

ON-SITE | INSIGHT

THE GREAT DEBRIS DEBATE

A best practice approach to debris protection in high-rise construction

Optimising
health and safety

Specifying
a safety screen
system

Bringing structures to life

R•M•D
KWIKFORM

THE SKY'S THE LIMIT

Over recent decades, increasing urbanisation has led to an upturn in the construction of high-rise and other tall commercial buildings around the world. This is particularly true in emerging economies.

The key economic driver for this trend is the lack of space in densely urbanised areas. The rising population in cities has also meant that mixed-use buildings are gaining greater importance, and high-rise construction is certainly no longer limited to just the financial and business sectors. In fact, high-rise and tall commercial building construction is now an accepted global model for managing the increasing number of city dwellers, as more than one million people around the world move to cities every single week.

The Council on Tall Buildings and Urban Habitat publishes an annual report which examines all projects completed that are at least 200 metres tall. By the end of 2019, it found:

- There were 1,604 buildings in the world that are at least 200 metres tall, with 126 of these completed in 2019
- This is an increase of 161 per cent from 2010, when there were just 614

- China claimed the largest number of completions by country in 2019 with 44 per cent, with Asia having the largest completions by region with 68 per cent
- Shenzhen in China recorded 15 completions in 2019, making it the fourth year in a row that the city completed the world's largest number of 200-metre-plus buildings, followed by Dubai with nine completions, and then New York and Chongqing with eight

As of July 2019, Hong Kong had 7,913 high-rise buildings, defined as at least 12 storeys tall; Moscow in Russia had 12,317; Seoul in South Korea had 16,359. And with Siemens Building Technologies UK reporting that there are more than four million high-rise buildings across the globe, and a further 3.5 million proposed, it seems clear that the trend for tall commercial buildings will only continue to accelerate.

In light of this trend, RMD Kwikform recently undertook a piece of research to better understand high-rise and commercial building construction methods, focusing on productivity, safety and the use of formwork and shoring systems. This surveyed leading contractors – both general and specialist – and engineering consultants from around the world, unearthing areas

where temporary works can have a significant impact on high-rise and commercial building projects, as well as identifying where there is a need for education and knowledge transfer.

Considering the wider context of increasing urbanisation, fast growth in high-rise and commercial building projects and the latest findings of our research, debris protection is one area that needs addressing urgently to ensure contractors and their employees, as well as the general public, remain safe and secure. Particularly with cast concrete construction, where concrete slabs extend beyond a building's footprint, the opportunity for debris to fall over the edge is high unless there is protection in place.

Furthermore, buildings are not only getting taller, but more intricate too. The complex geometries of new high-rise and commercial projects has encouraged more advanced designs and evolved construction techniques, which has enabled buildings to be constructed that would have been simply unimaginable in previous decades. The result is an increasingly spectacular skyline in hundreds of cities around the world, but one that comes with

an ever-growing range of challenges for contractors involved in the development of these. All the while, debris protection to help ensure the health and safety of workers and the public is becoming increasingly important. Complex geometries are driving the need for increasing collaboration from suppliers and more dynamic debris protection systems.



Our research said...

As is evident from our research, multi-level safety screens play an important role in helping drive productivity. Forty-nine per cent agreed that they offer productivity gains, while also improving health and safety. Thirty-five per cent, the second highest ranked finding, said that multi-level safety systems also help speed up working cycles on the façades.

MAKING PROTECTION A PRIORITY



Did you know?
An M20 nut falling 12 floors gains 50 joules of kinetic energy – more than 14 joules is enough to fracture a human skull.

A contractor must be able to demonstrate that they have the skills, knowledge, experience and capability to carry out the intended work safely and without risk to health. In addition, all contractors know that every possible opportunity should be taken to protect the employees working on a project, as well as members of the public.

Did you know that an M20 nut that falls 12 floors gains 50 joules of kinetic energy? The energy needed to fracture a human skull is between 14-70 joules. Therefore, it should go without saying that specifying adequate debris protection and safety screens on high-rise and other tall commercial building sites is absolutely critical.

