



# HIGH-RISE CONSTRUCTION

DRIVING PRODUCTIVITY & SAFETY



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### THE FOCUS

In January 2019 KHL Group and its magazine *International Construction* carried out a survey on high-rise and commercial building construction methods, focusing on productivity, safety and the use of formwork and falsework systems.



### WHAT WAS ASKED

We asked contractors about the types of work they are doing, the techniques they are using, and how they view new developments in temporary works technology.



### WHO WAS ASKED

The survey, which was sponsored by RMD Kwikform, was completed by more than 138 respondents worldwide, primarily contractors (general and specialist) and engineering consultants.



### THE FINDINGS

The study highlights areas where temporary works can have a significant impact on productivity and safety, and highlights where there is a need for education and knowledge transfer.

## 2.

## KEY FINDINGS

### PRODUCTIVITY AND TEMPORARY WORKS



The survey shows clearly that **labour productivity is viewed as the major opportunity to improve efficiency on sites**, whether freeing up workers for other tasks or speeding up time-consuming activities, such as the management of formwork and falsework.



**Formwork and falsework are a major element of expenditure for contractors**, particularly specialist contractors, typically representing around 5 to 7% of total annual turnover.”



Temporary works can play **a key role in productivity**, in terms of ease of erection and movement as well as cycle times.

**There is no ‘one solution fits all’ formula when it comes to formwork and falsework.** For example, although slip form methods for core construction can be fast, they bring their own problems, including issues with concrete finish as well as health and safety.



## 2.

## KEY FINDINGS

### HEALTH AND SAFETY AND HIGH-RISE PROJECTS



The highest rated factor in improving health and safety was **the need for individual workers to take personal responsibility**. This was considered more important than for contractors to improve site conditions. Given the duty of care that contractors owe their employees, and the need for them to provide training and a safe working environment, this is a surprising finding.

**Formwork and falsework has a key role to play in safety.**



As well as its enormous potential impact on the productivity of high-rise projects, it can have a major positive influence on safety.

There is a clear demand for safer methods of construction, and the survey shows that most respondents felt that **both individuals and contractors needed to do more.**



What is clear from the survey is **that contractors and others on high-rise projects see a clear need for action on multiple fronts** –


contractor actions, personal responsibilities, the need for safety methods of construction and for health and safety be accorded priority.



## 2.


## KEY FINDINGS

### HIGH-RISE CONSTRUCTION METHODS




In addition to historic regional preferences, **there are good reasons for using different methods** of construction for high-rise cores. The need, or not, to use cranes to move formwork and falsework is heavily influenced by the type of structure.

The survey highlights the **continuing popularity of slip forming for core construction**, despite issues with concrete finish quality. This implies a need for education about other core construction methods.



Groundworks remains a key area in the early stages of high-rise construction. The use of **structural steel is still popular in many areas**, which highlights the need for further education around alternative, dedicated ground shoring techniques.



Basement construction remains an important element of high-rise projects and **there is a trend for basements to get deeper**. The depth, as well as the length of time that shoring is required, all play into the decision over the choice of solution.

## SUMMARY OF SURVEY RESULTS

### WHAT DRIVES PRODUCTIVITY IN HIGH-RISE CONSTRUCTION?

- **Reducing labour** is the key factor **driving productivity** improvements for contractors and others involved in high-rise construction.
- Adopting **building methods that reduce labour requirements** was considered the number one factor in improving productivity, followed by the use of **formwork and falsework systems that reduce time and labour** required to assemble and strike.
- When it comes to formwork and falsework, contractors want it to be **easy to erect and dismantle**. This is rated as more important than other attributes such as weight, strength to weight ratio and safety features.
- **Price is not the key determinant** in choice of technology. Contractors want the best solution, regardless of existing supplier relationships or the equipment they already own in-house.
- Multi-level safety screens below the deck level are seen as playing **a key role in improving productivity**, alongside safety benefits.
- **Formwork and falsework** is a key item for contractors, helping drive productivity and safety on site. It is also a **major cost** item, typically representing 5% or more of annual turnover.

### WHAT DRIVES IMPROVEMENTS IN HEALTH AND SAFETY?

- There is a widespread **need for safer methods of construction** to be introduced.
- A minority of contractors believe that health and safety regulations are already adequate. **The vast majority are not complacent** about safety.
- Contractors believe that individuals on site need to take **personal responsibility** for health and safety. At the same time, many believe **the onus is on contractors themselves** to improve conditions on site.
- **Multi-level safety screens** below the deck level are seen as playing a **key role in improving construction safety**, alongside productivity benefits. They are also seen as a way of speeding up working cycles on façades.
- **Safety screen systems** are the most popular **solution to the problems of debris** falling during high-rise working. Debris skirts and standard edge protection systems with toe boards were considered the next most important preventive measure.

### BUILDING METHODS AND HIGH-RISE CONSTRUCTION

- **Slip forming** is the preferred core construction method for buildings **higher than 20 storeys**. Crane-lifted core forming and self-climbing core formwork and falsework are the most popular for buildings in the 12 to 20 storey range. For lower buildings, a mix of all three techniques are used.
- **Basements continue to become deeper**, particularly in Europe.
- Contractors favour appointing **specialist groundworks contractors** for basement works, either using ground shoring systems – the most popular option - or structural steel shoring solutions.
- To reinforce basement excavations, contractors are **most likely to hire shoring systems or use structural steel methods**, rather than use their own ground shoring systems.



# 4.

# PRODUCTIVITY

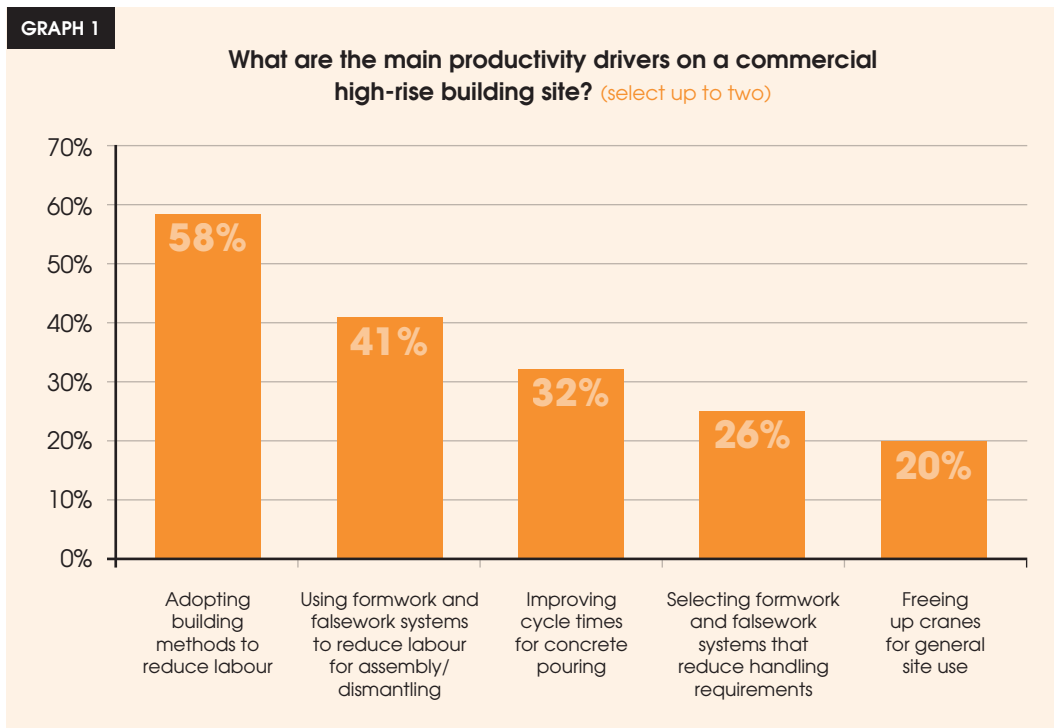
## 1. KEY DRIVERS OF PRODUCTIVITY?

