or not there are existing shorter buildings surrounding the site, which could potentially get damaged or destroyed.

Q 2. What are the most common incidents, which occur during construction? What is the most current incident occurred?

A.: Struck by falling objects (debris). Piece of heavy lumber has fallen off of 48th level, luckily hasn't injured anyone.

Q 3. How tall does a projected building have to be in order to require urban protection plan?

A.: 2 stories and up.

Q 4. What is the percentage of sites using nowadays safety and protection tools?

A.: 8 out of 10

Q 5. What are the most commonly used protection tools used?

A.: Outrigger and Canopy debris containment netting systems, walkway overhead protection, flaggers (manpower).

Q 6. What percentage of safety plans dedicated to urban protection?

A.: Approximately 70%

Q 7. Is there any classification of levels of protection commonly used?

A.: Yes, low level 1-2 tools, medium level 3-5, high level 6 and up.

4. Current State-of-Practice

After careful analysis the authors determined the main tools to avoid injury or damages from falling objects that are currently used in construction operations:

1. Handrail (Figure 1)

   By OSHA handrails to be constructed of top rail, mid rail, and toe board with mesh net to prevent items being kicked off the edge of platforms. Hand rails with toe boards are the most commonly used tool, as besides protecting from falling object, it serves as a safety fall protection for construction employees.

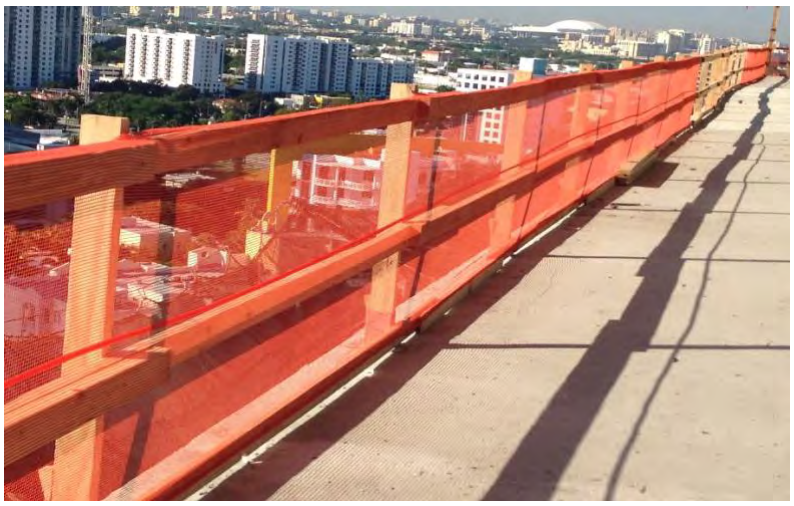

Figure 1: Handrail

2. Overhead/Walkway Canopy (Figure 2)
    - Allows safe pedestrian walkway path along construction sites;
    - Preventing injuries from falling objects (debris, materials, tools);
    - OSHA requires canopies to be of a certain width and height.

3. Outrigger Debris Containment Netting System (Figure 3) - connected the slab edge to help prevent materials that come loose during the working deck pouring, cleaning, stripping operations from falling to the ground (CFR 2018).
    - Drilled or clamped to slab edge;
    - No more than 30 feet (9.1 m) below working deck (OSHA 1926.502(c)(1))
    - Installed with sufficient clearance under them to prevent contact with the surface (OSHA 1926.502(c)(3)

Figure 2: Overhead/Walkway Canopy

Figure 3: Outrigger Debris Containment Netting System

4. Vertical Netting System (Cocoon System) (Figure 4)
    - Increase safety by preventing debris from falling on the public and adjacent properties below;
    - Installed 6' away to allow work in swing stages;
    - Bottom part of net is folded to create a "catching bag"

5. Canopy Netting System (Figure 5)
    - Used to cover objects located below working deck in radius of 20 feet;
    - Double netting (liners, cargo nets)
    - Liners replaced periodically;
    - Installed with sufficient clearance under them to prevent contact with the surface (CFR 2018)

Figure 4: Vertical Netting System

Figure 5: Canopy Netting System

5. Conclusions

This paper studied urban protection tools that are available in the construction industry. The current state of practice was determined based on a questionnaire and interview survey which included nationwide general contractor companies and the project executive of a safety management company located in South Florida. The study showed that there are five tools which are most commonly used in construction practices including Hand Rails with Toe boards, Overhead/Walkway Canopy, Outrigger Debris Containment Netting System, Canopy Netting System, and Vertical Netting System (Cocoon System). Based on the questionnaire survey, the construction companies seemed to have a strong safety and urban protection policy. However, safety and urban protection was not a priority when determining the construction work budget.

6. References

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