

REACHING BEYOND

The innovations driving the next wave of high rise

Burj Khalifa, Dubai, UAE

Architect: Adrian Smith



Architects have made astonishing progress since the first skyscrapers emerged in the late 19th century. Cast a glance across the global skyline and it is clear that a new wave of gleaming towers will soon define the cities of the future, taking incredible design and extraordinary scale to new heights. The tallest of them all is the soon-to-be completed Jeddah Tower in Jeddah, Saudi Arabia, which will soar a kilometre into the heavens to steal the crown of Dubai's Burj Khalifa by 180m (591ft).

The achievements this, and other planned high rise towers represents are significant. But there is much more to come. Even the Jeddah Tower was scaled back from the original ambition of creating the world's first mile-high structure.

How long before an architect tables a vision that becomes the first to pass this milestone?

High rise structures have always pushed against the boundaries of what's considered possible, and as material and technological innovations emerge, architects will need to take advantage of every tool at their disposal to break through existing barriers.

So, what are the challenges the new wave of high rise poses? And more importantly, how are architects responding with innovative solutions that will lay the groundwork for the skyscrapers of the future?



20 Fenchurch Street, London, UK
Architect: Rafael Viñoly

DIGITAL MODELLING AND VIRTUAL REALITY

STANDING OUT WHILE BLENDING IN

More than ever before, architects need to consider the impact of their designs on the environment around them. No one can quite forget how Rafael Vinoly's Walkie Talkie skyscraper in London's 20 Fenchurch Street was dubbed the 'Walkie Scorchie' after the curvaceous façade of the building reflected sunlight in a beam so hot it damaged cars parked on the street below.

Since then, digital modelling tools have advanced, enabling architects to accurately predict how a building will behave in certain weather conditions and in particular light. Companies such as VU.CITY use game engine technology to enable users to import their own 3D model to immediately place their proposals in context and test their visual impact, scale and massing.

Gordon Ingram, Managing Director at the company, says that he has had success in the past with mapping daylight levels, privacy, outlook and air pollution. "We've created an app for particular schemes which allows us to study the local environment and affect planning decisions," he says.

But architects also need to be mindful of the broader effects of a building within a community.

The ability to attract and include the public can be crucial if a building is to be seen as a benefit to the area, and as a result architects are placing a premium on public spaces in future projects. →

→ The Tulip, the Foster + Partners London skyscraper which won approval in March 2019, is a perfect example with the architects putting public experiences – including a rooftop terrace, 360 degree views, internal glass slides and gondola pod rides on the building's façade – right at its heart.¹

To help stakeholders experience what their buildings will eventually look like, architects are using virtual reality software to take their clients there without ever having to leave the office.

Companies such as IrisVR work with architects' existing 3D files in programmes such as SketchUp, Revit, Rhino, Grasshopper, and OBJ to create immersive virtual reality walkthroughs. But there's still plenty of room for the technique to grow as clients become more aware of the benefits it can offer.

Myles Taylor, director at Squire & Partners – which is leading on the Landmark Pinnacle residential tower in London – says that take-up for virtual reality among clients has been slow and the technique is still an emerging tool.

"We have used it for clients to show what amenities are available," says Taylor. "But its use isn't widespread yet."

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GORDON INGRAM
Managing Director, VU.CITY

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8 Spruce Street, New York, US
Architect: Frank Gehry

SUSTAINABLE MATERIAL INNOVATIONS

MAKING THE RIGHT KIND OF IMPACT

Architects have obligations to a variety of public and political sensitivities when building tall towers – and perhaps one of the most important of these is the need to design high-rise developments to be more sustainable and energy efficient.