The survey shows clearly that labour productivity is a major opportunity to improve efficiency on sites, whether freeing up workers for other tasks or speeding up time-consuming activities, such as the management of formwork and falsework.

Temporary works can play a key role in productivity, in terms of ease of erection and movement as well as cycle times. In addition, formwork and falsework are a major element of expenditure for contractors, particularly specialist firms such as concrete frame contractors. Typically, the formwork and falsework spend represents around 5 to 7% of a contractor's total annual turnover." (See Graph 2, page 10.)

Freeing up crane time is another key issue here, although the choice of formwork and falsework will depend also on the height of the building and whether there are multiple structures or not, and not just on whether it can reduce crane time.

There is no 'one solution fits all' formula when it comes to temporary works. For example, although slip form core methods can be quick, particularly for very high buildings, they bring their own problems, including issues with concrete finish as well as health and safety. This also touches heavily on concrete technology, with new monitoring systems allowing more accurate timelines for striking of formwork and falsework.



# 4.

# PRODUCTIVITY

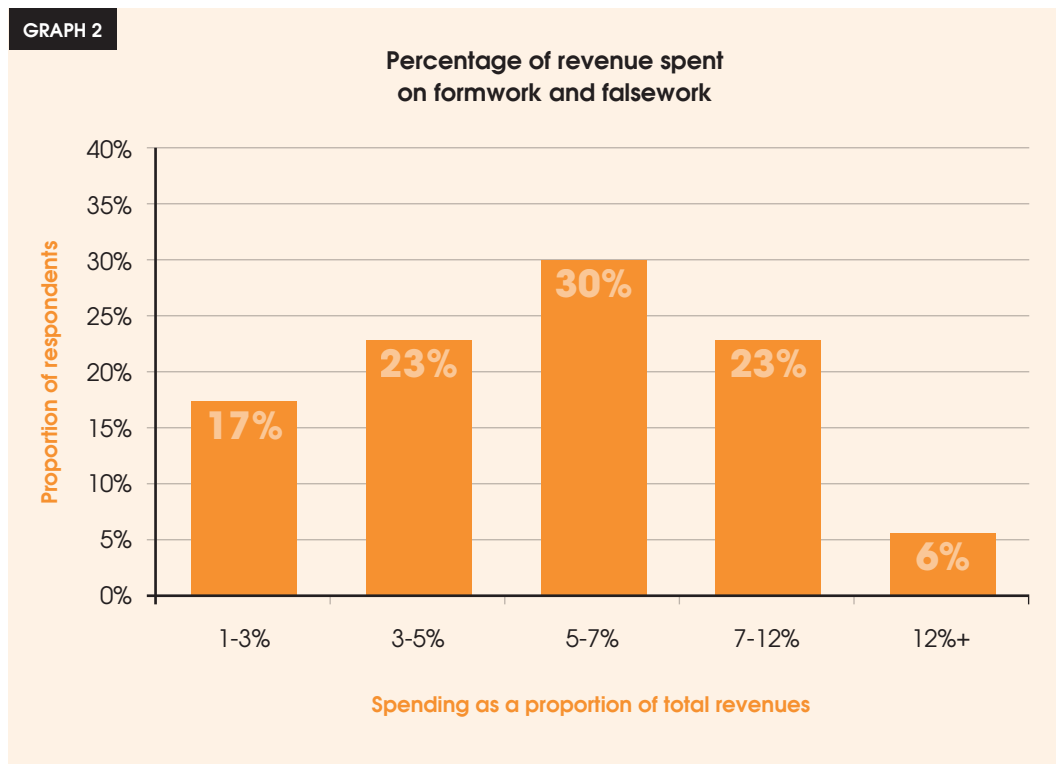
## SURVEY RESULTS

What are the main productivity drivers on commercial high-rise projects? The clear winner was the adoption of building methods to reduce labour requirements, which was chosen by almost 60% of all respondents. Next most important was using formwork and falsework products that reduce the time and labour required to assemble and strike such systems, chosen by 41% of those surveyed. (See Graph 1, previous page.)

These two results indicate that reducing labour requirements generally is a key factor for contractors and others involved in high-rise construction. The fact that the key driver is a generalised aim – to adopt measures to reduce the size of the workforce – is a clear indicator that those involved in construction are looking for labour efficient processes and methods.

The second most cited driver - the use of formwork and falsework systems that reduce installation and dismantling times – indicates that this technology remains a key area to drive improvements in construction productivity.

While these two factors are pre-eminent, it should be noted that improved cycle times for concrete pouring was chosen as a key factor by 32% of respondents, which makes it another significant issue.



## 4.

## PRODUCTIVITY



### TYPES OF COMPANY

Were there any big differences between different types of respondent? The two biggest groups of people who completed the survey were general contractors (GCs) (52% of the total) and engineering consultants (34%), followed by specialist contractors (14%).

The key difference between contractors and consultants on this question was the greater focus on reducing manual handling of formwork and falsework on site, which was considered a top-two factor for 35% of contractors against 15% of consultants. This clearly relates to the quite different perspectives of those who are concerned with designing a building and those who are engaged on site.

Specialist contractors (whether focused on concrete, formwork and falsework or groundworks) were also significantly more interested in getting access to cranes. Some 50% of specialist contractors rated this as a top-two concern against 20% for the whole sample. This reflects the need for sub-contractors to negotiate crane time with the main contractor.



### REGIONAL DIFFERENCES

While every region placed the 'adoption of building methods to reduce labour requirements' as the number one factor in driving up productivity, in Asia Pacific there was an almost equal importance given to using formwork and falsework systems to reduce man hours required for assemble and dismantling.

No respondents in Europe chose freeing up cranes for general site use as one of their two most important productivity drivers. That contrasted with every other region, where it was typically cited by between 20 and 30% of respondents as a key factor.



Productivity  
does

**relate directly to the temporary works system, particularly the ability to erect, dismantle, manoeuvre and man-handle the solutions. In turn, a system ticks these boxes if it allows for a reduction in labour.”**

SIMON DOWD

Major Projects Manager,  
RMD Kwikform

# 4.

# PRODUCTIVITY

## 2. THE MOST IMPORTANT FEATURES OF A FORMWORK AND FALSEWORK SYSTEM

Respondents clearly ranked ease and speed of erection and the labour hours required for assembly and disassembly as the two most important features of formwork and falsework. Both obviously have a major impact on costs, productivity and scheduling.

Three other factors were highly rated – although significant below the top two – and these were weight, strength to weight ratio and safety features. While it is good to know that 40% of respondents rated safety as a top three feature, it is perhaps more alarming that 60% did not.

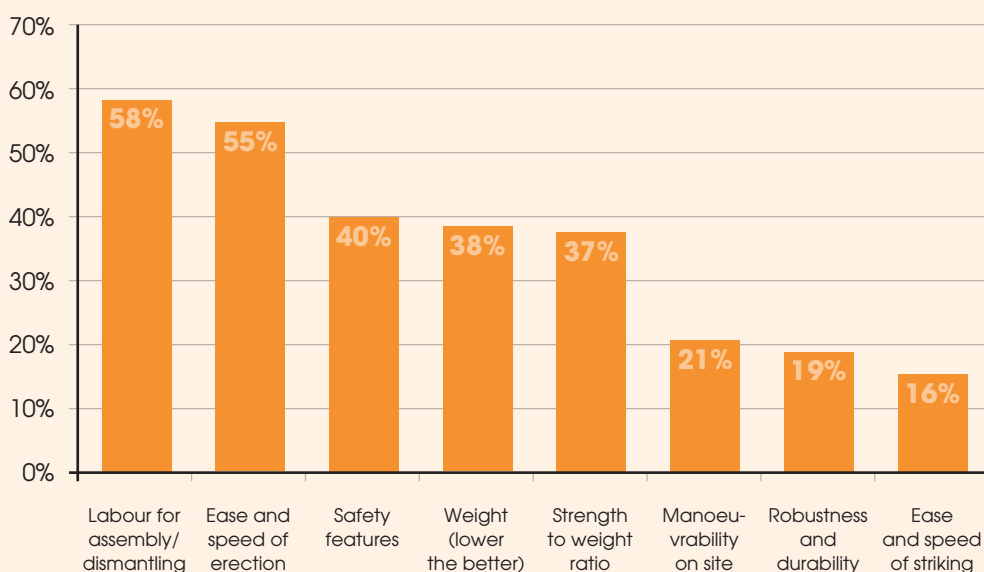
“ We prefer to have a formwork system which is easy to assemble, install and strike, and with the best finish.”