On site, contractors are under pressure to turn developments around quickly, on time and on budget. When the sheer scale of a project, tight timeframes and number of sub-contractors and teams that are involved in a development are all taken into account, it is clear how easy it can potentially be for health and safety risks to arise.

There are plenty of potential risks to consider. In inner-city areas with limited space, pedestrian walkways on the periphery of a site need to be protected from falling objects. On the construction site itself, workers on the ground – who might be transporting goods from one point to another – must be kept safe from the building work that is taking place above them. On the other end of the spectrum, falls from height are the main causes of fatal accidents for those working in the construction industry in the EU. And then there's also the issue of ensuring neighbouring buildings are not damaged, or a contractor could be faced with a costly penalty and dispute.

In short, the construction industry has a duty to make the protection of people an absolute priority.

ENSURING SAFETY DOESN'T SLIP THROUGH THE NET

At present, the debris netting is the typical solution to protect people from falling objects. It is generally made from a durable, heavy-duty plastic netting. In the UK, for instance, the Work at Height Regulations 2005 states that where public access to a potentially dangerous area is necessary, debris netting must be used to catch falling materials, including dust, which can cause discomfort or eye injuries.

For some projects, debris netting on its own will be enough of a solution. It generally provides safe containment of debris, while its versatility means it is easy and economical to handle. It can also hang vertically or horizontally to achieve maximum coverage, and allows air movement to help reduce wind loading. For workers, it can provide shading against bright sunlight while enabling adequate light in for construction work to be performed, and it is flame retardant too.

However, for those seeking an assured debris protection solution, safety screens are a best practice approach for controlling health and safety for high-rise and other tall commercial building projects.

Indeed, we found in our research that safety screens are the most commonly cited solution to the problem of falling debris – and this was true in every region around the world. Debris netting and standard edge protection systems with toe boards were the next most important methods.



Our research said...

Europeans and those in South America were the keenest on the need for improved debris protection. For both regions, more than 40 per cent of respondents held this view.

TOP FIVE REASONS TO CHOOSE SAFETY SCREEN SYSTEMS

- 1** Provide perimeter edge protection for site operatives, preventing falls from height
- 2** Seal in construction debris and prevents objects from falling
- 3** Accommodate for various climates, with some systems available to shelter workers from wind and rain and some to provide ventilation, ultimately minimising downtime
- 4** Help reduce the possibility of workers experiencing vertigo, therefore improving productivity
- 5** Multi-level safety screens can help significantly speed up working cycles for contractors

KEY CONSIDERATIONS WHEN SPECIFYING A SYSTEM



Space on site: The space that is available will determine whether safety screens arrive preassembled or are assembled on site.



Wind: Wind load has always been an important consideration when erecting tall buildings, and it only becomes more important and complex as the height increases.



Cost: Available budget will naturally impact the safety screen selection. Decisions such as whether the systems are being assembled on site or not, and how long the systems will be needed for, will all impact on cost.



Labour: The capabilities of on-site operatives may dictate whether the systems arrive ready-assembled. However, many of today's systems have been developed so they can be easily assembled by a contractor's workforce, and suppliers will offer demonstrations on how to assemble the kit.



Crane Usage: Having a system that minimises or eliminates crane usage can significantly improve efficiency and productivity, as crane time is freed up for other works on site.



Heating and ventilation: The environment and climate will dictate the specified system. In warmer climates, a screen that provides ventilation is crucial. In more volatile climates, the system must protect workers from the elements.



Our research said...

When it comes to crane regulations on 'flying' of equipment, 54 per cent said this really varies depending on location and site conditions, such as the proximity of neighbouring buildings.

THEN | NOW

OVERCOMING TRADITIONAL SAFETY SCREEN OBSTACLES



WEIGHT

Then

Previously, many screens relied on cranes to be lifted into position, which would then 'climb' as the building rises. This not only meant these screens required crane-assisted lifting, but that cranes were not free to be used for other on-site tasks.

Now

Efficient hydraulic lifting capabilities now mean screens can be 'self-climbing', removing the need for crane-assisted lifting. This frees the crane up for other jobs around the site and can help reduce cycle times. Safety screens now also have loading platforms built into them, which can help with the logistics of transporting materials to levels below the slab that are under construction, helping to further reduce reliance on cranes.