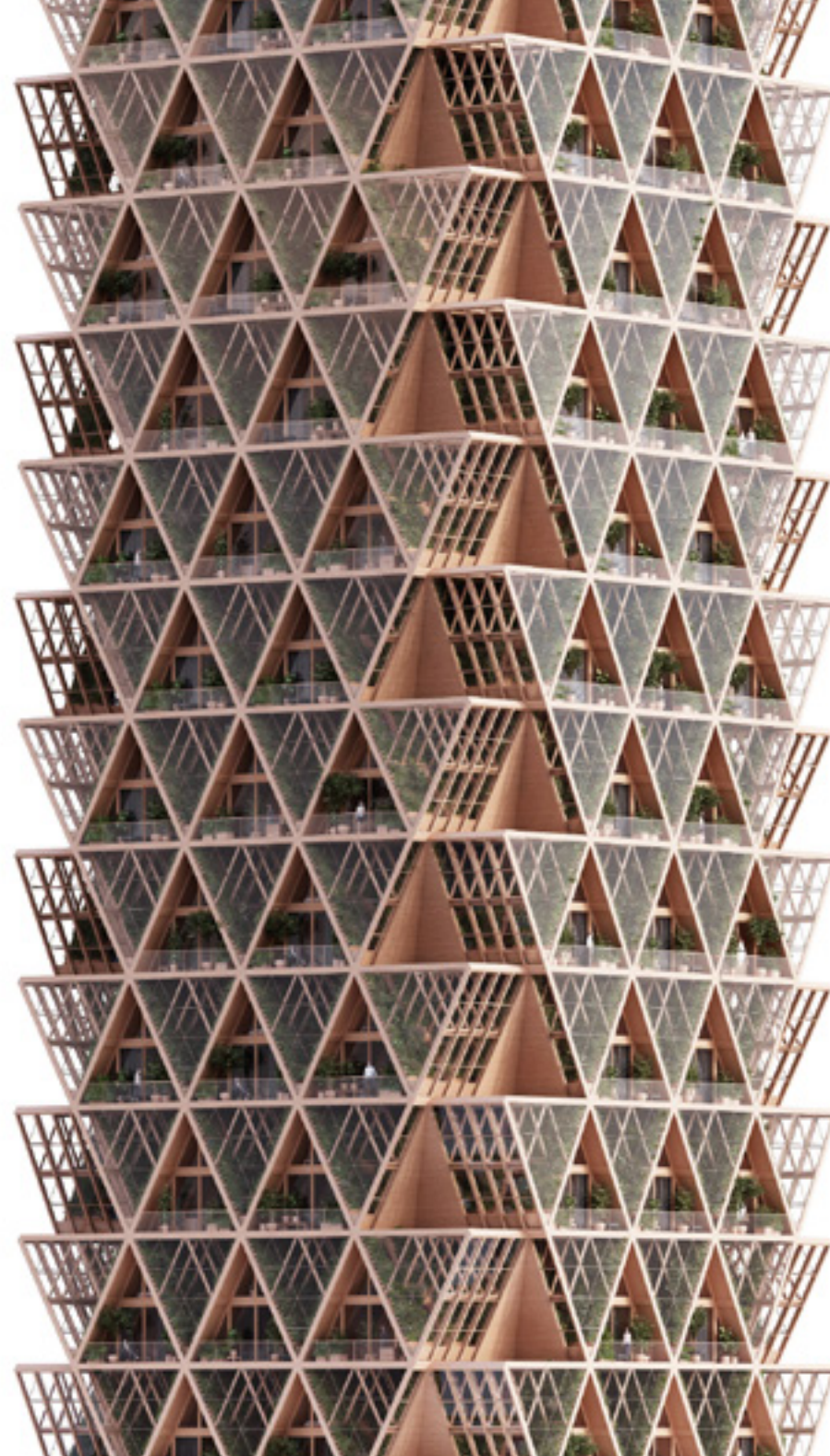
Skyscrapers are already eschewing the inefficiencies of the past, but the architectural challenge has moved towards ensuring that new towers are positive forces for the environment.

One way this is being addressed is with innovations in materials and, as the world becomes increasingly aware of the high volume of CO₂ emissions associated with concrete production,² architects are looking to other options. Andrew Waugh, of Waugh Thistleton Architects, is an advocate of using cross-laminated timber to create buildings which are as good for the environment as they are attractive. →

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CONCRETE WITHIN A
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ANDREW WAUGH

Founding Partner,
Waugh Thistleton Architects



The Farmhouse (concept)
Architect: Chris Precht,
Fei Tang Precht

→ “I think timber and replenishable materials will completely replace concrete within a generation,” he says.

In March 2019, Mjøstårnet in Brumunddal, Norway, was verified as the world’s tallest timber building. The 18-storey mixed-use building, which was designed by Voll Arkitekter, contains apartments, a hotel, swimming pool, office space, and a restaurant.