GENERAL CONTRACTOR,  
Middle East & North Africa

GRAPH 3

### The most important features of a formwork and falsework system

(choose the top three)



## 4.

## PRODUCTIVITY



### TYPE OF COMPANY

There is almost total agreement on the three most important attributes of a formwork and falsework safety between contractors and consultants.

There was just one exception to this, with consultants being less concerned about the manoeuvrability of formwork and falsework on site. This is a factor that will reflect on a person's practical experience of site and some of the 'real world' difficulties that can arise.



### REGIONAL DIFFERENCES

There was a greater emphasis on the manoeuvrability of formwork and falsework on sites in North America than in other territories – even if it was still not highly ranked – and more weight given to robustness and durability in Asia Pacific and MENA.

In South America there is a greater focus on the strength to weight ratio of formwork and falsework than in every other region, and it was also given a high ranking in Asia Pacific and North America. Weight was rated highly as a factor in Europe, South America and MENA, but less so in Asia Pacific.

## 3. WHAT INFLUENCES YOUR CHOICE OF FORMWORK AND FALSEWORK SYSTEM?

Contractors want the right system for the application, and that trumps other considerations such as price, site team preference and whether a contractor already owns formwork and falsework equipment.

The other dominant factors, with only a few exceptions geographically, are having a full range of formwork and falsework for all applications; price, and features and benefits to improve productivity. This might seem to contradict the greater focus on productivity referred to earlier, but it seems that contractors view 'having the right solution' as essential when it comes to completing the project effectively. In most markets, existing ownership of formwork and falsework, the preferences of the local site team, and having a strategic relationship with a supplier, are not deemed key influencers.



### TYPE OF COMPANY

It is no surprise to learn that consultants view 'site team preferences' as more important than do contractors. Consultants are working for the contractors, so the preferences of the staff on site will inevitably be a consideration. Even for consultants, however, it is rated fourth out of the seven options.

# 4.


# PRODUCTIVITY

## REGIONAL DIFFERENCES

Price is a second-tier influencer in almost every region, although given most consideration in Europe and the Middle East and North Africa (MENA) – where it was a top-three influencer for 50% of respondents.

Having a strategic relationship with a formwork and falsework supplier was given high importance in North America – almost 40% of respondents ranked it in the top three – and to a lesser extent also in South America. Perhaps strategic relationships count for more in the Americas.

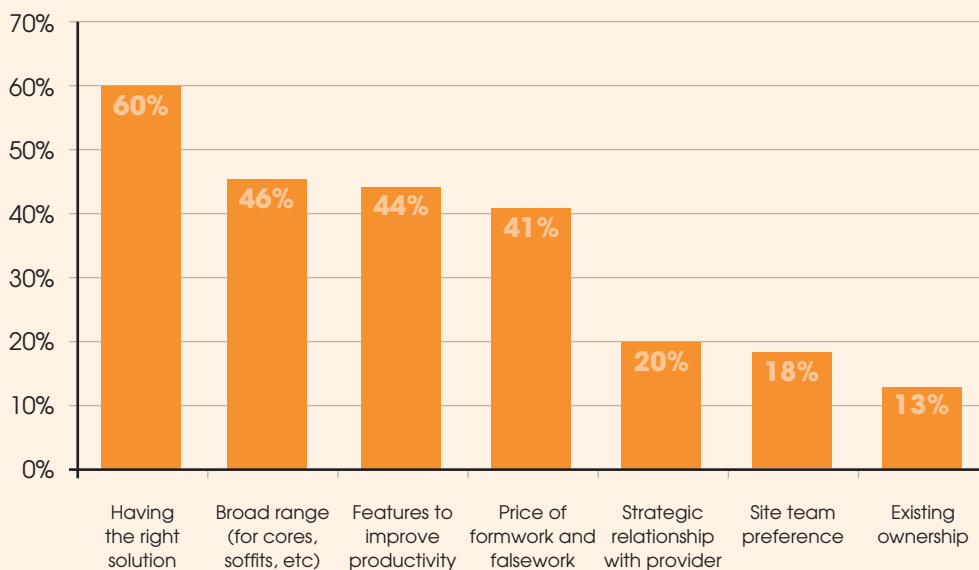
In contrast, strategic relationships appear to matter least in Europe, with just 17% citing this as an influencer in their choice of formwork and falsework system. How to explain this? Perhaps it reflects the highly mature nature of the business in Europe, with many established formwork and falsework suppliers: contractors are confident that they will find the right solution without needing the comfort offered by a strategic relationship.

 **Formwork systems require a crane to hoist and position the system, which means time allocated for crane work. This means that we can't cast the concrete using the tower crane until it has completed the formwork and falsework installation."**

CONSULTANT,  
Asia Pacific

GRAPH 4

When sourcing formwork and falsework what are the top three influencers on your decision? (choose the top three)



#### 4. ROLE IN PRODUCTIVITY FOR MULTI-LEVEL SAFETY SCREENS BELOW THE 'WET DECK'

Multi-level safety screens do offer productivity gains, with the top two options (see Graph 5 on page 16) highlighting productivity and safety as well as speeded up cycle times for working on façades. Second highest ranked, chosen by 35% of respondents, was the view that multi-level systems speed up working cycles on the façades.

The potential commercial benefits of multi-level screen systems – for selling as advertising space or for non-commercial messages – was highlighted by 25% of respondents, making it one of the most highly rated benefits.

While the survey paints an overwhelmingly positive picture of the role that such systems can play, this should not obscure some of the findings that run counter to that view. For example, 17% of respondents – a sizeable minority – think that the safety screens move up the building too quickly to be used effectively for façade work.

In addition, more than 10% also think that such systems do not offer a wide enough platform to create a meaningful working space.



Regardless of the actual temporary works system, a lot of focus is now around concrete technology, which includes monitoring the curing speed following a pour. This allows for more accurate planning of the following pours and provides a more accurate timeline for the supply chain.”