TIME

Then

Screens could not be lifted before slab concrete had cured and the falsework had been struck. The screens would not be big enough to cover two storeys, which means that column construction would stop just over one storey above the last cured concrete level. This would mean that column construction would have to be carried out above the protection of a screen, or workers had to wait until the screen could be lifted.

Now

Many of today's safety systems can be removed and lifted whilst the slab shoring is still in place. A lot of systems now also span two full storeys above the wet deck level, which enables work to be carried out on multiple levels at any one time. This ensures the slab and the columns above can also be cast. The screens can then be lifted up, with typically at least a metre of protection available. Both of these measures help save critical time for contractors.



SAFETY

Then

Steel mesh was typically the only screen cladding available. While this is effective, it does have its limitations too.

Now

Nowadays, safety screens come with a variety of cladding options, providing the contractor with the opportunity to select the best option for the job. Steel mesh provides a fully rentable cladding option, for where multi-use is required. Alternatively, plastic film cladding offers a number of advantages, such as protection from the elements – particularly the wind. This option also offers contractors advertising opportunities, as branding and marketing messages can be printed onto it while it is on site. Fire retardant nylon mesh screens can also be a very cost-effective alternative.



LOGISTICS

Then

Traditionally, large screens had to be assembled on site, with contractors having to take into account any space and time constraints, as well as storing all the loose materials needed for the job. Screens that were assembled off site were restricted to being only three metres wide and could generally not be stacked well for transportation, meaning only one or two could be fitted onto a trailer. The result? Increased transport costs, inefficiencies when it came to storing screens on site and a higher carbon footprint.

Now

Modern features such as telescopic width adjustment enable screens that are over five metres wide to be built off site, which can then be closed down to three metres for when they are being transported to site. Today's systems can be stacked much more easily too, reducing transport costs for contractors and ensuring better storage on site.



PERFORMANCE

Then

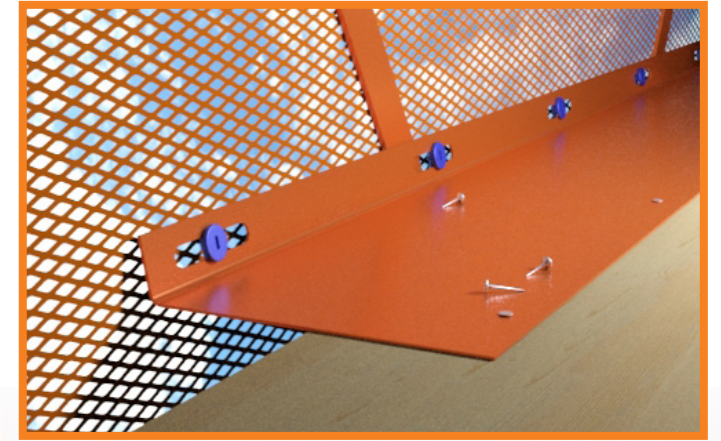
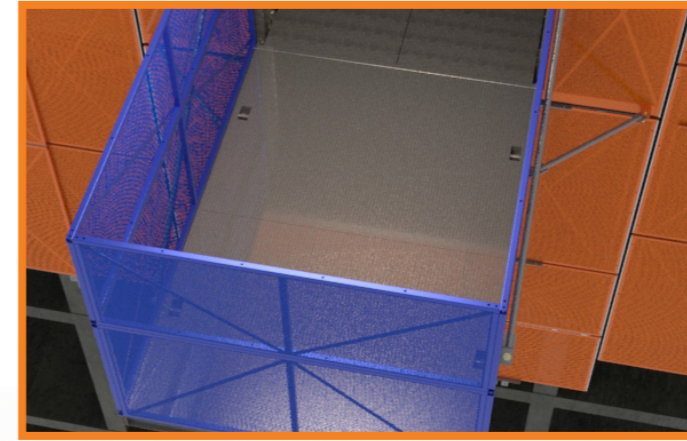
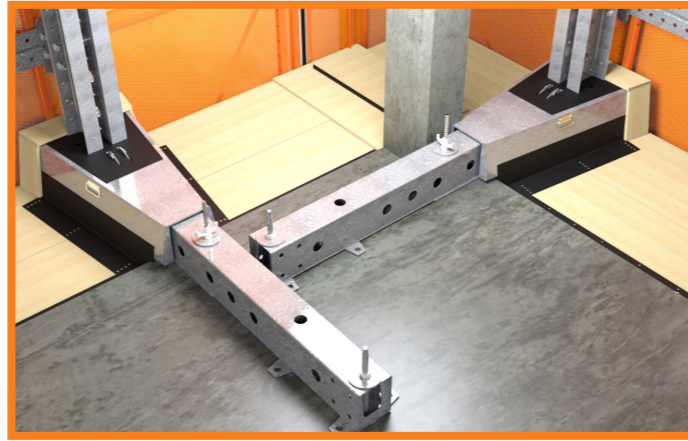
Screens would often struggle to close corners or would not be well sealed between modules. There were also many instances where the gap between the lower slabs and the screen were not sealed properly. Finally, many screens would not provide sufficient edge protection, which meant independent systems had to be specified, adding further to costs.