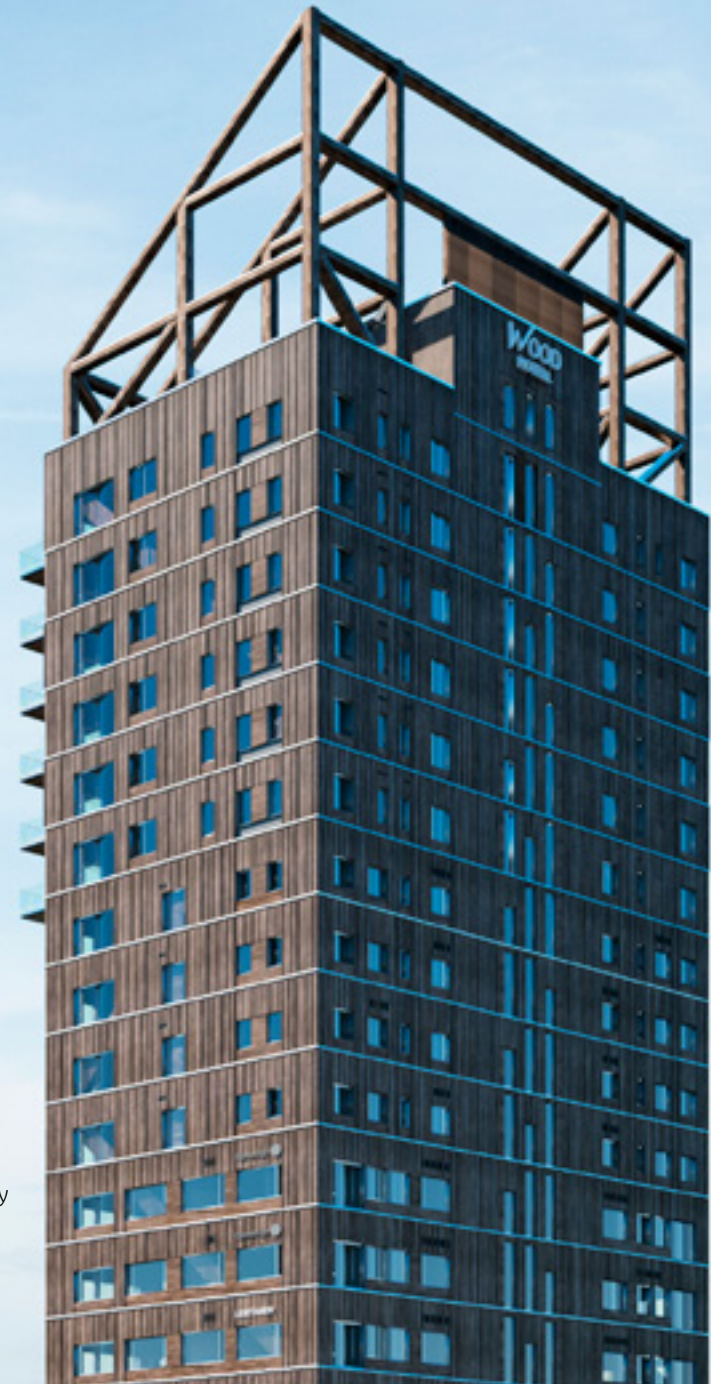
But timber is unpredictable. It can change shape, adding time, and therefore cost, to the design process. As a result, architects have begun using 3D scanning technology to get better insights about the material and how it might change during the build.

And as architects look to future projects, ‘fifth generation’ skyscrapers – which aim to be carbon neutral – will use a range of innovations such as renewable energy generation and solar shading, says David Nicholson-Cole, Assistant Professor in Architecture at the UK’s University of Nottingham.³

New proposals are already taking environmental ambitions to the next level.

One example is The Sky Mile tower in Tokyo. A conceptual design being pitched at a 2045 opening by architects Kohn Pedersen Fox, it would be situated at the heart of a 12.5km square eco-district partly built on reclaimed land in the Tokyo Bay.⁴ If approved, the tower will feature an articulated façade that will enable water to be collected from cloud harvesting. Wastewater will be recycled, and an anaerobic digester will manage the organic waste and generate natural gas.

Mjøstårnet, Brumunddal, Norway
Architect: Voll Arkitekter



BIM AND OFF-SITE CONSTRUCTION

BUILDING BIG FROM SMALL

In densely populated cities, the constraints architects are facing due to the land that is available to develop are getting more severe.