SIMON DOWD  
Major Projects Manager,  
RMD Kwikform

# 4.

# PRODUCTIVITY

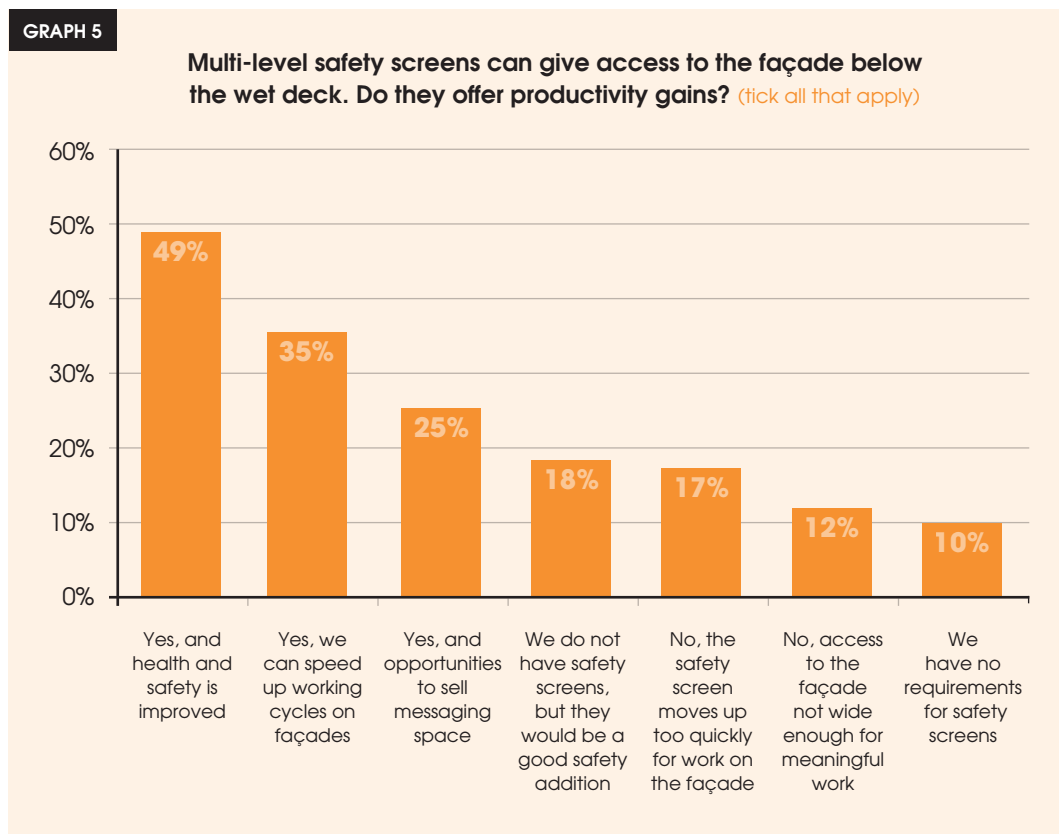
## REGIONAL DIFFERENCES

In Europe, where such screens are already in widespread use, not a single respondent thought that such systems were too narrow for effective working, and only one said that safety screens moved too quickly up the building.

Where such systems are used, contractors work to exploit their potential benefits, designing working methods and practices that allow for relatively narrow working areas and for rapid cycle times.

The regions that most recognised the potential commercial benefits via advertising were the Middle East and South America. Anyone who has visited Dubai in recent years will be able to attest to the fact that contractors and developers are expert at using such spaces for promotion. That was less so the case among North America respondents, only 16% of whom recognised it as a benefit.

Contractors in Asia Pacific were the most likely to express the view that screens were moved too quickly for façade work, with more than a quarter expressing this view.





## 4.

# HEALTH AND SAFETY

### 1. WHAT SHOULD BE DONE TO IMPROVE HEALTH AND SAFETY ON HIGH-RISE PROJECTS?

There is a clear demand for safer methods of construction, and the survey shows that most respondents felt that both individuals and contractors needed to do more.

In fact, it is perhaps surprising – and dispiriting - to see that the need for individual workers to take personal responsibility was the highest rated factor in improving health and safety. That was rated more important than for contractors to improve site conditions. Personal responsibility is important, of course, but an employer's role in providing a safe working environment – and all that entails in training, equipment etc - is surely paramount.

What is clear from the survey is that contractors and others on high-rise projects see a clear need for action on multiple fronts – contractor actions, personal responsibilities, the need for safety methods of construction and for health and safety be accorded priority.

Formwork and falsework again has a key role to play here. As well as its enormous potential impact on the productivity of high-rise projects, it can have a major positive influence on safety. However, our survey shows that, while safety features are considered important, they take a back-seat to productivity.

Modern formwork and falsework systems often have integrated safety features – such as working platforms that are protected and sealed off during lifting – but features like these do not seem to have the highest priority.

Slip form solutions for core construction have taken a central role in high-rise projects and remain popular on very high buildings because of their speed of rise. On the other hand, such systems can have safety implications because they are constantly moving. Indeed, in busy city-centre sites it is often not considered a viable solution.

The viability of 'flying' formwork and falsework – transporting by crane – is standard practice in markets like the USA, the Middle East and India, but less popular elsewhere. This is reflected in the survey. There are now systems coming on the market that remove the need for flying of tables.

However, in the case of multi-level safety screens giving access to façade levels below the wet deck, safety is a key consideration.



**Training programmes are urgently required to be organised for work contractors/workers in this region.”**

CONSULTANT, South Asia

# 4.

# HEALTH AND SAFETY



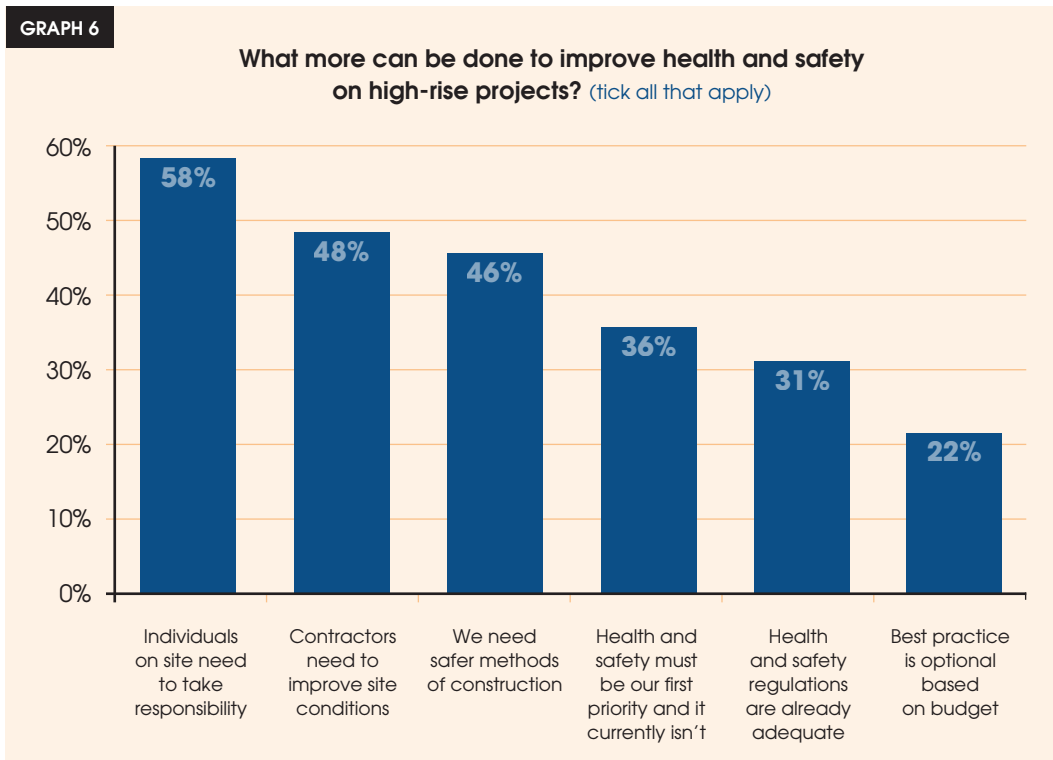
## DETAILED RESULTS

Respondents were able to tick all the possible response to the question of what can be done to improve safety on high-rise projects, so it is not surprising that multiple factors were considered important.

One of the key issues, according to 56% proportion of respondents – the highest rated factor – is that individuals on site need to take personal responsibility for health and safety. If that suggests contractors are happy to ‘outsource’ safety to their employees, then it is important to note that the second ranked factor - almost 50% of all respondents – said also that contractors needed to work to improve conditions on sites.

Is there a degree of complacency on safety? Based on this survey the answer would be no. Just 30% of respondents said health and safety regulations were already adequate, and an even lower proportion, 22% (the lowest), agreed that the adoption of best practices on safety was related to budgetary considerations.

