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The TopDownWay: An Innovative System for Skyscrapers' Controlled Demolition

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The future calls for vertical cities, which will inevitably get rid of what no longer works, is not tall enough or is no longer efficient. Despe has created TopDownWay®, a solution that demolishes what's old, to make space for what's new. The intelligent system enables the controlled demolition of skyscrapers of any shape and size. It is an innovative solution that prioritizes safety and guarantees no impact on the environment because it contains all demolition byproducts (debris, noise, dust, vibrations) by completely enclosing the skyscraper. TopDownWay is a useful tool for renovating both the cities of today and those of tomorrow.

Founded in 1975, DESPE is an Italian company specializing in engineered demolition work and, in particular, complex and high-risk operations. The company's headquarters is in Bergamo, located 50 kilometers from Milan, but it carries out demolition projects throughout Italy, across Europe and soon, the United States.

The company is a family business and in 2015, celebrated its 40th year of activity operating in the following fields: nuclear and oil station decommissioning and decontamination services, demolition of power plants, industrial plants, historical monuments and sporting facilities, infrastructures, including: the demolition of underground structures, waterways and emergency operations in case of natural catastrophes, and real estate. The company is a member of the EDA: European Demolition Association.

TopDownWay is a demolition method that can bring numerous advantages to the real estate market, enabling the development of the "City of Tomorrow." Why? Because it brings a new, innovative, safe and green solution for the demolition of skyscrapers.

Unlike Europe, America has no lack of space, but in big cities or metropolises we all have the same needs; to increase or improve the supply of housing in a specific area.

We cannot increase the available space at ground level, so we have to concentrate on vertical growth. Prime locations are scarce

Opposite: The old Tour UAP, France (left), which was demolished with TopDownWay, and the new Tour Incity (right), built in its place. Source: Despe Spa

Right: The top-down demolition of Tour UAP, France. Source: Despe Spa

in cities such as New York City, and developers need to maximize their investments, as property values continue to rise in such areas.

There are 100-meter high-rise buildings that could go to 200 meters, and there are 200-meter high-rise buildings that are out of use because they are no longer efficient. There is always the option of a complete refurbishment of the existing building; gutting the interiors, and stripping and replacing the exterior, but such works are of course quite expensive, and the result is a "new looking" building, but with exactly the same amount of available space, therefore not taking advantage of the possibility to actually increase the square footage, and improve the layout to adapt it to modern times. The need for both approaches is linked. We must construct vertical cities in prime locations and get rid of what is out of function.

The Solution

In 2012, a large French group decided to demolish the UAP Tower, a 100-meter skyscraper in the business center of Lyon, in order to build a taller one, taking advantage of the existing nearby amenities, such as a metro stop and shopping mall, that this prime location offers. In this example, an old building had to be removed and a new skyscraper had to be built. Despe asked "How could this be done in the safest and fastest way?"

The building was five meters away from a big shopping center, therefore using explosives was ruled out for many reasons. The contractor's requirements were to work in total safety, as fast as possible to limit the disruption, and without any dust, noise, vibration and disturbance in the district.

Despe faced the challenge with this question: instead of looking at existing solutions, for example, the use of conventional scaffolding as a containment system for demolition debris, that we all knew had a host of possible problems, why not look for new ones? Moreover, scaffoldings were not created for this specific purpose and wouldn't perform safely and efficiently during deconstruction and wouldn't meet the contractor's requirements.

Working on this project, it took six months to come up with and invent a solution. The result is a safe, economical, green, and controlled system for high-rise demolition.

Safety

When a skyscraper has to be demolished in the heart of a city, close to many other buildings containing millions of people and commercial activities, safety is essential. This solution is 100% safe because it is a completely sealed containment system.

Everything produced during demolition stays inside the system and there isn't any waste, dust or noise outside the structure. There is no space between the skyscraper and the platform, they adhere perfectly and nothing can filter outside. This solution protects the exterior from the interior, but also the interior from the exterior; the operators work in safe conditions even when they are located at great heights.

Despite the perceived risk of demolishing tall buildings in the middle of a city, this system greatly eliminates such risks, making it a viable option in such cases. In France, as confirmed by City Council representatives, the UAP Tower "disappeared quietly" in less than 4 months. Out of the client, City Council, the community, and the shop center: no one complained about the demolition.

Time Savings

In every real estate project, time is money. If you are working in a big city like New York, its means a lot of money. With this solution, installation and demolition times are faster.

The system is quickly assembled directly on the top of the building in only 20 days. It operates on three floors at a time; while demolition work is carried out on the top, other demolition activities are taking place on the others two floors, such as: removing building façades and windows containing asbestos. This system saves more time and allows crews to work faster.

Indeed, the workforce, even though operating at great heights, is completely protected by the platform, ensuring their safety. The feeling of trust creates increased efficiency, and demolition therefore proceeds faster.