Now

Systems today benefit from features such as rotating cladding beam ends and compression edge seals to help eliminate gaps. To seal lower slabs and the screen, plywood cladding flaps and flexible joint seals can help, while modern solutions are designed with perimeter edge protection in mind too.

MODULAR EQUIPMENT

Considering the ideal safety screen, edge protection and debris containment solution?



Prevent debris falling

It is vital that equipment and debris is prevented from falling out of a structure. Get into the habit of prioritising. It is surprising to see that 26 per cent of respondents to RMD Kwikform's high-rise survey stated, 'debris was not a real hazard on a construction site'. It is paramount that contractors are proactive about debris falling and health and safety in general. If a reactive approach is adopted, the safety of on-site workers and construction cycles could be jeopardised.

Debris seal accessories

Screens can still have various gaps at joints and corners. While a site's requirements for the level of debris sealing can vary, it's recommended that contractors seek a system that can provide a range of accessories to ensure the appropriate level of debris sealing is assured. This can help keep costs down, while ensuring an appropriate level of containment.

Allow for adjustments

Look for fine level adjustments in the slab bracket. This helps 'plumb' the screens so that they sit accurately next to the building and the other screens. This will remove the need for shims and other clumsy packing techniques and promotes safe and efficient operation of the screens as they climb the building. Also consider how the slab brackets are anchored and set out as the slab is being cast. Modern anchor systems minimize the number of lost parts and can speed up setting out, this will help reduce hidden costs.

Loading platforms

Built in loading platforms allow easy movement of materials onto and away from levels below the slab level. This can have a substantial impact on site productivity, reducing the amount of manhandling between floors. These access platforms should themselves create a perimeter seal preventing accidental falling debris.

Minimise gaps

Built in hinged access platforms provide a safe and secure access between the slab and the screen. These platforms can be flipped out of the way when the screen is lifted or transported. This can save considerable time sealing the edges as the screen moves from floor to floor.

GLOBAL VIEWS: THE BIGGER PICTURE

DEALING WITH DEBRIS

When surveying contractors and consultants on how they deal with debris on site, our research revealed a range of insights, detailed below.

There was, however, universal agreement that edge protection systems offer both safety and productivity gains. While there is a clear need for edge protection systems to be quick to erect and easy to assemble, safety is absolutely paramount.

Contractors surveyed in our research highlighted safety features of formwork systems as more important than factors such as ease and speed of striking, manoeuvrability on site, and robustness and durability. Safety screen systems were the most commonly cited solution to the problem of debris falling from working levels on high-rise and tall commercial building projects, in all regions around the world.

• 100 per cent of respondents in Europe said falling debris was a problem, contrasting with 40 per cent in MENA and 26 per cent in Asia Pacific

• Less than 15 per cent of respondents in North America agreed that better edge protection was needed, the lowest proportion by a considerable margin

• In all regions apart from North America, at least 35 per cent of respondents agreed that more needed to be done around edge protection systems

• Europeans and those in South America were the keenest on the need for improved edge protection – in both cases, more than 40 per cent of respondents agreed with this view

WHOSE RESPONSIBILITY?