In most regions of the world, there was agreement that - in addition to companies improving site conditions and individuals taking responsibility – there was a need for safer methods of construction to be introduced (46%) and that health and safety wasn't their first priority.



## 4.

# HEALTH AND SAFETY



## REGIONAL DIFFERENCES

South American respondents were the most likely to agree that adoption of best practices on safety were related to budgetary considerations. The pressure of difficult current market conditions may be influencing that view.

Regarding whether health and safety regulations were already adequate, it was respondents in MENA region who were least convinced of that – just 15% thought regulations were sufficient – and even in Europe, which is a highly regulated market in relation to health and safety, just 18% of respondents believed that regulations were up to the task.

North Americans were the most likely to think that existing regulations were adequate, and they were also the most likely to view safety as an issue of personal responsibility. Without wishing to typecast, might that parallel broader societal attitudes in the USA towards government regulations and issues of individual responsibility?

In Europe, there was a clear focus on the need for contractors to improve site conditions – this was the number one rated issue – but that was closely followed by the need for individuals to take personal responsibility.



## TYPE OF COMPANY

More than 50% of contractors said individuals needed to take responsibility for health on safety on site, and that was their highest rated factor in improving safety. However, it is to their credit that the second rated factor was that contractors themselves needed to do more to improve site conditions.

Almost 65% of consultants said that contractors needed to do more on safety. Some might comment that it is easy for them to say.



**Previously, slip form was the stand-out solution for high-rise. However, there were issues with health and safety, particularly as slip form is a constantly moving system. In busy city centres it was not a viable option for health and safety reasons.”**

SIMON DOWD

Major Projects Manager,  
RMD Kwikform

# 4.

# HEALTH AND SAFETY

## 2. SAFETY FEATURES OF FORMWORK AND FALSEWORK SYSTEMS

When asked to highlight the three most important features of formwork and falsework, respondents clearly ranked safety features as less important than ease and speed of erection and the labour hours required to assembly and dismantle.

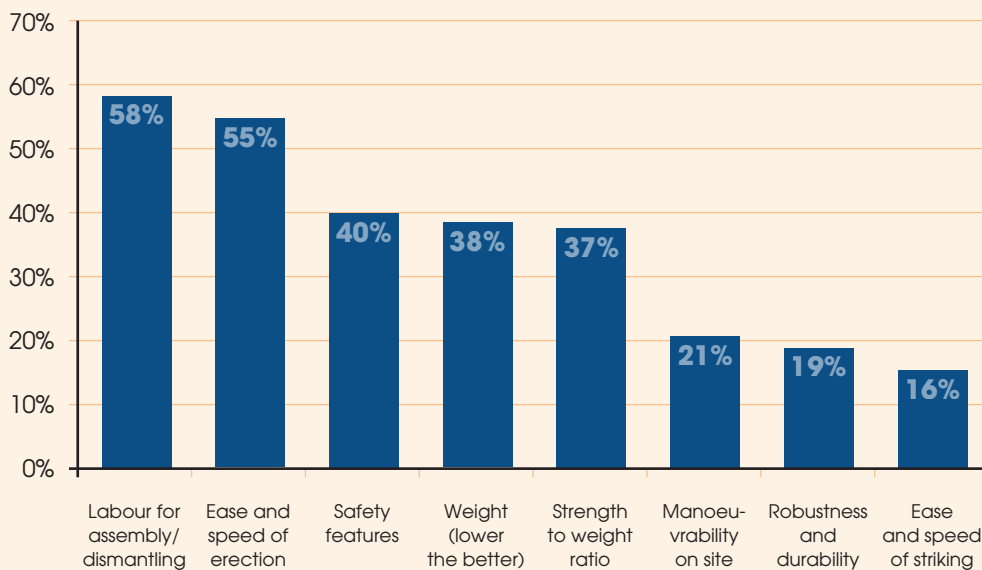
While it is good to know that 40% of respondents rated safety as a top-three feature, it is perhaps more alarming that 60% did not. Still, safety was rated higher than ease and speed of striking, manoeuvrability on site, and robustness and durability.

“ Respondents clearly ranked safety features as less important than ease and speed of erection and the labour hours required to assembly and dismantle.”

GRAPH 7

The most important features of a formwork and falsework system

(choose the top three)



## 4.

# HEALTH AND SAFETY

### REGIONAL DIFFERENCES

In South America, Asia Pacific and the Middle East and North Africa (MENA), where there might be a perception that safety is given less importance, safety features were rated a higher priority than in Europe and North America.

It is unfair to simply label less-developed markets as being not safety conscious, but perhaps the finding here reflects the fact that developing markets are seeing an increased focus on safety, while in Europe and North America – where a culture of health and safety is already ingrained – there is an assumption that formwork and falsework systems and methods of working will be safe. In that context, in Europe and North America, the focus shifts to factors such as productivity and efficiency.

Safety was the single most important feature of formwork and falsework in Asia Pacific, which indicates that contractors in the region are really looking for features that help companies improve the safety of construction sites.

### **3. THE ROLE FOR MULTI-LEVEL SAFETY SCREENS BELOW THE 'WET DECK' LEVEL**

Do safety screen systems covering multiple floors, giving access to the building façade below the wet deck, offer safety and productivity benefits?

There was almost universal agreement that such systems offered both safety and productivity gains, and it was the combination of the two that proved to be the most popular factor, with 50% agreeing. Second highest ranked, chosen by 35% of respondents, was the statement that the systems speed up working cycles on the façades. The potential commercial benefits of multi-level screen systems – for selling as advertising space or for non-commercial messages – was highlighted by 25% of respondents, making it one of the most highly rated benefits.

Almost 20% said that safety screens were not available in their region, but that they would be a good addition for safety. That points to an opportunity for product marketing and education.

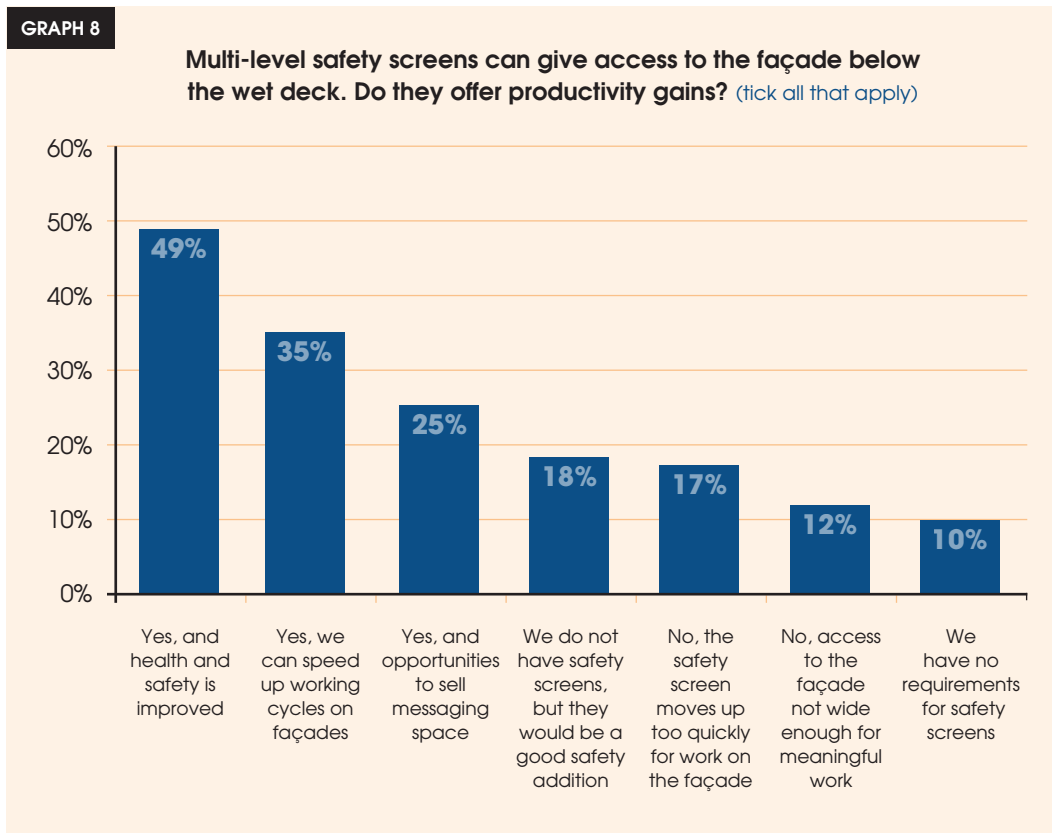
While the survey paints an overwhelmingly positive picture of the role that such systems can play, that should not obscure some of the findings that run counter to that view. For example, 17% of respondents – a sizeable minority – think that the safety screens move up the building too quickly to be used effectively for façade work. More than 10% also think that such systems do not offer a wide enough platform to create a meaningful working space.