In some instances, what's most challenging are the practicalities around building a huge structure on plot of land where there is little extra space other than upwards.

Squire & Partner's Taylor explains that on the 239m Landmark Pinnacle in London, many of the components were made off-site. Building Information Modelling (BIM) was used to plan and control the detail of the manufacturing processes that would be used.

The same approach was pioneered on the Shard, Renzo Piano's 310m tower which had its iconic spire pre-assembled off-site before it was erected high above the constrained position on top of one of London's busiest stations.



*"IN THESE DENSE CITIES LIKE CHONGQING THERE'S
NO ROOM FOR BIG PUBLIC PARKS [ON THE GROUND],
SO WE HAVE TO LIFT THEM INTO THE SKY"*

MOSHE SAFDIE
Principal, Safdie Architects



The Shard, London, UK
Architect: Renzo Piano

DIGITAL SIMULATION AND 3D ZONING

REDRAWING BOUNDARIES

Architects also face challenges where the plots of land available just aren't big enough to build the kind of tall buildings that would have been considered in the past.

The trend for slender skyscrapers is one of the ways this land scarcity is being addressed, but these skinny towers can pose challenges. Defying the power of the wind is one of the biggest. The more slender a building, the more likely it is to sway in high winds. The only way to safely design past this is to look to advances in modelling techniques to find new ways to make buildings more aerodynamically effective.

"Digital simulation using computational fluid dynamics (CFD) can simulate the effect of worst-case and general wind load on built structures," Andrew Watts, CEO at building engineering specialist Newtecnic, told Engineering & Technology.⁵ "We use it to avoid turbulence around the structure, and to break up eddies – both of which produce noise and stress to building components."

But skinny skyscrapers are not the only solution to the challenges of high-density land use. Another option is to make more use of the air above. The Raffles City Chongqing project in China, which is expected to open in late-2019, incorporates a 42nd floor 'horizontal skyscraper' that is 300m in length and spans four of the development's eight towers.

"In these dense cities like Chongqing there's no room for big public parks [on the ground], so we have to lift them into the sky," Moshe Safdie, the architect heading the project, told The Guardian.⁶ "I see a period in which zoning changes to being more three-dimensional. Rather than just thinking of land as two-dimensional, zoning will start requiring people to connect between one property and another – first at ground level, then above ground."



PRINTING SOLUTIONS AND DIGITAL COLLABORATION

OPTIMISING PERFORMANCE

There is understandable excitement as we head towards the third decade of a century that has already seen some of the most astonishing high-rise constructions ever designed.

