

# Reengineering elevators could transform 21st-century cities

By [Antony Wood](#) and [Dario Trabucco](#)

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In the 160 or so years since the first skyscrapers were built, technological innovations of many kinds have allowed us to build them to reach astonishing heights. Today, there is a [1,000-metre \(167-storey\) building](#) under construction in Jeddah, Saudi Arabia. Even [taller buildings are possible](#) with [today's structural technology](#).



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But people still don't really live in skyscrapers the way futurists had envisioned, for one reason: elevators go only up and down. In the *Harry Potter* movies, *Charlie and the Chocolate Factory* and others, we see cableless boxes that can travel not just vertically but horizontally and even diagonally. Today, that future might be closer than ever. A new system invented and being tested by German elevator producer [ThyssenKrupp](#) would [get rid of cables altogether](#) and build elevators more like magnetic levitation trains, which are common in Japan and China.

Our work at the non-profit [Council on Tall Buildings and Urban Habitat](#) studies how tall buildings can better interact with their urban environments. One aspect is a look at how buildings might work [in a world of ropeless elevators](#). We imagine that people might live, say, on the 50th floor of a tall building and only rarely have to go all the way down to street level. Instead,

they might go sideways to the next tower over, or to the bridge between them, for a swim, a trip to the doctor or the grocery store.

This research project, set to conclude in September 2018, will explore as many of the practical implications of ropeless elevator travel as possible. But we already know that thinking of elevators the way ThyssenKrupp suggests could revolutionise the construction and use of tall buildings. Builders could create structures that are both far taller and far wider than current skyscrapers – and people could move through them much more easily than we do in cities today.

## It's hard to get high

Very few buildings are [taller than 500 metres](#) because of the limitations of those everyday devices that make high-rise buildings practical in the first place – elevators. Traditional, steel-rope-hung elevators can travel only [around 500 metres](#) before the weight of the rope itself makes it inconvenient. That takes more and more energy and space – which all costs developers money.



A wide-angle view of an elevator machine room shows the large spool of rope and the ropes. [Dennis van Zullekom](#) CC BY-SA

Replacing steel ropes with carbon fiber ones can save energy and space. But even so, people who want to go to the uppermost floors from the lowest floors don't want to wait for the elevator to stop at the dozens of floors in between. That means developers need to [make room in their buildings](#) for multiple shafts, for express and local elevators, and for “[sky lobbies](#)” where people can switch between them. All of that space devoted to vertical transportation reduces the amount of rentable space on each floor, which makes the economics of the building more difficult the higher it gets.

## Travelling in three dimensions

A [new elevator system](#) uses [electric linear induction motors](#) – the same kind of contactless energy transfer that powers [magnetic levitation trains](#) – instead of cables to move elevator cars around. This also lets them move independently of each other in a shaft, which in turn means multiple cabins can be working in one shaft at the same time. That reduces the need for parallel shafts serving different floors and frees up more real estate for commercial use. And there's no inherent limit to

how far they can travel.

Even more exciting is that these cabins can travel horizontally, and potentially even diagonally: the motors pivot to follow the powered track, while the floor of the cabin remains level. That opens up a whole world of possibilities. Without the ropes, it is also feasible to reduce the number of shafts a building requires, by allowing more cars to travel in one single shaft. It also becomes feasible to build massive building complexes interconnected by motorised vehicles operating high above the ground.

The difference between an elevator and a car, or even a train, becomes less clear – as does the difference between a building, a bridge and an entire city. Instead of descending from your 50th-floor apartment to the street in an elevator, then taking a taxi or the subway to another building across town, and going back up to the 50th floor, you might instead have a door-to-door ride between buildings, at height, in a single vehicle.



Without ropes, cars can move horizontally and share shafts and passageways through buildings. [ThyssenKrupp](#), [CC BY-ND](#)

## Creating the cities of the future

Is the world actually ready for this? Probably not right away. In the short term, we can expect to see systems like carbon-fiber-ropeless and ropeless elevators used in some of the very tallest, most high-profile (and expensive) buildings. Many of these structures house spaces used for [many different purposes](#) – residences, restaurants, retail stores, offices, cinemas and even sports. The people who live in, work in or visit those buildings have a wide range of destinations – they might want to stop at a shop to pick up something before going to a friend's apartment for dinner before heading to a movie. And so they need options for travelling within the building.

At the moment, these systems are far more expensive than the conventional alternatives. Building owners won't use them until they can save – or earn – lots more money by building systems like this. But as we've seen with computers and many other forms of technology, the [cost goes down rapidly](#) as more people buy the systems, and as research advances improve them.

There are probably physical constraints and efficiency limits on how many elevator cars could share a particular complex of shafts and passageways. And structural engineers might need to analyse what supports and reinforcements are needed to move people and machinery throughout large buildings. But the tall building industry has no standard data or recommendations to guide designers today. That's what we're trying to develop.

The technology is arriving – and with them the certainty that the old ways of travelling through a building are about to change more substantially than ever before.

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