# 4.

# HEALTH AND SAFETY

## TYPE OF COMPANY

Consultants were most alive to the question of safety, with 65% viewing these multi-level safety screen systems as providing a safety benefit (in addition to productivity gains), which compared to 41% of contractors. Safety was, however, the top ranked benefit for both types of company.



## 4. WHAT IS DONE TO PREVENT PROBLEMS WITH DEBRIS ON HIGH-RISE PROJECTS?

Safety screen systems are the most commonly cited solution to the problems of debris falling from working levels on high-rise projects. That was true in every region of the world.

Debris skirts and standard edge protection systems with toe boards were the next most important methods. Just over 30% of all respondents said that debris protection systems needed to improve, while 25% said it was not a problem in their region.

# 4.

# HEALTH AND SAFETY

## REGIONAL DIFFERENCES

It was European respondents who were perhaps most honest – or self-critical - on the question of falling debris: none said it was not problem. That contrasts with 40% in MENA and 26% in Asia Pacific. Perhaps a bit more self-reflection, or realism, is required in these regions?

Europeans and those in South America were the keenest on the need for improved debris protection: in both cases it was more than 40% who agreed with this view.

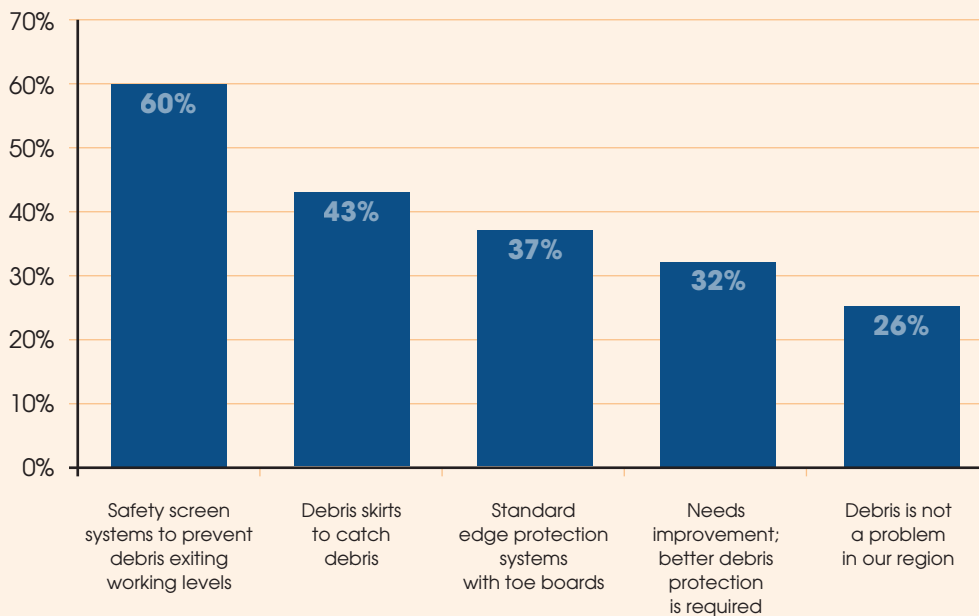
Fewer than 15% of North America agreed that better systems were required, which was the lowest proportion by a considerable margin (in every other region 35% or more agreed that more needed to be done).

“It is very good to see how debris is addressed in many areas. However, the varying emphasis is concerning – this could be improved in many regions.”

SIMON DOWD  
Major Projects Manager,  
RMD Kwikform

GRAPH 9

Debris can be a real hazard on high-rise projects.  
How is this dealt with? (tick all that apply)



## 4.

## HEALTH AND SAFETY

### 5. WHAT ARE THE REGULATIONS ON 'FLYING' OF EQUIPMENT ON SITES?

What contractors are permitted to do with regard to using cranes to 'fly' equipment on site – such as formwork and falsework panels – is highly dependent to the conditions of individual sites, such as the proximity of site neighbours.

It also reflects differing practices around the world. 'Flying' of tables is standard practice, for example, in markets like the USA, the Middle East and India, but less popular elsewhere.

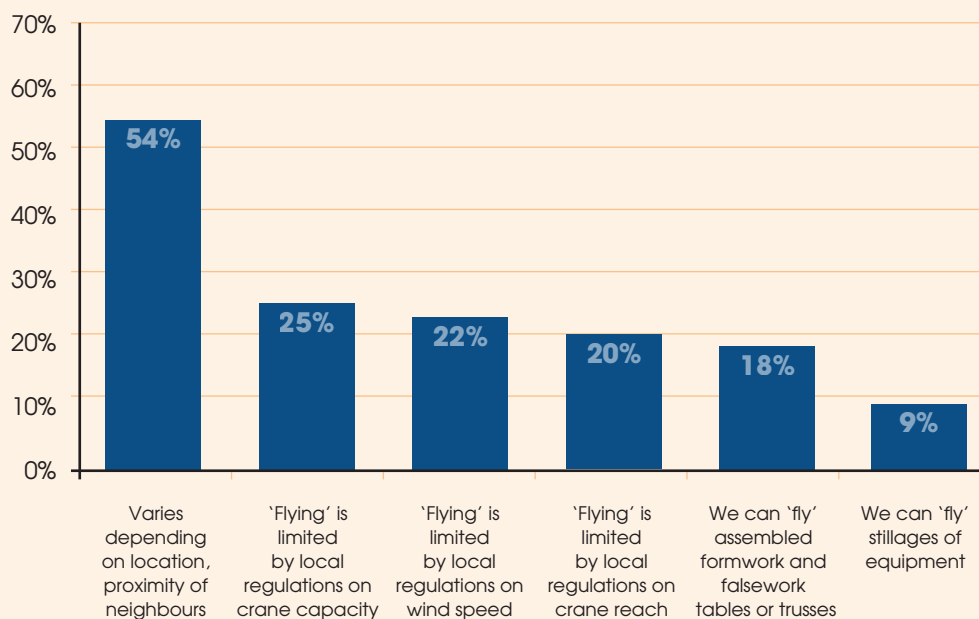
Almost 55% of respondents said regulations and limitations varied from site to site, and there was unanimity that this was the case wherever you are in the world.

Are there specific limitations relating to crane capacity, wind speed or crane reach? Yes, of course, with regulations governing all these things in operation in most markets. Wind speed was highlighted in particular by respondents in Europe and the Middle East and Africa, while crane capacity is also an obvious factor wherever you are operating.

The overwhelming finding, however, is that what limits the ability to fly equipment relates to specific site conditions.