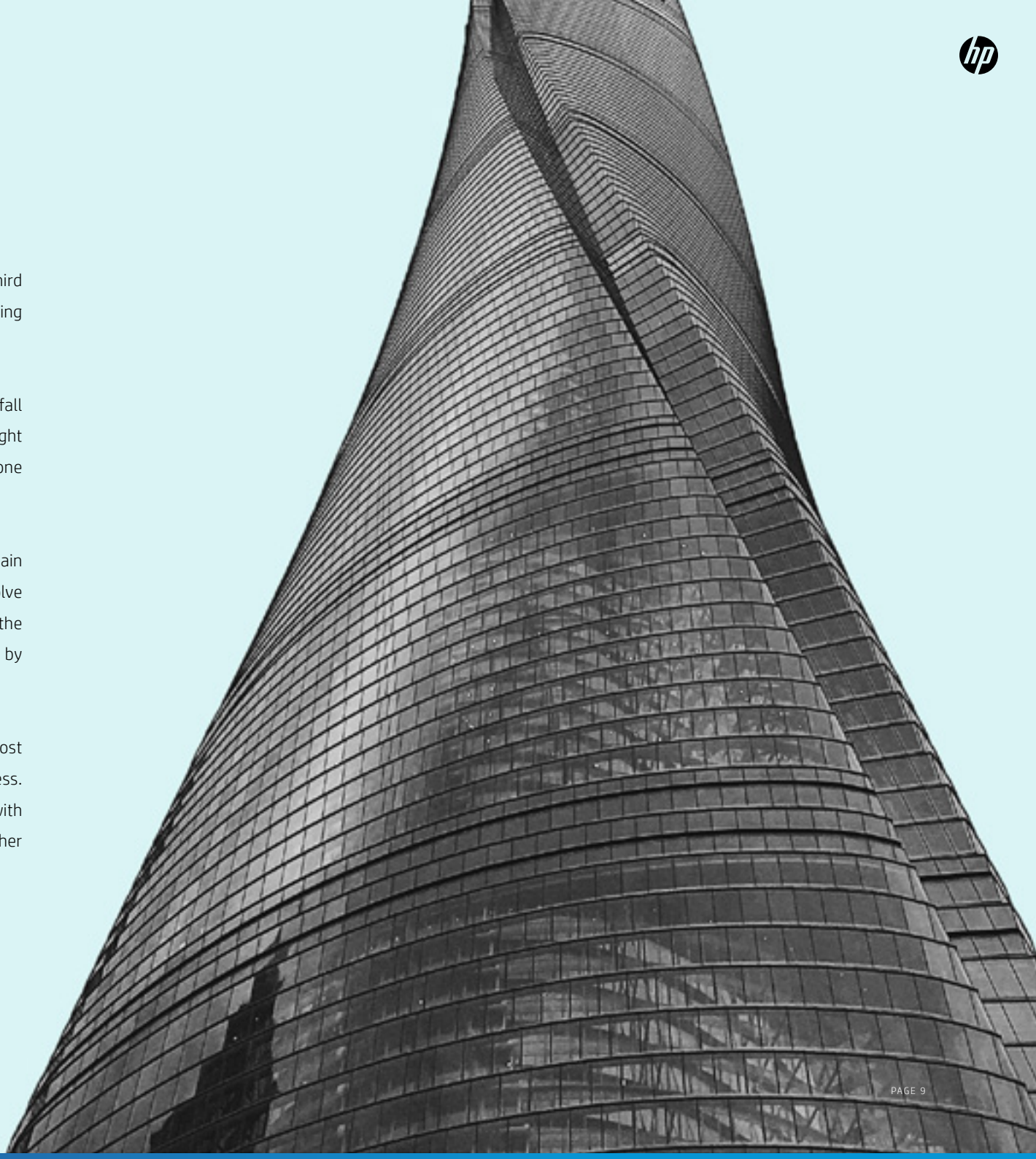
But the most aspirational visions for how we can reach further will fall short if they are not supported by advances in the way they are brought to life. It is often the day-to-day practicalities of getting the work done that can make all the difference to the success of a project.

Just as the construction industry is having to find ways to maintain efficient processes at high altitudes, architects are having to solve problems more quickly and adapt to fast iteration cycles in which the digital and physical often intersect. This is made even more difficult by teams often being based in different countries.

As a result, there is mounting pressure to optimise workflows, boost productivity and increase efficiency at every stage of the design process. A new generation of HP large-format printers has been designed with this in mind, helping to smooth the process for teams working together right through a project from ideation to inauguration. →

Shanghai Tower, Shanghai, China

Architect: Jun Xia



→ First of all, the printers offer high quality prints to successfully sell in proposals to prospective clients. Whether initial sketches or more detailed CADs, HP's large-format technology is enabling firms to push print quality and line accuracy further so they can present work with confidence, while also being able to control costs.

The large-format printers are also robust enough to be used on-site, making it easier to deliver updated designs for construction teams and engineers to work from. This is making the process of adapting and quickly sharing CAD files and other designs much easier, increasing the potential to significantly reduce errors and improve production speeds.

But perhaps one of the biggest challenges facing the profession is improving collaboration. Working together efficiently is essential for architects looking to save time and money, minimise costly errors and deliver projects to deadline.

While many architects are exploring new software to improve their digital collaboration with other firms and disciplines, there is also a need to look at enabling better collaboration at team level. HP's large-format multifunction printers (MFPs) are playing a key role in facilitating this, enabling more effective collaboration by integrating seamlessly into everyday tasks.

The MFPs enable each team member to work on design iterations, scan in changes and share quickly among the wider group. The flexibility to operate alongside modern working lives is built in too, with designers and engineers able to scan, print, copy and share to drive quick decisions and fast results.

[See how HP large-format printers can improve workflows and drive effective collaboration for your business:](#)

[FIND OUT MORE](#)



EXTERNAL SOURCES

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6. <https://www.theguardian.com/cities/2018/jun/04/is-chongqing-china-horizontal-skyscraper-the-answer-to-overcrowded-cities-raffles>

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