Health and safety should be a top priority for contractors and workers in the construction industry. However, rather surprisingly, 56 per cent of respondents in our research said individuals on site needed to take more responsibility for their own well-being.

While half of those surveyed said contractors need to work harder to improve site conditions, it was unexpected to discover that more felt it was the role of the individual to ensure they were meeting the right health and safety standards, having undertaken the appropriate preventative measures.

This tension between individuals on site taking personal responsibility for health and safety, and many believing that the onus is on contractors themselves to improve conditions, is key to addressing this issue. Personal responsibility is, of course, important but an employer's role in providing a safe working environment – and all that entails in terms of equipment used, training, and so on – is paramount.

In fact, one consultant surveyed in South Asia said: "Training programmes are urgently required for contractors and workers in this region."

'FLYING' FORMWORK

What contractors are permitted to do with regards to using cranes to 'fly' equipment on site – such as formwork panels – is very much dependent on the conditions of the site in question. Factors such as the proximity of other buildings in densely populated city centres, for instance, can have a big impact on whether this is possible.

Yet 'flying' of tables is standard practice, for example, in markets such as the USA, the Middle East and India, but it is less popular in other regions.

RMD Kwikform's research uncovered the following insights:

- 54 per cent of respondents said the regulations around using cranes to 'fly' equipment varies depending on the project's location and the proximity to neighbouring buildings
- 25 per cent of respondents agreed that 'flying' is limited by local regulations on crane capacity
- 22 per cent of respondents agreed that 'flying' is limited by local regulations on wind speed
- 20 per cent of respondents said 'flying' is limited by local regulations on crane reach
- 18 per cent of respondents said they can 'fly' assembled formwork tables or trusses

Fortunately, there are new systems coming on the market that remove the need for flying tables, helping to further improve health and safety for construction projects.

OTHER OPPORTUNITIES

1 Advertising potential

One additional benefit of using safety screens is that they can be used for advertising. While plywood or corrugated steel cladding requires any marketing to be added to the systems separately, plastic screens can be printed with promotional messages in mind. This is a very popular option, as it can help provide the ultimate protection against the elements for workers, while also advertising brands and key marketing messages in prime locations in busy city centres.

In fact, savvy contractors can even sell this advertising space to their client or other third parties, with the capital raised going towards the cost of the safety screen system.



Our research said...

The regions that most recognised the commercial benefits of advertising were the Middle East and South America. Those that have visited Dubai in recent years will confirm that contractors and developers in the commercial building market are experts at using these spaces for advertising and promotion. This was less true of those based in North America, with only 16 per cent recognising this as a potential benefit.

2 A hydraulic boost

In the latest systems, hydraulic climbing options can help reduce the reliance on cranes. This functionality enables multiple screens to be lifted on the same hydraulic cycle, further improving safety and efficiency levels. An integral spring-loaded latch ensures safe and simple hydraulic lifting.

3 Avoiding hazards

Previous screen platforms would typically be half a metre or so below the slab shoring, resulting in a perimeter platform that was practically redundant, as well as presenting a real potential trip hazard for workers. The latest systems now ensure that perimeter access platforms are absolutely level with the falsework soffit, to help reduce trip hazards and guaranteed peace of mind for contractors that health and safety in this environment is optimised.

THE ONLY WAY IS UP

As the high-rise and commercial building market shows no signs of letting up, contractors need to make sure that they have every confidence in the safety systems selected to help with debris protection. Not only do these prevent health and safety issues on site, but they can also increase the speed and ease of erection, saving contractors valuable time and money.

The latest debris protection solutions offer features such as the capability to support multiple slab level access, enabling work to commence quickly and safely at levels below the wet decks, as well as multi-screen hydraulic climbing capabilities, which reduces the reliance on crane availability and improves operational efficiencies. Supported by stronger masts, single depth profiles that can be more easily transported to site, and multiple screen cladding options that can accommodate increasingly complex building geometries, the latest solutions ensure contractors can feel confident that the systems meet the necessary health and safety standards.

Rendered image of Ascent 200, the latest edge protection system from RMD Kwikform



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