GRAPH 10

#### Crane regulations on 'flying' of equipment differ worldwide. What is the situation in your market? (tick all that apply)





## 4. CONSTRUCTION METHODS

### 1. MOST POPULAR CONSTRUCTION METHOD FOR HIGH-RISE CORES?

Quite apart from regional preferences, there are good reasons for using different methods of construction for high-rise cores. For example, very high buildings will require crane usage, while cranes become more problematic for clusters of lower height buildings.

The choice of formwork also has an impact on the finished product. Slip forming – although typically the quickest method – is not always the best solution if the quality of concrete finish is important.

This makes it interesting that the survey highlights the popularity of slip forming and accentuates the need for knowledge to be spread about other methods. As RMD Kwikform's Simon Dowd puts it, "quicker isn't always the right option."

When it comes to basement construction and temporary shoring methods, basement construction remains an important element of high-rise projects and that there is a trend for basements to get deeper. The depth, as well as the length of time that shoring is required, all play into the decision over the choice of solution.

Groundworks remain a key area where health and safety is paramount. The use of structural steel is still popular in South America and Asia Pacific, which highlights areas where knowledge transfer regarding alternative, dedicated ground shoring techniques would be beneficial.

It is clear from the survey that contractors favour specialist contractors to do this work – it is a specialist area after all – and it is relatively rare for a general contractor to use its own ground shoring systems.



The choice of formwork

has an impact on the finished product. Slip forming – although typically the quickest method – is not always the best solution if the quality of concrete finish is important.”

## 4. CONSTRUCTION METHODS

### DETAILED RESULTS

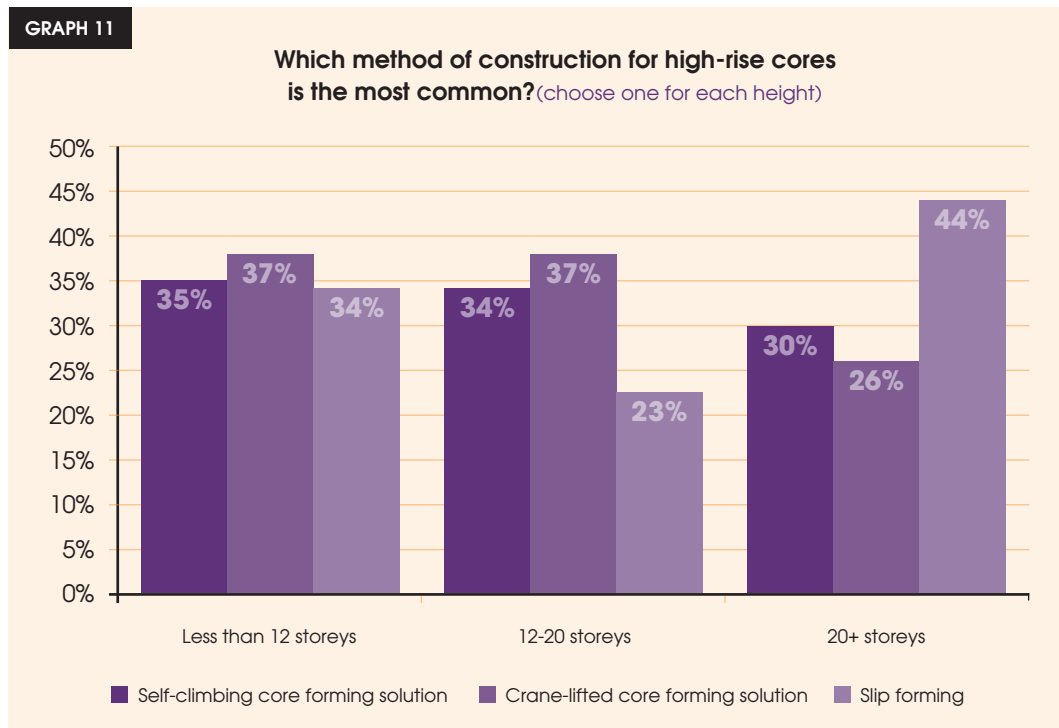
For building under 12 storeys there is an almost equal split between the three prime core construction techniques: self-climbing core forming, crane-lifted core forming and slip forming.

However, the higher the building gets, the more there are differences in the favoured technology. For buildings in the 12 to 20 storey category slip forming becomes a significantly less popular method, with crane lifting the most popular, followed closely by self-climbing core forming.

Move into the 20 storey and above heights, though, and there is a major shift to slip forming, which is the favoured technology for almost 45% of all respondents. That compares to closer to 30% for both the other techniques.

### TYPE OF COMPANY

A notable difference between contractors and consultants concerned crane lifted core forming, where contractors were less likely to cite this as an option for very high buildings (+20 storeys) than were consultants.



## 4. CONSTRUCTION METHODS

### REGIONAL DIFFERENCES

Is there a geographical element to this? Yes, and there are pronounced differences. In Europe, for example, with +20 storey buildings crane lifting is a seldom used technique, with self-climbing formwork the favoured solution, followed closely by slip forming.

Generally, there is a trend showing the greatest regional variation in techniques when buildings are in the +20-storey category. The sample sizes at these heights are smaller – there are fewer respondents working on projects of this size – but slip forming and self-climbing core forming would appear to be the most popular methods.

At lower height buildings in Europe, there is a more even split between the three techniques, with an exception being in the 12-20 storey category, where self-climbing core forming being a significantly less popular solution.

This contrasts with the Middle East and North Africa (MENA), where slip forming is by a large margin the most popular method for +20 storey buildings.

Other significant regional departures from the norm include in Asia Pacific, where self-climbing core forming is easily the most popular method for +20 storey buildings.

In North America crane lifted core forming and slip forming were the most popular core construction methods for under 12 storey projects, while self-climbing core formwork was the dominant solution for mid-height buildings from 12 to 20 stories. For the +20 storey buildings, the three methods of construction were equally popular.

 **Building methods, and the right temporary works solution, will vary depending on the project and its requirements. A 50-storey building serviced by a crane can have very different requirements and drivers to, say, a complex of five mid-rise structures where crane coverage is not viable across the entire site.”**

SIMON DOWD  
Major Projects Manager,  
RMD Kwikform

## 4. CONSTRUCTION METHODS

### 2. IMPORTANCE OF BASEMENTS IN HIGH-RISE CONSTRUCTION?

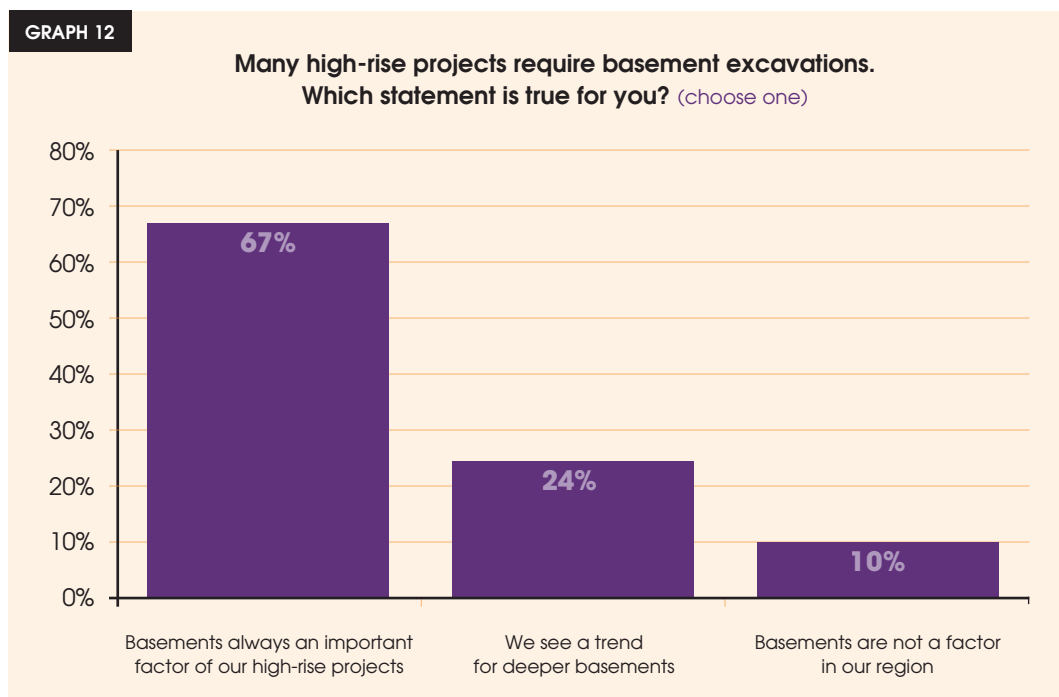
A large majority of respondents (67%) said that basements have always been an important factor in high-rise construction.