In France for example, the use of this solution enabled the builder to save six months of time. If you do the numbers related to the cost savings of a six-month financial burden, you get a number that greatly justifies using this technology.

Zero Environmental Impact

This solution ensures that there is no impact on the environment or the surrounding buildings. That means 100% protection from debris, dust, noise, vaporized water and vibrations.

In Lyon, for example, the levels of noise, dust and vibration were monitored throughout the demolition phases by 15 sensors. The results were excellent and never once exceeded the allowable values imposed by the Prefecture regulations of the city.

These reports were examined and approved by the contractor. The demolition materials were all easily recovered and sent to recycling plants, achieving a total recycling rate for

Opposite: The interior of the TopDownWay system, closely adhering to Tour UAP, France. Source: Despe Spa

Bottom: The interior of the TopDownWay system, closely adhering to Tour UAP, France. Source: Despe Spa

"When a skyscraper has to be demolished in the heart of a city, close to many other buildings containing millions of people and commercial activities, safety is essential. This solution is 100% safe because it is a completely sealed containment system. Everything produced during demolition stays inside the system and there isn't any waste, dust or noise outside the structure."

all worksite substances of over 95%. These results highlight the outstanding environmental impact reductions that this solution is able to guarantee.

Image

Being pioneers captures a fascination that produces more than just objective benefits. Undertaking a successful new solution is both immensely satisfying and great for the company image. The first time this solution appeared on the top of a skyscraper, a lot of people wondered what it was, newspapers were talking about it, and traces of the new system appeared in many photographs.

How It Works

TopDownWay is an exclusive trademark protected by copyright and international patent. It has acquired CE certification and had passed all safety and compliance tests.

The system is a self-descending grid structure made of steel. It works according to hydraulic principles and is controlled by an automatic system that monitors movement and ensures safety. All parts of the machine are assembled on the ground: the orange-colored load-bearing parts, which are mounted directly on top of the skyscraper; and the bridge modules, which are suspended from white and red load-bearing components. The system is assembled in 20 days and it is immediately operational. It is a modular and flexible machine as its shape and height can be adapted to any high-rise building.

This system enables you to work simultaneously on all three of the floors that it occupies. As the works proceeds, the platform descends in a controlled manner, through the use of hydraulic jacks, and positions itself on the next floor down. The skyscraper is demolished floor by floor until ground level is reached.

Case Study: Twin Tower Demolition in Glasgow

A recent project in Glasgow involved the controlled demolition of two towers located at 109 Bluevale Street and 51 Whitevale Street using this solution. The project was awarded to Safedem Ltd, a local demolition company specializing in explosives, which in turn established a relationship with Despe to use this system, as the implosion alternative was disallowed.

The two buildings are located in the area known as "The Gallowgate" within Glasgow's East End. The surrounding areas are predominantly residential and commercial, with a small number of industrial areas. Residential properties are located north of the site. There are four-story-high residential buildings surrounding the towers, which will remain after the demolition is complete.

The 31-story towers were constructed in 1968 and both reach a height of 90 meters. The plan size of each block is 21.25 m x 19.50 m.

Included within the scope of this work is the demolition of both tower blocks excluding the removal of the existing foundations and landscaping upon completion.

Before choosing this solution, several other options were carefully considered but later deemed unsuitable for this project.

Four main factors of this particular site were taken into consideration as part of the analysis:

- The stability cores present within the buildings
- The foundations used in the towers
- The proximity of the towers to each other, to neighboring properties and to domestic properties that have been constructed since the time of the original tender bid
- The proximity of Network Rail assets

Stability Cores

The buildings employ a central stability core to achieve lateral stability against wind loading. The cores, compared to the floor plate, are significant on these blocks. Calculations show that the stability core occupies about 40% of the area, which is a significant percentage if you compare this with Rosemount Street, for example, where the cores took up an area equivalent to only about 12%.

Opposite: The system being installed on top of the building. Source: Despe Spa

Bottom: Crew working safely within the system. Source: Despe Spa

The walls forming the stability cores are set up with reinforced concrete, with thicknesses varying between 1'0" and 1'3" (300 mm and 380 mm); these are sustaining walls. This means that, if the demolition process was carried out with controlled explosives, we would need an adequate control to avoid the collapse of the structure. This clearly increases the risk of flying debris and if we could control this, it would lead to a significant source of protection for these levels.

High reach machine demolition was not considered as an option for this site since the interaction with people at such close proximity and the flying debris coming from these operations lead to a significant risk without the possibility for satisfactory risk-reduction mechanisms.