The trend towards deeper basements was highlighted by 24% of all respondents – a significant proportion – while those stating that basements were not an important factor in their high-rise projects numbered less than 10%.

#### REGIONAL DIFFERENCES

More than any other region it is European contractors who are facing a shift towards deeper basements – that was chosen by 36% of respondents. It was considered less of a trend in North and South America, and respondents from these regions were also the most likely to state that basements were not an issue in high-rise jobs, although that was still a small proportion at around 17% for both.

Extensive basement excavations in high-rise construction is very common, with a clear trend towards deeper basements particularly in Europe.



## 4. CONSTRUCTION METHODS



### TYPE OF COMPANY

It is worth noting that there was complete agreement between consultants and contractors on this question.

### 3. SHORING SYSTEMS FOR BASEMENT CONSTRUCTION

Respondents were given five possible methods of shoring basement excavations and were able to choose all that they had used.

The top two technical options both involve the use of specialist sub-contractors. The most popular solution is to leave it to specialist groundworks contractors using ground shoring systems, which was ticked by 44% of respondents. That was followed by specialist contractors using structural steel shoring solutions.

The results show that it is least common for contractors to use their own ground shoring systems: they are far more likely to hire in the systems they need or use structural steel to reinforce basement excavations.

The survey did not ask about the use of load monitoring equipment, but as basements increase in depth, this will become more of an issue, as Simon Dowd, Major Projects Manager, RMD Kwikform, says; "The deeper an excavation, it is advisable to consider load monitoring and other ground shoring technologies to analyse the ground, and the strength and weight of the equipment."



On the  
face of it

**the longer a job lasts the more economical structural steel solutions become. However, aspects such as recovery rates, environmental concerns, and hybrid solutions, can have a big impact on the choice. Early engagement with a specialist ground shoring provider can often create surprising savings."**

SIMON DOWD  
Major Projects Manager,  
RMD Kwikform

## 4. CONSTRUCTION METHODS

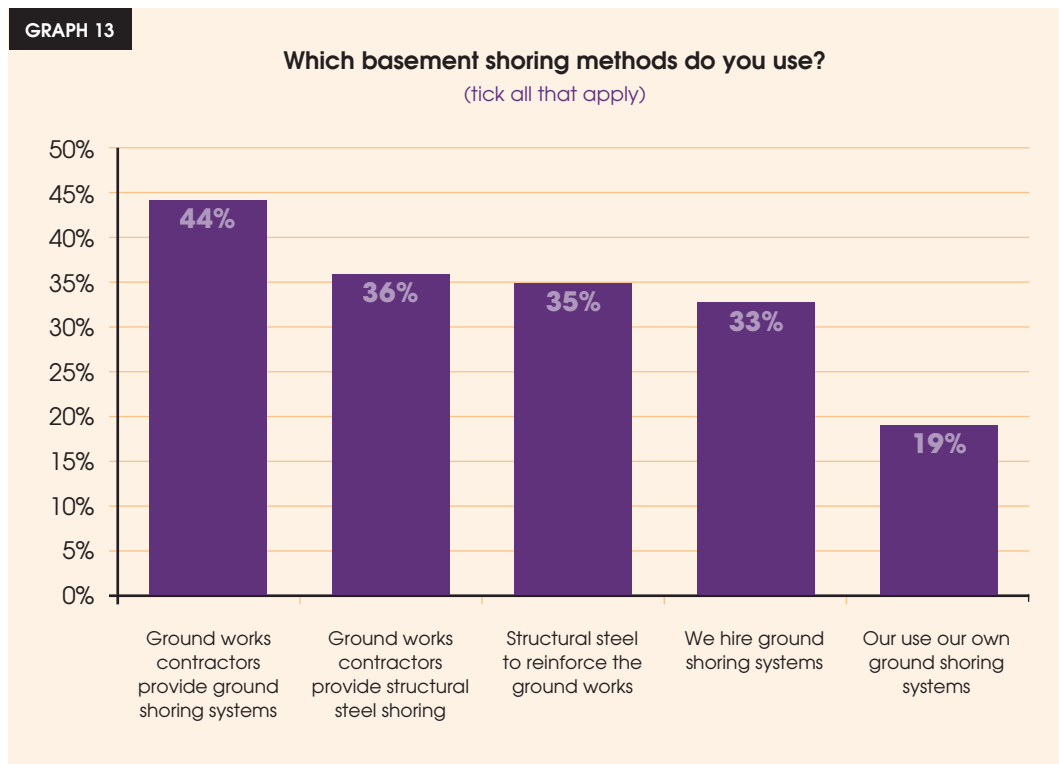
### REGIONAL DIFFERENCES

There is quite strong agreement between respondents in different parts of the world. Owning your own shoring systems seems to be relatively uncommon wherever you are.

What about reliance on specialist sub-contractors? It's common everywhere, although in South America the sub-contractors seem to favour shoring systems over structural steel.

Rental or hiring of shoring systems is accepted pretty much everywhere, although is most popular in North America. One reason for this is that some of the biggest rental companies in the world operate in the USA and these sometimes offer specialist shoring services. That means the rental option is highly visible and easily available.

Structural steel as a method of basement shoring is most popular in South America and Asia Pacific, with at least half of respondents in these regions citing this as a technology they use.



## 5.

## CALLS TO ACTION

**The survey findings suggest several issues that formwork and falsework suppliers, contractors and consultants might consider as areas for further action or emphasis. These include:**

- Contractors are looking for methods of high-rise construction that increase labour productivity and reduce labour requirements. This key finding should be borne in mind by designers and suppliers of temporary works systems.
- In terms of formwork and falsework systems, the priority needs to be given to developing systems that reduce demands on labour for assembly and dismantling, followed by systems that can be erected easily.
- Spending on temporary works is a major expense for contractors. In the survey, respondents reported that typically 5-7% of annual revenues was spent on formwork and falsework – a significant sum. This highlights the importance of these products and the need to make properly considered design choices.
- Given the impact that formwork and falsework can have in both productivity and safety, contractors should include discussions with specialists – both internal and external – as early as possible in the design process.
- The fact that ‘individuals taking responsibility’ was the highest rated action to improve safety on sites suggests that some contractors are unwilling to acknowledge their own leading role in promoting and delivering a safe working environment. This key role needs to be continually reinforced.
- Contractors say that price is not the key influencer – not even in the top three factors – when they are sourcing formwork and falsework. This should embolden suppliers of this technology to view themselves as product experts and solution providers, rather than suppliers of a ‘commodified’, off-the-shelf product.
- The acceptance of the benefits of multi-level safety screens in certain markets points to a need for education and knowledge-building throughout the construction industry.
- The continued reliance on slip form methods to construct high-rise cores reinforces the view that speed is all-important. This finding points to the need for education on other core construction methods that can produce higher quality concrete finishes.
- Structural steel is still a valued method of basement construction, despite the availability of dedicated excavation shoring systems. While structural still has a place in the market, there is a need for more knowledge sharing on alternative methods.

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