The Foundations Used for the Towers

The archive drawings issued as part of the tender enquiry show that the foundations of both towers are made of concrete raft slabs. There is no indication of piles which leads us to believe that the raft sits on cohesive glacial till or shallow rock. A borehole was sunk and geotechnical testing was carried out, which confirmed the presence of glacial till with a safe bearing pressure increasing with depth. Through our research, there are suggestions that hydraulic jacks were incorporated into the blocks to help control lateral sway under wind loads; these jacks are not detailed on any of the archive drawings, but cannot be ignored due to the guidance available online. The client has confirmed that they have no record of any maintenance being carried out on these jacks. If such hydraulic jacks are present, then any changes to the loading of the building must be considered carefully. The most important point would be the buildings self-weight, which would cause pre-compression on the jacks such that the height of the buildings is reduced. The building may "lift" a little if the jacks try to recover.

For this reason it is considered unreasonable to wrap the buildings in scaffolding along their full height as the scaffolding would be ground bearing and laterally tied into the towers for stability. Any vertical movement of the buildings caused by the jacks during demolition would distort the ties and may lead to the scaffolding becoming unstable. It must be noted that whilst "suggestions" are made on some websites regarding the presence of hydraulic jacks, there is no technical or factual support for these claims.

Implementing the Top Down Solution

Based on the information noted above and after taking all factors into account it is clear that the correct method for these towers is "top down deconstruction." Due to the possible presence of hydraulic jacks in the existing foundation system, the top down method has been designed and confirmed so that traditional full height scaffolding isn't required.

Schedule of Works

It took two months of work to design and adapt this system to the first of the two buildings. Assembly and dismantling occurred in complete safety for both operators and the surrounding environment. All parts of the machine are assembled on the ground. Hoisting the assembled sections of the system to the top of the structure is performed by a tower crane designed to safely lift the determined section weights. Once the structure is placed on top of the building, the vertical hydraulic pistons move simultaneously to

lower the entire platform. Upon arrival at the new position, there is a check to control the perfect leveling of the equipment.

Reinforcing the Existing Structure

The demolition is carried out by demolition machines positioned on the existing floor plates. For this reason a careful assessment of the archive drawings was made in conjunction with a detailed dimensional check of the building. In addition to this and to ensure a comprehensive analysis, the following intrusive testing can be carried out on both blocks.

The lowest compressive strength proven for each of the elements was taken to be the actual compressive strength for the entire structure; this is a conservative approach. A detailed analysis was then carried out considering all loads being applied to the structure by the demolition activities along with a demolition rubble allowance.

This check utilized the factual information obtained on the structure and has allowed a detailed back propping system to be determined; this system will be installed and monitored through demolition activities to ensure they remain tight and plumb. They will be sequentially moved as the demolition activities progress down the height of the building to maintain the structural integrity of the building.

It took 38 trips and 15 days to transport the modular supporting structure from Italy to Scotland and move all the demolition equipment needed. After the pre-assembly stage on the ground, 19 lifts were needed to raise the supporting structure, another 27 to complete the structure with its modules and two under-bridges with an average of 8–9 men present at all times.

What was so difficult about this job, especially in the lowering stages of the assembly and structure, was the wind, which reached speeds of up to 150 mph. We couldn't work when conditions were extreme; but even with these bad weather conditions, the 27 floors to be demolished came down safely in three months.

The Way Forward

In the three years since its invention, this solution has demolished a building in France, one in Scotland and is about to finish the demolition on its third structure, also in Scotland.

The world premier in Lyon was a success as was the demolition in Glasgow. The next one will be in Paris, France, for a 100-meter building located in La Defense, the heart of the financial district. This skyscraper, the Tour Aurore, is just few meters from two other skyscrapers and it is in a very delicate area. Bouygues construction will replace it with a higher Tour Air 2 and intends to demolish Tour Aurore in a safe, fast, and eco-friendly way.

Despe is now actively looking at the North American market, and has recently incorporated in North America to better monitor this very dynamic market. They feel that the opportunities there are huge, as long as the market understands that such an alternative exists, and is one with a proven track record.

Until today, this solution has fully responded to expectations, demonstrating its great potential and flexibility. It has an extraordinary level of performance, and does not impact the surrounding environment.

"The system is assembled in 20 days and it is immediately operational. It is a modular and flexible machine as its shape and height can be adapted to any high-rise building."

Opposite: Progressive system descent. Source: Despe Spa

Top: The three-floor demolition process in detail. Source: Despe Spa

Bottom: Two buildings in Scotland, one being demolished with TopDownWay. Source: Despe Spa

This system is a tool that provides the industry with a safe and feasible alternative for vertical real estate development. The hope is that demolition could become part of the construction process.

These days, demolition is seen as a "brutal, messy, dirty, unprofessional job" that no one wants to see, but in a sophisticated urban environment, this can no longer be the case. Instead, it should be the first step in a construction process, its debut. Moreover, for this reason, it should get the same attention, quality, respect and magnitude as all the other phases of the project. If we tried to look at the world of demolition the way we look at construction, we'd understand that they are two sides of the same coin.